

A multi-country investigation of the magnitude and mechanisms of economic inequalities in adolescents' mental health

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Thesis submitted for the degree of Doctor of Philosophy (PhD)

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Declaration

I, Thomas Steare, confirm that the work presented in my thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

Adolescents living in poorer economic circumstances have an increased risk of mental health problems. Most research investigating this is from high-income countries in Europe and North America. There is less understanding of the determinants of mental health in low- and middle-income countries where the majority of the world's adolescents live. In my thesis, I investigated the magnitude and the causal mechanisms of economic inequalities in adolescents' mental health in multiple countries.

In study 1, I mapped and categorised causal mechanisms through which adolescents' economic circumstances might impact their internalising mental health. These were identified through a systematic search of mediation studies and by consulting experts. In study 2, I examined the cross-sectional association between food insecurity and suicidal thoughts and behaviours. The magnitude of the association differed across eighty-three countries and indicators of country-level context, including countries' economic development.

In study 3, I investigated the longitudinal association between adolescents' economic circumstances and their internalising symptoms, which varied in magnitude across eight countries. Subjective measures of economic circumstances were more strongly associated with future internalising symptoms than objective measures were. Motivated by the lack of mediation studies in low- and middle-income countries, as identified in study 1, I investigated if adolescents' positive relations with their parents or peers mediated the longitudinal association between their economic circumstances and internalising symptoms in Ethiopia, India, Peru and Vietnam in the final study. I found no evidence of mediation in any country.

The magnitude of the association between different measures of economic circumstances and adolescents' mental health varies across countries. My thesis also highlight the complex causal mechanisms through which economic circumstances affect adolescents' internalising mental health, and that they may differ across settings. Economic inequalities in adolescents' mental health are therefore not generalisable across countries and are likely shaped by the wider societal context.

Impact statement

Ninety percent of the world's adolescents live in low- and middle-income countries. Yet, the majority of research on the social determinants of mental health problems in adolescents, including their economic circumstances, is conducted in high-income countries in Europe and North America, which are contextually different to low- and middle-income countries.

I investigated whether economic inequalities in adolescents' mental health varied across countries and indicators of country-level context. I purposefully analysed data from a diverse range of world regions that are typically underrepresented in mental health research. I analysed solely free-to-access secondary data from datasets that are underused despite their methodological rigour.

I critiqued theories regarding economic inequalities in adolescents' mental health outcomes, and highlighted their limitations, such as their focus on causal mechanisms within the household and their reliance on observations from high-income countries. I investigated potential causal mechanisms that link adolescents' economic circumstances to internalising mental health problems which could be targeted in approaches to help reduce economic inequalities in mental health. I also mapped and categorised numerous candidate causal mechanisms through which adolescents' economic circumstances might impact their internalising mental health. This included many candidate causal mechanisms that had not previously been investigated or proposed in leading theories of health inequalities.

I published versions of two chapters in peer-reviewed journals and I am preparing two further papers for publication. I have presented results from my thesis at four international conferences, thereby sharing my findings with the academic community.

My thesis and published chapters could help the discoverability of datasets in low- and middle-income countries with measures on adolescents' mental health, such as the Global School-based Student Health Survey and Young Lives, which could be analysed in future cross-country research. The identified evidence gaps in different candidate causal mechanisms could form the basis of future mediation studies, which might identify mechanisms that could be targeted and modified to reduce economic inequalities in adolescents' mental health, potentially alongside poverty alleviation strategies.

My findings also have implications for the prevention of suicidal thoughts and behaviours and internalising mental health problems. My thesis could encourage policy actions to improve adolescents' economic circumstances and improvements in adolescents' food insecurity and economic circumstances, which might lead to better mental health outcomes in adolescents in most countries.

The highlighting of the limited generalisability of findings from one setting to another could encourage a culture change where researchers increasingly focus on understanding the determinants of adolescents' mental health in low- and middle-income countries. This could, in turn, lead to re-evaluations regarding whether theories of health inequalities are suitable in diverse settings and might also encourage the development of new theories that are culturally relevant to adolescents who do not live in high-income countries. Further research in low- and middle-income countries where awareness of the causes of mental health problems is limited, holds promise in improving the health and life chances of future generations.

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Table of contents

Declaration.....	2
Abstract.....	3
Impact statement	4
Research paper declaration forms	6
Acknowledgements.....	10
Table of contents.....	13
List of tables.....	15
List of figures	17
List of abbreviations	19
1 Introduction.....	20
1.1 Low-, middle- and high-income countries: a note on terminology.....	20
1.2 The importance of context in adolescent development	22
1.3 Mental health in adolescence	25
1.4 The social determinants of adolescents' mental health	28
1.5 Thesis objectives	37
1.6 Conclusion.....	38
2 How do economic circumstances impact adolescents' internalising mental health? Insights from theories of health inequalities	39
2.1 Background	39
2.2 Objectives.....	41
2.3 Theories of health inequalities	41
2.4 Theories of health inequalities in adolescents.....	46
2.5 Discussion	49
3 Causal mechanisms through which adolescents' economic circumstances might affect their internalising mental health: insights from mediation analyses and expert consultation	54
3.1 Background	54
3.2 Methods.....	60
3.3 Results	64
3.4 Discussion	95
4 Inequalities in suicidal thoughts and behaviours according to food insecurity in adolescents: variation across countries and contexts.....	103
4.1 Background	103
4.2 Methods.....	117
4.3 Results	125

4.4	Discussion	143
5	Longitudinal data used in my thesis	154
5.1	Rationale of approach.....	154
5.2	Longitudinal population studies.....	156
5.3	Conclusion.....	163
6	Economic inequalities in adolescents' internalising symptoms: comparative analyses of longitudinal population studies across eight countries.....	164
6.1	Background	164
6.2	Methods.....	180
6.3	Results	202
6.4	Discussion	220
7	Economic inequalities in adolescents' internalising symptoms across four countries: mediating roles of adolescents' positive relations with their parents and peers	233
7.1	Background	233
7.2	Methods.....	242
7.3	Results	254
7.4	Discussion	265
8	General discussion	274
8.1	Summary of the aims and findings of my thesis	274
8.2	Themes throughout my thesis.....	280
8.3	Limitations of my thesis	291
8.4	Multi-country research considerations	299
8.5	Implications and future directions.....	303
8.6	Conclusion.....	312
	References	313
	Appendices	362
	Appendix A: Systematic search of mediation studies	362
	Appendix B: Supplementary results from Chapter 4.....	377
	Appendix C: Supplementary methods from Chapter 6.....	389
	Appendix D: Supplementary methods and results from Chapter 7	391

List of tables

Table 3.1. Key characteristics of mediation studies.	66
Table 3.2. Measures of economic circumstances used within the mediation studies.	67
Table 3.3. Mediation studies across continents, grouped according to domain of mediator investigated.....	68
Table 3.4 Candidate social mechanisms through which economic circumstances may impact adolescents' internalising mental health.	73
Table 3.5. Candidate psychological mechanisms through which economic circumstances may impact adolescents' internalising mental health.....	79
Table 3.6. Candidate material mechanisms through which economic circumstances may impact adolescents' internalising mental health.....	82
Table 3.7. Candidate biological mechanisms through which economic circumstances may impact adolescents' internalising mental health.....	86
Table 3.8. Candidate environmental mechanisms through which economic circumstances may impact adolescents' internalising mental health.....	88
Table 3.9. Candidate behavioural mechanisms through which economic circumstances may impact adolescents' internalising mental health.....	89
Table 4.1. Prevalence of food insecurity across world regions in 2023, in millions.....	104
Table 4.2. Example of ridit score transformation for the food insecurity item for 100 respondents.	119
Table 4.3. Participants according to WHO region.	127
Table 4.4. Correlations between country-level indicators.	135
Table 4.5. Meta-regression results of the association between indicators of country-level context and the Relative Index of Inequality for suicidal ideation, making a suicide plan and suicide attempt.....	137
Table 4.6 Relative Index of Inequality with 95% confidence intervals from the mixed-effects Poisson regression models.	138
Table 4.7. Meta-regression results with 95% confidence intervals of the association between indicators of country-level context and log-prevalence ratios for suicidal ideation, making a suicide plan and suicide attempt according to moderation by national prevalence of food insecurity among school-going adolescents (binary food insecurity variable).	140
Table 4.8. Prevalence ratios coefficients with 95% confidence intervals from the mixed-effects Poisson regression models according to moderation by national prevalence of food insecurity among school-going adolescents (binary food insecurity variable).	140
Table 4.9. Meta-regression results of the association between the UHC index and the Relative Index of Inequality and log-prevalence ratios for suicidal ideation, making a suicide plan and suicide attempt after adjustment for national prevalence of food insecurity in adolescents.....	142
Table 5.2. Eligible adolescent sample in the Mexican Family Life Survey.	159
Table 5.3. Eligible adolescent sample in the National Income Dynamics Study.	160

Table 5.1. Site selection procedure within each Young Lives country.	162
Table 6.1. Summary of key country-level data of included countries.....	168
Table 6.2. Profiles of the longitudinal population studies and the baseline and follow-up timepoints.	180
Table 6.3. Measures of household income across countries.....	183
Table 6.4. Individual domains used to inform annual household consumption expenditure within countries.	185
Table 6.5. Measures of adolescent-reported subjective wealth across countries.	186
Table 6.7. Variables used to capture minoritised status within each country.	196
Table 6.8. Auxiliary variables associated with the outcome included in country-specific imputation models.	198
Table 6.9. Details of analytic samples across each country.	202
Table 6.10. Internal consistency of the measures of internalising symptoms within each country.....	203
Table 6.11. Variance of internalising symptoms at follow-up explained by each measure of economic circumstances.	211
Table 7.1. Sample attrition through the study period.....	254
Table 7.2. Descriptive statistics of key variables for adolescents in the main analyses (imputed samples).....	255
Table 7.3. Internal consistency of the Self-Description Questionnaire parent and peer relations subscales at T2 and the SDQ-E at T3 within each country.	256
Table 7.4. Linear regression coefficients for the association between adolescents' economic circumstances at T1 and their positive relations with their parents and peers at T2.....	261
Table 7.5. Linear regression coefficients for the association between adolescents' positive relations with their parents and peers at T2 and internalising symptoms at T3.	262
Table 7.6. Natural indirect effect and PM for pathways from household consumption expenditure to internalising symptoms, with and without adjustment for intermediate confounders.	264
Table 7.7. Natural indirect effect and PM for pathways from subjective wealth to internalising symptoms, with and without adjustment for intermediate confounders.	264

List of figures

Figure 1.1. The Ecological Systems Theory model.....	23
Figure 1.2. Conceptualisation of economic circumstances and the indicators that aim to measure it.	30
Figure 2.1. The Family Stress Model of Economic Hardship	47
Figure 2.2. The Family Investment Model	49
Figure 3.1. Estimates and pathways within mediation analyses.	56
Figure 3.2. Parallel and sequential mediation analyses.....	56
Figure 3.3. PRISMA flowchart of included studies.	65
Figure 3.4. Mediation studies across countries.....	65
Figure 3.5. Conceptual model outlining how the causal mechanisms and their relationship to one another may explain the processes through which adolescents' economic circumstances impact their internalising mental health.	91
Figure 4.1. Proposed causal model of food insecurity leading to suicidal thoughts and behaviours in adolescents based on the Interpersonal Theory of Suicide	110
Figure 4.2. Flowchart of GSHS countries and participants.	126
Figure 4.3. Map of countries participating in the GSHS with available data on food insecurity and suicidal thoughts and behaviours included in the analysis.....	127
Figure 4.5. Relative Index of Inequality for making a suicide plan according to food insecurity status, across countries and WHO World Regions.	132
Figure 4.6. Relative Index of Inequality for suicide attempts according to food insecurity status, across countries and WHO World Regions.	133
Figure 6.1. World map detailing the countries included in this chapter.	167
Figure 6.3. Association between log-transformed household income with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.	204
Figure 6.4. Association between log-transformed household consumption expenditure with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.	206
Figure 6.5. The Slope Index of Inequality according to adolescents' subjective wealth for internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.	208
Figure 6.6. Variance of internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline, explained by household income, household consumption expenditure and subjective wealth across countries.....	210

Figure 6.7. Association between log-transformed equivalised household income with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.	212
Figure 6.8. Association between log-transformed equivalised household consumption expenditure with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.....	214
Figure 6.9. Association between log-transformed household income with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline (harmonised measure).	215
Figure 6.10. Association between log-transformed household consumption expenditure with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline (harmonised measure).	217
Figure 6.11. The Slope Index of Inequality according to adolescents' subjective wealth for internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline (harmonised measure).	219
Figure 7.1. Conceptual model linking adolescents' objective and subjective economic circumstances with their internalising symptoms.	246
Figure 7.2. Total causal effect and the natural indirect effect of the association between household consumption expenditure and internalising symptoms, for analyses of (a) both mediators, (b) positive relations with parents, and (c) positive relations with peers.	257
Figure 7.3. Total causal effect and the natural indirect effect of the association between subjective wealth and internalising symptoms, for analyses of (a) both mediators, (b) positive relations with parents, and (c) positive relations with peers.	259

List of abbreviations

Below is a list of abbreviations used throughout my thesis:

CCDSD	Cuestionario Clinico para el Diagnostico del Sindrome Depresivo
CES-D	Center for Epidemiologic Studies Depression Scale
GDP	Gross Domestic Product
GNI	Gross National Income
GSHS	Global School-based Student Health Survey
HBSC	Health Behaviour in School Children
K10	Kessler Psychological Distress Scale
LSAC	Longitudinal Study of Australian Children
MxFLS	Mexican Family Life Survey
MCS	Millenium Cohort Study
NIDS	National Income Dynamics Study
PM	Proportion Mediated
PPP	Purchase Power Parity
PR	Prevalence Ratio
RII	Relative Index of Inequality
SDG	Sustainable Development Goal
SDQ-E	Strengths and Difficulties Questionnaire (Emotional Symptoms subscale)
SII	Slope Index of Inequality
UHC	Universal Health Coverage
WHO	World Health Organization

1 Introduction

Adolescence is a developmental period between childhood and adulthood characterised by physical, psychological and social changes (Spear, 2000). It is commonly categorised into early- (ages 11 to 14), middle- (ages 15 to 17) and late-adolescence (ages 18 to 21) (Hagan et al., 2008). Recent proposals suggest that adolescence could extend to the age of 25 (Sawyer et al., 2018). This reflects increased awareness of ongoing neural development that extends beyond the first two decades of life and a recent trend where transitions from adolescence into adult-type social roles are occurring at a later age compared to previous generations.

Adolescence is a period of heightened vulnerability to mental health problems. A meta-analysis of 192 studies found that close to half of all mental health problems develop by the age of 18 (M. Solmi et al., 2022). Poor mental health during adolescence can have severe implications throughout the life course. Mental health problems can negatively affect adolescents' social and educational outcomes and increase the likelihood of experiencing poor physical and mental health in adulthood (Clayborne et al., 2019; Copeland et al., 2015; Fletcher, 2013). The prevention of mental health problems in this age group would benefit adolescents in the present and help pave the way for healthy lives in adulthood (McGorry et al., 2024; Patton et al., 2018).

A greater understanding of the causes and determinants is needed to prevent mental health problems and effectively allocate resources to adolescents who are in need. Further awareness of the determinants of mental health problems is most needed in low- and middle-income countries. Ninety percent of the world's adolescents live in these countries but only 10% of mental health research is conducted in them (Blum & Boyden, 2018; Kieling et al., 2011).

1.1 Low-, middle- and high-income countries: a note on terminology

Throughout my thesis I commonly make a distinction between low- and middle-income countries and high-income countries. This grouping of countries is informed by the World Bank according to countries' economic development as measured by gross national income (GNI) per capita (Metreau et al., 2024). GNI refers to the gross income of a country's residents and income from overseas, such as foreign investments. As

of July 2024, countries are classed as low income if their GNI per capita is 1,145 US dollars or less (number of countries=26). Lower-middle income countries have a GNI per capita between 1,146 and 4,515 US dollars (n=51), whilst upper-middle income countries have a GNI per capita between 4,516 and 14,005 US dollars (n=54). Finally, high-income countries have a GNI per capita of 14,006 US dollars or greater (n=86).

The distinction of countries according to these income categories is routinely used in health research, but its use is not without limitations. Countries within the same income classification can vary considerably in relation to culture, language, religion, political governance and societal values (Khan et al., 2022). Grouping countries together by their economic development overlooks these distinctions. Differentiating countries by their income level in research has also been criticised as it is often applied without justification or a theoretical rationale regarding why a country's economic development might be important for a phenomenon of interest (Lencucha & Neupane, 2022).

Throughout my thesis, I categorise countries according to their income level and use the terms low-, middle- and high-income countries. I use this categorisation as I theorise that a country's level of economic development may be an important contextual factor that influences the development and mental health of adolescents, potentially through influencing the determinants of mental health problems that adolescents are exposed to (Marquez et al., 2024; Viner et al., 2012). This assumption is supported by findings from cross-country research, but the evidence base is limited (Elgar et al., 2015; Mahumud et al., 2022; Weinberg et al., 2021).

Despite the limitations of categorising countries according to their economic development, there is a lack of other suitable approaches that could be used to differentiate countries instead. The term Global South is increasingly used to refer to a broad group of countries within the regions of Asia, Africa and South America. However, the term Global South still implies a hierarchy based on economic development and that countries within the Global North and Global South regions are alike in terms of cultural and societal factors. Consequently, the terms Global South and Global North share similar criticisms with grouping countries by their economic development (Khan et al., 2022). Countries are also grouped by the World Health Organization (WHO) into six different geographic regions; but these categories also feature countries that are heterogeneous to one another.

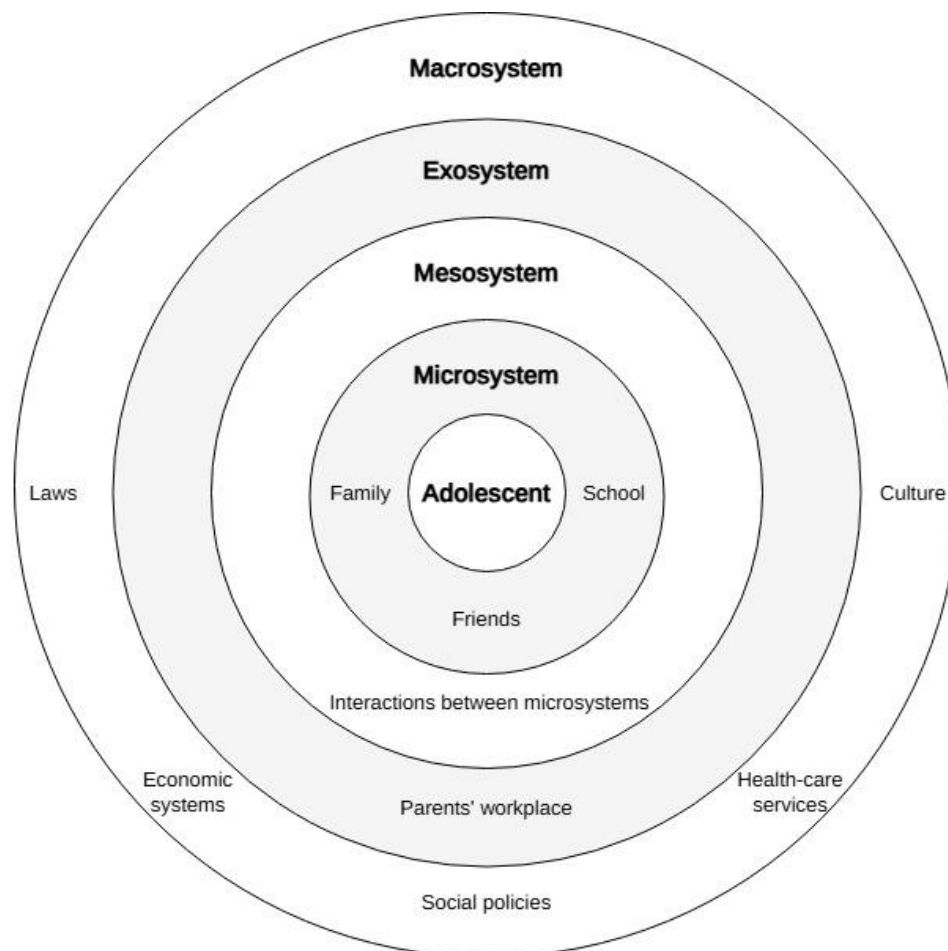
1.2 The importance of context in adolescent development

Adolescents grow up in diverse environments that vary within- and between-countries. Adolescents' development is therefore influenced by the contexts that they experience. Subsequently, the determinants of adolescents' mental health problems are likely to vary across place.

1.2.1 The Ecological Systems Theory

The Ecological Systems Theory is one of the most influential frameworks regarding adolescent development (Bronfenbrenner & Morris, 2006). The framework theorises that adolescent development is driven by engagement in reciprocal interactions and activities. These enable adolescents to make sense of their world and develop an understanding of their place within it. These interactions are predominantly with people in adolescents' immediate environment, such as family, friends and school peers, and are shaped by the wider context in which they occur (Figure 1.1).

Figure 1.1. The Ecological Systems Theory model (adapted from Vélez-Agosto et al., (2017)).



According to the Ecological Systems Theory, there are four interconnected contextual levels in which adolescents are embedded in. At the smallest level is the microsystem. The microsystem is the adolescent's immediate and intimate world, including their family, friends, school or neighbourhood. At the next level is the mesosystem, which refers to the interactions between microsystems, such as adolescents' friends interacting with their family. The next level, the exosystem, refers to environments that adolescents are not part of, but might indirectly affect them (e.g., parents' workplace). Finally, the macrosystem is the largest level. It encompasses the broader societal and cultural context in which all lower levels are embedded in. The macrosystem consists of, but is not limited to, factors related to culture (including societal norms and values), governments and politics, social policies, economic systems, health-care resources, laws and law enforcement practices which create the social, financial and political contexts where adolescent development takes place. The macrosystem emphasises

the importance of wider societal and cultural factors that affect adolescent development and therefore mental health outcomes. The Ecological Systems Theory implies that there are likely to be differences in adolescents' mental health across countries owing to the differing contexts in which development takes place (Doom et al., 2021; Marquez et al., 2024).

1.2.2 Adolescents' lives across contexts

The daily lives of adolescents vary across countries and country-income groupings, all of which affect adolescent development and long-term outcomes. This is apparent across adolescents' education and schooling, employment status, social factors and health.

Education is an important part of adolescents' life and future health, social and economic outcomes. However, completion of education varies across countries. Most adolescents in high-income countries complete secondary education. This contrasts with low- and middle-income countries where completion rates are much lower, particularly for girls (Patton et al., 2018). Subsequently, adolescents in low- and middle-income countries are more likely to transition into the workforce at a younger age than adolescents in high-income countries (Patton et al., 2016). This might be due to the need to earn an income to support their household and supplement their parents' earnings. This concern is less prominent for adolescents in high-income countries. Child marriage for girls is also prevalent in several low-income countries and is a common determinant of leaving education early. It is particularly common in South Asia and sub-Saharan Africa, where approximately 30% and 40% of women are married before 18, respectively (United Nations Children's Fund, 2018). Adolescent births are also far more common in low-income countries, where 53% of women have given birth by age 20, compared to 7% in high-income countries (Patton et al., 2018).

The health problems that are prevalent and are a concern for adolescents also differ across countries and regions (Patton et al., 2016). In high-income countries, primarily in Europe and North America, adolescents' health problems are typically non-communicable, meaning they are not transmissible from person to person. These health problems consist of physical, mental and substance use disorders. Health problems owing to injuries and infectious diseases are rare in comparison to other countries. In countries primarily in central Asia and South America there is a notable

excess of preventable physical injuries experienced by adolescents compared to other countries. Health problems in these countries, which are predominantly middle-income, are often a result of unintentional injury, violence, or adolescent births. Finally, half of the world's adolescents live in countries where there is a high risk of health problems from infectious diseases, injuries, violence and factors associated with living in poverty (e.g., HIV, undernutrition, poor sexual health). These countries are typically low-income countries in Oceania, southeast Asia and sub-Saharan Africa. Consequently, adolescent mortality rates are high in these countries.

1.3 Mental health in adolescence

My thesis focuses on both the symptoms of internalising mental health problems, such as depression and anxiety, and on suicidal thoughts and behaviours. Internalising mental health problems are the most common form of mental health problem across the lifespan and their onset commonly occurs in adolescence (M. Solmi et al., 2022). They are often an antecedent of suicide, which is one of the leading causes of death in adolescents worldwide (Bridge et al., 2006; L. Liu et al., 2022; Villavicencio et al., 2024). The prevention of both is a public health priority.

1.3.1 Internalising mental health problems

Internalising mental health problems are characterised by negative affect and psychological distress. Approximately two-thirds of mental health problems in adolescents are one of either depression or anxiety (Polanczyk et al., 2015).

Depression is a mood disorder where individuals experience several different symptoms. These are mainly low mood and a reduced interest and pleasure in activities, known as anhedonia (L. Miller & Campo, 2021). It is rare in childhood. However, incidence increases sharply during adolescence, with 13% of all depressive disorders developing by the age of 18 (M. Solmi et al., 2022).

Anxiety disorders are characterised by excessive worry and difficulties with controlling worries (Garber & Weersing, 2010). Adolescence is a life stage where there is the greatest risk of developing an anxiety disorder. Approximately close to half of anxiety disorders develop by age 18 (M. Solmi et al., 2022). Depression in adolescence is often co-morbid with anxiety. Anxiety disorders are also common in adolescents even if depression is not present.

Both depression and anxiety are debilitating. They affect adolescents' social, educational and daily functioning, and increase the risk of suicide (L. Miller & Campo, 2021). Due to their high prevalence and adverse impact, internalising mental health problems are leading causes of illness and disability among adolescents (Kassebaum et al., 2017; United Nations Children's Fund, 2021).

Depression and anxiety disorders have discrete thresholds within diagnostic manuals. This implies a dichotomy where one does or does not have one of these mental health problems. However, both anxiety and depression should be seen as a continuum, with the most severe presentations representing the extreme end of a broad range of possible experiences (Hankin et al., 2005; Patel et al., 2018). Severe presentations that meet diagnostic criteria naturally receive greater levels of treatment, but the impact of sub-threshold anxiety and depressive symptoms on adolescents and overall population health should not be overlooked. Subthreshold internalising symptoms are more common in adolescents compared to manifestations that meet a clinical cut-off and can have a comparable impact on adolescents' quality of life and functioning (Balázs et al., 2013; Gotlib et al., 1995; Noyes et al., 2022; Shorey et al., 2022).

1.3.2 Suicidal thoughts and behaviours

Suicide refers to intentionally ending one's own life (Turecki et al., 2019). Suicidal thoughts, often known as ideation, are thoughts about ending one's life. Suicidal behaviours are actions that have the aim of ending one's life (e.g., suicide attempts), regardless of whether the outcome of the behaviour is fatal or not.

Suicide is one of the leading causes of death in adolescents worldwide. In 2022, an estimated 56,000 adolescents between the ages of 15 and 19 died from suicide (L. Liu et al., 2022; Villavicencio et al., 2024). Global evidence shows that the risk of suicide is low in childhood but increases dramatically in adolescence. The mortality rate from suicide remains relatively low in adolescence compared to later-life, but the absolute number of deaths from suicide each year is comparable to other age groups due to the large global adolescent population (Naghavi, 2019; World Health Organization, 2021). The prevention of suicide is therefore a global public health priority and one of the United Nations' targets within its aim to promote health and wellbeing worldwide (United Nations General Assembly, 2015). This need is most

apparent in low- and middle-income countries where 88% of all suicides in adolescents occur (World Health Organization, 2021).

Suicide is not considered a clinical mental health problem. However, suicidal thoughts and behaviours mainly occur following acute or chronic severe emotional distress and feelings of hopelessness; experiences that are apparent in internalising mental health problems (Franklin et al., 2017; Van Orden et al., 2010). Furthermore, suicidal thoughts and behaviours are considered a symptom of depression, although they can develop without the presence of a mental health problem (L. Miller & Campo, 2021). One of the major determinants of suicide in adolescents is therefore experiencing a mental health problem. This is particularly the case in high-income countries where close to 90% of adolescents who die by suicide have a mental health problem (Bridge et al., 2006; Gili et al., 2019).

1.3.3 Considerations

The conceptual origins and study of internalising mental health problems and suicide are rooted in the fields of psychology and psychiatry developed primarily in European and North American countries (Jilek, 1995). Clinical diagnoses and the tools to measure them might accurately capture different expressions of psychological distress within these populations, however, they may not be valid in all cultures. The societal and cultural context which an individual lives in influences their conceptualisation of what constitutes positive and negative mental health, as well as how individual's experiences suffering and difficult thoughts or emotions (Kohrt et al., 2014).

Within my thesis, I investigate internalising mental health problems using measures of symptom severity rather than assessing whether presentations meet clinical criteria. This is consistent with calls within the field of global mental health to reframe mental health problems as existing on a continuum (Patel et al., 2018). Approaches that use discrete cut-offs to indicate the presence of a clinical mental health problem might complicate cross-country comparisons due to the likely cross-country variation in what constitutes a clinical level of symptoms (de Vries et al., 2018). Accordingly, I use the terms (a) internalising mental health, and (b) internalising symptoms throughout this thesis to indicate a continuum and emphasise the importance of symptoms at both the clinical- and sub-clinical level.

1.4 The social determinants of adolescents' mental health

Internalising mental health problems and suicidal thoughts and behaviours are widely associated with a broad range of social and economic factors, known as the social determinants of mental health (Lund et al., 2018). These have been conceptualised across five domains: demographic, economic, neighbourhood, environmental events and social and cultural determinants. Within these domains there are proximal factors in the immediate external environment which individuals directly interact with, and distal factors that are the broad structural arrangements within societies (Lund et al., 2018).

The social determinants of mental health have been described as the most promising targets for intervention to prevent the onset of mental health problems and promote positive mental health worldwide (Kirkbride et al., 2024). Strategies to reduce exposure to adverse social determinants and increase access to positive ones might have substantial benefits in reducing the prevalence of mental health problems in both current and future generations if aimed at children and adolescents (Kirkbride et al., 2024).

Children and adolescents are theorised to be particularly vulnerable to the long-term mental health impacts of the social determinants of health compared to adults. This is due to the ongoing neurodevelopment that might be affected and adolescents' heightened sensitivity to the social environment, parents and peers (Blakemore, 2019; McGorry et al., 2024). The experience of mental health problems in this life stage can also limit social and educational opportunities, thus social, economic and health disadvantages cluster and reinforce each other over time (Clayborne et al., 2019; Copeland et al., 2015; Fletcher, 2013). Consequently, interventions that improve the social determinants of mental health in adolescents have significant potential to promote better mental health and social outcomes throughout the lifespan.

1.4.1 Economic circumstances

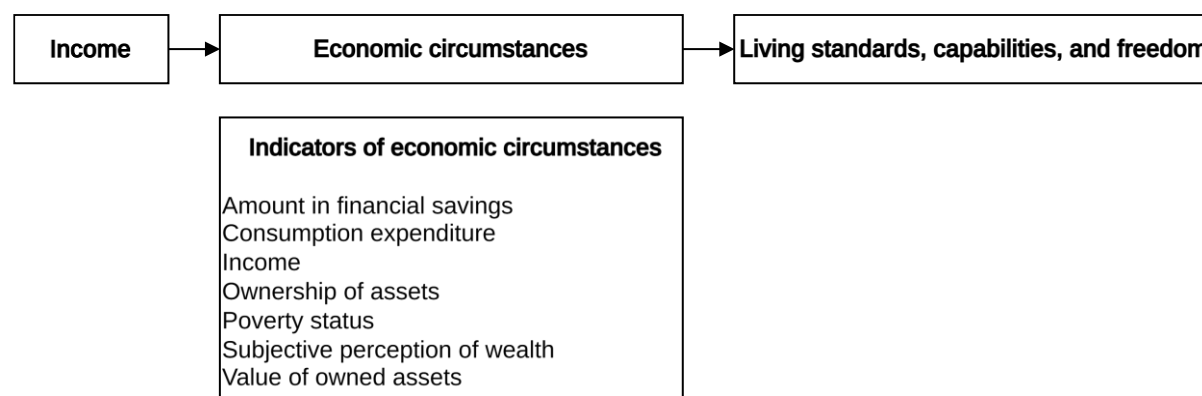
Adolescents' economic circumstances are a social determinant of mental health that might hold promise as a target for intervention (Reiss, 2013). I define economic circumstances as the financial resources that are available to a household or individual which can be used to meet essential needs, ensure an adequate standard of living and enable the capability and freedom to pursue valued outcomes (Figure 1.2).

A households' or an individuals' economic circumstances are determined by the level of accrued and current income from all sources, including salary, earnings, inheritance and benefits or social security, either in monetary form or payment-in-kind. Economic circumstances in turn determine the quantity, quality and financial value of assets, goods and services that can be purchased and the activities that can be engaged in, therefore impacting living standards. Consequently, living in wealthier economic circumstances reduces the exposure to negative social determinants of health and increases access to positive ones (Link & Phelan, 1995). Poverty, where individuals live in extremely poor economic circumstances, has also been conceptualised as a limitation of capabilities and freedom. Therefore, economic circumstances also determine an individual's ability to achieve and pursue outcomes that they value (Sen, 2001). For adolescents, this may include attending school, socialising with peers and pursuing their preferred employment opportunities.

Economic circumstances might vary in their importance in determining an individual's living standards, capabilities and freedom across countries. For instance, living in poorer economic circumstances might have a less negative impact on living standards in countries where essential services or goods, such as health care services, housing and education, are provided either free of charge or at reduced cost and are of sufficient standard (Esping-Andersen, 1999; Zambon et al., 2006).

Economic circumstances are captured through different measures. These include objective indicators that capture the value of a household's or individuals' goods, assets, expenditure, or income, or subjective assessments of an individual's own financial standing (Figure 1.2). The suitability of different measures varies across countries dependent on contextual norms regarding the labour market, payment practices and resource-sharing (Cooper et al., 2012; Howe et al., 2012).

Figure 1.2. Conceptualisation of economic circumstances and the indicators that aim to measure it.



Economic circumstances are also commonly measured and discussed in binary terms: to be living in poverty, or not. One-hundred-and-twenty million adolescents between the ages of 10 and 17 live in absolute poverty (Salmeron Gomez et al., 2023). These adolescents live in households where income is below a threshold (\$2.15 per day) where it is assumed basic life necessities cannot be secured (World Bank, 2022a). Relative poverty, on the other hand, refers to experiencing low levels of income compared to other households within a country (e.g., below 60% of the median income of households). Compared to absolute poverty, those living in relative poverty might still have the economic means to secure necessities and pursue valued outcomes.

Economic circumstances are commonly conflated with socio-economic position in the psychiatric epidemiology literature. Socio-economic position refers to an individual's rank within a societal hierarchy according to socially valued indicators. Commonly, socio-economic position is captured through a composite measure of individual's education-level, occupation and income, or through one of these indicators only (Braveman et al., 2005; Liberatos et al., 1988). Adolescents' socio-economic position is typically assessed according to the education-level, occupation and income of their parents. How socio-economic position is measured and conceptualised is heterogeneous across studies and different indicators are commonly used interchangeably. Thus, there is often limited consideration of the explanatory mechanisms through which specific indicators of socio-economic position might impact health (Braveman et al., 2005; Zaneva et al., 2024).

In my thesis, I consider economic circumstances to be conceptually distinct from socio-economic position. However, they are highly correlated as both economic circumstances and socio-economic position are partially determined by income. I conceptualise economic circumstances as a measure of what you have (i.e., the material resources and living standards available). In contrast, measures of socio-economic position are more concerned with who you are (i.e., high or low social class, based on education, occupation and income). Consequently, the pathways through which economic circumstances and socio-economic position affect adolescents' mental health, as well as the interventions to change them, are likely to differ (Braveman et al., 2005).

1.4.1.1 Economic circumstances as a social determinant of adolescents' mental health

According to several theories, including the Family Stress Model of Economic Hardship and the Family Investment Model (see Chapter 2 for a summary), wealthier economic circumstances enable increased access to health-promoting resources. Poorer economic circumstances are theorised to lead to stress in parents and a reduced propensity to provide warm and nurturing parenting practices to their children. In turn, this is theorised to lead to differences in adolescents' mental health outcomes according to their economic circumstances (Conger & Donnellan, 2007; Duncan et al., 2017; Masarik & Conger, 2017).

As a result, adolescents' economic circumstances are routinely associated with mental health problems. Twenty-nine studies, primarily carried out in high-income countries, were identified in a systematic review that investigated the association between children's and adolescents' economic circumstances (measured through household income or poverty status) and the presence of a mental health problem (Reiss, 2013). Adolescents living in poorer economic circumstances typically had greater rates of mental health problems compared to wealthier peers. This was apparent in both cross-sectional and longitudinal studies. However, studies varied in the extent of adjustment for confounders and no causal association can be inferred given the observational design of the studies.

Economic circumstances can also be measured subjectively. Adolescents' subjective perception of their economic circumstances is informed by their objective economic

circumstances but also influenced by social comparisons to other peers or households. Research primarily in high-income countries shows that adolescents' perception of their subjective wealth is commonly associated with their internalising symptoms (E. Goodman et al., 2001; Quon & McGrath, 2014). This association is often apparent even after adjustment for objective measures of economic circumstances. Due to the social evaluative nature of subjective wealth measures, hypothesised pathways from poorer subjective economic circumstances to poorer internalising mental health have centred around mechanisms involving shame, stress and status anxiety (Ding & Huang, 2024).

Cross-sectional studies in the Netherlands and the US have found that subjective measures of economic circumstances are more strongly associated with adolescents' internalising mental health than objective indicators of economic circumstances are (McLaughlin et al., 2012; Weinberg et al., 2019). There is also some support for this from a study of twins in the UK that used both cross-sectional and longitudinal data. In the study, there was a strong cross-sectional association between greater perception of family socio-economic status and fewer anxiety and depressive symptoms at age 18. There was a weaker association between adolescents' objective socio-economic status at age 5 (indicated by a composite of parental income, education and occupation) and future anxiety and depressive symptoms at age 18 (Rivenbark et al., 2020). However, the measures used were not specific to economic circumstances. Furthermore, differences in the associations based on how socio-economic status was measured might be due to the different age when objective and subjective indicators was assessed, and the greater risk of bias in the cross-sectional analyses of subjective socio-economic status compared to the longitudinal analyses of objective socio-economic status.

Adolescents living in poorer economic circumstances also appear to have an increased risk of suicidal thoughts and behaviours. Evidence of this has been found in cross-sectional studies in low- (Uganda), middle- (India) and high-income countries (Republic of Korea, the US), and in a longitudinal study in Hong Kong (Foley et al., 2006; Kinyanda et al., 2011; Ko et al., 2014; Law & Shek, 2016; Mukhopadhyay et al., 2012). However, the strength and direction of the association might not be consistent across countries. In a cross-sectional study, there was no evidence of an association between adolescents' economic circumstances and suicidal ideation in the middle-

income countries (China and Vietnam) or the high-income country (Taiwan) (Blum et al., 2012). In China, suicide attempts were least prevalent in adolescents in the second poorest wealth quintile, whilst suicide attempts were most prevalent in adolescents in the second poorest wealth quintile in Vietnam. There was no association between adolescents' economic circumstances and suicide attempts in Taiwan.

There is evidence that the relationship between adolescents' economic circumstances and mental health problems is likely to be causal, rather than due to alternative explanations such as confounding (Ridley et al., 2020). Supportive evidence comes from randomised controlled trials of anti-poverty interventions conducted in low- and middle-income countries. These trials aim to test the effectiveness of cash transfer programmes – payments by formal institutions to households with the aim of reducing poverty and related vulnerabilities (Baird et al., 2014). Cash transfers might be unconditional or require recipients to engage in specified actions to be eligible, such as attend school. These programmes were not originally established with the aim of improving adolescents' mental health.

In many cases, receipt of cash from these programmes is associated with improvements in adolescents' mental health outcomes. In a meta-analysis of eight studies of cash transfer programmes across low-, middle- and high-income countries, the receipt of financial support was associated with a reduction in children's and adolescents' internalising symptoms in comparison to controls (Zaneva et al., 2022). The improvement of adolescents' economic circumstances therefore led to an improvement in their mental health. As the exposure is randomly manipulated, the association between adolescents' economic circumstances and their internalising mental health cannot be explained by confounding. However, not all trials of cash transfers programmes have shown evidence that wealthier economic circumstances are associated with better mental health outcomes in adolescents. In fact, some have had unintended negative effects and led to a worsening of mental health symptoms (Baird et al., 2025). Some of the heterogeneity in study results could be driven by differences in the generosity of cash transfers, as well as their regularity and predictability (Fisher et al., 2017; McGuire et al., 2022).

Natural experiments can also provide evidence on whether economic circumstances have a causal impact on adolescents' mental health. In these studies, households

experience differences in economic circumstances due to external policy changes or other exogenous events or shocks. In these scenarios, changes in adolescents' economic circumstances are primarily a product of chance which eliminates confounding bias and strengthens causal inferences. In North Carolina, all Native American families received profits every six months since 1996 from a casino that opened on a tribal reservation. Native American adolescents that lived in households below the federal poverty line four years prior to the casino opening had high levels of emotional symptoms (Costello et al., 2003). However, adolescents that were no longer in poverty four years after the casino opening had fewer emotional symptoms compared to the previous timepoint when they were living in poverty. Furthermore, their level of symptoms at the follow-up timepoint was comparable to those of Native American adolescents that had never lived in poverty.

Economic circumstances can be improved through social policies and interventions, as shown in trials of cash transfer programmes. Economic circumstances are therefore a feasible target for interventions, and improvements can be made swiftly with likely short-term benefits. In comparison, changes to other social determinants of adolescents' mental health might take a longer time to implement (e.g., parental education) or may be logistically more complex (e.g., distal factors). Evidence widely suggests that adolescents' economic circumstances are a modifiable determinant for mental health problems including internalising mental health problems and suicidal thoughts and behaviours. Even if the association between adolescents' economic circumstances and their mental health is not causal, awareness of economic inequalities in adolescents' mental health is important in informing service planning and targeted prevention strategies.

1.4.1.2 Multi-country research

There is limited evidence in low- and middle-income countries regarding the association between adolescents' economic circumstances and internalising mental health or suicidal thoughts and behaviours (Blum et al., 2012; Reiss, 2013). If evidence is available in low- and middle-income countries, it is commonly from urban areas or locations where specific events such as natural disasters or conflict have occurred, or from samples of school-going adolescents only (Erskine et al., 2024). The results of these studies cannot be generalised to understand the association between

adolescents' economic circumstances and mental health problems at the national level. The lack of research in low- and middle-income countries hampers understanding of where resources should be allocated in these countries, including whether means to improve adolescents' economic circumstances might lead to improvements in population mental health and reductions in health inequalities.

Findings from high-income countries, where most of the world's research on adolescents' mental health is conducted, is unlikely to translate to low- and middle-income countries due to the diversity in adolescents' economic and cultural contexts which leads to cross-country variation in adolescent development (Bronfenbrenner & Morris, 2006). Cross-country differences in the association between adolescents' economic circumstances and their internalising mental health is shown in analyses of the Health Behaviour in School Children (HBSC) cross-sectional surveys. These surveys have been carried out primarily across high-income countries in Europe and North America.

Studies to date have investigated how the association between living in poorer economic circumstances (as measured by either subjective perception of wealth or ownership of certain assets) and higher levels of internalising symptoms varies across different indicators of country-level context. One study analysed data from the HBSC surveys carried out in 2002, 2006 and 2010. The association between living in poorer economic circumstances, as assessed through ownership of certain assets, and experiencing more severe psychosomatic symptoms was stronger in the countries with lower GNI per capita (Elgar et al., 2015). However, there was no evidence that the association varied according to countries' economic development in another study that analysed 2014 HBSC data (Weinberg et al., 2021). Studies have also investigated whether the association between economic circumstances and psychosomatic symptoms varies according to countries' level of economic inequality. In the study by Elgar and colleagues (2015), economic circumstances were more strongly associated with psychosomatic symptoms in countries with greater levels of income inequality. This was also found in analyses of the 2010, 2014 and 2018 HBSC surveys (Dierckens et al., 2020). The study by Weinberg and colleagues (2021) replicated this finding when economic circumstances were measured according to asset ownership. However, when economic circumstances were assessed through adolescents' perception of their households' wealth, economic circumstances were more strongly

associated with psychosomatic symptoms in countries with lower levels of income inequality. These studies show that findings from one country cannot be extrapolated to another, potentially as the wider economic conditions within countries might influence the association between adolescents' economic circumstances and their internalising mental health. However, all studies were cross-sectional and featured limited confounder adjustment, as they controlled for adolescents' sex, age and migration history only. They were also primarily carried out in countries in Europe.

Cross-country research across low- and middle-income countries is relatively scarce. Studies investigating adolescents' internalising mental health have featured three or four different countries only, limiting the ability to detect cross-country differences. Zimmerman and colleagues (2022) analysed data from three different cross-sectional studies. In the study, experiencing multidimensional poverty was associated with increased depressive symptoms in Colombia and Mexico only, but not in South Africa. In another study, cross-sectional data from Ethiopia, India, Peru and Vietnam was analysed, comparing the association between a composite wealth index and whether adolescents reported experiencing low mood at ages 15 and 19 (Ward & Viner, 2018). There was no cross-country difference in the direction or magnitude of the association. A greater number of studies have investigated differences in the association between economic circumstances and suicidal thoughts and behaviours across low- and middle-income countries. Using food insecurity as a proxy measure of economic circumstances, one study found that the association between experiencing food insecurity and increased risk of suicidal thoughts and behaviours was strongest in middle-income countries (Mahumud et al., 2022). Two other studies found no variation in the association according to country income-levels; however, they investigated suicide attempts only (Koyanagi et al., 2019; Probst et al., 2021).

These studies show that the extent adolescents' economic circumstances are associated with their mental health might vary across countries. Studies are inconclusive, as all have analysed cross-sectional data. Within these studies, it is not clear whether living in poorer economic circumstances is a cause of, or a result of, experiencing mental health problems, as the temporal order of the two cannot be established. Studies have also featured insufficient or inappropriate confounder adjustment, meaning the associations between adolescents' economic circumstances

and their mental health could be due to the impact of an unmeasured third variable, rather than a causal relationship between two.

In summary, economic circumstances, concerning the availability of a households' financial resources, are a modifiable social determinant of adolescents' mental health. Improving adolescents' economic circumstances could result in improvements in their mental health. The overwhelming research focus within high-income countries and the comparative lack of research in low- and middle-income countries limits understanding of adolescent development across different contexts.

1.5 Thesis objectives

The research within the following chapters aims to investigate economic inequalities in adolescents' internalising symptoms and suicidal thoughts and behaviours using data from a diverse range of countries and whether the magnitude of these inequalities in adolescents' mental health may vary across countries.

Objective 1. To summarise theories of health inequalities and critique their suitability in understanding how adolescents' economic circumstances might impact their internalising mental health (Chapter 2).

Objective 2. To outline the candidate causal mechanisms through which economic circumstances might affect adolescents' internalising mental health based on a systematic search of mediation studies and expert consultation (Chapter 3).

Objective 3. To investigate the magnitude of inequalities in suicidal thoughts and behaviours in adolescents according to levels of food insecurity in multiple countries, and whether the magnitude of these inequalities vary across countries and according to different indicators of country-level context (Chapter 4).

Objective 4. To investigate the longitudinal association between different measures of adolescents' economic circumstances and their future internalising symptoms across eight different countries (Chapter 6).

Objective 5. To investigate whether adolescents' positive relations with their parents and peers mediate the longitudinal association between adolescents' economic circumstances and their future internalising symptoms in four low- and middle-income countries (Chapter 7).

1.6 Conclusion

In this chapter, I have presented the importance of economic circumstances for adolescents' development and their mental health. This chapter outlines the need for further research on economic inequalities in adolescents' mental health in countries where most of the worlds' adolescents live yet mental health data and research is sparse.

2 How do economic circumstances impact adolescents' internalising mental health? Insights from theories of health inequalities

2.1 Background

In recent decades, there has been growing awareness of the social gradient in health. This refers to the phenomenon where there is a correlation between increases in an individuals' economic circumstances (and other measures of social position) and decreases in negative health outcomes (Marmot et al., 1997). Differences in health according to economic circumstances and social position are apparent from infancy to the end of life (van Zon et al., 2015). These differences in health across economic groups are conceptualised by many as health inequalities – defined as avoidable and unfair differences in health (McCartney et al., 2019).

A landmark report commissioned by the UK government, known as the Black Report, was one of the first attempts to understand why health inequalities were apparent in society (Department of Health and Social Security, 1980). The Black Report proposed four theoretical explanations regarding why health outcomes were worse in individuals living in poorer economic circumstances.

The first explanation theorised in the Black Report is measurement error. Individuals living in poorer economic circumstances might overreport symptoms or health problems, whilst individuals living in wealthier economic circumstances may underreport. Differences in health across economic groups could be an artifact of measurement. The second explanation refers to social selection (sometimes known as social drift). Experiencing poor health can impact an individual's employment status and income and therefore their economic circumstances (Lund & Cois, 2018). Therefore, differences in health across economic groups might arise due to the impact of health problems on an individual's economic circumstances. This explanation implies that economic circumstances have no impact on health. The third explanation theorises that differences in health across economic groups arise as individuals living in poorer economic circumstances may be more likely to engage in behaviours that are negative for health. Finally, the fourth explanation theorises that living in poorer economic circumstances leads to increased exposure to material deprivation, reduced

access to resources fundamental to health, and negative psychological and social impacts from being relatively poorer compared to others. This implies that living in poorer economic circumstances is a cause of ill health (Link & Phelan, 1995).

Since the publication of the Black Report, effort has been made to establish whether economic circumstances, primarily income, are a cause of health outcomes. Establishing causality is difficult as the association between economic circumstances and health will at least partially be explained by confounding factors that affect both economic circumstances and health. The strongest evidence for causality is likely to arise from studies where economic circumstances are randomly manipulated, either as part of a randomised controlled trial or a natural experiment.

Regarding mental health outcomes, a meta-analysis of 86 studies investigated changes in mental health symptoms in working-age adults in response to increases or decreases in income owing to welfare policies, natural disasters, taxation, lottery wins, illness, caring responsibilities, or salary changes (Thomson et al., 2022). Income changes that lifted working-age adults out of poverty were associated with a small improvement in their mental health. Experiencing a decrease in income was associated with a deterioration in their mental health. Evidence from randomised controlled trials of cash transfer programmes in low- and middle-income countries are also associated with improvements in mental health outcomes in both adolescents and adults (McGuire et al., 2022; Zaneva et al., 2022).

Whilst the other explanations of health inequalities within the Black Report cannot be fully refuted, evidence from randomised studies suggest that living in poorer economic circumstances is a cause of mental ill health. Naturally, the processes regarding how economic circumstances affect an individual's mental health has been widely theorised. Understanding how health inequalities are generated and maintained within societies is vital to inform actions that can prevent health inequalities and improve population health (Diderichsen et al., 2001).

2.2 Objectives

The overarching objective of this chapter is to summarise how health inequalities are theorised to develop. A secondary aim is to discuss the suitability of the leading theories of health inequalities as explanations of how economic circumstances might impact adolescents' internalising mental health. In the first section, I discuss the foundations of health inequalities based on leading theories that have a social causation perspective – that is, social conditions are a direct cause of health outcomes. In the second section, I narrow the focus to theories that are specific to children and adolescents.

2.3 Theories of health inequalities

Most theories of health inequalities are concerned with differences in health across different social positions – that is, an individual's position on a social hierarchy within society. Having a higher social position is theorised to lead to better health. The concept of social position stems from the sociologist Max Weber's concept of socio-economic status, based on his observation that European societies are typically stratified according to dimensions of economic circumstances, occupation and education (Galobardes et al., 2007). However, an individual's social position is likely to be determined by a wider pool of factors than the three proposed by Weber. Others have proposed seven forms of goods and assets that are socially valued and that societies are socially stratified by: economic, political, cultural, social, honorific, civil and human assets (Grusky, 2001). Further personal characteristics, such as gender, ethnicity, or religion are also important determinants of social position and these characteristics, as well as Grusky's proposed assets, vary in their importance for determining social position based on a country's cultural and societal norms and values (Diderichsen et al., 2001; Grusky, 2001).

In this section I summarise the two key foundations of health inequalities that are apparent throughout the leading theories. The first foundation refers to the presence of social stratification within societies or populations. The second refers to the causal mechanisms through which social position directly impacts health.

2.3.1 The stratification of society and the social production of illness

The first foundation of health inequalities is that there is social stratification within a population. This stratification leads to social hierarchies where different groups have differing levels of privilege and status (Grusky & Takata, 1992). In the context of economic circumstances, this can be interpreted as stratification in society according to differing levels of income, wealth and other economic resources, all of which bring multiple advantages and privileges.

The role of social stratification as the primary driver in the production of health inequalities was first heavily emphasised in the Fundamental Cause Theory developed by Bruce Link and Jo Phelan (1995). They argue that action must be focused on improving distal factors, such as economic circumstances, that drive exposure to more proximal causes of illness (e.g., smoking, physical inactivity, poor sleep), rather than focusing on the proximal causes themselves, to generate substantial population health benefits (Link & Phelan, 1995). The Fundamental Cause Theory has been instrumental in highlighting the driving role social stratification has on ill health and health inequalities; however, it provides little understanding of how social stratification develops in the first place.

Diderichsen and colleagues (2001) expanded on the Fundamental Cause Theory by emphasizing that social stratification is driven and reinforced by the social context of society. They propose various factors that have a key role in the distribution of power and wealth within populations and stratify societies, such as the educational system, government policies and gender norms. Diderichsen and colleagues (2001) emphasise that the origins of social stratification, and in turn health inequalities, are both social and political in nature.

The Commission on Social Determinants of Health was established by the WHO in 2005 to help and encourage countries to address the social determinants of ill health. In the report that followed, Solar and Irwin (2010) expanded on the work of Diderichsen and colleagues (2001) by proposing six key contextual factors that they theorised drive social stratification within populations. The first contextual factor they identified was governance patterns, defined as “the system of values, policies and institutions by which society manages economic, political and social affairs through interactions within and among the state, civil society and the private sector”. The second contextual

factor, macroeconomic policies, refers to fiscal, monetary and trade policies and the labour market structures within a country. The third and fourth contextual factors refer to social policies, specifically those that affect labour, social welfare and the distribution of land and housing, and public policies affecting education, health care, water and sanitation, respectively. The fifth contextual factor refers to countries' culture and societal values. The report provides minimal expansion on this but proposes that the social value placed on health within societies is of particular importance in how health inequalities might develop. The final contextual factor refers to the prevalence and severity of epidemiological conditions, such as major epidemics such as AIDS or COVID-19, that have a significant impact on policy-making and social structures within a population. These contextual factors are all theorised to have a powerful but unquantifiable influence in generating the patterns of social stratification and therefore health inequalities.

2.3.2 Causal mechanisms from low social position to ill health

The second foundation of health inequalities is that there must be causal mechanisms through which an individual's social position impacts their health. If not, worse health in people living in poorer economic circumstances would be a result of confounding, measurement error, or social selection (i.e., reverse causation) and therefore not driven by the impact of social position itself (Department of Health and Social Security, 1980).

Causal mechanisms have been proposed across different theories of health inequalities. Each of these mechanisms are one of the many processes through which social position is likely to impact health. According to Diderichsen and colleagues (2001), these mechanisms can be categorised into two forms. The first, differential exposure, refers to how people of different social positions encounter differing levels of exposure to positive or negative influences on health. The second, differential vulnerability, refers to different levels of susceptibility to the negative impact of determinants of ill health across social groups even if the determinant is distributed evenly. Most proposed mechanisms have focused on differential exposures at the individual-level. However, as theorised by the ecosocial theory of health inequalities, there is likely to be cumulative interplay between differential exposure, susceptibility

and resilience across individual-, community- and regional-levels (Krieger, 2001, 2021).

2.3.2.1 Differential exposure

2.3.2.1.1 Access to health-promoting resources and exposure to risk-factors of ill health

According to the Fundamental Cause Theory, the persistent association between social position and health is due to differing access to resources that can be used to avoid health risks and minimise the impact of ill health once it occurs (Link & Phelan, 1995). In other words, an individual's social position determines their level of exposure to health-promoting resources. These may be material resources such as housing, social resources such as social support, or cognitive resources such as an individual's own knowledge. An individual's social position also impacts the level of exposure to factors that have a negative impact on health. Theories which state that health inequalities primarily arise due to differences in the exposure to factors detrimental to health (e.g., poorer living or working conditions) are commonly referred to as materialist explanations (Macintyre, 1997).

It is widely theorised that individuals from higher social groups have greater access to resources that are fundamental to good health, owing to the increased power that they have within society (Link & Phelan, 1995). The definition of power is contested but is commonly conceptualised as a form of domination ("power over others") or as a form of empowerment ("power to") (McCartney et al., 2021). Having economic power, either through owning different forms of capital or having a high income, enables individuals to maintain their own social position and the status quo of economic inequality. This is achieved through a variety of means including dominating the labour market and the available housing stock (including owning multiple properties and letting to lower-status individuals with less power). Inequalities in income and wealth and consequently health can be viewed as a circular relationship where the existing economic structures direct wealth to those with economic power (such as through rents) (Sayer, 2015). Differing levels of economic power within a population therefore maintains economic inequality and social stratification within a population and leads to differences in individuals' ability to access key resources fundamental to good

health. What constitutes a key health resource is likely to be contingent on the population, the wider societal context and the health outcome of interest.

2.3.2.1.2 Biological embodiment

According to the ecosocial theory of health inequalities, people biologically “embody” their material and social environment (Krieger, 2001, 2021). In other words, individuals from a lower social position accumulate and biologically express their experiences of economic and social inequality. The pathways of embodiment are diverse and likely involve exposure to economic deprivation, hazards, trauma and inadequate health care.

2.3.2.1.3 Psychosocial impact

According to psychosocial explanations, health inequalities primarily arise owing to the impact that social inequality has on how people feel. Social comparisons made by people from lower social positions to wealthier individuals trigger negative affect states. These lead to feelings of inferiority, alienation and shame (Adler & Tan, 2017). In turn, this can lead to an increased stress response that affects neural, endocrine and immune systems within the body which increases the susceptibility to ill health (Seeman et al., 2010). Psychosocial explanations stress the importance of relative disadvantage and social comparisons in the generation of health inequalities (Runciman, 1966).

2.3.2.1.4 Cultural-behavioural explanations

Cultural-behavioural explanations concern how health behaviours differ across social groups. For instance, many behaviours that are detrimental to health, such as poor diet or smoking, are more prevalent in individuals from a lower a social position. These health behaviours are seen to arise as a response to living in a lower social position or as a coping mechanism (Pampel et al., 2010).

People with higher social position also commonly exhibit more behaviours that are beneficial for health. This includes, but is not limited to, help seeking and accessing medical care. For instance, in the UK where health care can be accessed free of charge, individuals from higher social positions navigate health services more effectively and are more likely to access them. This is despite having a lower need for health services in comparison to individuals from lower social positions (Hart, 1971).

2.3.2.2 Differential vulnerability

Numerous theories discuss ways that differential exposure to resources across social groups might lead to health inequalities, but comparatively fewer have focused on the concept of differential vulnerability.

2.3.2.2.1 Reserve capacity

The reserve capacity model emphasises the role of differential vulnerability as explanation of differences in health outcomes across social groups (Gallo, 2009; Gallo et al., 2009). The model proposes that individuals from lower social positions often have fewer interpersonal resources, such as social support, and psychological resources, such as perceived control, optimism and self-esteem. These psychosocial resources help buffer the impact of stressors and negative events. Even if the risk of exposure to negative factors for health are held constant across social groups, it is theorised that individuals from lower social groups will still have poorer health, as they have fewer resources that protect against the adverse health effects of stressors.

2.4 Theories of health inequalities in adolescents

There are two main theories that have been specifically developed to explain differences in outcomes in children and adolescents according to their economic circumstances.

2.4.1 The Family Stress Model of Economic Hardship

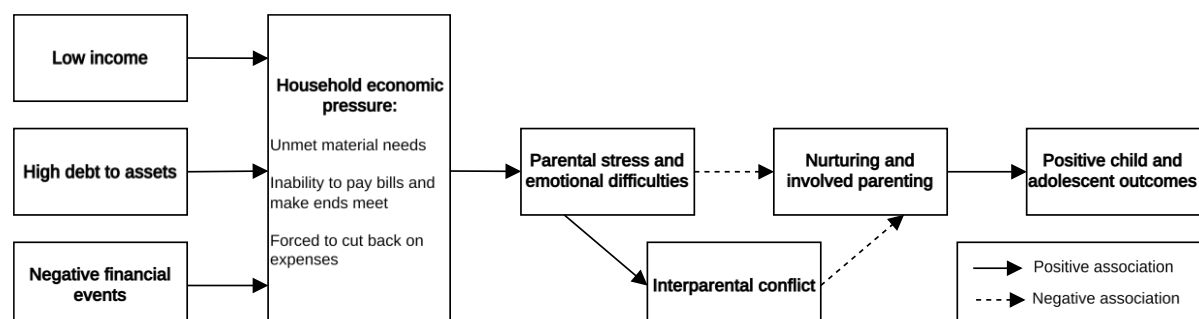
The Family Stress Model of Economic Hardship was first developed as a conceptual model of how family income loss might affect children's functioning and development during the Great Depression in the US (Elder, 1974). The model proposes that the negative impacts of economic stress on children are produced indirectly through changes in family relations, specifically through increasing the rejecting behaviour of parents towards their children. The Family Stress Model was further developed two decades later to explain the links between economic stress in families and adjustment of adolescent boys in the American Midwest following agricultural crises that led to families and communities facing sudden economic shocks (Conger et al., 1992).

The Family Stress Model outlines a theoretical process through which family economic hardship affects both positive adjustment, such as cognitive ability, social skills and

academic achievement, as well as negative outcomes including internalising or externalising mental health problems for children and adolescents (Masarik & Conger, 2017) (Figure 2.1). The Family Stress Model defines adolescents' economic circumstances according to their family's experiences of economic hardship. These hardships refer to low income, high financial debt compared to value of owned assets and negative financial events including work instability and income losses. Economic hardship leads to household economic pressures in the first pathway of the model. These economic pressures are daily stressors such as unmet material necessities, an inability to make ends meet and cutbacks on necessary expenses. These stressors are theorised to give parents psychological meaning and significance to their unstable or precarious economic circumstances.

In the second pathway, household economic pressure creates high levels of stress and emotional difficulties in parents. In the third pathway, economically-influenced distress in parents impacts their relationship with one another. As parents struggle with making ends meet, their interactions with each other are theorised to become more hostile with greater levels of conflict. In the fourth pathway, increased parental stress and interparental conflict are proposed to limit parents' ability to consistently provide warm and nurturing parenting to their child. Parenting practices are proposed to be less consistent, stimulating, or supportive as a direct consequence of economically-influenced distress and interparental conflict. In the final pathway, the disruptions in parenting lead to an increased risk of adverse adolescent outcomes.

Figure 2.1. The Family Stress Model of Economic Hardship (adapted from Conger & Donnellan (2007)).



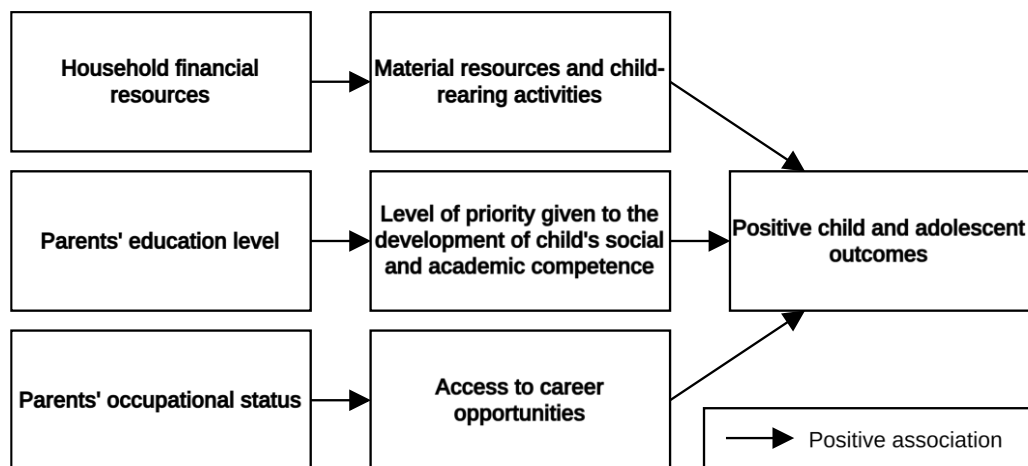
2.4.2 The Family Investment Model

Another model of inequalities in adolescents' outcomes is the Family Investment Model (Figure 2.2). The model proposes specific pathways from household financial resources, parents' education level and parent's occupation to child and adolescent outcomes through specific investments that are made by parents.

The earliest iterations of the Family Investment Model solely focused on the impact economic resources have on children and adolescents. The model states that families with greater wealth and financial resources can invest a greater level of resources (both material and time) that are beneficial for children's and adolescents' development (Becker, 1991). Material resources include sufficient food and nutrition, cognitively stimulating resources such as books, high-quality schooling and health care and housing within a safe and nurturing neighbourhood; all of which are linked to a variety of positive child and adolescent outcomes (Duncan et al., 2017). Parents living in poorer economic circumstances might be unable to invest as much time in their children, potentially due to higher rates of single parenthood or inflexible or non-standard working hours (Duncan et al., 2017). Additionally, the experience of economic deprivation is likely to capture parents' attention and cognitive resources. This could mean less attention and time is dedicated to child-rearing activities, compared to parents with no or fewer economic stressors. Economic circumstances may affect parents' involvement and relationship with their children, thus sharing a similar pathway to one theorised in the Family Stress Model.

The original model was later expanded on to account for the role parents' education-level and occupation might have on the investments that parents provide for their children (Conger & Donnellan, 2007). Parents' level of education is theorised to play an important role through impacting the level of priority that parents put on activities, goods and services that foster positive adolescent development. A greater level of education may help parents acquire more knowledge regarding adolescent development as well as means and strategies to encourage adolescents' social and academic competence (Bornstein, 2013). Finally, parents' social capital, as indicated by their occupational status, is proposed to be an important determinant of adolescents' future career, by increasing their access to high-quality employment opportunities.

Figure 2.2. The Family Investment Model (adapted from Conger & Donnellan (2007)).



2.5 Discussion

2.5.1 Summary and critique of theories

General theories of health inequalities have established that for these inequalities to exist, there must be social stratification within the population and causal mechanisms through which social position impacts health outcomes.

Social stratification within society is a “fundamental cause” of health inequalities. Therefore, health inequalities are a result of political and economic institutions and policies that create and maintain social privilege and hierarchies (Diderichsen et al., 2001; Link & Phelan, 1995). The 2005 WHO commission and the work by Diderichsen and colleagues (2001) propose contextual factors that may drive social stratification; however, they give little justification for the selection of specific factors. Furthermore, neither explain the complex processes regarding how these factors cause social stratification (Diderichsen et al., 2001; Solar & Irwin, 2010). There is also an absence of historical factors within these theories, such as colonialism, slavery and conflict that have a long-lasting impact on social stratification and health inequalities within countries (Czyzewski, 2011). Due to the complexity of different structural factors that combine to generate social stratification, empirical studies to identify these factors are lacking. Relevant research commonly compares the extent of health inequalities across countries that are differentiated by a major form of governance or policy approach (e.g., countries with different forms of welfare states). Research following this

approach aims to understand how different economic and political systems contribute to social stratification and health inequalities (McLeod et al., 2012).

A diverse range of causal mechanisms through which social position might impact health outcomes has been proposed within different theories of health inequalities. Most proposed causal mechanisms concern differences in the extent of exposure to positive or negative determinants of health across social groups. The impact of negative exposures accumulate and are embodied into an individuals' biology over time and elicit negative affect states and an increased stress response, leading to negative health outcomes (Adler & Tan, 2017; Krieger, 2001, 2021). Other mechanisms refer to differences in the psychosocial resources that are available for different social groups (Gallo et al., 2009). These resources help buffer the negative impact of stressors and negative life events, but they may be less accessible for individuals with a low social position.

The theories of health inequalities have several limitations that affect their ability to explain how economic circumstances impact adolescents' internalising mental health. First, all theories of health inequalities view health as a single concept and do not distinguish between physical or mental health outcomes. All theories therefore have little or no consideration regarding how the development and magnitude of inequalities in health might vary according to different health outcomes. The extent to which different health outcomes are associated with adults' economic circumstances varies within countries (Kivimäki et al., 2020; Pallesen et al., 2024). Notably, the association between living in poorer economic circumstances is often more strongly associated with an increased risk of mental health problems compared to physical health problems (Kivimäki et al., 2020; Pallesen et al., 2024). The causal mechanisms through which economic circumstances are theorised to impact health cannot be assumed to be universal across different health outcomes.

Second, all the reviewed theories have been developed by researchers from high-income countries in Europe and North America. The validity of these theories might not universally extend to other countries that are contextually and societally different from the countries from which supporting evidence of the theories are drawn from. This is particularly apparent when investigating health inequalities in adolescents given that 90% live in low- and middle-income countries that theories of health

inequalities typically overlook (Blum & Boyden, 2018). Despite theories of health inequalities emphasising the role that contextual factors have on the social stratification within countries, they provide limited insight regarding how these contextual factors could impact the presence or strength of causal mechanisms through which social position may impact health outcomes. Theories therefore neglect the potential differences in the causal mechanisms across population and settings.

Third, in all cases theories have focused on health inequalities according to individual's social position within a hierarchy. Economic circumstances are widely seen as a major determinant of social position within society, but they are ultimately different concepts. Their structural determinants and causal mechanisms through which they impact health are likely to differ (Braveman et al., 2005). Consequently, current theories might neglect causal mechanisms that link adolescents' economic circumstances to their internalising mental health, whilst some proposed causal mechanisms for social position may not be relevant when health inequalities are defined by individuals' economic circumstances. Furthermore, the concept of social position stem from the work of European scholars Karl Marx and Max Weber, which emphasised capital ownership and occupational class as the key drivers that shape social hierarchies in societies (Mackenbach, 2019). Theories of health inequalities that are focused on social position as determined by occupational class might be less valid in contexts where other factors may be just as important in determining social position such as caste or religion (Kumar et al., 2009).

Fourth, theories of health inequalities are overwhelmingly focused on the social position and health outcomes of adults. The causal mechanisms that impact health outcomes in adulthood might extend to adolescence but there are likely to be specific mechanisms that could be more salient for adolescents. For instance, the Ecological Systems Theory emphasises the role that adolescents' family, peers and school have on adolescent development, however these are not theorised as a causal mechanism in any general theories of health inequalities (Bronfenbrenner & Morris, 2006). Ultimately, the theorised drivers of health inequalities might not apply to internalising mental health, low- and middle-income countries, economic circumstances, or adolescents.

Two theories of inequalities are specific to both children and adolescents and economic circumstances (Conger & Donnellan, 2007; Duncan et al., 2017; Masarik & Conger, 2017). These theories are more likely to be suitable for understanding how economic inequalities in adolescents' internalising mental health may develop. These theories, the Family Stress Model and the Family Investment Model, propose explanations of how economic circumstances might affect social, educational and health outcomes in adolescents. They focus on the role of adolescents' parents and emphasise the importance of parenting behaviours or the resources that parents provide on the development of children and adolescents. They do not state how social stratification within societies is generated, unlike the general theories of health inequalities.

These models were not developed to explain differences across economic circumstances solely in health, but also for a variety of different factors including educational and social outcomes. The theorised pathways may be similar across different outcomes, but there are likely to be mechanisms in the development of mental health problems in adolescents which are not considered within these models (e.g., factors outside the adolescents' immediate family or household). As was the case for more general theories of health inequalities, these models have also been developed and primarily tested by researchers in high-income countries in Europe and North America based on observations in these contexts. In summary, both the Family Stress Model and the Family Investment Model theorise a narrow range of causal mechanisms through which adolescents' economic circumstances might impact future outcomes. These causal mechanisms might be apparent in the development of economic inequalities in adolescents' internalising mental health.

2.5.2 Conclusion

In this chapter, I have summarised the main foundations that generate health inequalities and the causal mechanisms through which social position might affect health outcomes as proposed by theories of health inequalities. Numerous causal mechanisms have been proposed; however, they have typically focused on adults and non-specific health outcomes. These causal mechanisms might not extend to health inequalities according to economic circumstances rather than social position. Causal mechanisms that have been proposed to link adolescents' economic circumstances

and their health are narrow in scope, disregard factors outside the adolescents' household and are overly reliant on observations from research in high-income countries. Existing theories of economic inequalities in adolescents' health therefore disregard the likely complexity and multitude of different causal mechanisms involved and might not extend to settings that are contextually different from those where the theories originated from. To the best of my knowledge, there is no theory that specifically focuses on economic inequalities in adolescents' mental health. The next chapter in my thesis reviews which variables have been investigated as potential causal mechanisms that might link adolescents' economic circumstances to their internalising mental health.

3 Causal mechanisms through which adolescents' economic circumstances might affect their internalising mental health: insights from mediation analyses and expert consultation

3.1 Background

Awareness of the specific causal mechanisms through which economic circumstances affect adolescents' internalising mental health is vital to inform actions and policies that can help prevent health inequalities and improve population mental health. Interventions can target these causal mechanisms to help improve mental health outcomes for adolescents living in poorer economic circumstances. The identification of causal mechanisms can also raise confidence that the association between economic circumstances and adolescents' internalising mental health is causal as a clear process of how the exposure leads to the outcome is made visible (Röth, 2023). This would weaken arguments that theorise economic inequalities in internalising mental health result from social drift or measurement error and strengthen claims of a causal relationship (Department of Health and Social Security, 1980).

It is important to note that actions to directly improve adolescents' economic circumstances and in theory their mental health are preferential from an ethical perspective. This would likely have benefits across a wide range of health, economic and social outcomes at the individual- and societal-level. However, interventions designed to do this, such as cash transfers, are not always feasible as they require significant political will and sufficient resources (Lund, 2023). In some cases, economic interventions have been found to be ineffective or have only a small impact on mental health outcomes in adolescents (Baird et al., 2025; Garman, Eyal, et al., 2022; Zaneva et al., 2022). As a result, there have been calls to further understand the causal mechanisms through which economic circumstances affect adolescents' mental health (Evans-Lacko et al., 2023; Lund, 2023). Greater awareness of the causal mechanisms would identify targets that can be targeted alongside economic interventions to help improve the mental health outcomes of adolescents living in poorer economic circumstances (Maselko, 2017).

3.1.1 Objectives

The overarching objective of this review is to outline the candidate causal mechanisms through which economic circumstances may affect adolescents' internalising mental health. This is informed through a systematic search of studies designed to investigate this, known as mediation studies, and consultation with experts in mental health inequalities from a variety of disciplines. A secondary aim is to develop a conceptual model of candidate causal mechanisms based on the systematic search and expert consultation.

The following section presents the methodological approach of mediation studies that aim to identify causal mechanisms of an association. It also discusses the major threats to validity that are apparent in mediation studies.

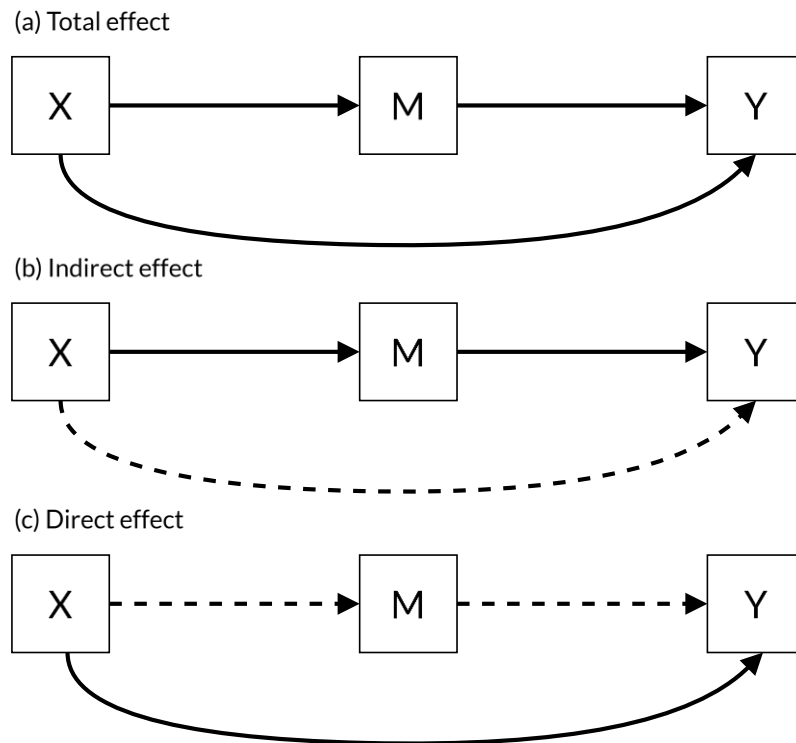
3.1.2 Methodological approaches to identify causal mechanisms of an association

Mediation analyses are designed to identify whether a variable, known as a mediator, is caused by the exposure and also causes the outcome. Mediation analyses can in theory identify mechanisms through which economic circumstances affect adolescents' internalising mental health. In most analytic models, three estimates are produced within the framework of mediation analyses. These are used to identify a potential mechanism of an association between an exposure (X) and an outcome (Y) (Figure 3.1). These are commonly known as the total effect, the indirect effect and the direct effect; however, the terminology differs across analytic approaches.

The total effect is the X-Y association through any potential mechanism (Figure 3.1a). The indirect effect refers to the X-Y association that is solely through the mediator of interest (M) (Figure 3.1b). The strength of indirect effect is contingent on the strength of the X-M and M-Y associations. Finally, the direct effect refers to the X-Y association that is through all other mechanisms except for M (Figure 3.1c). Accordingly, the total effect is the sum of the direct effect and the indirect effect. In some analytic models a further estimate known as the proportion mediated (PM) can be calculated by dividing the indirect effect by the total effect. This generates a value that corresponds to the percentage of the X-Y association that is through M. Compared to a low PM, a high

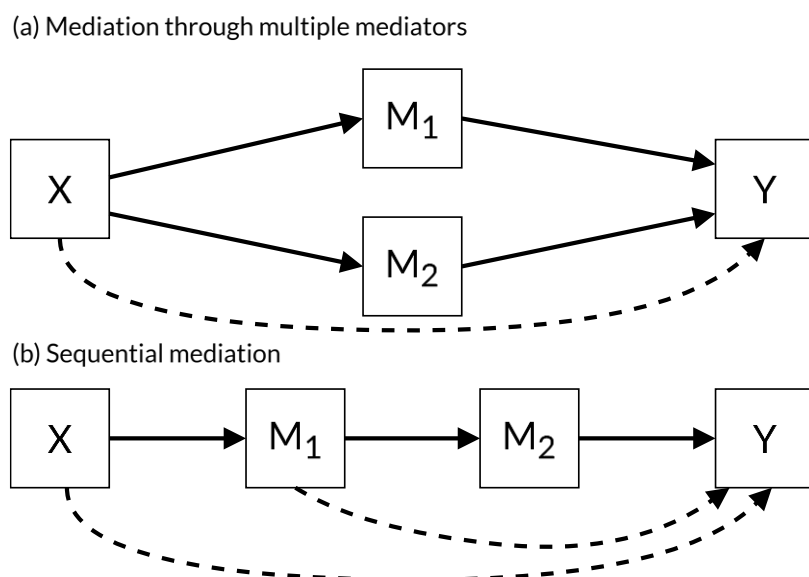
PM indicates that the X-Y association is through M to a greater extent and thus M constitutes a substantial mediator.

Figure 3.1. Estimates and pathways within mediation analyses.



Mediation analyses can include multiple mediators that are theorised to be unrelated to one another (parallel mediation) (Figure 3.2a) or use sequential modelling where the mediators are proposed to affect other mediators (Figure 3.2b).

Figure 3.2. Parallel and sequential mediation analyses.



3.1.2.1 Challenges in identifying causal mechanisms

Mediation analyses are subject to a range of threats to validity. A study might provide statistical evidence that M mediates the X-Y association, however inferring that M constitutes a causal mechanism can be false due to threats to validity that are often not dealt with.

The first threat to validity is apparent in analyses of cross-sectional data. At least three causal relationships are assumed in any mediation analysis. First, that the exposure is a cause of the mediator (X-M association). Second, that the exposure is a cause of the outcome (X-Y association). The third, that the mediator is a cause of the outcome (M-Y association). These three assumptions imply a temporal ordering between all three variables; the exposure happened first, followed by the mediator, followed by the outcome. Mediation analyses using cross-sectional data are unable to appropriately model the temporal ordering of variables and therefore identify any causal relationship in the X-M, X-Y and M-Y associations. Consequently, mediation analyses of cross-sectional data are at a high risk of bias. In most scenarios they overestimate the extent to which a mediating variable is a causal mechanism of an association (Maxwell & Cole, 2007). In some cases, the temporal ordering can be assumed from cross-sectional data if variables are captured retrospectively and refer to different time periods, or the exposure is not time-varying (e.g., assigned sex at birth or ethnicity) and can be assumed to occur prior to the mediator and outcome (Schuler et al., 2024). In most cases, the use of longitudinal data where the exposure, mediator and outcome are measured at different timepoints is needed to ensure temporal separation and thus reduce the risk that associations are driven by reverse causation. In turn, this reduces the likelihood that any observed mediation is a result of bias.

A second key issue within mediation analyses is unmeasured confounding. The X-Y, X-M and M-Y associations might all be subject to bias owing to confounding or inappropriate measurement of confounders that have been adjusted for. The assumption that there is no unmeasured confounding needs to be met to obtain valid estimates. Mediation analyses are further complicated by intermediate confounders; variables caused by the exposure and themselves cause both the mediator and outcome. Intermediate confounders therefore confound the M-Y association (Sheikh et al., 2016). A lack of adjustment for intermediate confounders means the M-Y

association is likely to be overestimated which in turn could lead to the incorrect conclusion that M is a mechanism through which X causes Y.

The third key threat to validity in mediation analyses is collider bias. Collider bias in mediation analyses refers to cases where a third variable, known as a collider, is a cause of both the mediator and the outcome but is not associated with the exposure (Richiardi et al., 2013). In mediation analyses the X-Y association after adjusting for M is estimated to identify the direct effect (the association between X and Y through all other potential mechanisms except for M). To estimate this, M is controlled for. As a result, the collider opens a backdoor path from X to Y. This results in a spurious association between X and Y, inducing bias and potentially leading to false inferences. All confounders of the M-Y association need to be adjusted for to prevent collider bias when estimating the direct effect, otherwise inferences drawn from mediation analyses are likely to be invalid (Röth, 2023).

The fourth and final key threat to validity refers to regression dilution bias (Hutcheon et al., 2010). Regression dilution bias occurs when there is measurement error of the exposure within a regression model, which leads to associations biasing towards the null. In the context of mediation analyses, measurement error of the mediator means the M-Y association is biased to the null, and therefore the indirect effect is underestimated. Consequently, measurement error of mediators can lead to underestimating the extent of mediation.

Overall, mediation analyses are subject to numerous threats to validity that limit the strength of inferences regarding whether a variable may be a causal mechanism within an association. All statistical approaches will produce biased results if there is unmeasured confounding of the X-Y, M-Y and X-M association or unmeasured intermediate confounders. All methods are also at further risk of bias if there are unmeasured colliders or the data is cross-sectional. Different statistical methods to carry out mediation analyses vary in how much they can refute these biases. In most case, these threats to validity can only be handled through robust study design.

3.1.2.2 Statistical approaches to identify causal mechanisms

3.1.2.2.1 Traditional approaches

Mediation analyses are synonymous with a method pioneered by Reuben Baron and David Kenny (1986). Separate regression analyses are run to ascertain whether there is statistical evidence of the X-Y association, the X-M association and the M-Y association within their mediation framework. If there is statistical evidence of all associations the X-Y regression analysis is re-run controlling for M. It is assumed that M is a causal mechanism that fully links the exposure to the outcome if the X-Y association is no longer significant after adjusting for M. This implies that there are no other causal mechanisms beyond M. If the magnitude of the coefficient has attenuated but the X-Y association remains significant it is then assumed that M is a causal mechanism that partially links the exposure to the outcome.

This method has been widely used (as of March 2025, the original paper has been cited over 135,000 times) but features significant limitations. The reliance on significance testing means that the precision rather than the magnitude of estimates is used to identify potential mediation. Consequently, findings are dependent on sample size and measurement error and are reliant on changes in p-values and whether they cross an arbitrary threshold (i.e., $p < 0.05$). The method also does not estimate an effect size for the indirect effect meaning the PM cannot be estimated. This limits the understanding of the relative importance of mediators within a X-Y association. The method also requires evidence of a X-Y association; however, this is not necessary to test for an indirect effect (MacKinnon et al., 2000).

Other regression-based traditional approaches do not rely on significance testing and can estimate the magnitude of the indirect effect (VanderWeele, 2021). In the difference in coefficients method the total effect (the X-Y association) is first estimated. The direct effect is then estimated through regressing Y on both X and M. The coefficient for X is interpreted as the direct effect on the outcome excluding through the mediator of interest. The indirect effect (the X-Y association that is solely through M) is then estimated by subtracting the direct effect from the total effect.

The product of coefficients method follows a similar approach (VanderWeele, 2021). The X-M association is first estimated, followed by the M-Y association controlling for X. The indirect effect is then calculated by multiplying the resultant coefficients of X-M

and M-Y associations together. This method is commonly used within a Path Analysis or Structural Equation Modelling framework with bootstrapping applied.

These regression-based approaches are less flawed than the Baron and Kenny (1986) approach to mediation but still have several limitations. They are unable to incorporate interactions between the exposure and mediator variables, when in most cases it is unrealistic to assume that there is no exposure-mediator interaction (Valeri & VanderWeele, 2013). They can also only model continuous mediators limiting what variables can be investigated.

3.1.2.2.2 Causal mediation analyses

Causal mediation analyses are based on the counterfactual framework. Causal effects are estimated through modelling participants' values of the outcome based on observed and counterfactual values of the exposure and mediator(s) (Rijnhart et al., 2021). Several methods have been developed that follow the counterfactual framework. This includes weighting-based approaches where participants are weighted according to the probability of being exposed based on the values of the confounders, and Monte-Carlo simulation approaches which model outcomes based on simulating hypothetical scenarios under different values of the exposure and mediator(s).

Causal mediation methods have several advantages over traditional regression-based approaches. They can model an X-M interaction. Most causal mediation analysis methods are also non-parametric, meaning they can handle continuous or categorical variables of the exposure, mediator(s) and outcome (Rijnhart et al., 2021).

3.2 Methods

I used a systematic search strategy to identify mediation studies that met the inclusion criteria. The aim of the review was to scope potential mechanisms that have been studied and to inform a model of how economic circumstances might affect adolescents' internalising mental health. Aspects of systematic reviews such as risk of bias assessment and use of a second reviewer were therefore not conducted. The review protocol and search strategy were pre-registered at OSF Registries (<https://osf.io/jhx4z>).

3.2.1 Search strategy

The review used a systematic search to identify relevant studies from six different bibliographic databases: MEDLINE, Global Health, PsycINFO, EconLit, Child Development and Adolescent Studies and Web of Science (Science Citation Index Expanded, Social Sciences Citation Index). Studies were eligible from database inception to 26th March 2024 (the date of the search). Search terms were related to adolescents, economic circumstances, internalising mental health and mediation analyses. Full search terms are provided in Appendix A.

Following the searches, I uploaded the records into Endnote software to identify duplicates. I then uploaded titles and abstracts of the studies to the *Rayyan* online screening tool (Ouzzani et al., 2016). I carried out all screening of records at title and abstract-level and at full-text with no second reviewer.

I included published studies that met the following criteria:

3.2.1.1 Participants

I included studies of adolescents where the outcome (internalising mental health) was measured between the ages of 10 to 21. There is no agreed consensus regarding the age adolescence starts and ends. I chose this age range (10 to 21) based on a compromise between the World Health Organization's definition of adolescence (10 to 19) and recent debate, primarily in Western countries, regarding whether adolescence might extend to the age of 25 (Sawyer et al., 2018; World Health Organization, 2024). Given the dissonance of all aspects of life between a 10-year-old and a 25-year-old I used a slightly narrower definition based on the assumption that mediators in early adulthood might differ to those in adolescence.

Adolescents' age was indicated by mean age of the sample when internalising mental health was measured. If the mean age was not reported, I determined study eligibility from the age range or school year of the sample. There were no criteria regarding the age adolescents were when the exposures or mediators were measured.

3.2.1.2 Exposure

I included any study that measured adolescents' economic circumstances, including but not limited to measures of family or household wealth, income, or subjective assessments. I also included studies that assessed socio-economic position or status.

This was to reduce the likelihood of missing key literature despite these terms differing in concept to economic circumstances, but they are often used interchangeably (Zaneva et al., 2024).

3.2.1.3 Outcomes

I included studies which measured the symptoms or caseness of internalising mental health problems including anxiety and depression, and non-diagnostic specific measures of psychological distress, internalising or emotional symptoms, or psychosomatic symptoms. I included studies that had a measure of internalising mental health regardless of the informant, such as adolescents themselves, their parents or caregivers or adolescents' teachers.

3.2.1.4 Study design

I included studies of any design which investigated whether any variable(s) mediates the association between economic circumstances and internalising mental health in adolescents. I included both cross-sectional and longitudinal studies. I excluded non-English language studies, dissertations, conference abstracts and study protocols.

3.2.2 Data extraction

I extracted key study data using an Excel-based form. Extracted data included the age of participants, the variables representing the exposure, mediator(s) and outcome and how they were measured, the study design, the analytic approach and the studies' results. I did not carry out any formal risk of bias assessments for any included study or a GRADE approach to assess and summarise the quality of the overall evidence.

3.2.3 Creation of mechanism domains

I identified candidate causal mechanism from the mediation studies and categorised them into different domains and further sub-domains. Domains were chosen based on their conceptual coherence and distinctiveness. I then used a non-systematic approach to search for studies that provided evidence that specific variables were associated with both adolescents' economic circumstances and internalising mental health, thus representing a candidate causal mechanism despite not being formally tested in a mediation analysis (Braveman et al., 2011). These candidate causal mechanisms were then added to the list of existing candidate causal mechanisms

found from the systematic search. Non-systematic searches were primarily carried out in Google Scholar and Web of Science. Both the creation of the domains and non-systemic searches followed an iterative approach and were ongoing throughout data extraction and the expert consultation period.

3.2.4 Expert consultation

After defining the initial domains and categorising each candidate causal mechanism, I sought input from experts to identify candidate causal mechanisms that have yet to be formally investigated in mediation studies and hence missing from the initial list. The list of domains and candidate causal mechanisms were first presented to a group of six researchers based at University College London, who provided advice regarding the domain groupings and suggested further candidate causal mechanisms.

Next, I identified external experts through examining the corresponding authors of studies that were identified within the systematic search and identifying experts with interest in how economic circumstances affect mental health. Experts were identified through Google searches, discussions with supervisors, identifying corresponding authors of key papers cited throughout my thesis, or through having lived experience of mental health problems in adolescence. I contacted experts from a variety of different disciplines including psychology, psychiatry, economics and sociology, as well as from different world regions. This resulted in a list of 34 experts.

Contact was carried out over two stages. First, I randomly selected 17 experts who were contacted via email in July 2024. Emails followed a similar layout but there were minor personalised alterations tailored to each expert. Emails included an explainer of the domains of the causal mechanisms and a list of the candidate causal mechanisms presented within their corresponding domains. In the emails I asked for further suggestions of candidate causal mechanisms that might be missing. In the first stage eight experts responded. Seven of these experts suggested further candidate causal mechanisms. I updated the domains and candidate causal mechanisms based on the expert input from the first stage. I emailed the remaining 17 experts with the updated domains and mechanisms three weeks after the initial emails were sent to the first set of experts. I again asked for further suggestions and feedback. In the second stage seven experts responded, and six suggested further candidate causal mechanisms.

3.2.5 Data synthesis

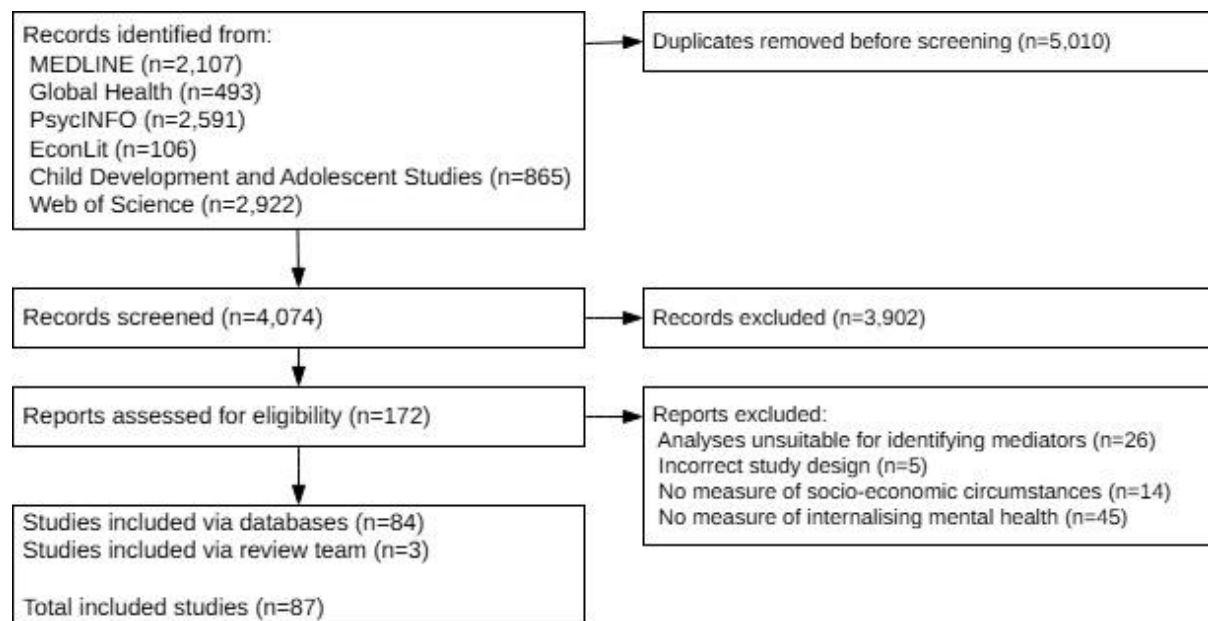
I conducted a narrative synthesis to describe and summarise what variables have been investigated as a mediator of the association between economic circumstances and internalising mental health in adolescents, and additional candidate causal mechanisms that were suggested by experts or identified through non-systematic searches. To aid the synthesis, I categorised the mediation studies that were identified through the systematic searches according to the mediating variable they investigated. I then produced a narrative summary regarding the main candidate causal mechanisms of the association between adolescents' economic circumstances and their internalising mental health. Summaries were grouped according to six broad domains; social, psychological, material, biological, environmental and behavioural factors. The narrative summaries within each domain feature a discussion of a select number of studies. I prioritised discussion of high-quality evidence where available, and I also aimed to capture the variety of different candidate causal mechanisms and evidence from a variety of different world regions.

3.3 Results

3.3.1 Candidate causal mechanisms through which economic circumstances may affect adolescents' internalising mental health

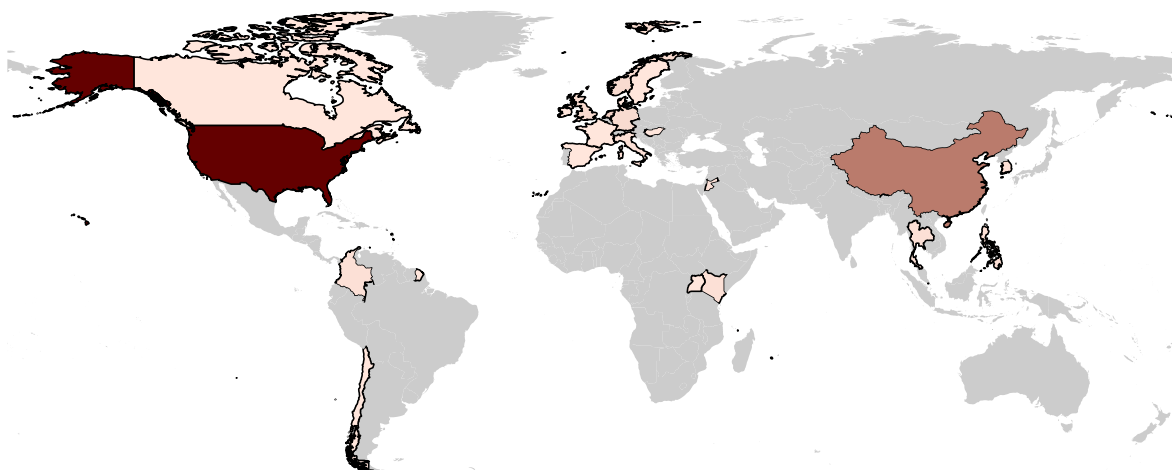
I identified 84 mediation studies from 85 reports that met inclusion criteria (Figure 3.3). Three further mediation studies, not identified in the searches, were included resulting in a total of 87 studies.

Figure 3.3. PRISMA flowchart of included studies.



Fifty-eight studies (66.7%) were carried out in Europe or North America (Figure 3.4; Table 3.1). Eighteen of the 22 studies in Asia were carried out in China or Hong Kong. One study was carried out in an African country (Uganda), whilst one was conducted in South America (Chile). Two cross-country studies included countries across Asia, Europe, North America and South America.

Figure 3.4. Mediation studies across countries.



Note: Darker shades of red indicate a higher number of studies conducted within the country. Gray indicates no mediation studies were identified in those countries.

Studies primarily measured adolescents' internalising mental health in early- or middle-adolescence. Over half of mediation studies measured the outcome, adolescents' internalising mental health, when adolescents were between the ages of 10 and 15.

Table 3.1. Key characteristics of mediation studies.

	N (%)
Continent	
Asia	22 (25.3)
Africa	1 (1.1)
Cross-continent	2 (2.3)
Europe	16 (18.4)
North America	42 (48.3)
Oceania	0 (0)
South America	1 (1.1)
Mean age at outcome	
10 to 12	28 (32.2)
13 to 15	33 (38)
16 to 18	15 (17.2)
19 to 21	1 (1.1)
Not stated	10 (11.5)
Study design	
Cross-sectional	63 (72.4)
Longitudinal	24 (27.6)
Any confounder adjustment	
Yes	60 (70)
No	27 (30)
Method to assess mediation	
Baron and Kenny method	7 (8)
Difference-of-coefficients, Product-of-coefficients, Structural Equation Modelling	77 (88.5)
Causal mediation	3 (3.4)
Type of mediation tested	
Single mediator	26 (29.9)
Parallel mediators	14 (16.1)
Sequential mediators	35 (40.2)
Both parallel and sequential	12 (13.8)

Sixty-three studies (72.4%) were cross-sectional. In the longitudinal studies (n=24), the time between the baseline timepoint to the follow-up timepoint ranged from 6 months to 13 years. Any confounder adjustment was only carried out in two-thirds of studies. Regression-based approaches, consisting of methods using product or difference of coefficients methods, were used to assess mediation in close to 90% of studies. Close to a third of studies investigated a single mediator (29.9%) and 16

percent investigated multiple mediators in parallel. The remaining studies carried out sequential mediation (40.2%) or both sequential and parallel mediation (13.8%). Further characteristics of each study (country, design, and the exposure and mediator variables) are presented in Appendix A.

Measures to assess adolescents' economic circumstances were categorised into eight classifications (Table 3.2). Most studies used either a measure of financial stress, income, or a single or composite measure of socio-economic status.

Table 3.2. Measures of economic circumstances used within the mediation studies.

Measure	Definition	N (%)
Economic intervention	Interventions that aim to improve economic circumstances received directly by adolescents or their family.	1 (1.1)
Financial poverty	Poverty based on whether household income is below a predefined cut-off.	5 (5.7)
Financial stress	Subjective self-reports of families being unable to pay for living expenses, or composite measures capturing financial stressors including negative economic shocks, financial cutbacks, income loss and debt.	24 (27.5)
Income	The level of household income, presented as raw values, quantiles, or equivalised to household size.	21 (24.1)
Multidimensional poverty	Composite measures referring to deprivation across multiple household domains, including food security, health care and housing.	8 (9.2)
Objective socio-economic status	Single or composite measures capturing parents' education-level, occupation, income and household assets.	22 (25.3)
Subjective socio-economic status	Adolescents' or parents' perception of their economic circumstances or social position within society.	6 (6.9)
Wealth	The value of or ownership of specific household assets.	2 (2.3)

Note: Percentages add up to over 100% as several studies investigated multiple measures of economic circumstances.

The final list of domains features six different domains of candidate causal mechanisms: social, psychological, material, biological, environmental and behavioural. Social factors were the most studied mediator (Table 3.3). They were investigated in 62 studies, with 34 carried out fully or partially in Canada or the US. This was followed by studies investigating psychological (24 studies), material (11), biological (6), environmental (5) and behavioural mediators (1). Within these domains are secondary domains which capture more specific mechanisms. Tertiary domains are also provided which consist of a non-exhaustive list of exemplar mechanisms within the secondary domains.

Table 3.3. Mediation studies across continents, grouped according to domain of mediator investigated.

Continent	Domain					
	Social	Psychological	Material	Biological	Environment	Behavioural
Africa	2	0	1	0	0	0
Asia	20	11	4	0	2	0
Europe	11	6	0	1	0	1
North America	34	6	5	5	3	0
Oceania	0	0	0	0	0	0
South America	3	1	1	0	0	0

Note: Number of studies is greater than 87 due to multi-country studies and studies that investigated multiple mediators from different domains.

3.3.2 Social mechanisms

3.3.2.1 Mechanisms at the family-level

Most studies investigated the potential mediating role of factors related to adolescents' family, particularly their parents (n=51). Nine of these studies investigated the Family Stress Model in full. This involved testing sequential mediation from economic pressures to economic stress, to parental stress, to parent-relationship difficulties and parenting practices to adolescents' internalising mental health. Seven of the nine investigations of the full Family Stress Model were wholly or partially conducted in the US.

I found two studies that investigated the Family Stress Model using longitudinal data. The first study featured 422 African American families in the US (Landers-Potts et al., 2015). Measures of income, economic pressure, parents' internalising symptoms and parent conflict was measured at timepoint 1 (mean age 10.5), and nurturant-involved parenting and adolescents' internalising symptoms were measured two years later. The Family Stress Model partially explained the greater level of internalising symptoms seen in adolescents' living in poorer economic circumstances.

The second study used data from 10 cultural groups across seven countries (Zietz et al., 2022). Economic hardship, as indicated by household income, income losses and perceived economic pressure was measured when adolescents were aged 12. These were hypothesised to impact parents' mental health and support to one another when

adolescents were aged 13. Levels of harsh and disengaged parenting were measured at age 14, and adolescents' internalising symptoms were measured at age 15. There was support for the Family Stress Model, and therefore mediation through parenting practices in eight of the ten cultural groups, including in several low- and middle-income countries: Colombia, Jordan, the Philippines and Thailand. In the US sample of white adolescents, the Family Stress Model was not supported for adolescents' internalising symptoms as economic pressure was not associated with internalising symptoms in mothers. There was also no support for the model in the Kenyan sample as household income had no association with parents' perception of economic pressure.

Many other studies did not test the Family Stress Model in full but instead investigated one of the single mediators that are theorised as a pathway within the model. These were namely parental stress or factors linked to parenting such as the level of authoritative practices, parents' disciplinary styles, or parent-child conflict. Outside of the family-level factors theorised in the Family Stress Model, one cross-sectional study in Spain found that aspects related to family functioning mediated the association between adolescents' economic circumstances and their internalising symptoms (Caño González & Rodríguez-Naranjo, 2024). Another study modelled the family environment based on the marital status of adolescents' parents, the number of adults in the household and adolescents' perceived support from parents. Family environment was found to mediate the association between family income and adolescents' internalising symptoms; but the study followed the Baron and Kenny approach to assess mediation and findings might be invalid (Tracy et al., 2008).

3.3.2.2 Peer relationships

Comparatively less attention has been made to the potential mediating role of adolescents' relationships with their peers. Economic disadvantage can reduce the opportunities for adolescents to develop and maintain friendships. This could be through having reduced means to access social activities (e.g., financial or practical barriers), experiencing increased stigma or low peer acceptance from peers due to being of lower social status, or through the negative impact that living in poorer economic circumstances might have on their social skills (Attree, 2006; Bukowski et al., 2020). Consequently, adolescents living in poorer households are more likely to

experience social isolation, have fewer close friends and spend less time with friends outside of school than adolescents from wealthier households, however most evidence is from countries in Europe (Gibb et al., 2016; Hjalmarsson & Mood, 2015; Olsson, 2007). Positive social relations with peers such as friendships and social support are associated with better mental health in adolescents, whilst negative experiences such as being bullied or experiencing loneliness or social isolation are associated with poorer mental health (Alsarrani et al., 2022). This suggests a potential pathway through which economic circumstances could impact adolescents' internalising mental health.

Five studies have looked at the potential mediating roles of aspects regarding peer relations. Four studies have been conducted in China and another study in the Republic of Korea. All studies used cross-sectional data. Three studies investigated the mediating role of peer conflict or victimisation. These studies found that living in poorer economic circumstances was associated with a greater likelihood of peer conflict or victimisation, which in turn was associated with increased psychological distress and internalising symptoms (Jiang, 2020; Lee et al., 2023; Wang et al., 2022). In two further studies, social support from classmates, parents and friends was assessed in a single measure. In both studies, social support was found to mediate the association between economic circumstances and internalising symptoms in Chinese adolescents (C. Li & Zhang, 2023; Zou et al., 2020).

3.3.2.3 School and education

School is a social environment that plays a significant role in adolescents' development (Aldridge & McChesney, 2018; Bronfenbrenner, 1979). School can be a positive context for adolescents as it fosters social connections and the learning of new skills and competencies. It is also an environment with negative stressors associated with adverse mental health outcomes such as peer victimisation and academic pressure (Arseneault, 2018; Steare et al., 2023). Some evidence suggests that the likelihood of experiencing school as a positive or negative environment is associated with adolescents' economic circumstances. For instance, peer victimisation in schools is more common in adolescents living in poorer economic circumstances (Hosozawa et al., 2021). It may also act as an environment where an adolescents' low social standing

or poorer economic circumstances is made more salient in comparison to wealthier peers.

I found four studies that investigated the mediating role of school-related factors. This included three cross-sectional studies. In a study of Chinese adolescents, the association between family income and adolescents' internalising symptoms was partially mediated by adolescents' feelings regarding the atmosphere of their school (Gu et al., 2023). In two further studies, living in poorer economic circumstances was associated with reduced academic performance, which in turn was associated with increased internalising symptoms (Lee et al., 2023; Wang et al., 2022). In the sole longitudinal study, the association between living in a household under the poverty line and higher levels of internalising symptoms was not mediated by adolescents' perceived satisfaction with their school (Keegan Eamon, 2002). However, the study used the Baron and Kenny approach to assess mediation.

3.3.2.4 Adverse childhood experiences and stressful life events

Adverse childhood experiences refer to extreme stressors such as maltreatment (emotional, physical or sexual abuse or neglect) or family adversity, such as violence or substance abuse, in adolescents' household (Finkelhor et al., 2013). Five studies investigated the experience of maltreatment as a potential mediator of the association between adolescents' economic circumstances and their internalising mental health. This includes three longitudinal studies carried out in the US.

In the first longitudinal study the association between economic circumstances at age 3 and internalising symptoms at age 11 was partially mediated by adolescents living in poorer economic circumstances experiencing higher levels of maltreatment (characterised by being a victim of interpersonal violence, high levels of exposure to trauma and to severe violence) (Weissman et al., 2022). In the second longitudinal study, adverse childhood experiences over the past year at age 11 was found to partially mediate the association between reduced household income at age 10 and increased internalising symptoms two years later (Barnhart et al., 2022). The final longitudinal study found that greater levels of income instability from birth to age 5 was associated with increased physical and psychological abuse between the ages of 5 and 9, which in turn was associated with increased anxiety symptoms at age 15 (L. Zhang et al., 2024). There was no evidence of mediation through child neglect.

Four studies investigated factors classed as stressful life events – experiences that are more transient and less severe than adverse childhood experiences. These include stressors at the adolescent-level, such as problems at school or conflict with peers or family, or at the household-level such as parental unemployment or a serious illness in the family. In all studies, these were measured using composite measures of different stressors to assess the frequency of stressful life events experienced by adolescents and their household. The sole longitudinal study was carried out in the US during the COVID-19 pandemic. It found that the association between lower household income and increased internalising symptoms at follow-up was partially mediated by adolescents from poorer households experiencing more stressful life events during lockdown restrictions (Lengua et al., 2022).

3.3.2.5 Expert consultation and grouping of social mechanisms

Social mechanisms were grouped into eight secondary domains. Table 3.4 shows the emphasis of mediation studies on family-related factors to date. Many other candidate social mechanisms have not been investigated in mediation studies.

Four of the eight secondary domains were added following the expert consultation. The first additional secondary domain refers to the institutional discrimination (e.g., from school, health services, police) and stigma from others in the community that adolescents living in poorer economic circumstances might experience (Inglis et al., 2023). The second additional secondary domain refers to adolescents' employment status. Adolescents living in poorer economic circumstances might leave education early to help financially support their family (Putnick & Bornstein, 2015). This work may be low-skilled, precarious or in dangerous conditions that negatively impacts adolescents' internalising mental health (Benjet, 2010; Benjet et al., 2012). The third additional secondary domain refers to the increased likelihood that adolescents living in poorer economic circumstances are in contact and engaging with state systems and services, including the criminal justice system, social care and welfare services. Increased involvement with these services might increase internal or external stigma (Lapham & Martinson, 2022). The final additional secondary domain, migration and mobility, was added as adolescents living in poorer economic circumstances might have less stability regarding where they live and face more stressors associated with

moving home, potentially due to forced displacement to escape conflict or natural disasters (Ihrke & Faber, 2012; Kohlbeck et al., 2024).

Table 3.4 Candidate social mechanisms through which economic circumstances may impact adolescents' internalising mental health.

Secondary mechanism domain	Tertiary mechanism domain
Adverse childhood experiences	<i>Child marriage</i>
	Maltreatment
<i>Discrimination</i>	<i>Institutional discrimination</i>
	<i>Stigma and shame from others regarding poverty</i>
<i>Employment</i>	<i>Child labour</i>
<i>Engagement with state systems and services</i>	<i>Contact with criminal justice system</i>
	<i>Social care</i>
	<i>Welfare policies and services</i>
Family factors	Family and household conflict/domestic violence
	<i>Family member death or ill health</i>
	<i>Gender preference</i>
	Parenting practices
	<i>Parental separation</i>
	Parental stress and mental health problems
<i>Migration and mobility</i>	<i>International migration</i>
	<i>Refugee and forced displacement</i>
	<i>Residential mobility</i>
Peer relationships	Friendships, peer relationship quality and social support
	<i>Social skills deficits</i>
	Victimisation
School and education	Academic performance
	<i>Academic pressure</i>
	<i>Dropout, enrolment and attendance</i>
	<i>School belongingness</i>
	School climate

Bold = investigated in a mediation study identified in the systematic search. Italics = suggested by experts or identified through non-systematic searches.

3.3.3 Psychological mechanisms

The symptoms of internalising mental health problems, such as low mood and anxiety, are primarily experienced in the mind. A vast array of theories of mental health problems, and their treatment, are therefore rooted in the understanding of psychology. Unsurprisingly, many studies (n=24) investigated the extent to which psychological factors mediate the association between economic circumstances and internalising symptoms.

3.3.3.1 Autonomy

Autonomy refers to the perception of being self-governed rather than being controlled by external forces or factors (Legault, 2016). Adolescents with high levels of autonomy can make their own decisions and have the opportunity to pursue their goals. This facilitates healthy development and positive wellbeing (Ryan & Deci, 2000).

One candidate causal mechanism that concerns adolescents' autonomy is their sense of control, defined as an individual's belief that their actions matter in determining their own outcomes (Lachman & Weaver, 1998). Adolescents living in poorer economic circumstances are theorised to have a reduced sense of control in comparison to wealthier peers. This might be due to having fewer social and material resources that enable control over their circumstances and environment (Bosma et al., 2014). In turn, a reduced sense of control may lead to feelings of entrapment and frustration leading to a greater risk of internalising mental health problems.

In a longitudinal study in the US, there was evidence of sequential mediation where household economic pressure led to increased adolescents' awareness of family hardship, which led to a reduced sense of control and higher levels of future distress (Conger et al., 1999). In a more recent longitudinal study in the Netherlands, adolescents who perceived their family wealth to be poor had increased internalising symptoms at follow-up. The association was partially mediated by adolescents' sense of control (Weinberg et al., 2023).

3.3.3.2 Beliefs and attitudes

Adolescents' beliefs and attitudes are influenced by their economic circumstances. Adolescents' beliefs and attitudes regarding themselves or others could also influence the risk of internalising symptoms. Despite this, I found only one study that focused on

adolescents' beliefs and attitudes, specifically belief in a just world, as a potential mediator.

Belief in a just world is the belief that the world or society is fair, and that peoples' outcomes are a result of this fairness (Lerner, 1980). Individuals that believe in a just world view high levels of success and status as a result of hard work. Consequently, they view low levels of success and status to be a result of negative personal choices or actions. Individuals who do not believe in a just world view these differing outcomes as products of luck and unfairness. Belief in a just world is conceptualised as personal if views of injustice refer to oneself, or as general if the views refer to wider society.

Adolescents living in poorer economic circumstances are less likely to believe in a just world due to their or their family's increased likelihood of experiencing adversity and injustice (Thomas & Mucherah, 2016). They might also perceive society to be unfair as means to understand their low social position. In turn, being less likely to believe in a just world is likely to reduce optimism and trust of others, which may potentially increase the risk of internalising mental health problems (Furnham, 2003).

A single study investigated the potential mediating role of adolescents' belief in a just world (both personal and general) in the cross-sectional association between both objective and subjective economic circumstances and internalising symptoms (Weinberg, Stevens, Peeters, Visser, Tigchelaar, et al., 2023). Increased subjective wealth was associated with being more likely to believe in a just world and in turn was associated with decreased internalising symptoms. There was no mediation when the objective measure of wealth was the exposure.

3.3.3.3 Personality and emotional development

Adolescence is a critical period for the development of personality and sense of self. It is also a period where emotional states can be intense and variable, and when the ability to regulate emotions gradually improve (McLaughlin et al., 2015).

Several studies investigated whether factors linked to adolescents' emotion may mediate the association between economic circumstances and internalising mental health. This included emotional resilience, referring to the ability to quickly recover from negative emotional experiences (Davidson, 2000), emotional intelligence, referring to the ability to recognise, comprehend and control emotions (Cheung et al.,

2018), and emotion regulation, referring to the ability to manage and respond to different emotional experiences (Palacios-Barrios & Hanson, 2019). There was evidence that emotional resilience, emotional intelligence and emotional regulation were greater in wealthier adolescents in comparison to adolescents living in poorer economic circumstances in three studies. In turn these were associated with reduced internalising symptoms (Barch et al., 2020; M. Cao et al., 2021; Cheung et al., 2018).

Several studies investigated the potential mediating role of self-esteem. Self-esteem is defined as the evaluation of an individual's own importance, worth, or value (Blascovich & Tomaka, 1991). Having low self-esteem, characterised by a negative view of oneself, is consistently associated with experiencing a mental health problem (Keane & Loades, 2017). Across the lifespan, self-esteem is commonly higher in individuals living in wealthier economic circumstances, including in adolescents (Twenge & Campbell, 2002). Adolescents living in poorer economic circumstances might experience external or internal stigma based on their low economic standing, leading to reduced self-esteem and therefore a greater risk of mental health problems (Attree, 2006). I found seven studies that investigated whether adolescents' self-esteem mediated the association between economic circumstances and their internalising mental health (J. Cao et al., 2024; Jiang, 2020; J. Kim, 2021; Lee et al., 2021; Lee & Allen, 2021; Martinez et al., 2015; Weinberg, Stevens, Peeters, Visser, Frankenhuis, et al., 2023; Wen et al., 2023).

There were mixed findings in the longitudinal studies. There was support that self-esteem partially mediated the association between poorer economic circumstances and increased internalising symptoms in two studies in China and the US (J. Cao et al., 2024; J. Kim, 2021). In another longitudinal study in the Netherlands, adolescents' perceived family wealth was not associated with adolescents' self-esteem; therefore, there was no support for mediation (Weinberg, Stevens, Peeters, Visser, Frankenhuis, et al., 2023). In another longitudinal study of low-income families in Singapore, 1-year trajectories of economic hardship were associated with clinical levels of anxiety but not depression. There was no mediation through self-esteem (Wen et al., 2023).

Two studies investigated whether differences in disengagement and engagement coping strategies mediated the association between economic circumstances and adolescents' internalising mental health. Disengagement coping strategies are efforts

to orient attention away from a stressor or thoughts and emotions related to a stressor, such as avoidance or inaction. Engagement coping strategies are efforts to actively orient toward a stressor by direct action, problem-solving or through seeking support. In a longitudinal study of US adolescents, the extent to which adolescents practised disengagement coping strategies (but not engagement coping strategies) mediated the association between internalising symptoms and the number of years spent in financial poverty since birth (P. Kim et al., 2016). Adolescents who lived in poverty for longer had increased use of disengagement coping strategies, which in turn was associated with increased internalising symptoms.

Several studies investigated adolescents' optimism – a generalised feeling of confidence in positive future outcomes (Carver et al., 2010). Optimism may be lower in adolescents living in poorer economic circumstances compared to wealthier peers, as they have more financial and practical barriers that need to be overcome to achieve future goals. Adolescents living in poorer economic circumstances also experience more adverse and negative circumstances which reduce optimism regarding the future (Segerstrom, 2007). Low levels of optimism are associated with a reduced ability to cope with stressors and an increased risk of mental health problems in adolescents (Hitlin et al., 2015; Rincón Uribe et al., 2022). There was no evidence of mediation through adolescents' level of optimism in the sole longitudinal study. Dutch adolescents' perceived family wealth was not associated with adolescents' levels of optimism, meaning there was no support for mediation (Weinberg, Stevens, Peeters, Visser, Frankenhuis, et al., 2023). However, there was support for mediation through adolescents' optimism in two cross-sectional studies (Piko et al., 2013; Zou et al., 2020).

The extent to which adolescents are mindful, present and aware might also mediate the association between economic circumstances and internalising mental health. Higher levels of trait mindfulness are proposed to lead to more objective perceptions of moment-to-moment experiences and more adaptive responses to negative situations and threats (Shapiro et al., 2006). Trait mindfulness is therefore a potential protective factor for mental health problems. A longitudinal study of Chinese high school students between the ages of 14 and 17 found that living in wealthier economic circumstances was associated with increased levels of trait mindfulness. Increased

trait mindfulness was associated with decreased internalising symptoms one year later (Yuan et al., 2023).

3.3.3.4 Expert consultation and categorisation of psychological mechanisms

Psychological mechanisms were categorised into four secondary domains (Table 3.5). Very few further candidate causal mechanisms were proposed. This suggests that current mediation studies have investigated the variables that may be the most promising candidate psychological mechanisms.

The sole additional secondary domain, cognition, is comprised of candidate causal mechanisms that were suggested by experts. The first exemplar tertiary mechanism within the cognition secondary domain refers to bandwidth tax. Bandwidth tax refers to the reduced enjoyment obtained from activities by individuals living in poorer economic circumstances as their cognitive resources are focused on the stressors associated with economic disadvantage (Schofield & Venkataramani, 2021). The second tertiary mechanism refers to adolescents' hyperparameters – cognitive parameters that control learning processes. Childhood adversities, such as poverty, are proposed to impact hyperparameters that control the extent to which behaviours are explore-orientated (broad, noisy, oriented towards information) or exploit-orientated (narrow, efficient, orientated to reward) (Frankenhuis & Gopnik, 2023). Living in poorer economic circumstances can increase the preference towards exploit-orientated behaviours earlier in adolescence owing to previous changes to hyperparameters. This is to help obtain immediate rewards, rather than risk rewards being unavailable in the future. This accelerated cognitive development might have immediate benefits, but these changes may negatively impact long-term development. The final tertiary mechanism refers to health literacy – the extent to which adolescents or their caregivers have the capacity to obtain and understand health information and services and consequently make appropriate decisions for the adolescent's health (Peerson & Saunders, 2009). Health literacy is commonly lower in individuals living in poorer economic circumstances and could impact the extent to which they seek treatment and avoid risks for mental ill health as well as their ability to navigate health services, therefore potentially exacerbating the risk of mental health problems (Mantwill et al., 2015).

Table 3.5. Candidate psychological mechanisms through which economic circumstances may impact adolescents' internalising mental health.

Secondary mechanism domain	Tertiary mechanism domain
Autonomy	Sense of control
Beliefs and attitudes	Belief in a just world
	<i>Internalised shame</i>
	<i>Negative self-schemas</i>
<i>Cognition</i>	<i>Bandwidth tax (reduced enjoyment from activities)</i>
	<i>Explore/exploit trade-off</i>
	<i>Health literacy</i>
Personality and emotional development	<i>Attachment styles</i>
	Coping strategies
	Emotional intelligence
	Emotion regulation
	Emotional resilience
	Optimism
	Self-esteem
	<i>Self-regulation (capacity to set goals, maintain goal-directed behaviour and adapt behaviour to achieve goals)</i>
	<i>Temperament</i>
	Trait mindfulness

Bold = investigated in a mediation study identified in the systematic search. Italics = suggested by experts or identified through non-systematic searches.

3.3.4 Material resources

This domain consists of material resources that are found in adolescents' household or land and are likely to be directly provided by their caregivers. According to the Family Investment Model, living in wealthier economic circumstances enables the purchasing and access of good and resources that are important for positive child and adolescent outcomes as well as greater levels of parental involvement (Masarik & Conger, 2017). I found eleven studies that investigated the mediating role of variables related to material resources or investments akin to the Family Investment Model. Six of these studies were longitudinal. There was a high level of heterogeneity regarding how material resources were assessed. Many studies featured composite variables based on different indicators or included different forms of material resources as separate mediators within the same analytic model.

3.3.4.1 Access to essential consumables

Essential consumables are the basic goods and resources needed to maintain good health such as food, water or clothing. These goods and resources might cost relatively little and their consumption may be transient, but they are essential for everyday life.

In a cross-sectional study of adolescents in Hong Kong, reduced household income was associated with adolescents' having fewer material necessities such as warm clothes, school uniforms and pocket money, which in turn was associated with increased internalising symptoms (J.-K. Chen et al., 2021).

Two studies assessed food insecurity as a mediator with mixed findings. In a longitudinal study in the US, the association between reduced household income and increased internalising symptoms at follow-up was partially mediated by adolescents living in poorer households experiencing higher levels of food insecurity (J. H. Chen et al., 2024). The other study carried out mediation analyses within a trial of adolescents living with HIV in Uganda. In the trial, the impact of a family-based economic empowerment intervention with a savings account matched with cash transfers over two years on adolescents' internalising symptoms was compared with treatment as usual (Cavazos-Rehg et al., 2021). The intervention led to a reduction in food insecurity, but food insecurity had no association with internalising symptoms. Consequently, there was no evidence that the effect of the economic intervention on reducing internalising symptoms was through increasing adolescents' level of food security.

3.3.4.2 Material assets

Material assets include large and substantial resources such as housing, that make up a significant proportion of a family's total wealth. Families with high levels of income can afford material assets that are greater in both quantity and quality in comparison to less wealthy families.

In the trial of Ugandan adolescents with HIV, there was support of mediation through material assets (Cavazos-Rehg et al., 2021). The economic intervention was associated with fewer internalising symptoms at follow-up, partially through increasing the number of family assets. Family assets included housing value and ownership of

livestock, transport and land. A cross-sectional study in Chile found that lower levels of socio-economic status was associated with a less suitable home environment (cleanliness, structural safety, over-crowding), which in turn was associated with increased internalising symptoms (Martinez et al., 2015).

3.3.4.3 Cognitive stimulation and parental involvement

One longitudinal study in the US found that the association between reduced household income and increased internalising symptoms in adolescents was partially mediated by adolescents from poorer households experiencing higher levels of deprivation experiences (Weissman et al., 2022). Deprivation experiences were measured with a composite capturing low cognitive stimulation, increased food insecurity and physical and emotional neglect. In another longitudinal study in the US, the association between higher levels of poverty experienced between kindergarten and third grade and higher levels of internalising symptoms at eighth grade was partially mediated by the availability of cognitively stimulating materials in the adolescents' home at fifth grade (L. Zhang & Han, 2021). There was no mediation through parental school involvement as it was not associated with adolescents' internalising symptoms.

In a cross-sectional study in China, the association between higher levels of self-reported wealth and reduced internalising symptoms in adolescents was partially mediated by increased levels of organised activities and greater parental help with homework in wealthier households (Y. Zhang, 2021). There was no mediation through the provision of cognitively stimulating materials. The composite measure, which was based on computer access, having a desk and the number of books in household, was not associated with adolescents' internalising symptoms.

3.3.4.4 Expert consultation and categorisation of material mechanisms

Material mechanisms were categorised into four secondary domains (Table 3.6). The sole secondary domain that was added following the expert consultation refers to the financial means to access services. Adolescents living in poorer economic circumstances might be unable to access essential services due to financial barriers associated with insurance costs, fees and travel costs. In comparison, wealthier adolescents may be able to afford private education or health care. This might

contribute to greater levels of internalising symptoms in adolescents living in poorer economic circumstances (F. V. Lopes et al., 2022).

Table 3.6. Candidate material mechanisms through which economic circumstances may impact adolescents' internalising mental health.

Secondary mechanism domain	Tertiary mechanism domain
Access to essential consumables	Clothing
	<i>Electricity</i>
	Food security
	<i>Fuel</i>
	<i>Water security</i>
Cognitive stimulation and parental involvement	Cognitively stimulating resources at home
	Cognitively stimulating activities outside the home
<i>Financial means to access services</i>	
Material assets	<i>Household appliances</i>
	Housing ownership and quality
	Land
	<i>Livestock</i>
	<i>Sanitation facilities</i>
	Transport

Bold = investigated in a mediation study identified in the systematic search. Italics = suggested by experts or identified through non-systematic searches.

3.3.5 Biological mechanisms

Six studies investigated biological mechanisms through which economic circumstances may impact adolescents' internalising mental health. These studies align with the ecosocial theory of health inequalities which theorises that individuals embody their experiences of economic inequality which leads to biological changes that increase the risk of ill health (Krieger, 2001, 2021).

3.3.5.1 Neurological factors

Childhood and adolescence are critical periods for neurological development. Economic circumstances during this period can impact numerous brain functions and structures. The increased exposure to stressful and adverse events experienced by adolescents living in poverty is associated with reduced volume in some brain regions, potentially due to the negative effects of chronic stress (Luby et al., 2013). This is proposed to lead to an increased risk of adverse mental health outcomes (Hackman

et al., 2010). I found six studies that investigated whether neurological factors mediated the association between economic circumstances and internalising mental health, all of which were conducted in North America or Europe.

One candidate neurological mechanism relates to structural and functional differences in the prefrontal cortex – a brain region that controls many higher-order functions, including emotion regulation. A longitudinal study of 123 adolescent girls in the US found that greater financial stress in childhood, according to number of years receiving public assistance, was associated with increased medial prefrontal cortex activation during a reward task and future internalising symptoms. After including medial prefrontal cortex activation as a mediator in the analytic model, there was no longer evidence of an association between financial stress and internalising symptoms. The study suggests that functional differences in the medial prefrontal cortex might mediate the association between economic circumstances and internalising symptoms (Romens et al., 2015). Another longitudinal study of 78 adolescents in the US found that greater household income at age 10 was associated with increased activity in the subgenual anterior cingulate during a reward learning and decision-making task at age 15. Increased activity was associated with fewer internalising symptoms one-year later (Palacios-Barrios et al., 2021).

Three studies specifically investigated the function or structure of the amygdala, given its central role in threat detection, stress reactivity and memory of negative information. The amygdala displays heightened reactivity to stressors in individuals with anxiety and depression, suggesting it could be involved in the aetiology of internalising mental health problems (Groenewold et al., 2013; Swartz et al., 2015). In one longitudinal study, increased resting state functional connectivity between the amygdala and the prefrontal cortex was associated with increased internalising symptoms at follow-up. Multidimensional poverty was not associated with resting state functional connectivity, however. Consequently, frontoamygdala functional connectivity did not mediate the association (Ip et al., 2022). Another null finding was found in a cross-sectional study of 14-year-old adolescents across France, Germany, Ireland and the UK. Increased parent-reported financial stress was associated with reduced volume of the amygdala, but amygdala volume had no association with adolescents' internalising symptoms (Stepanous et al., 2023). In another longitudinal study, socio-economic status was assessed through a composite of household income and parental education. There

was evidence of an indirect effect from socio-economic status on future changes in adolescents' internalising symptoms via increased threat-related amygdala reactivity (Swartz et al., 2017).

Only one study investigated brain regions outside of the prefrontal cortex. Hippocampal volume was investigated given the role it has in stress reactivity (van Bodegom et al., 2017). In a study of 167 US adolescents, income in early childhood (3 to 5) was associated with changes in hippocampal volume from ages 8 to 15, which in turn was associated with internalising symptoms at age 15 (Barch et al., 2020).

3.3.5.2 Epigenetics

I found one study which investigated the potential role of epigenetics as a mediator of the association between economic circumstances and internalising symptoms. Epigenetics refers to changes in the expression of specific genes due to environmental effects. In one longitudinal study of 183 US adolescents, sequential modelling was used to identify whether the association between socio-economic status and change in internalising symptoms was mediated through a pathway consisting of two variables (Swartz et al., 2017). The first variable was change in DNA methylation (a marker of changes in the expression of genes) of the proximal promoter region of the serotonin transporter gene (SLC6A4). Previous studies have found that SLC6A4 is linked to the risk of mental health problems, partially through impacting amygdala reactivity to threats (Swartz et al., 2015). The second variable was the change in threat-related amygdala reactivity. The study found that being of lower socio-economic status was associated with greater changes in SLC6A4 methylation, which in turn was associated with greater increases in threat-related amygdala reactivity. Greater increases in threat-related amygdala reactivity were associated with increased internalising symptoms (Swartz et al., 2017). Evidence of mediation was found only for adolescents that had a parent with a history of depression. The study suggests that living in poorer economic circumstances might lead to increased internalising symptoms in adolescents with a positive family history of depression partially as a result of changes to gene expression and subsequent changes in threat-related amygdala reactivity.

3.3.5.3 Hormones

I found one study which investigated the potential role of hormones as a mediator of the association between economic circumstances and internalising mental health in

adolescents. The study specifically investigated testosterone as its regulation might be impacted by early adversity, and testosterone dysregulation may negatively affect development of the hippocampus – which has a role in stress reactivity (van Bodegom et al., 2017). In the longitudinal study of adolescents in the US, living in wealthier economic circumstances was associated with greater increases in testosterone. In turn, increases in testosterone was associated with increases in hippocampus volume. Increased hippocampus volume was associated with reduced emotional dysregulation. In the final step of the model, greater levels of emotion dysregulation were associated with increased internalising symptoms (Barch et al., 2020). The study therefore found that economic circumstances may lead to future internalising symptoms through influencing testosterone levels during adolescence.

3.3.5.4 Expert consultation and categorisation of biological mechanisms

Biological mechanisms were grouped into seven secondary domains (Table 3.7). Several candidate causal mechanisms were proposed by experts, vastly outnumbering the small number of biological mechanisms that have been formally investigated in mediation studies. Four of the seven secondary domains were solely comprised of suggested mechanisms not yet studied in mediation analyses.

The first secondary domain refers to genetic factors. The second consists of hormones, with oestrogen, testosterone and cortisol seen as key candidate causal mechanisms. The next secondary domain refers to obstetric factors. Pregnancy and birth complications are more common in families living in poorer economic circumstances and can have long-term impacts on offspring's mental health (M. K. Kim et al., 2018; R. Robinson et al., 2020). The fourth secondary domain, neurological factors, includes the function and structure of key brain regions. It also includes neurotransmitters owing to their key function in mood and emotion. The fifth secondary domain refers to the pace and timing of physical development. Living in poorer economic circumstances is commonly associated with earlier onset of puberty in girls, which in turn is associated with an increased risk of internalising mental health problems (Colich et al., 2020; Ullsperger & Nikolas, 2017). The experience of poverty-related stressors can also lead to an earlier maturation of the brain systems that are important for emotion expression, which is proposed to increase the risk of mental health problems (Callaghan & Tottenham, 2016). The sixth secondary domain refers

to the physical health of adolescents. Severe illness, injuries and health conditions are associated with increased anxiety and depressive symptoms and are typically more common in adolescents living in poorer economic circumstances (Arrondo et al., 2022). Finally, the seventh secondary domain refers to different physiological states, systems and functioning, including inflammation, the microbiome and biological sensitivity to context. Biological sensitivity to context refers to the theory that some adolescents are more biologically sensitive to their environments and experiences than others. Evidence suggests that adolescents living in poorer economic circumstances might have a heightened biological sensitivity to stressors (Armstrong-Carter & Telzer, 2022).

Table 3.7. Candidate biological mechanisms through which economic circumstances may impact adolescents' internalising mental health.

Secondary mechanism domain	Tertiary mechanism domain
Epigenetics	
Hormones	<i>Cortisol</i>
	<i>Oestrogen</i>
	Testosterone
<i>Obstetric factors</i>	<i>Foetal environment</i>
	<i>Low birth weight</i>
	<i>Premature birth</i>
Neurological factors	Function and structure of brain regions (amygdala, anterior cingulate cortex, hippocampus)
	<i>Neurotransmitters</i>
<i>Pace and timing of development</i>	<i>Brain maturation</i>
	<i>Puberty</i>
<i>Physical health problems</i>	<i>Disability</i>
	<i>Chronic health condition</i>
<i>Physiological states, systems and functioning</i>	<i>Biological sensitivity to context</i>
	<i>Inflammation</i>
	<i>Microbiome</i>

Bold = investigated in a mediation study identified in the systematic search. Italics = suggested by experts or identified through non-systematic searches.

3.3.6 The wider environment

Environmental mechanisms concern factors linked to the area where adolescents live. The wider environment is one of the mechanisms theorised in the Family Investment Model. The Family Investment Model states that wealthier economic circumstances enable adolescents to live in safer and more suitable neighbourhoods that foster healthy development (Duncan et al., 2017).

3.3.6.1 Neighbourhood and the local community

In a longitudinal study in the US, the association between greater household financial stress and increased internalising symptoms was partially mediated by the social cohesion and trust of adolescents' neighbourhood. Specifically, adolescents from households with higher levels of financial stress at age 3 lived in areas with less social cohesion and trust at age 3, which in turn was associated with increased depressive symptoms at age 15 (Oh & Thomas, 2024). In a Chinese cross-sectional study, the association between lower family income and increased internalising symptoms in adolescents was partially mediated by neighbourhood cohesion, but not neighbourhood safety or trust (Gu et al., 2023). In another cross-sectional study in China, the associations between higher levels of self-reported wealth and reduced internalising symptoms in adolescents were partially mediated by wealthier adolescents living in neighbourhoods that were safer and less polluted (Y. Zhang, 2021).

3.3.6.2 Expert consultation and categorisation of environmental mechanisms

I categorised environmental mechanisms into three secondary domains (Table 3.8). The first refers to the accessibility and quality of local services that play an important role in adolescents' development. Some evidence suggests that service accessibility is reduced in the most deprived regions within countries (Frola et al., 2024; J. Pearce et al., 2008). The second refers to environmental hazards that are more commonly experienced by adolescents living in poorer economic circumstances and can have an adverse effect on mental health. The third domain refers to the quality and safety of the neighbourhood that adolescents' live in.

Table 3.8. Candidate environmental mechanisms through which economic circumstances may impact adolescents' internalising mental health.

Secondary mechanism domain	Tertiary mechanism domain
<i>Accessibility and quality of local services</i>	<i>Educational</i>
	<i>Health care</i>
	<i>Recreational</i>
Environmental hazards	<i>Extreme weather events</i>
	<i>Famine</i>
	<i>Lead contamination</i>
	Pollution
Neighbourhood and the local community	<i>Green space</i>
	Safety, trust and cohesion
	<i>Noise pollution</i>
	<i>Transport infrastructure</i>

Bold = investigated in a mediation study identified in the systematic search. Italics = suggested by experts or identified through non-systematic searches.

3.3.7 Behaviours

As theorised in cultural-behavioural explanations of health inequalities, economic circumstances may impact adolescents' internalising mental health through affecting their own health-related behaviours (Pampel et al., 2010). I found a single mediation study that investigated any behaviour.

3.3.7.1 Physical activity

In the sole study, longitudinal data were analysed of UK adolescents. Household income was measured at age 5, physical activity measured at age 7 and internalising symptoms measured at age 11 (Chigogora et al., 2020). Different levels of physical activity for each adolescent were simulated to reflect hypothetical values if different interventions were implemented to increase adolescents' levels of physical activity. There was no evidence that the association between adolescents' economic circumstances and their internalising symptoms was mediated through their level of physical activity.

3.3.7.2 Expert consultation and categorisation of behavioural mechanisms

Behavioural mechanisms were categorised into two secondary domains: health-related behaviours and help-seeking (Table 3.9). Relevant health-related behaviours were suggested including diet, substance use, screen time and sleep. A further candidate causal mechanism refers to a potential decreased willingness in adolescents living in poorer economic circumstances to seek clinical or non-clinical help in response to experiencing internalising symptoms. Wealthier adolescents in comparison might be more likely to seek help and subsequently receive effective treatment that improves their internalising mental health. Differences in help-seeking may be due to increased practical or financial barriers to seeking help or decreased optimism that help would be given or effective for adolescents living in poorer economic circumstances (Radez et al., 2021).

Table 3.9. Candidate behavioural mechanisms through which economic circumstances may impact adolescents' internalising mental health.

Secondary mechanism domain	Tertiary mechanism domain
Health-related behaviours	<i>Diet</i>
	Physical activity
	<i>Substance use</i>
	<i>Screen time</i>
	<i>Sleep</i>
<i>Help-seeking</i>	

Bold = investigated in a mediation study identified in the systematic search. Italics = suggested by experts or identified through non-systematic searches.

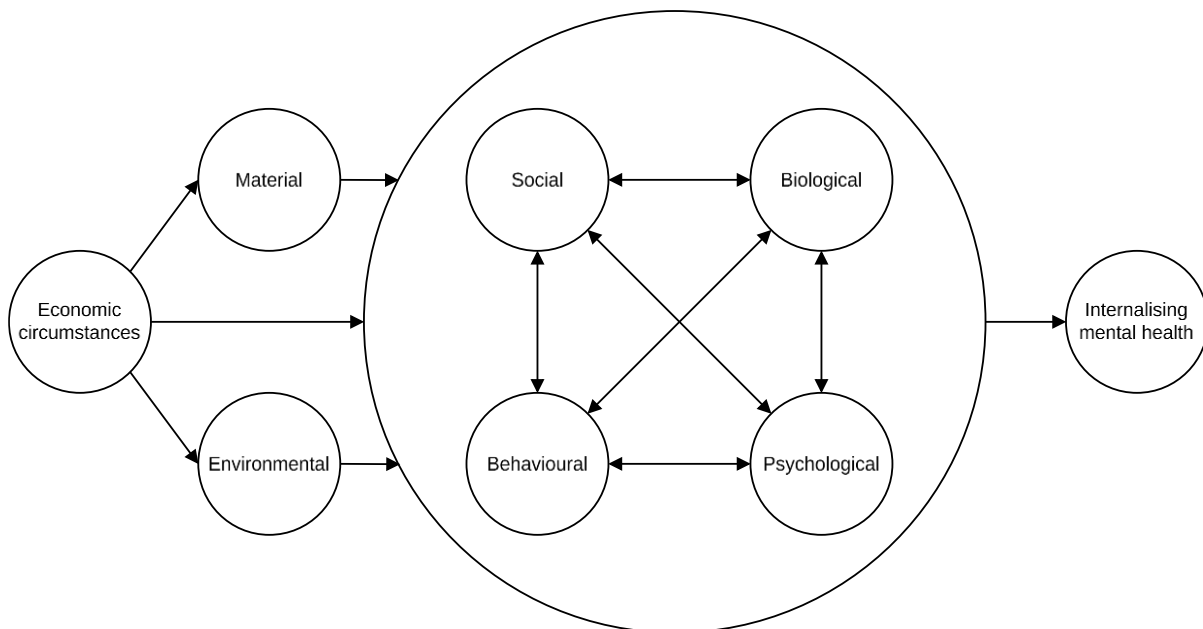
3.3.8 Conceptual model

In summary, I mapped and categorised a diverse range of candidate causal mechanisms. These were found through a systematic search of mediation studies and through an expert consultation. The candidate causal mechanisms are presented within broad domains; however, they should not be considered wholly separate to one another. Each mechanism is likely to be a descendant of others, and in turn a cause of other mechanisms too, including mechanisms in the same or in different domains. There is likely to be a complex interplay between these mechanisms from birth and throughout adolescence. Complex relationships between mechanisms were found in studies of sequential mediation. Barch and colleagues (2020) found evidence of a complex mechanistic pathway from poorer economic circumstances to increased levels of internalising symptoms through biological mediators (testosterone levels and hippocampal volume) impacting a psychological mediator (emotional dysregulation). Another study found that economic circumstances impacted a social mediator (social support), which impacted a psychological mediator (optimism), which in turn affected internalising symptoms (Zou et al., 2020).

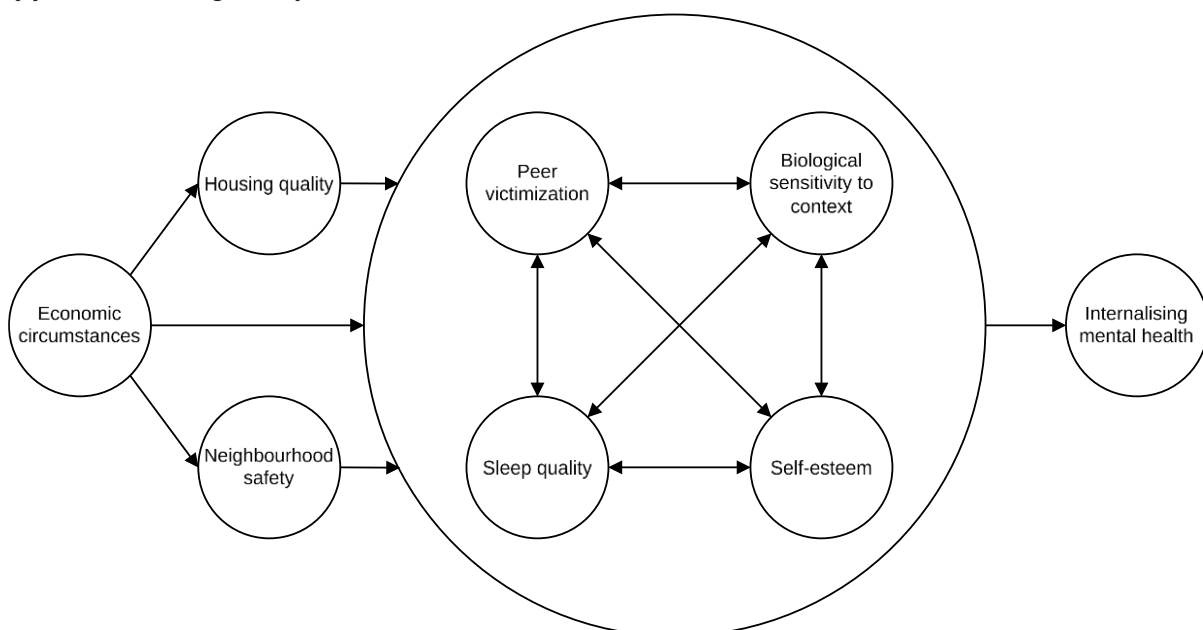
Figure 3.5a presents a conceptual model of the potential temporal ordering and relationship between different domains of candidate causal mechanisms. Figure 3.5b provides examples of candidate causal mechanisms within these domains. The conceptual model is designed to show the interconnectedness of different causal mechanisms and the complexity of the processes through which economic circumstances might impact internalising mental health in adolescents. For different adolescents, certain connections may or may not be apparent and the strength of the association between different domains might vary in magnitude. In the context of economic inequalities in adolescents' internalising mental health, it could aid intervention development or help inform the design of mediation studies.

Figure 3.5. Conceptual model outlining how the causal mechanisms and their relationship to one another may explain the processes through which adolescents' economic circumstances impact their internalising mental health.

(a) Model outlining the connections between domains of causal mechanisms



(b) Model outlining example mechanisms within the domains of causal mechanisms



In the following section, I describe the model and provide examples of ways that one mechanism within a domain might impact another mechanism in a different domain. A lack of connection between domains of mechanisms does not mean that there is likely to be no direct relationship between them. Instead, the included pathways between different domains represent the most plausible relationship between mechanisms.

3.3.8.1 The impact of economic circumstances on adolescents' material resources and wider environment

In the first part of the model, adolescents' economic circumstances directly impact the availability and quality of material resources and essentials within a household and the wider environment in which adolescents live in (Duncan et al., 2017).

3.3.8.2 The impact of adolescents' economic circumstances, material resources and wider environment on their social world, biological states and processes, behaviours and psychological factors

Deprivation in material resources and living in a wider environment that has many hazards is proposed to impact adolescents' social world, their biological states and processes, their behaviours and psychological factors. For example, adolescents living in poverty or in a less affluent neighbourhood might face stigma or bullying from peers (Attree, 2006). Furthermore, having a reduced ability to access safe and sufficient food or water could lead to poorer physical health (Moradi et al., 2019). Living in an overcrowded house in a noisy neighbourhood is likely to impact sleep quality (Mayne et al., 2021). Finally, owning fewer goods and possessions compared to peers may lead to feelings of shame or low self-esteem (Isaksen & Roper, 2012).

Poorer economic circumstances may also impact these mechanistic domains directly. For instance, sudden household income loss might impact parents' levels of stress and subsequent parenting practices (Masarik & Conger, 2017). Poorer economic circumstances during pregnancy can lead to more obstetric complications and poorer physical health outcomes in offspring (M. K. Kim et al., 2018). Economic circumstances are likely to directly impact the affordability of health services and therefore help-seeking (Radez et al., 2021). Finally, adolescents' concerns over their economic circumstances could reduce their ability to enjoy activities (bandwidth tax) (Schofield & Venkataramani, 2021).

3.3.8.3 Bidirectional relationships between social, biological, behavioural and psychological mechanisms

The third part of the model theorises a complex interplay between different mechanisms. Specifically, there is a bidirectional relationship between mechanisms within four different domains.

Adolescents' social experiences are theorised to affect their biology, their behaviour and psychological outcomes. According to the Family Stress Model, adolescents living in poorer economic circumstances experience less parental warmth (Masarik & Conger, 2017). Experiencing less warm parenting can lead to an increased biological sensitivity to context in adolescents (Han et al., 2020). Adolescents' social experiences can also impact their behaviours. Experiencing social stress might lead to increased use of substances as a coping mechanism or due to social pressure (Lindenberg et al., 1993). Finally, adolescents' social experiences are likely to influence a range of psychological factors. As shown in the mediation study by Zou and colleagues (2020), economic circumstances can affect the amount of social support received from others, which in turn influences levels of optimism.

The biological states and processes of adolescents are also likely to impact mechanisms from other domains. Experiencing early puberty, which is more common in adolescents living in poorer economic circumstances, can lead to an increased risk of experiencing bullying victimisation from peers (Hiatt et al., 2021; Su et al., 2018). Earlier puberty is also associated with an increased risk behaviours in adolescents (Kowalski et al., 2021). As shown in the study by Barch and colleagues (2020), economic circumstances can also affect the volume of the hippocampus, a brain area involved in stress reactivity, which in turn affects adolescents' emotion regulation.

Adolescents' behaviours too can impact their social experiences, biology and psychological factors. Attending different social clubs and activities is likely to help foster friendships. Adolescents' neurological development can be affected by their behaviours such as substance use (Squeglia et al., 2009). Finally, high levels of social media use might lead to increased negative social comparisons affecting adolescents' self-esteem (Woods & Scott, 2016).

Finally, mechanisms within the psychological domain may impact adolescents' social experiences, different biological states and processes and their behaviours.

Adolescents who effectively regulate their emotions can handle conflict with others more effectively and typically have higher quality social relationships as a result (P. N. Lopes et al., 2011). Adolescents with effective emotional regulation might also have a more adaptive biological stress response following exposure to stressors (Kliewer, 2016). Finally, adolescents' health literacy is likely to impact both their health-related behaviours and help-seeking (Goodfellow et al., 2023).

3.3.8.4 Social, biological, behavioural and psychological mechanisms impact adolescents' internalising mental health

In the final part of the model, social, biological, behavioural and psychological mechanisms are proposed to link to adolescents' internalising mental health. These mechanisms may link to internalising mental health through different pathways for different mechanisms. For instance, they might influence how adolescents perceive themselves, their life situation, their future and the wider world (Beck, 1967, 1976). Alternatively, they could negatively alter the functioning of different biological processes implicated in mental health problems (Spenrath et al., 2011).

3.3.8.5 Summary of conceptual model

The model proposes complex links between different causal mechanisms through which economic circumstances may impact adolescents' internalising mental health. In summary, the model proposes that economic circumstances impact the material resources available to adolescents and the wider environment they grow up in. In turn, these are theorised to affect adolescents' social experiences, their biological states and process, their behaviours and psychological factors. Mechanisms within these four domains are theorised to affect one another, as well as directly influencing adolescents' internalising mental health.

The main assumption within the model is that adolescents' economic circumstances, material deprivation, or the wider environment have no direct impact on adolescents' internalising mental health. They impact adolescents' internalising mental health through influencing their social world, biological states and processes, behaviours and psychological factors.

3.4 Discussion

I identified 87 studies that investigated specific variables which may mediate the association between economic circumstances and internalising mental health in adolescents. Most studies focused on causal mechanisms akin to the theories of differential exposure – where economic circumstances predispose adolescents to experience greater or fewer resources and experiences that are consequential for internalising mental health. I created a conceptual model by drawing on the results of the systematic search and expert consultation. The model outlines the potential relationships between adolescents' economic circumstances, causal mechanism domains from six different domains and their internalising mental health.

3.4.1 Systematic search of mediation studies and expert consultation

3.4.1.1 Focus on specific causal mechanisms in mediation studies

Mediation studies primarily focused on social mechanisms. In particular, 58% of mediation studies investigated factors linked to adolescents' parents or family. Awareness of causal mechanisms from different domains is limited in comparison.

Studies that assessed psychological mechanisms primarily investigated the role of factors relating to adolescents' personality and emotional development. There was a comparative lack of research that investigated adolescents' beliefs, attitudes and cognitions. Material mechanisms were assessed in only eleven studies; however, based on the expert consultation, there are only a few candidate material mechanisms that had not yet been investigated.

Only six studies investigated biological mechanisms. This could be due to the challenges and costs associated with measuring biological factors, particularly through approaches such as neuroimaging. Furthermore, many biological mechanisms (e.g., genetics, neurological factors) are not feasible or practical targets for interventions that aim to reduce economic inequalities in adolescents' mental health. This might discourage researchers from investigating biological causal mechanisms.

Despite the significant research interest in the effects of the environment and neighbourhood on adolescents' mental health, only five mediation studies investigated these as causal mechanisms (Visser et al., 2021). Studies were limited in scope and

focused primarily on neighbourhood attributes. There were no mediation studies that investigated the accessibility and quality of local services, and only one study investigated an environmental hazard.

Only a single study investigated behavioural mechanisms. The limited number of studies could be due to criticisms towards behavioural explanations of health inequalities. The individualistic focus of these explanations can emphasise blame towards individuals, even though health behaviours are seen as structurally determined and influenced by many social determinants of health (A. Pearce et al., 2019).

In summary, mediation studies have overwhelmingly researched social mechanisms to date. This is most likely due to the influence of the Family Stress Model (Masarik & Conger, 2017). Many further causal mechanisms were proposed in all domains as part of the expert consultation and non-systematic searches. This suggests that there are many candidate causal mechanisms through which adolescents' economic circumstances might affect their internalising mental health that have not been formally investigated.

3.4.1.2 Methodological limitations of the evidence base

Only 24 mediation studies (27.6%) analysed longitudinal data. Mediation analyses of cross-sectional data are subject to significant threats to validity. It is likely that most mediation studies identified in the search overestimate the extent of mediation through any variable as any of the exposure-mediator, exposure-outcome, or mediator-outcome associations could be partially or wholly driven by reverse causation (Maxwell & Cole, 2007). Twenty-eight studies did not adjust for any confounders meaning these studies are also likely to provide biased results regarding mediation.

Approximately a third of studies investigated mediators in parallel with others. Inferring from separate studies of single mediators can risk overestimating the extent to which the association between economic circumstances and adolescents' internalising mental health might be explained by mediation through different variables, especially if these variables are conceptually similar and correlated with one-another. In the systematic search, I identified several studies that investigated a single psychological factor. There was evidence across these studies that similar constructs, such as emotional intelligence, emotion resilience and emotion regulation were mediators of

the association between economic circumstances and adolescents' internalising mental health. These variables are all likely to be highly correlated with one another and could even affect one another. They are also likely to be measuring similar aspects of a broader construct (e.g., adolescents' emotional development). Mediation for each individual variable might not be apparent if these mediators are tested in parallel within a single model. The conceptual overlap between mediators could mean the proportion mediated by the mediators included together in the same model may be less than the proportion mediated for each mediator modelled separately then summed together. This is shown in a study where mediators of self-esteem, sense of control and optimism were first investigated separately and then in parallel in the same model (Weinberg, Stevens, Peeters, Visser, Frankenhuis, et al., 2023). Indirect effects for each mediator were smaller when modelled in parallel in the same model in comparison to when each mediator was modelled separately. As only 26 studies modelled mediators in parallel, the literature might inadvertently suggest that there are numerous different mediators that when summed together explain a significant proportion of the association between adolescents' economic circumstances and their internalising mental health. The limited number of analyses that modelled different mediators in parallel also limits within-study comparisons of the strength of the indirect effect for different mediators. As a result, there is limited awareness regarding which mechanisms might have the greatest role in linking adolescents' economic circumstances to their internalising mental health.

3.4.1.3 Limited evidence from specific world regions

As is the case with other forms of mental health research, studies were overwhelmingly carried out in high-income countries in North America (n=44) or Europe (n=18). Twenty-seven studies were carried out in Asia, but only seven studies of these studies were conducted in Asian countries outside of China. Only three studies were carried out in Africa and South America. The dominance of research in high-income countries means there is limited understanding of causal mechanisms in contexts where 90 percent of the world's adolescents live (Blum & Boyden, 2018).

Specific causal mechanisms through which economic circumstances affect adolescents' internalising mental health might be more or less important in certain countries, or potentially not apparent at all. In line with the Family Stress Model, in

countries where households' economic circumstances have no or only a weak association with economic stress, the impact of economic circumstances on parenting and consequently adolescents' mental health should be limited. Macro-level factors such as sufficient unemployment benefits and social security for new parents – all of which are more apparent in high-income countries – could lead to reduced economic stress in parents from low-income households and therefore, a reduced impact of economic circumstances on parenting behaviours and subsequent mental health problems in adolescents (Hansen & Stutzer, 2022). The association between parenting practices and adolescents' internalising mental health might also be influenced by macro-level factors. Evidence suggests that negative parenting practices have a greater impact on adolescents' internalising mental health in countries where the parenting practices are not normative within their cultural context (Deater-Deckard & Dodge, 1997; Gershoff et al., 2010). The extent to which parenting practices may be causal mechanism through which adolescents' economic circumstances affects their internalising mental health is likely to be dependent on macro-level factors that influence the strength of the associations between economic circumstances and parenting practices, and between parenting practices and internalising mental health. This will apply to other causal mechanisms in cases where the exposure-mediator and mediator-outcome associations differ across contexts.

Specific causal mechanisms might also only exist in certain contexts. Child marriage is a likely causal mechanism in the countries it is practiced, as it is more common for adolescents living in poorer economic circumstances and is widely associated with poorer mental health, particularly for girls (Burgess et al., 2022). Child marriage is common in some countries, but is extremely rare in others (United Nations Children's Fund, 2018). Therefore, child marriage can only be a causal mechanism in countries where it is practiced.

Results from mediation studies from one world region therefore cannot be universally applied to other contexts. This is highlighted in a study that investigated the generalisability of the Family Stress Model across 10 cultural groups across seven countries. There was support for the model in all cultural groups except for the white American and Kenyan samples (Zietz et al., 2022). There is a clear need to identify causal mechanisms that are relevant in low- and middle-income countries, given the lack of research in these settings. This would increase understanding of how different

contexts affects the development of adolescents' mental health problems that may be caused by economic disadvantage. It could also importantly help inform culturally appropriate strategies and interventions that could improve the mental health of adolescents living in poorer economic circumstances (Maselko, 2017).

3.4.1.4 Strengths and limitations

This is the first review to systematically identify what variables have been theorised to mediate the association between economic circumstances and internalising mental health in adolescents. Other reviews have focused on adults, broader psychosocial outcomes such as wellbeing, or more general measures of socio-economic status (Benzeval et al., 2014; Devenish et al., 2017; Ridley et al., 2020).

The review had several key limitations. I included studies that used different measures to capture economic circumstances to help identify as many studies as possible. However, different indicators such as income, wealth, or socioeconomic status are only moderately correlated with one another, and their association with adolescents' internalising mental health are unlikely to be interchangeable between one another (Braveman et al., 2005; Hazell et al., 2022). The extent to which a variable mediates the association between economic circumstances and adolescents' internalising mental health might vary dependent on how economic circumstances are measured. For instance, subjective measures of economic circumstances might have a greater association with psychological factors compared to objective measures, given that psychological factors such as mood, self-esteem and optimism are all likely to influence one own's self-assessment of their living conditions (Lundberg & Kristenson, 2008). Differences in the extent of mediation by different variables across studies could be a function of the use of different measures of economic circumstances, rather than a reflection of differences in whether specific variables are a causal mechanism of the association between economic circumstances and internalising mental health.

I also did not carry out any formal risk of bias assessments. This limits the understanding of the strength of the evidence from the mediation studies. However, there are no quality assessment tools that are specific to mediation studies that have been rigorously developed and validated, limiting the benefit that a formal risk of bias assessment would have had (Vo et al., 2022).

I included a broad age range of adolescents, but did not investigate how causal mechanisms might differ according to early-, middle- and late-adolescence. Causal mechanisms might not be consistent across these age groups owing to differences in adolescents' development and everyday life.

3.4.2 Conceptual model

3.4.2.1 Implications

The model proposes the relationships between adolescents' economic circumstances and subsequent causal mechanisms that may impact adolescents' internalising mental health. Links between different domains are modifiable pathways that could be targeted to reduce economic inequalities in adolescents' mental health, potentially alongside delivery of economic interventions such as cash transfer programmes. According to the model, targeting upstream mechanisms, such as adolescents' material resources and their wider environment might hold the most promise given that they are key determinants of the downstream causal mechanisms (e.g., social, biological, behavioural and psychological mechanisms).

The model also has implications for other models of economic inequalities in adolescents' outcomes such as the Family Stress Model and the Family Investment Model (Conger & Donnellan, 2007; Duncan et al., 2017; Masarik & Conger, 2017). First, the model includes six different domains of causal mechanisms. In comparison, the Family Stress Model and the Family Investment Model feature causal mechanisms from only two and three different domains respectively. As discussed in Chapter 2, these models theorise a narrow set of mechanisms through which economic circumstances may impact adolescents' mental health outcomes. In particular, they neglect biological, behavioural and psychological causal mechanisms. Second, the model proposes a cyclical relationship between different mechanisms. This contrasts with the Family Stress Model and the Family Investment Model that assume there are no bidirectional paths between mechanisms.

The model also emphasises the importance of confounder selection when estimating the magnitude of economic inequalities in adolescents' internalising mental health. Researchers should take care not to adjust for one of the candidate causal

mechanisms as this could bias the association between economic circumstances and adolescents' internalising mental health towards the null (Schisterman et al., 2009).

Finally, the conceptual model has implications for policymakers as well. The numerous candidate causal mechanisms raise confidence that the association between economic circumstances and adolescents' internalising mental health is causal, as there are numerous plausible processes of how living in poorer economic circumstances can lead to internalising mental health problems (Röth, 2023). This could potentially help encourage policy actions that aim to improve the social determinants of adolescents' mental health, such as their economic circumstances.

3.4.2.2 Strengths and limitations

The main strength of the model is that its development draws from studies that are specific to adolescents, economic circumstances and internalising mental health. This contrasts to other theories of health inequalities, which are primarily focused on adults and social position and conceptualise health as a general outcome. The specificity of this model is also a limitation however, as it should not be applied to other social determinants of health or health outcomes. Most mediation studies that I used to inform the conceptual model were conducted primarily in high-income countries, meaning the model might not be valid across different settings. Finally, the studies used to inform the development of the model may overestimate the extent of mediation by different variables, particularly in those that analysed cross-sectional data. In several cases, the candidate causal mechanisms within the model are based on mediation studies that have not used robust methods.

3.4.3 Conclusion

The causal mechanisms through which adolescents' economic circumstances may affect their internalising mental health are numerous and complex. The mechanisms are not fully captured in existing theories of economic inequalities in adolescents' outcomes. These causal mechanisms stretch across six interconnected domains: material, environmental, social, biological, behavioural and psychological. There is limited understanding of which mechanisms are the most important in linking adolescents' economic circumstances to their internalising mental health, partly due to the predominant use of cross-sectional data in mediation analyses. There is also

limited awareness of the causal mechanisms in low- and middle-income countries, and whether the strength of causal mechanisms differs across countries.

In the following chapters, I investigate the cross-country variation in inequalities in adolescents' internalising symptoms and suicidal thoughts and behaviours, and causal mechanisms of the association between adolescents' economic circumstances and their internalising symptoms in four low- and middle-income countries.

4 Inequalities in suicidal thoughts and behaviours according to food insecurity in adolescents: variation across countries and contexts

A modified version of this chapter was published in the *Journal of Adolescent Health*:

Stearns, T., Lewis, G., Evans-Lacko, S., Pitman, A., Rose-Clarke, K., & Patalay, P. (2024). Food Insecurity, Adolescent Suicidal Thoughts and Behaviors, and Country-Level Context: A Multi-Country Cross-Sectional Analysis. *Journal of Adolescent Health*, 74(3), 545–555.

4.1 Background

In this chapter, I investigate the association between food insecurity and suicidal thoughts and behaviours in adolescents across a diverse range of countries. I further investigate whether the magnitude of the association varies across countries and indicators of societal context. The chapter uses data from one of the largest multi-country studies with data on mental health outcomes in adolescents who live in low- and middle-income countries – the Global School-based Student Health Survey (GSHS). Measures of economic circumstances are not available in the dataset, however data on food insecurity is. Food insecurity is a form of material deprivation and is commonly a consequence of living in poorer economic circumstances (de Sousa et al., 2019). Food insecurity is a prevalent stressor in low- and middle-income countries and a significant public health concern (FAO et al., 2024). The chapter aims to investigate the potential heterogeneity in the magnitude of inequalities in adolescents' suicidal thoughts and behaviours according to food insecurity status across countries and identify settings where these inequalities are most stark.

4.1.1 What is food insecurity?

The leading definition of food security was developed at the 1996 World Food Summit. It states that food security is "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (Food and Agriculture Organization, 1996).

Food insecurity is multifaceted and exists on a continuum. Mild food insecurity consists of uncertainty regarding the ability to obtain food, whilst moderate food insecurity

entails compromises on food quantity, quality or variety, leading to a less healthy diet than ideal. Meals might be occasionally skipped and, in some cases, households might run out of food. The most severe forms of food insecurity involve experiencing days without eating due to not having any food (Cafiero et al., 2018).

4.1.2 Who does food insecurity affect?

Moderate food insecurity affects around 1.3 billion every year worldwide. A further 900 million people experience severe food insecurity (Table 4.1) (FAO et al., 2024). Approximately 90% of people experiencing any form of food insecurity live in Africa or Asia. Rates of food insecurity are particularly high in Africa, where close to 60% of the population experienced moderate or severe food insecurity at some point over the year 2023. Ending food insecurity by 2030 is one of the United Nations' Sustainable Development Goals (SDG) (United Nations General Assembly, 2015). This is unlikely to be achieved owing to declines in global agricultural performance due to climate change and growing populations (Rahut et al., 2022).

Table 4.1. Prevalence of food insecurity across world regions in 2023, in millions.

Region	Moderate food insecurity (n, % of population)	Severe food insecurity (n, % of population)	Any food insecurity (n, % of population)
World	1,362 (17.9)	864 (10.7)	2,226 (28.6)
Africa	531 (36.4)	315 (21.6)	846 (58)
Asia	714 (15)	467 (9.8)	1,181 (24.8)
Europe	46 (6.2)	15 (2)	61 (8.2)
Latin America & the Caribbean	130 (19.5)	58 (8.7)	188 (28.2)
North America	33 (8.8)	4 (1)	37 (9.8)
Oceania	7 (16.4)	5 (10.4)	12 (26.8)

Data extracted from the State of Food Security and Nutrition in the World report (FAO et al., 2024).

Food insecurity is determined by a variety of factors across different levels. Macro-level determinants of regional food insecurity include war, conflict, or political unrest. These geopolitical factors can affect supply chains, reduce the availability of key foods and lead to price inflation. Agricultural performance in commercial and residential farming settings is dependent on suitable growing conditions and therefore is affected by climate and weather. Consequently, food insecurity is more common following periods of intense heat, drought or flooding (K. Hadley et al., 2023; Niles & Salerno,

2018). At the household-level, evidence from a diverse range of countries has shown that income poverty is one of the strongest predictors of food insecurity (de Sousa et al., 2019). Household food insecurity is also associated with household size, living in a rural or urban area and engaging in crop or livestock production; however, the strength and direction of these associations vary across countries (Fram et al., 2022; Moncada et al., 2022).

Cross-country research suggests that younger adolescents are less likely to experience food insecurity in comparison to older adolescents (Fram et al., 2022). Younger children are commonly prioritised by parents regarding household food management strategies. Older adolescents might also forgo food so that their younger siblings have sufficient food to eat. In some countries, girls are more likely to experience food insecurity compared to boys (C. Hadley et al., 2008).

4.1.3 Why does food insecurity matter for adolescents?

Food and nutrition play a vital role in physiological development and short- and long-term physical health. Children and adolescents that experience mild or moderate food insecurity, such as reduced access to a variety of healthy food, are more likely to have a higher body mass index and increased risk of obesity (Hooper et al., 2022; B. H. Kim et al., 2021; Widome et al., 2009). Experiencing more severe food insecurity, where there is a reduced food intake, can lead to serious physical health problems, such as increased risk of stunted growth or being underweight. These health problems in childhood and adolescence carry long-term health risks throughout the life course, including increased morbidity and mortality (Dewey & Begum, 2011; Moradi et al., 2019).

Growing up in a food-insecure household can affect a variety of social outcomes and practices in adolescents. Meals held together as a family provide an opportunity for positive parenting and closeness between siblings and other family members (Glanz et al., 2021). Meals therefore have an important social function across cultures. Longitudinal evidence suggests that shared family meals are associated with higher levels of future communication between parents and adolescents (Fulkerson et al., 2010). Conversely, adolescents in food-insecure households report that food insecurity can put a strain on their relationship with their parents and siblings (Leung et al., 2020). Living in a food-insecure household might mean parents skip meals for

their children to have sufficient food, thus impacting their own health. In turn, this could lead to increased stress in parents and affect the quality of their parenting (Ashiabi & O'Neal, 2008).

Food-insecure adolescents commonly have poorer educational outcomes compared to food-secure peers. Experiencing hunger and associated fatigue hampers the ability to learn as effectively in school (Belachew et al., 2011; Jyoti et al., 2005). In low- and middle-income countries, living in a food-insecure household can lead to adolescents leaving education early. Adolescents may be forced to seek employment to help financially support their family and provide food for the household (Morrow et al., 2017). Consequently, food-insecure adolescents are more likely to be absent from school (Baiden et al., 2020). For girls, food insecurity is associated with an increased likelihood of marrying at a young age during childhood or adolescence. This is often to reduce food insecurity in the girls' household by having one less person that needs to eat (Gambir et al., 2024). These strategies to manage food insecurity might offer short-term relief and reduce immediate food insecurity, but they are associated with increased likelihood of future poverty and food insecurity for the adolescent. Therefore, they create a poverty trap for food-insecure young people (Lambon-Quayefio & Owoo, 2021).

The social context of food insecurity is also linked to adolescents' wellbeing. Adolescents often report feeling shame and embarrassment for experiencing food insecurity, or from using strategies to mitigate hunger such as the use of food banks or free school meals (Gagliano et al., 2023). The experience of food insecurity is a salient reminder for adolescents of their lower social status compared to peers or other families (Bernal et al., 2016). This might be particularly pronounced in the school environment. Students' shared lunch times could heighten food-insecure adolescents' awareness of their food insecurity and therefore their lower status (MacNeil et al., 2022). Food-insecure adolescents are more likely to be bullied in school than food-secure peers, commonly as a direct result of their food insecurity that highlights their lower social status (Edwards & Taub, 2017; Sampasa-Kanyinga & Willmore, 2015). This association is heterogenous across countries, however. Food insecurity is more strongly associated with bullying victimisation in high-income countries compared to low- and middle-income countries (Liang et al., 2021).

4.1.4 What links does food insecurity have with adolescents' mental health?

At the sub-clinical level, food-insecure adolescents experience an increased risk of negative emotions owing to missed meals. The physiological impacts of hunger can have immediate impacts on mood and emotions, due to reduced energy from limited calorie intake, low blood sugar and impacts on cortisol levels. In a study of 11-year-old Canadian students, missing a single meal was associated with increased negative affect and reduced positive affect across a day (MacNeil et al., 2022). Unsurprisingly, food insecurity is associated with an increased risk of mental health problems in adolescents, including internalising mental health problems such as depression and anxiety. Support for a potential causal relationship comes from longitudinal studies, however these are limited to adolescents from North America and the UK.

In a study of twins born between 1994 and 1995 in England or Wales, living in a household that was experiencing food insecurity at either age 7 or age 10 was associated with increased emotional symptoms at age 12. This association was independent of household income, factors linked to maternal personality and the households' sensitivity to children's needs (Belsky et al., 2010).

In a study in the US, children that had experienced persistent food insecurity over a six-month period during the ages of 4 and 14 (mean age: 8.2) had a higher prevalence of internalising symptoms that met a clinical cut-off at the two-year follow-up compared to those that had not experienced any food insecurity during that period (Slopen et al., 2010). This association was apparent after adjusting for household poverty status, children's symptoms at baseline and caregiver and child characteristics.

In a longitudinal study in Canada, ever experiencing food insecurity between the ages of 0 and 11 and 12 and 23, was associated with an increased risk of meeting the cut-off on a composite measure of depression and suicidal ideation at ages 14-25 (mean age: 19.3) (McIntyre et al., 2013). This association was independent of a range of child and household characteristics, maternal depression and household income. In another Canadian study, experiencing high levels of food insecurity between the ages of 1 to 13, had no significant association with depression symptoms at age 15 after adjusting for sex, household income at age 1 and parental mental health at age 3 (Paquin et al., 2021).

Another study in Canada measured self-reports of food insecurity during adolescence (age 16 to 21) (McIntyre et al., 2017). Depression risk, as inferred from meeting a cut-off score, was measured across ages 20 to 25. Experiencing food insecurity was associated with increased odds of depression risk, independent of past depression and parental socio-economic factors.

Further evidence of a potential causal relationship comes from analyses of food assistance programs that aim to reduce food insecurity. The Supplemental Nutrition Assistance Programme in the US is a federal aid intervention designed to alleviate food insecurity, hunger and undernutrition through financial aid specifically for the purchase of food. In a longitudinal study, receipt of Supplemental Nutrition Assistance Programme was associated with reduced psychological distress at follow-up for adolescents who experienced food insecurity independent of family and child characteristics (Pryor et al., 2022). Trial evidence is lacking, but the study suggests that strategies that increase access to sufficient and nutritious food could improve adolescents' mental health.

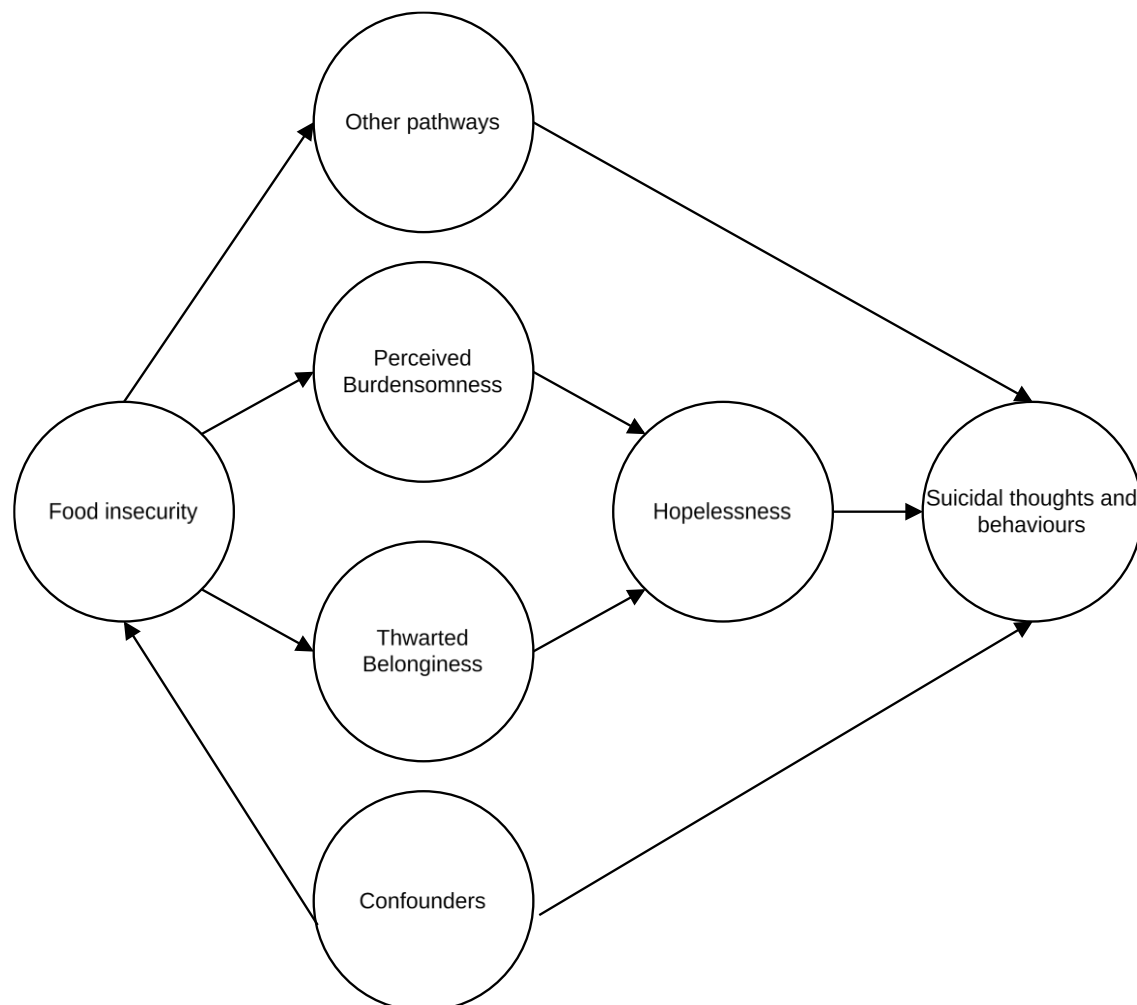
4.1.5 The impact of food insecurity on suicidal thoughts and behaviours in adolescents

Suicide is one of the leading causes of death in adolescents (L. Liu et al., 2022). Preventing suicide is a global public health priority and a key target of the United Nations' SDGs to promote health and wellbeing (United Nations General Assembly, 2015). Effective prevention strategies require a sufficient understanding of the causes of suicide that can be targeted and modified to reduce risk. One such cause might be food insecurity. Food insecurity in adolescents has extensive impacts on a variety of health, social and educational outcomes, and could also contribute to the development of suicidal thoughts and behaviours. Cross-sectional research has shown that the prevalence of suicidal thoughts and behaviours is typically greater in adolescents who experience food insecurity (Fram et al., 2022). However, studies using designs suitable for causal inferences are lacking.

Experiencing food insecurity might impact key cognitive-affective states that increase the risk of suicidal thoughts and behaviours (Figure 4.1). According to the Interpersonal Theory of Suicide, there are two constructs that contribute to the development and experience of suicidal ideation: thwarted belongingness and

perceived burdensomeness (Joiner, 2005; Van Orden et al., 2010). The first construct, *thwarted belongingness*, refers to a cognitive-affective state where the psychological needs of social connection are unmet and there is an absence of reciprocally caring relationships. Thwarted belongingness is hypothesised to develop due to feeling alone. Individuals that experience thwarted belongingness are therefore likely to experience loneliness, social isolation and withdrawal and family conflict. Individuals might experience the second construct, *perceived burdensomeness*, if they believe they are a burden to others. Perceived burdensomeness is theorised to comprise two dimensions. The first refers to the individuals' belief that they are flawed and a liability to others, particularly family members. The second refers to feelings of self-hate, characterised by low self-esteem and high levels of distress and shame. If the experience of thwarted belongingness and perceived burdensomeness are perceived by the individual to be stable and unchanging this can lead to a state of hopelessness. Experiencing *hopelessness* is subsequently considered a cause of active suicidal desire. Hopelessness that cooccurs with a reduced fear of death and elevated tolerance of physical pain is theorised to create the conditions under where an individual might attempt suicide.

Figure 4.1. Proposed causal model of food insecurity leading to suicidal thoughts and behaviours in adolescents based on the Interpersonal Theory of Suicide (Joiner, 2005; Van Orden et al., 2010)



Evidence suggests that food insecurity can lead to feelings associated with both thwarted belongingness and perceived burdensomeness in adolescents. Therefore, food insecurity might lead to an increased risk of suicidal thoughts and behaviours by affecting these pathways (Figure 4.1). Regarding factors related to thwarted belongingness, adolescents who experience food insecurity often report feeling stigmatised and socially isolated (Shtasel-Gottlieb et al., 2015). In a longitudinal study of young adults in the US, approximately half of the association between experiencing food insecurity and increased risk of suicidal ideation was mediated by increased social stress and isolation in those that were food insecure (C. Graham & Ciciurkaite, 2022). In a cross-sectional study of school-going adolescents in Eswatini, the association between a composite variable of experiencing food insecurity and the

outcome, a composite regarding bullying victimisation and experiencing suicidal thoughts or behaviours, was partially mediated by the effect of food insecurity on adolescents' experience of loneliness (Motsa et al., 2023). Regarding perceived burdensomeness, children and adolescents from food-insecure households commonly report feeling shame, sadness and family strain from having a lack of food (Leung et al., 2020). In turn these experiences might lead to experiencing perceived burdensomeness and an increased risk of suicidal thoughts or behaviours. Food insecurity might also increase the risk of suicidal thoughts and behaviours in adolescents through other pathways. This might include the physical effects of inadequate nutrition or through the impact of household food insecurity on parents' own mental health and their parenting practices (Dewey & Begum, 2011; Masarik & Conger, 2017).

4.1.6 Cross-country variation in the association between food insecurity and suicide outcomes in adolescents

More than three-quarters of research on the association between food insecurity and mental health has been conducted in high-income countries, even though food insecurity is far more prevalent in low- and middle-income countries (FAO et al., 2024; Sparling et al., 2022). Current understanding of the impact of food insecurity on suicide is limited in countries where most of the world's adolescents live (Blum & Boyden, 2018). Specific contextual factors within countries might moderate the association between experiencing food insecurity and experiencing suicidal thoughts and behaviours, but this has not been widely investigated. Societal and economic conditions (e.g., economic inequality, the prevalence of food insecurity in adolescents, the accessibility of health care and economic development) could influence the psychological and social impacts of food insecurity and in turn the likelihood of experiencing suicidal thoughts and behaviours as a result. Therefore, the extent to which food insecurity is associated with suicidal thoughts and behaviours in adolescents might vary across country.

According to the theory of relative deprivation, individuals compare their circumstances to others (Runciman, 1966). Such comparisons to those with greater resources and better circumstances can negatively affect adolescents' self-esteem, self-worth and levels of distress, and therefore the perception of perceived

burdensomeness and the risk of suicidal thoughts and behaviours (Schneider, 2019; Van Orden et al., 2010; Wetherall et al., 2019). These social comparisons are theorised to be exacerbated in contexts with large economic inequalities. This is because the stark differences in resources are more salient and noticeable between different economic groups (Pickett & Wilkinson, 2015; Schneider, 2019). In countries with high levels of economic inequality, social comparisons based on food insecurity status might be more salient and lead to a greater impact on perceived burdensomeness and therefore suicidal thoughts and behaviours. Additionally, a greater importance is commonly placed on social hierarchies in economically unequal countries (Schneider, 2019). Experiencing food insecurity in economically unequal countries might be associated with greater levels of thwarted belongingness as food-insecure adolescents might be more socially disconnected and isolated due to heightened stigma from peers (Shtasel-Gottlieb et al., 2015). Past studies of economic inequalities in adolescents' psychosomatic symptoms support this hypothesis, as the association between household wealth and psychological distress was found to be greater in countries with greater income inequality (Dierckens et al., 2020; Elgar et al., 2015; Weinberg et al., 2021). These studies featured primarily European countries only, and it is unclear whether the findings extend to different outcomes, countries, or indicators of economic circumstances.

The impact of food insecurity on suicidal thoughts and behaviours might also be linked to how prevalent food insecurity is within a country. Food-insecure adolescents may experience greater levels of social disconnection and perceived burdensomeness in countries where food insecurity is uncommon, as the experience is less normative and potentially more stigmatised (Liang et al., 2021). In countries where food insecurity is common, there might be an increase in social bonds and integration between food-insecure adolescents (Durkheim, 1951). In those countries, food insecurity may have less of an impact on adolescents' social disconnection and therefore thwarted belongingness and risk of suicidal thoughts and behaviours. There is some support for this hypothesis from one study that analysed the association between food insecurity and suicide attempts in adolescents across countries. The association between severe food insecurity and a greater risk of suicide attempts was stronger in countries where there was a lower national prevalence of food insecurity in adolescents (Koyanagi et

al., 2019). The study did not investigate other suicidal thoughts or behaviours such as ideation or making suicide a plan or control for other indicators of country-level context.

The accessibility of mental health care within a country is a further factor that could moderate the association between food insecurity and suicidal thoughts and behaviours. Mental health problems are associated with food insecurity and an increased risk of suicide in adolescents (Belsky et al., 2010; Bridge et al., 2006; Slopen et al., 2010). There is significant overlap of the symptoms of many mental health problems such as depression and the experiences associated with perceived burdensomeness, such as distress, low self-esteem and shame (Jahn et al., 2011). Consequently, effective treatment of mental health problems can reduce the risk of suicide (Cipriani et al., 2013). However, inequalities in health care access are common across countries and food-secure adolescents might be more likely to access health care than food-insecure adolescents (Kushel et al., 2006). Inequalities in health care access are typically reduced in countries where there is universal health care, which could lead to reduced health inequalities (Van Doorslaer et al., 2006). On the other hand, there might be greater inequalities in health care access according to adolescents' economic circumstances and their food insecurity status in countries where health care access requires fees and payments. Food-secure adolescents might be more likely to receive effective strategies that can prevent suicide, such as treatment of a mental health problem, compared to food-insecure adolescents. This might contribute to inequalities in suicidal thoughts and behaviours according to adolescents' food insecurity status.

Economic development is another potential country-level moderator of the association between food insecurity and suicidal thoughts and behaviours in adolescents. To date, research assessing cross-country differences in inequalities in mental health or suicide have primarily focused on countries' level of economic development (Koyanagi et al., 2019; Mahumud et al., 2022; Probst et al., 2021). Three studies have analysed pooled data of adolescents from the GSHS stratified by World Bank income classifications. One study found that the association between severe food insecurity and increased odds of suicidal ideation, making a suicide plan and attempting suicide were stronger in lower-middle income countries in comparison to low-income countries (Mahumud et al., 2022). Two other studies did not find any difference in the association between food insecurity and suicide attempts across country income classifications (Koyanagi

et al., 2019; Probst et al., 2021). Within both studies, the odds ratio for the association between food insecurity and suicide attempts increased in magnitude from low- to high-income country classifications. Confidence intervals for each effect estimates were large, prohibiting statistical evidence of moderation by country income classification. The studies provide conflicting results and conclusions are limited due to the use of categorical income groups rather than continuous measures of economic development. This likely limits statistical power due to the arbitrary classifications of economic development rather than modelling it continuously.

The mechanisms regarding how economic development might moderate the association between food insecurity and suicidal thoughts and behaviours are unclear and are likely to involve other country-level factors that are heavily determined by economic development. For instance, economic development can heavily determine the prevalence of food insecurity within a country. Food insecurity is less common in high-income countries but more common in low- and middle-income countries (FAO et al., 2024). Based on the theory of relative deprivation, the association between food insecurity and suicidal thoughts and behaviours could be greater in high-income countries as food insecurity is rare in these settings. However, universal health coverage is greater in high-income countries, meaning the association between food insecurity and suicidal thoughts and behaviours could in fact be weaker in high-income countries as there might be reduced inequalities in health care access and receipt of interventions (Wagstaff & Neelsen, 2020).

4.1.6.1 Limitations of the evidence base

Studies that have investigated cross-country differences in the association between food insecurity and suicidal thoughts and behaviours in adolescents have featured several limitations. First, numerous studies have adjusted for variables that are likely to be on the causal pathway from food insecurity to suicidal thoughts and behaviours (Koyanagi et al., 2019; Mahumud et al., 2022; McKinnon et al., 2016). These variables include loneliness, peer relationships and bullying victimisation, which are all key aspects of perceived burdensomeness and thwarted belongingness (Van Orden et al., 2010). Adjustment for these variables would have attenuated the within-country associations between food insecurity and suicidal thoughts and behaviours, meaning the association is likely to be underestimated (Schisterman et al., 2009). This might

have reduced the observed cross-country variability of the association as each country's estimates are likely to have been biased towards the null.

Second, studies have also modelled the single item assessing food insecurity within the GSHS as a categorical variable based on arbitrary distinctions. Groupings have predominantly consisted of “food-secure”, “moderately food-insecure” and “severely food-insecure”. Separate comparisons have been made between food-secure adolescents with adolescents who are either moderately or severely food-insecure (Koyanagi et al., 2019; Mahumud et al., 2022; McKinnon et al., 2016; Probst et al., 2021). This approach reduces the sample size for comparisons and limits precision, potentially affecting the ability to identify cross-country differences in the association. Alternatively, converting responses on the food insecurity measure using rdit scores might reduce the bias and loss of precision associated with categorisation. Rdit scores are where values between 0 and 1 are assigned based on individual's responses to an item as well as the responses of others in the population. Rdit-score transformations enable categorical variables to be modelled as a continuous variable in statistical analyses (Mackenbach & Kunst, 1997). Therefore, rdit-transformed variables are not subject to the potential bias and loss of statistical power that arbitrarily binarised variables are.

Third, the potential moderating role of economic development has been investigated using World Bank income classifications only (Koyanagi et al., 2019; Mahumud et al., 2022; Probst et al., 2021). In most cases, the classifications are inappropriate when used to model economic development as an explanatory variable within statistical analyses as they are constructed based on arbitrary groupings of a continuous variable: a country's GNI per capita. Measures of GNI per capita are not 100% accurate. Countries with a GNI per capita close to an arbitrary threshold that is used to inform income groupings could be wrongly classified into a different income classification if GNI per capita is over- or under-estimated. Furthermore, countries within the same income classification might be markedly different in terms of economic development yet are treated as the same in analyses. As an example, Bulgaria (GNI per capita in 2023 = \$14,280) and Bermuda (GNI per capita in 2023 = \$130,290) have vast differences in economic development between them but both are classed as high-income countries (World Bank, 2024c). The use of country income classifications might reduce statistical power due to reduced variability of the variable, conceal any

non-linear relationship, and be subject to misclassification. This might have reduced precision in past studies. Past analyses that have investigated the potential moderating role of economic development as indicated by country-income classifications are also likely to be biased.

4.1.7 Study aims and hypotheses

Using data from the GSHS, a cross-sectional survey of school-going adolescents across multiple countries, I build on previous work by examining the cross-country variation in the association between food insecurity and suicidal thoughts and behaviours in adolescents.

In this study, I aimed to investigate the extent of cross-country variation in the magnitude of inequalities in suicidal thoughts and behaviours in adolescents according to their experience of food insecurity. I also aimed to investigate whether the magnitude of these inequalities varies across four indicators of country-level context that are modifiable through national and international policy, in theory. The study could help identify different national contexts that might be relevant considerations in the development of suicidal thoughts and behaviours in food-insecure adolescents.

I hypothesised that being food-insecure will be associated with suicidal ideation (hypothesis 4.1), making a suicide plan (hypothesis 4.2) and attempting suicide (hypothesis 4.3) in the pooled sample of adolescents from all countries. I further hypothesised that there would be variability in the strength and direction of the association between food insecurity and each outcome across countries (hypotheses 4.4, 4.5 and 4.6). Finally, I hypothesised that inequalities in suicidal thoughts and behaviours according to food insecurity status would be greater in countries with high levels of economic development (hypothesis 4.7), high levels of income inequality (hypothesis 4.8), low levels of free-to-access universal health care (hypothesis 4.9) and a low prevalence of food insecurity in adolescents (hypothesis 4.10).

4.2 Methods

The study protocol was pre-registered at OSF Registries (<https://osf.io/kh4wx>).

4.2.1 Study design

I used data from the GSHS. The GSHS is a multi-country cross-sectional school-based survey of adolescents. The GSHS was developed by the WHO and the US Centres for Disease Control and Prevention. Data collection for GSHS surveys have been carried out across 104 countries and dependent territories since 2003.

A two-stage stratified sampling design was used in almost all countries (Bischops et al., 2022). Schools were first selected with probability proportional to student enrolment size. At the second stage, classes within selected schools were randomly chosen and all students within these classes were eligible for the study. The study design and sampling procedure are similar across almost all participating countries, but a census-based approach was used in several island countries with a small population. Students independently completed the survey within a regular class period. Data were available for 152 surveys carried out across 104 countries and dependent territories at the time of my analyses.

4.2.2 Participants

I included surveys from 2003 (the inception of the GSHS) that had data on food insecurity and at least one measure of suicidal thoughts or behaviour (ideation, plans or attempt) and where a national representative sampling framework was used. In the case that there were multiple surveys within a country, data from the most recent survey were used.

Participants were school-going adolescents between the ages of 11 and 18, consistent with the eligibility criteria of the GSHS. The analytic samples for each outcome consisted of participants that had complete data on food insecurity, age, gender and the outcome of interest.

4.2.3 Outcomes

The GSHS measured three different outcomes relating to suicidal thoughts and behaviours: suicidal ideation, making a suicide plan and suicide attempts.

Suicidal ideation and making a suicide plan were measured with two single-items: “During the past 12 months, did you seriously consider attempting suicide?” and “During the past 12 months, did you make a plan about how you would attempt suicide?”, respectively. Possible responses for each item were either “yes” or “no.”

Past suicide attempts were measured with a single item: “During the past 12 months, how many times did you actually attempt suicide?”. I dichotomised responses so that if participants reported any number of attempts, they were classed as “yes” and participants that reported no attempts were classed as “no”. This enabled comparable effect estimates across each outcome.

4.2.4 Exposure

Food insecurity was assessed with a single item: “During the past 30 days, how often did you go hungry because there was not enough food in your home?”. The item had five response options: “never”, “rarely”, “sometimes”, “most of the time” and “always”.

I transformed the food insecurity measure using rdit scores. Rdit score transformations consider the number of respondents for each response. Responses that have a smaller size are indicative of a more extreme social position (Table 4.2). For each response, the cumulative proportion of responses in all lower responses is added to one-half of the proportion of cases within its own corresponding response. I classified “always” to be the lowest response and “never” as the highest response.

Table 4.2. Example of ridity score transformation for the food insecurity item for 100 respondents.

Response	N	Proportion	Cumulative proportion	Ridity- transformation	Ridity value
Always	5	0.05	0.05	$= 0 + (0.05 \times 0.5)$	0.025
Most of the time	10	0.1	0.15	$= 0.05 + (0.1 \times 0.5)$	0.1
Sometimes	15	0.15	0.3	$= 0.15 + (0.15 \times 0.5)$	0.225
Rarely	30	0.3	0.6	$= 0.3 + (0.3 \times 0.5)$	0.45
Never	40	0.4	1	$= 0.6 + (0.4 \times 0.5)$	0.80

Note: The Ridity score for each response is calculated as the cumulative proportion of all previous responses plus half the proportion of the current response.

Ridity-transformed variables estimate the Relative Index of Inequality (RII) when modelled as an exposure in regression analyses of binary outcomes (Mackenbach & Kunst, 1997). The RII is the relative ratio of a binary outcome between individuals with the highest and lowest socio-economic position in a population and is frequently used to compare health inequalities across countries or populations (Sergeant & Firth, 2006). In the context of this study, the RII represents the relative ratio of suicide outcomes between those at the top and bottom of a hierarchy according to food security status.

All analyses were repeated using the WHO's dichotomisation of the food insecurity item within the GSHS dataset. I therefore classed participants as food insecure if they reported going hungry "most of the time" or "always".

4.2.5 Confounders

I adjusted for adolescents' age and gender. Confounders were selected based on past research showing age and gender differences in both suicide and food insecurity (Bertolote & Fleischmann, 2002; Fram et al., 2022; C. Hadley et al., 2008; Masa et al., 2020; McLoughlin et al., 2015). Age was measured using banding across all surveys; however, the upper age limit for the age measure was lower in earlier surveys (16 or older) in comparison to later surveys (18 or older). In all surveys the lower limit was 11. As the target sample of the GSHS is 13-year-olds and older, the following comparable age banding was used in analyses: "13 years old or younger", "14 years old", "15 years old" and "16 years old or older". Participant gender was assessed with a single measure, with "male" or "female" as the two response options.

4.2.6 Indicators of country-level context

I accessed data on country-level indicators from the World Bank Open Data Catalog and databases hosted by the WHO. I drew data on country-level indicators from the corresponding survey year for each country as the surveys were conducted across different years. In the case that survey data was not available for the specific year I used data closest to the relevant year going backwards in time.

I planned to use GNI per capita to indicate countries' level of economic development to match the specific data that informs the World Bank's country income classifications. Data on GNI per capita was only available for 47 (56.6%) countries in the study. Consequently, I used countries' Gross Domestic Product (GDP) per capita expressed in 2021 international dollars as an estimate of economic development. GDP refers to the sum of the gross income of a country's residents within that country. GNI differs slightly by additionally including income earned outside of the country, such as foreign aid or investments, or money sent back from residents working abroad. GNI per capita and GDP per capita were strongly correlated for the 47 countries within this study that had data available on both ($r=0.99$). I therefore assumed GDP per capita to be a suitable proxy measure of a countries' economic development. Purchase Power Parity (PPP) was applied to GDP per capita to control for price differences in goods across countries, thus aiding accurate cross-country comparisons (I. W. Marsh et al., 2012). I log-transformed GDP per capita (PPP) as the impact of an increase in GDP per capita on a nation's economic development is likely to diminish in high-income countries, and thus have a non-linear impact (Cahill, 2002).

The Gini index of income inequality was used as a measure of economic inequality within each country. Values from the Gini index represent the equality of a country's income distribution. A higher value indicates greater income inequality.

I accessed data from the WHO Universal Health Coverage (UHC) index to assess health care accessibility within countries (Wagstaff & Neelsen, 2020). The index is based on sixteen different indicators from four domains: (a) reproductive, maternal, new-born and child health, (b) infectious diseases, (c) noncommunicable diseases and (d) service capacity and access. There are no indicators that are specific to mental health care; however, the availability of other health services positively correlates with

the availability of primary care and mental health services within countries, thus it is likely a suitable proxy measure (J. Morris et al., 2012; Papanicolas et al., 2018).

As a further measure of access to health care within a country, I accessed data on the level of out-of-pocket health care expenditure, such as direct expenses to health services, excluding taxes and insurance premiums, from households within each country. Data represents the percentage of a country's health expenditure that is directly paid for by households. Subsequently the data values are a function of government health expenditure. I considered the level of out-of-pocket expenditure to be a suitable proxy for the availability of accessible free health care within countries where out-of-pocket health care expenditure is often the only means to access health care. Data on out-of-pocket health expenditure was drawn from the WHO Global Health Expenditure database.

Finally, I estimated the prevalence of food insecurity among school-going adolescents within each country. This was based on GSHS participants' responses on the food insecurity item with sample weights applied. The estimate refers to the percentage of the total country sample that reported being food-insecure "most of the time" or "always" in the past 30 days (consistent with the binary grouping used for the exposure).

4.2.7 Analysis

4.2.7.1 Poisson regression

I ran Poisson regression models to estimate the association between food insecurity and suicidal thoughts and behaviours. These were done separately for each country, exposure (binary and rdit-transformed food insecurity) and outcome (suicidal ideation, making a suicide plan and making a suicide attempt).

The resultant effect estimates were prevalence ratios (PRs). For analyses of the rdit-transformed food insecurity variable, the PRs represent the ratio of the proportion of the least food insecure adolescents who report the outcome in comparison to the proportion of the most food insecure adolescents who report the outcome. For analyses of the binary food insecurity variable, the PRs represent the ratio of the proportion of food-insecure adolescents who report the outcome in comparison to the proportion of food-secure adolescents who report the outcome. I did not use logistic

regression, which is commonly used for modelling binary outcomes including in previous studies that have conducted cross-national analyses of food insecurity and suicidal thoughts and behaviours (Koyanagi et al., 2019; Mahumud et al., 2022; Probst et al., 2021). Odds ratios produced by logistic regression can overstate the magnitude of an association when the outcome is common (>10%) (Xiao et al., 2022). This limits the validity of inferences made when comparing effect estimates as the prevalence of the outcome will differ across countries – an issue that does not impact PRs (Barros & Hirakata, 2003; Khang et al., 2008).

I adjusted for participant gender and age. To account for the complex two-stage sampling design of the GSHS, I accounted for participants' country-specific primary sampling unit (classrooms), stratum (school) and sample weight, using the `svyset` command in Stata. Strata with a single sampling unit were treated as certainty units.

4.2.7.2 Meta-analyses and meta-regression

Individual results from each Poisson regression model were pooled into a random-effects meta-analysis for each outcome to identify whether PRs varied across countries. Restricted maximum likelihood estimation was used to identify the level of total variation in PRs between countries due to heterogeneity rather than chance (I^2 statistic). The I^2 statistic provides a value between 0 and 100 reporting the percentage of between-country variability due to heterogeneity rather than chance. A higher I^2 statistic indicates that the variation in the effect estimates within a meta-analysis are primarily driven by between-country differences. Conversely, a smaller I^2 statistic suggests that between-country variability in effect estimates is likely to be due to random chance, rather than reflecting true differences in effect estimates (Higgins & Thompson, 2002). I present forest plots visualising the effect sizes and 95% confidence intervals for each country and outcome to aid interpretation of the extent of cross-country differences in the magnitude of the association between food insecurity and suicidal thoughts and behaviours.

I ran random effects meta-regression analyses to identify whether the country-level associations between food insecurity and suicidal thoughts and behaviours varied according to country-level context. In all meta-regression analyses, one country-level indicator was added as a predictor. Where food insecurity, Gini index, out-of-pocket health expenditure and Universal Health Coverage were entered as moderators I re-

ran each model controlling for GDP per capita. Where the prevalence of food insecurity among school-going adolescents was the moderator, I first controlled for GDP per capita only before I also controlled for Gini index. I report the adjusted R^2 statistic as a measure of the proportion of between-country variance explained by each country-level indicator. Within meta-regressions, adjusted R^2 is calculated as the difference in the between-country variance between (a) the constant only model and (b) the model with the country-level moderator, divided by (a) the between-country variance in the constant only model (Borenstein et al., 2009). Adjusted R^2 values are provided for the unadjusted meta-regression analyses only.

4.2.7.3 Mixed-effects Poisson regression

I also ran mixed-effects Poisson regression models for the overall pooled sample to test for interactions between food insecurity status and each country-level indicator. This enabled comparison of results between different statistical approaches, thus acting as a robustness test.

Models were run separately for the different exposures and outcomes. In all models, one of the suicidal thoughts or behaviours outcomes were entered as the outcome and food insecurity (ridit-transformed or binary) was added as a fixed effect. Age and gender were also added as fixed effects to adjust for potential confounding. Countries were added as random effects and food insecurity was included as a random slope. To test for interactions between food insecurity and the country-level indicators, I ran separate models for each individual country-level indicator. The country-level indicator was first added, then an interaction term was added between the country-level indicator and the food insecurity variable. In the next model GDP per capita was added to adjust for economic development. I additionally adjusted for Gini index scores in the models where the prevalence of food insecurity among school-going adolescents was the country-level indicator of interest.

Mixed-effects analyses did not converge in Stata. Therefore, the analyses were run using the R package *lme4* (Bates et al., 2015). This package has no option to include sampling weights. Country-level indicators, except for log-GDP per capita, were standardised to have a mean of zero and a standard deviation of 1 across the participating countries for the mixed-effects analyses. This was to reduce potential multi-collinearity in the models. Log-GDP per capita was mean-centred.

A key discrepancy between the meta-regression and mixed-effects analyses are how indicators of country-level context that are entered as control variables are handled within the analytic models. Additional country-level indicators added in meta-regression models act as potential confounders between the indicator of interest and the country-level effect estimates. These confounders are added to determine whether an initial association between a country-level indicator and the magnitude of the association between food insecurity and suicidal thoughts and behaviours may instead be explained by a different country-level indicator. In contrast, further indicators of country-level context added in mixed-effect models as fixed effects are modelled as a confounder of the association between the exposure (food insecurity) and the outcome (suicidal thoughts and behaviours), rather than a confounder of the association between the country-level indicator of interest and the country-level effect estimates. Further adjustment of indicators of country-level context within mixed-effects analyses will have little or no impact on the interaction term between food insecurity and the indicator of country-level context of interest. Results from the adjusted meta-regression will be more informative in identifying which indicators of country-level context might be drivers of the magnitude of inequalities in suicidal thoughts and behaviours due to food insecurity status independent of other country-level indicators.

4.2.7.4 National prevalence of food insecurity in adolescents

Ridit scores are calculated according to the distribution of food insecurity within each sample, meaning any association between the RII and the prevalence of food insecurity among school-going adolescents is likely to be tautological. Therefore, I only looked at the association between food insecurity prevalence with the binary exposure in the meta-regression and mixed-effects Poisson regression analyses.

4.2.7.5 Missing data

In all analyses, I used a complete case analysis where participant data were analysed if data were available for food insecurity status, age, gender and the specific outcome, and where relevant, data on country-level indicators. I did not impute missing data. There were insufficient auxiliary variables available across all countries which could be used in the imputation model, limiting potential efficiency gains or bias reduction from multiple imputation (Hughes et al., 2019).

4.2.7.6 Sensitivity analyses

I conducted two sensitivity analyses to investigate the robustness of the results. First, I assessed whether potential differences in results across the three outcomes may be influenced by the number of, or by specific countries that may be included in analyses for each outcome. I re-ran all analyses for suicidal ideation and making a suicide plan using data from the 68 countries where all suicidal thoughts and behaviours were measured (the same 68 countries that were analysed already in the suicide attempt analyses). These results are presented in Appendix B.

Second, I analysed data from older surveys from countries where a more recent survey was already used in the primary analyses. I aimed to identify whether the association between rdit-transformed food insecurity and suicidal thoughts and behaviours is consistent over time within countries. Potential consistency in the association over time within countries will increase confidence that country-level estimates within the study are accurate and that any country-level variability is robust and not an artefact of randomness or influenced by period effects (i.e., differences in survey years across countries). I ran additional Poisson regression models at country-level for each outcome and exposure for surveys previously excluded and compared results of the analyses of the additional and existing surveys for each country. This was carried out for the RII only as it formed the basis of the main analyses.

4.3 Results

The final sample consisted of 315,505 school-going adolescents from eighty-three countries and dependent territories with complete data on age, gender, food insecurity and at least one measure of an outcome. The suicidal ideation, making a suicide plan and suicide attempt samples consisted of 309,340 adolescents from 83 countries, 303,135 adolescents from 81 countries and 277,181 adolescents from 68 countries respectively (Figure 4.2; Figure 4.3). Countries excluded from analyses did not include measures of food insecurity (n=4) or suicidal thoughts or behaviours (n=11) or were not nationally representative (n=6).

Figure 4.2. Flowchart of GSHS countries and participants.

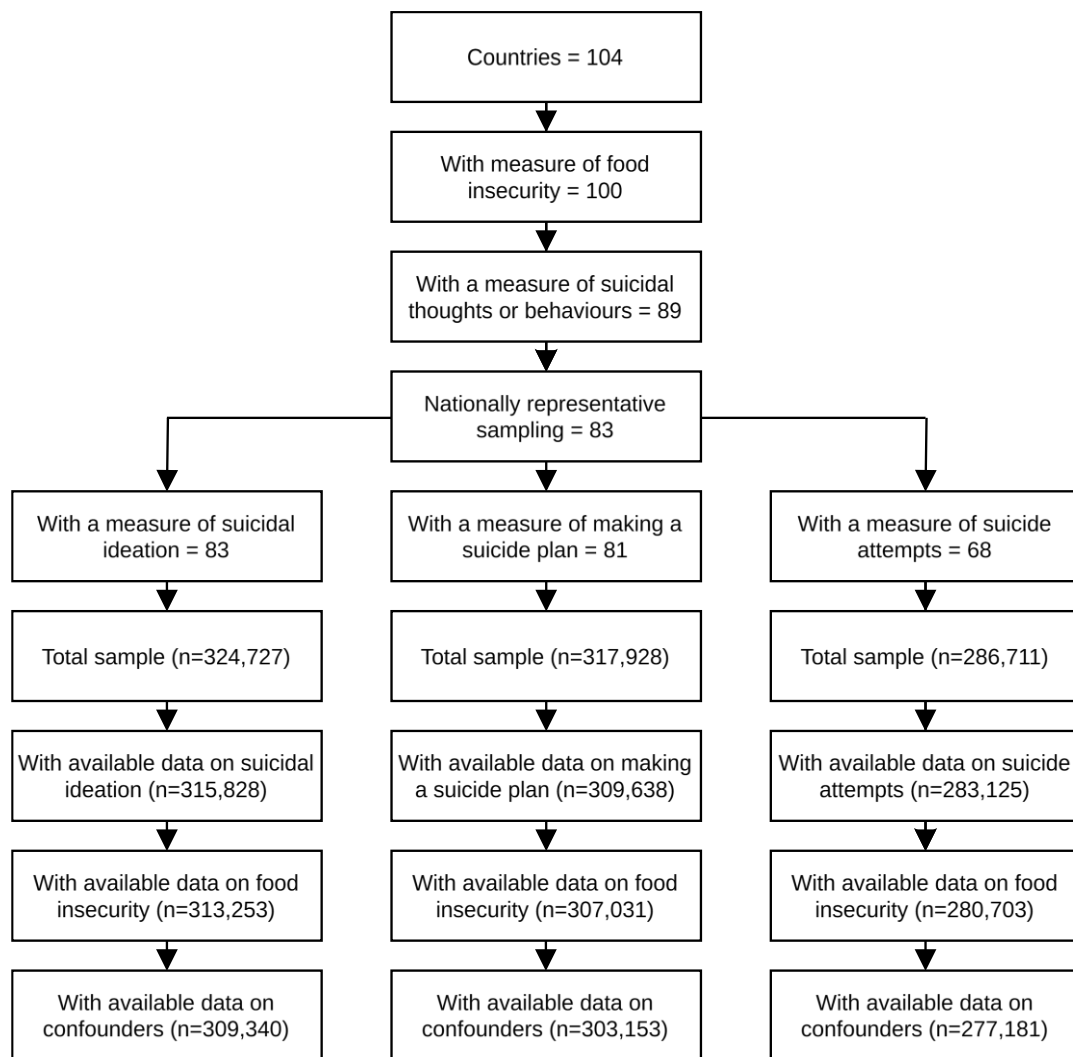
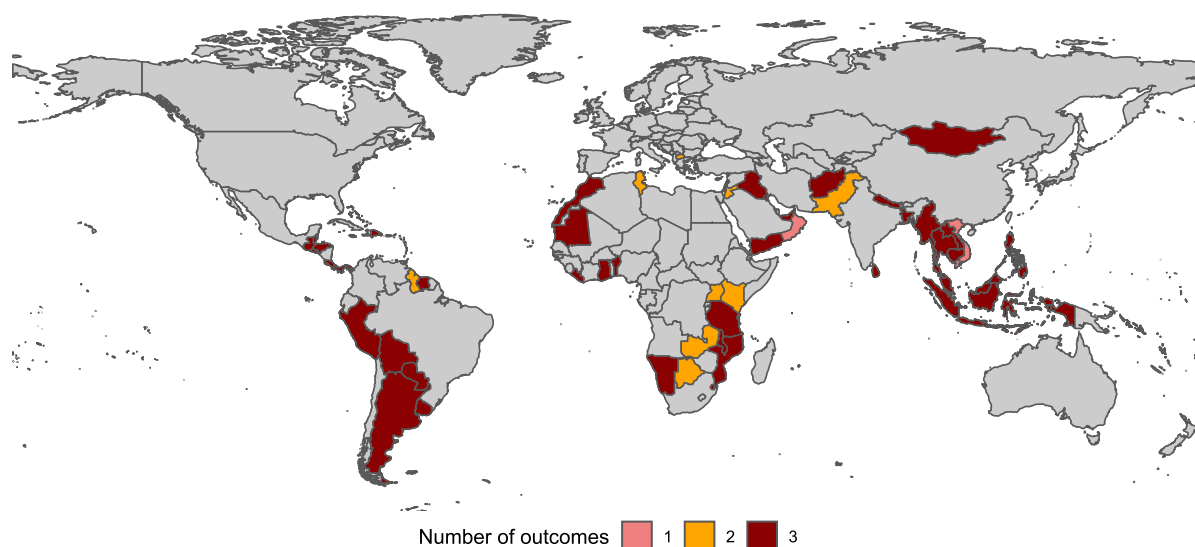


Figure 4.3. Map of countries participating in the GSHS with available data on food insecurity and suicidal thoughts and behaviours included in the analysis.



Note: Several small island countries and territories are not visible within the figure.

Over a third of participants were from the Americas, with a total of twenty-two countries from the WHO region (Table 4.3). North Macedonia was the sole country from the European Region that was included in the analysis. There were seven dependent territories without a corresponding WHO region (Anguilla, British Virgin Islands, Cayman Islands, Curacao, French Polynesia, Tokelau and Wallis and Futuna).

Table 4.3. Participants according to WHO region.

	Suicidal ideation sample	Making a suicide plan sample	Suicide attempt sample
WHO region	Participants (countries)	Participants (countries)	Participants (countries)
African	41,042 (15)	40,861 (15)	31,018 (11)
Americas	106,170 (22)	106,646 (22)	103,772 (20)
Eastern Mediterranean	38,912 (11)	35,567 (10)	31,615 (8)
European	2,052 (1)	2,042 (1)	-
South-East Asian	44,849 (10)	44,957 (10)	40,421 (9)
Western Pacific	65,750 (17)	65,449 (16)	60,952 (14)
No WHO region	10,565 (7)	10,631 (7)	9,403 (6)

The overall proportion of participants excluded owing to missing data on food insecurity, confounders, or the outcome was 4.7% for the pooled suicidal ideation sample. Missingness was highest in Nauru (12.5%) and lowest in Malaysia (1.3%). Overall missingness was 4.7% in the pooled sample for the analyses of making a suicide plan. The proportion of participants excluded owing to missing data was

highest in Afghanistan (12.2%) and lowest in Niue (0.7%). For the analyses of suicide attempts, the proportion of participants excluded owing to missing data was 3.3% within the pooled sample. Missingness was highest in the Solomon Islands (11.1%) and lowest in Niue (0%).

The prevalence of food insecurity and suicidal thoughts and behaviours varied across countries. In the pooled sample, 6.4% (95% CI: 6.1% to 6.7%) of adolescents reported experiencing food insecurity in the past 30 days (responded “most of the time” or “always”). Food insecurity was highest in Zambia (28.7%) and lowest in Vietnam (1.1%). The prevalence of suicidal ideation in the previous 12 months was 12.6% across the pooled sample (95% CI: 12.2 to 13). Suicidal ideation was most prevalent in Kiribati (34.7%) and least prevalent in Lao (2.9%). Making a suicide plan in the previous 12 months was reported by 11.7% of adolescents in the pooled sample (95% CI: 11.3 to 12). The prevalence of making a suicide plan was highest in Zambia (41.2%) and lowest in Lao (4.3%). Finally, 11.3% (95% CI: 10.7 to 11.8) of adolescents reported at least one suicide attempt in the past 12 months. Attempts were most prevalent in the Solomon Islands (33.5%) and least prevalent in Indonesia (3.9%). The prevalence of food insecurity and suicidal thoughts and behaviours as well as the values of the indicators of country-level context are presented for each country in Appendix B.

4.3.1 Variation in the magnitude of the association between food insecurity and suicidal thoughts and behaviours across countries

4.3.1.1 Suicidal ideation

The RII within the pooled sample of participants from 83 countries was 0.51 (95% CI: 0.47 to 0.55), suggesting that suicidal ideation was approximately half as prevalent in the most food-secure adolescents compared to the least food-secure adolescents. Sixty-five countries (78.3%) reported a RII significantly below 1, indicating that the prevalence of suicidal ideation was lower in adolescents with the highest level of food security compared to those with the lowest in those countries (Figure 4.4).

Inequality in suicidal ideation, according to the RII, was greatest in Myanmar (0.15 [95% CI: 0.09 to 0.25]), indicating that the prevalence of suicidal ideation was 85% lower in the most food-secure adolescents compared to the least food-secure

adolescents. No difference was found in 18 countries. There were five countries (Bangladesh (n=2,862), Nauru (n=506), Niue (n=138), Samoa (n=1,768), Vanuatu (n=2,039)), where the RII was greater than 1, thus indicative of a greater prevalence of suicidal ideation in adolescents with the highest level of food security, but confidence intervals were wide and crossed the null. Of note, the sample sizes of Nauru and Niue were small, significantly limiting the precision of these estimates. The I^2 statistic in the meta-analyses was 72.6%, indicating that a substantial proportion of the total variability in RIIs was due to between-country heterogeneity.

4.3.1.2 Making a suicide plan

The pooled RII across countries was 0.55 (95% CI: 0.51 to 0.59), suggesting that making a suicide plan was nearly half as prevalent in the most food-secure adolescents compared to the least food-secure adolescents. Fifty-eight countries (71.6%) of the 81 that assessed making a suicide plan reported a RII below 1, indicating that the prevalence of making a suicide plan was lower in adolescents with the highest level of food security compared to those with the lowest level (Figure 4.5).

Inequality in making a suicide plan according to the RII, was greatest in North Macedonia (0.25 [95% CI: 0.13 to 0.47]), contrasting with Niue where the RII was 2.32 (95% CI: 0.30 to 17.73). No difference was found in 23 countries. There were four countries (Mauritania (n=1,914), Niue (n=140), Samoa (n=1,801), Tokelau (n=126)), where the RII was greater than 1, thus indicative of a greater prevalence of suicidal ideation in adolescents with the highest level of food security. Confidence intervals of the RIIs were wide and all crossed the null. Of note, the sample sizes of Nauru and Tokelau were small, limiting the precision of these estimates. The I^2 statistic was 64.1%, indicating a substantial proportion of the total variability in RIIs was due to between-country heterogeneity.

4.3.1.3 Suicide attempts

The pooled RII across countries was 0.45 (95% CI: 0.42 to 0.50), suggesting that making a suicide plan was nearly half as prevalent in the most food-secure adolescents compared to the least food-secure adolescents. Sixty-one countries (89.7%) of the 68 that assessed suicide attempts reported a RII below 1 (Figure 4.6). Inequality in suicide attempts according to food security status was greatest in Morocco (0.2 [95% CI: 0.16 to 0.25]). No difference was found in the remaining 7

countries. In two countries (Malawi (n=2,179) and Samoa (n=1,829)), the RII was greater than 1, indicative of a greater prevalence of suicidal ideation in adolescents with the highest level of food security, but the confidence intervals were wide and crossed the null. The I^2 statistic was 71.6%, indicating a substantial proportion of the total variability in RIIs was due to between-country heterogeneity.

Figure 4.4. Relative Index of Inequality for suicidal ideation according to food insecurity status, across countries and WHO World Regions.

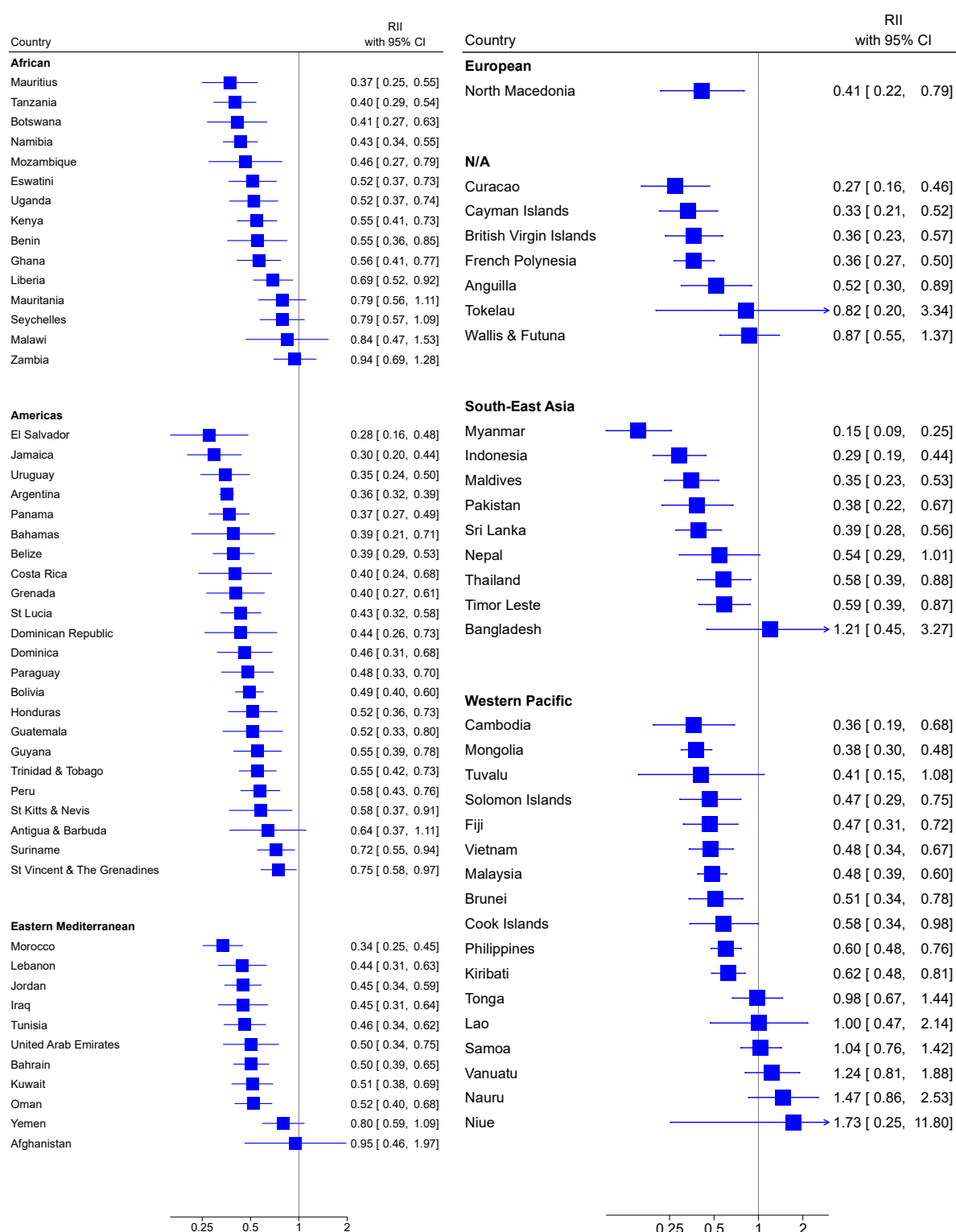


Figure 4.5. Relative Index of Inequality for making a suicide plan according to food insecurity status, across countries and WHO World Regions.

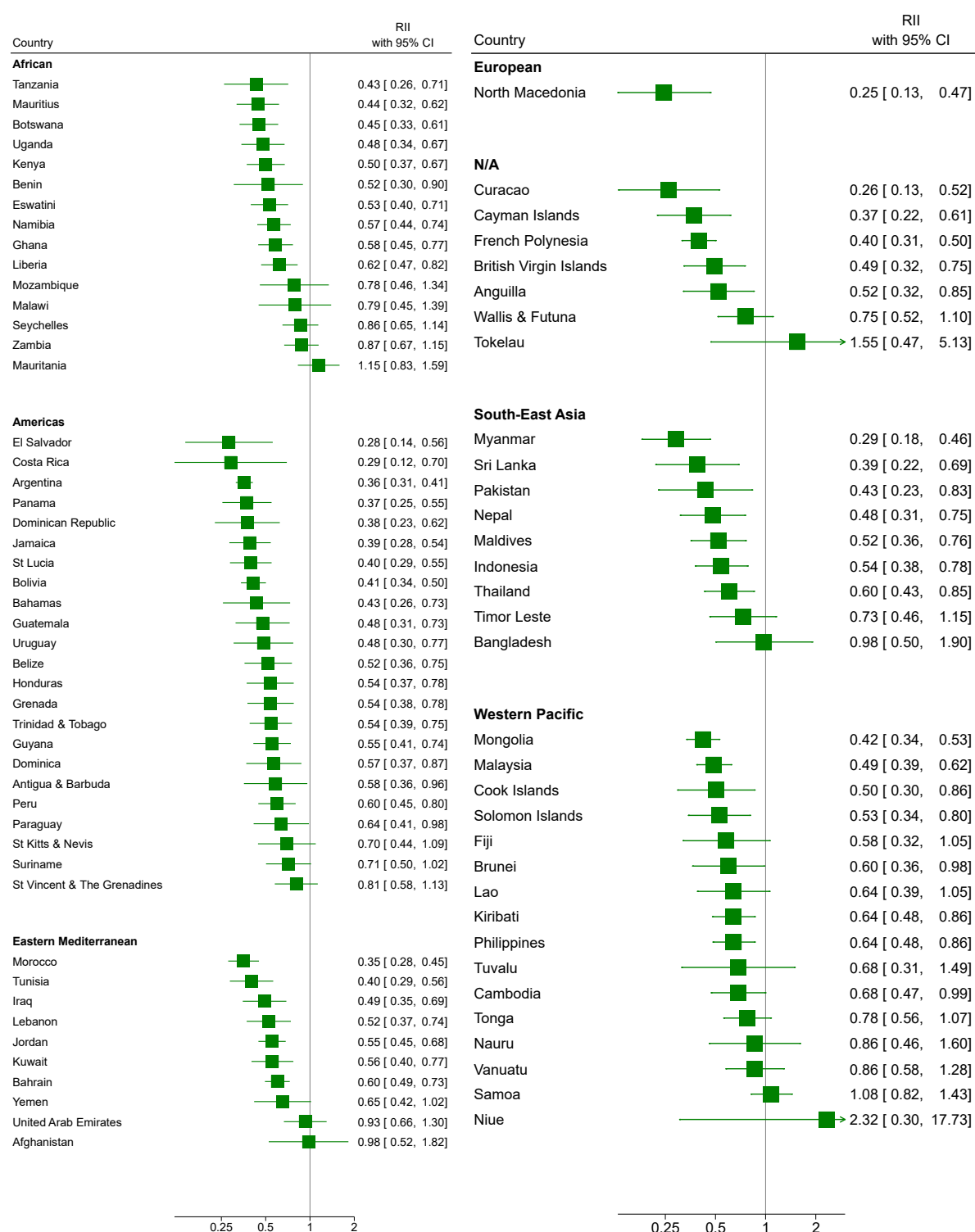
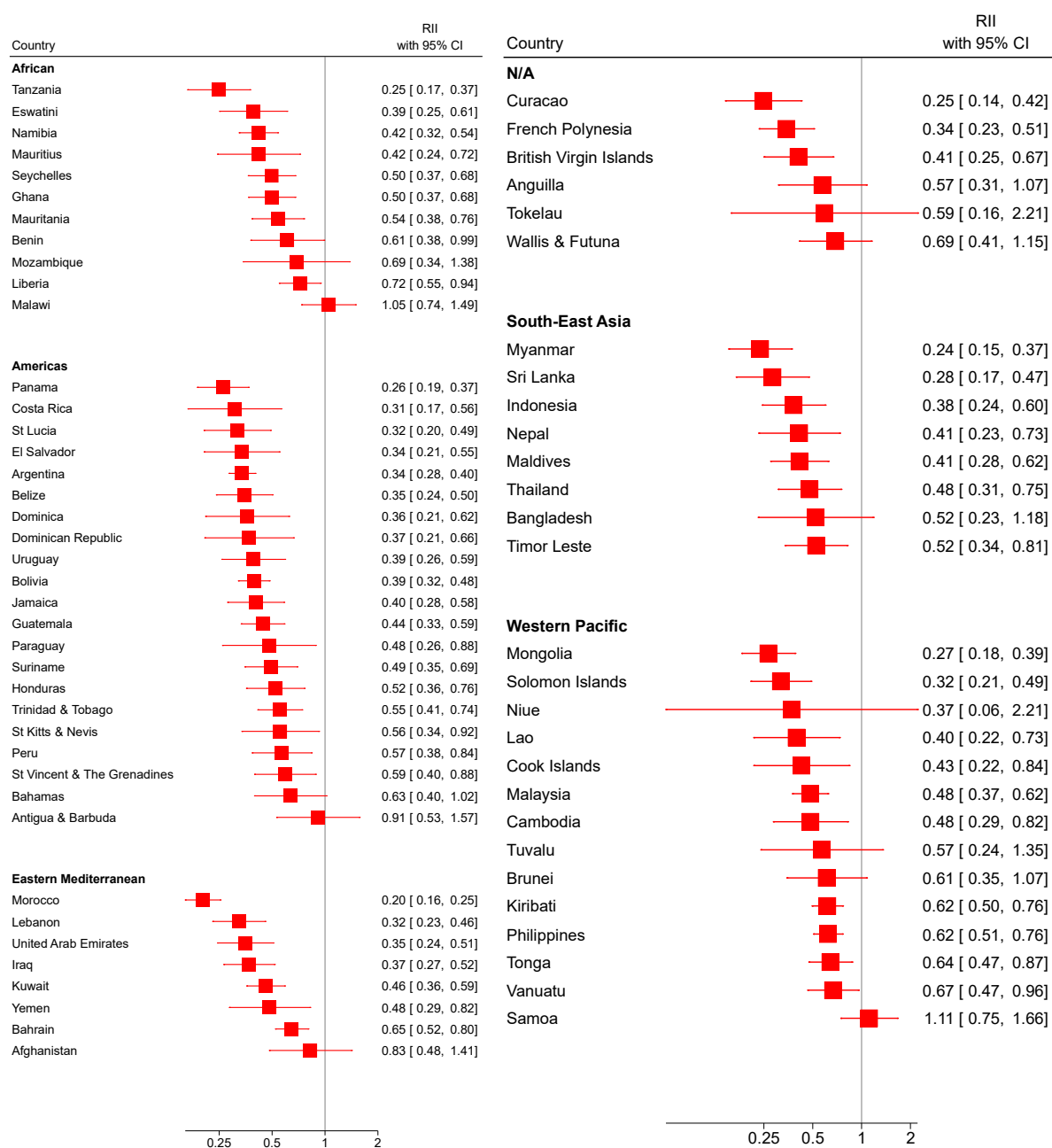


Figure 4.6. Relative Index of Inequality for suicide attempts according to food insecurity status, across countries and WHO World Regions.



4.3.1.4 Binary food insecurity exposure

The prevalence of suicidal ideation was higher in food-insecure adolescents compared to food-secure adolescents in 53 of the 83 countries (64%). Where an association was found, there was evidence of variability in the magnitude of the association between countries: the prevalence of suicidal ideation in food-insecure adolescents ranged from 28% more prevalent (Liberia) to over three times more prevalent (Myanmar) than in food-secure adolescents. The 95% confidence intervals overlapped between most countries, and in most cases, it was unclear if the magnitude of the associations differed significantly across countries. There was no observed difference in the prevalence of suicidal ideation between food-secure and food-insecure adolescents in the remaining 30 countries. The I^2 statistic in the meta-analyses was 66.5%.

In forty-seven (58%) of the 81 countries the prevalence of making a suicide plan was higher in food-insecure adolescents compared to food-secure adolescents. Where an association was found, there was significant variability with the prevalence of making a suicide plan in food-insecure adolescents ranging from 29% more common (Seychelles) to over three times more common (Costa Rica) than in food-secure adolescents. In the remaining 34 countries, no difference was found. The I^2 statistic was 66.1%.

The prevalence of suicide attempts was higher in food-insecure adolescents in comparison to food-secure adolescents in 46 of the 68 countries. Where an association was found, there was significant variability with the prevalence of suicide attempts in food-insecure adolescents ranging from 35% more common (Liberia) to over three times more common (Panama) compared to food-secure adolescents. In the remaining 22 countries, no difference was found. The I^2 statistic was 71.6%.

Forest plots for all outcomes are presented in Appendix B.

4.3.2 Country-level indicators as moderators of the association between food insecurity and suicidal thoughts and behaviours

The proportion of total variance of adolescents' suicidal thoughts and behaviours that was attributable to differences between countries was estimated to be 11.3% for suicidal ideation, 15% for making a suicide plan, and 9.4% for suicide attempts. This

was indicated by the conditional R^2 for the mixed-effects models where only the outcomes were included in the models and no fixed effects were entered.

Most country-level indicators were only weakly correlated with one another (Table 4.4). The UHC index had a moderate positive correlation with GDP per capita (PPP) ($r=0.61$) and a moderate negative correlation with the national prevalence of food insecurity ($r=-0.53$), indicating a higher level of universal health services in countries with greater levels of economic development and lower prevalence of food insecurity in adolescents.

Table 4.4. Correlations between country-level indicators.

	GDP per capita (PPP)	Gini index	UHC index	OOP health expenditure
Gini index	0.11			
UHC index	0.61	0.11		
OOP health expenditure	-0.24	-0.3	-0.21	
Prevalence of food insecurity in school-going adolescents	-0.23	0.14	-0.53	-0.12

Data on country-level indicators were not available for all countries. Of the 83 countries within the study, 76 had available data for GDP per capita, 55 had data on the Gini index and 74 countries had data on the UHC index and out-of-pocket health expenditure. Missing country-level data, particularly the Gini index, was primarily due to there being no available data for a number of small island countries, territories, or dependencies across the Americas, Western Pacific and N/A WHO regions.

4.3.2.1 Redit-transformed food insecurity

4.3.2.1.1 GDP per capita

In the meta-regression, there was evidence that as log-GDP per capita increased, the RII decreased. Subsequently, inequalities in suicidal ideation according to food insecurity status were of greater magnitude in the countries with a higher GDP per capita. Log-GDP per capita explained 10.7% of the between-country variance of the RII. There was no evidence that log-GDP per capita moderated the association between food insecurity and making a suicide plan (adjusted $R^2 = 3.8\%$) or attempting suicide (adjusted $R^2 = 4.7\%$) (Table 4.5).

Findings differed slightly in the mixed-effects analysis compared to results from the meta-regression. In the mixed-effects analyses there was evidence that as log-GDP per capita increased, the RII for suicidal ideation (interaction term = 0.92 [95% CI: 0.89 to 0.96]) and making a suicide plan became more unequal (interaction term = 0.95 [95% CI: 0.91 to 0.99]) (Table 4.6). The interaction between food insecurity status and log-GDP per capita for suicide attempts was the same magnitude to that of making a suicide plan, however the confidence intervals were slightly wider (interaction term = 0.95 [95% CI: 0.90 to 1.00]).

4.3.2.1.2 Gini index

Income inequality did not moderate the association between rdit-transformed food insecurity and any outcome in either the meta-regression or mixed-effects analyses (Tables 4.6 & 4.7). Additionally, income inequality did not account for any of the between-country variance of the RII in the meta-regression analyses.

4.3.2.1.3 Universal Health Coverage index

The level of universal health coverage, as indicated by the UHC index, moderated the association between food insecurity and all suicidal thoughts and behaviours in both the meta-regression and mixed-effects analyses (Tables 4.6 & 4.7). As the level of universal health service coverage increased, the RII decreased indicating that inequalities in all suicidal thoughts and behaviours according to food insecurity status were of greater magnitude in countries with greater universal health coverage. The UHC index explained approximately 15% of between-country variability for all suicidal thoughts and behaviours in the meta-regression analyses. Findings were robust after controlling for GDP per capita.

4.3.2.1.4 Out-of-pocket health expenditure

The level of out-of-pocket health expenditure as a proportion of a country's overall health expenditure did not moderate the association between food insecurity and any outcome (Tables 4.6 & 4.7). Out-of-pocket health expenditure explained only a small proportion of the between-country variability in the RII (approximately 3%) across the three suicidal thoughts and behaviours in the meta-regression analyses.

Table 4.5. Meta-regression results of the association between indicators of country-level context and the Relative Index of Inequality for suicidal ideation, making a suicide plan and suicide attempt.

	Suicidal ideation	Making a suicide plan	Suicide attempt
GDP per capita			
Countries	76	74	61
Change in RII per increase in log dollars in GDP per capita (95% CI)	-0.10 (-0.18 to -0.024)	-0.069 (-0.14 to 0.0026)	-0.081 (-0.17 to 0.023)
Between-country variance explained	10.7%	3.8%	4.7%
Gini index			
Countries	55	54	46
Change in RII per 1-point increase in the Gini index (95% CI)	-0.0032 (-0.016 to 0.0095)	-0.0034 (-0.014 to 0.0076)	-0.0019 (-0.018 to 0.014)
Between-country variance explained	0%	0%	0%
Change in RII per 1-point increase in the Gini index ^a (95% CI)	-0.0018 (-0.014 to 0.0099)	-0.0025 (-0.013 to 0.0079)	0.0022 (-0.013 to 0.017)
UHC Index			
Countries	74	72	60
Change in RII per 1-point increase in the UHC index (95% CI)	-0.0092 (-0.015 to -0.0038)	-0.0071 (-0.012 to -0.0022)	-0.0097 (-0.016 to -0.0031)
Between-country variance explained	17.9%	14.1%	16.7%
Change in RII per 1-point increase in the UHC index ^a (95% CI)	-0.0130 (-0.023 to -0.0021)	-0.012 (-0.021 to -0.0035)	-0.016 (-0.027 to -0.0041)
OOP health expenditure			
Countries	74	72	60
Change in RII per 1 percentage point increase in out-of-pocket health expenditure (95% CI)	-0.0033 (-0.0075 to 0.00080)	-0.0028 (-0.0065 to 0.00098)	-0.0036 (-0.0083 to 0.0012)
Between-country variance explained	3%	2.7%	3.3%
Change in RII per 1 percentage point increase in out-of-pocket health expenditure ^a (95% CI)	-0.0041 (-0.0082 to 0.00010)	-0.0032 (-0.0067 to 0.00052)	-0.0040 (-0.0087 to 0.00066)

^aadjusted for GDP per Capita (PPP).

Table 4.6 Relative Index of Inequality with 95% confidence intervals from the mixed-effects Poisson regression models.

	Suicidal ideation	Making a suicide plan	Suicide attempt
Model A: Food insecurity only Food-insecure	0.49 (0.46 to 0.53)	0.53 (0.50 to 0.57)	0.44 (0.41 to 0.47)
Model B: Individual-level confounders Food-insecure	0.49 (0.46 to 0.53)	0.53 (0.49 to 0.56)	0.43 (0.4 to 0.47)
Model C: GDP per capita Food-insecure GDP per capita	0.49 (0.46 to 0.52) 1.02 (0.98 to 1.06)	0.53 (0.49 to 0.56) 0.92 (0.88 to 0.96)	0.43 (0.4 to 0.46) 0.92 (0.89 to 0.95)
Model D: GDP per capita interaction Food-insecure GDP per capita GDP per capita X Food-insecure	1 (0.73 to 1.37) 1.04 (1 to 1.07) 0.92 (0.89 to 0.96)	0.86 (0.58 to 1.27) 0.93 (0.89 to 0.98) 0.95 (0.91 to 0.99)	0.72 (0.44 to 1.17) 0.93 (0.88 to 0.98) 0.95 (0.9 to 1)
Model E: Gini index Food-insecure Gini	0.49 (0.45 to 0.53) 1.19 (1.07 to 1.33)	0.52 (0.48 to 0.56) 1.24 (1.1 to 1.39)	0.42 (0.38 to 0.45) 1.19 (1.04 to 1.37)
Model F: Gini index interaction Food-insecure Gini Gini X Food-insecure	0.49 (0.45 to 0.53) 1.2 (1.06 to 1.34) 0.99 (0.91 to 1.08)	0.52 (0.48 to 0.56) 1.24 (1.1 to 1.4) 0.98 (0.9 to 1.05)	0.42 (0.38 to 0.45) 1.19 (1.04 to 1.37) 0.99 (0.9 to 1.1)
Model G: Gini index interaction ^a Food-insecure Gini Gini X Food-insecure	0.49 (0.45 to 0.53) 1.2 (1.07 to 1.35) 0.99 (0.91 to 1.08)	0.52 (0.48 to 0.56) 1.25 (1.12 to 1.41) 0.97 (0.9 to 1.05)	0.42 (0.38 to 0.45) 1.21 (1.05 to 1.39) 0.99 (0.9 to 1.09)
Model H: UHC index Food-insecure UHC index	0.49 (0.46 to 0.53) 1.07 (0.96 to 1.19)	0.53 (0.5 to 0.57) 0.95 (0.85 to 1.06)	0.43 (0.4 to 0.47) 0.97 (0.86 to 1.1)
Model I: UHC index interaction Food-insecure UHC index UHC index X Food-insecure	0.5 (0.47 to 0.53) 1.08 (0.98 to 1.19) 0.9 (0.84 to 0.96)	0.53 (0.5 to 0.57) 0.97 (0.87 to 1.08) 0.92 (0.87 to 0.98)	0.44 (0.41 to 0.47) 0.99 (0.89 to 1.11) 0.9 (0.83 to 0.97)
Model J: UHC index ^a Food-insecure UHC index UHC index X Food-insecure	0.5 (0.47 to 0.53) 1.12 (0.99 to 1.27) 0.9 (0.84 to 0.96)	0.53 (0.5 to 0.57) 1 (0.89 to 1.14) 0.92 (0.87 to 0.98)	0.44 (0.41 to 0.47) 1.07 (0.93 to 1.22) 0.9 (0.83 to 0.97)
Model K: OOP health expenditure Food-insecure OOP health expenditure	0.5 (0.46 to 0.53) 0.91 (0.82 to 1)	0.53 (0.5 to 0.57) 0.87 (0.79 to 0.97)	0.43 (0.4 to 0.47) 0.89 (0.8 to 0.99)
Model L: OOP health expenditure interaction Food-insecure OOP health expenditure OOP health expenditure X Food-insecure	0.5 (0.46 to 0.53) 0.91 (0.83 to 1.01) 0.96 (0.89 to 1.03)	0.53 (0.5 to 0.57) 0.88 (0.8 to 0.98) 0.96 (0.89 to 1.02)	0.43 (0.4 to 0.47) 0.9 (0.81 to 1) 0.96 (0.89 to 1.04)
Model M: OOP health expenditure adjusted ^a Food-insecure OOP health expenditure OOP health expenditure X Food-insecure	0.5 (0.46 to 0.53) 0.91 (0.82 to 1.01) 0.96 (0.89 to 1.03)	0.53 (0.5 to 0.57) 0.86 (0.78 to 0.96) 0.96 (0.89 to 1.02)	0.43 (0.4 to 0.47) 0.88 (0.79 to 0.98) 0.96 (0.89 to 1.04)

^aadjusted for GDP per Capita (PPP).

4.3.2.2 Binary food insecurity

All estimates are presented in Appendix B, except for the results where national prevalence of food insecurity among school-going adolescents was the country-level indicator of interest.

4.3.2.2.1 GDP per capita

Log-transformed GDP per capita moderated the relationship between binary food insecurity and all suicidal thoughts and behaviours in the meta-regression and mixed-effects analyses. PRs were higher in countries with higher levels of GDP per capita. The relationship was comparable across each outcome. According to the meta-regression analyses, log-transformed GDP per capita explained approximately 28.4% of between-country variability for suicidal ideation, 20.1% for making a suicide plan and 15.6% for suicide attempts.

4.3.2.2.2 Gini index

As was the case with the analyses of log-transformed food insecurity, income inequality did not moderate the association between food insecurity and any outcome. Income inequality explained almost none of the between-country variance in the meta-regression analyses.

4.3.2.2.3 Universal Health Coverage index

For the binary exposure, PRs were higher in countries with greater levels of universal health service coverage as indicated by the WHO index. This was apparent in both the meta-regression and mixed-effect analyses.

4.3.2.2.4 Out-of-pocket health expenditure

Out-of-pocket health expenditure explained almost none of the between-country variance for the binary exposure and did not moderate the association between food insecurity and any outcome.

4.3.2.2.5 Prevalence of food insecurity among school-going adolescents within countries

The prevalence of food insecurity among school-going adolescents within countries was found to moderate the association between food insecurity and all suicidal thoughts and behaviours in the meta-regression and mixed-effects analyses (Tables

4.7 & 4.8). Log-PRs were higher in countries where food insecurity was less prevalent. The relationship was stronger for suicide attempts than suicidal ideation and making a suicide plan in the meta-regression analyses, but there was no difference in the magnitude of the interaction terms in the mixed-effects models. According to the meta-regression analyses, national prevalence of food insecurity explained approximately 56.5%, 54.2% and 77.8% of the between-country variability for suicidal ideation, making a suicide plan and suicide attempts respectively. Findings were robust after controlling for GDP per capita and income inequality.

Table 4.7. Meta-regression results with 95% confidence intervals of the association between indicators of country-level context and log-prevalence ratios for suicidal ideation, making a suicide plan and suicide attempt according to moderation by national prevalence of food insecurity among school-going adolescents (binary food insecurity variable).

	Suicidal ideation	Making a suicide plan	Suicide attempt
Prevalence of food insecurity			
Countries	83	81	68
Change in log-prevalence ratio per 1 percentage point increase in food insecurity prevalence (95% CI)	-0.030 (-0.039 to -0.021)	-0.031 (-0.040 to -0.022)	-0.052 (-0.063 to -0.041)
Between-country variance explained	56.5%	54.2%	77.8%
Change in log-prevalence ratio per 1 percentage point increase in food insecurity prevalence ^a (95% CI)	-0.026 (-0.036 to -0.015)	-0.029 (-0.040 to -0.018)	-0.054 (-0.067 to -0.040)
Change in log-prevalence ratio per 1 percentage point increase in food insecurity prevalence ^b (95% CI)	-0.021 (-0.033 to -0.009)	-0.025 (-0.038 to -0.012)	-0.051 (-0.066 to -0.037)

^aadjusted for GDP per capita (PPP). ^badjusted for GDP per Capita (PPP) and Gini index.

Table 4.8. Prevalence ratios coefficients with 95% confidence intervals from the mixed-effects Poisson regression models according to moderation by national prevalence of food insecurity among school-going adolescents (binary food insecurity variable).

	Suicidal ideation	Making a suicide plan	Suicide attempt
Prevalence of food insecurity interaction			
Food-insecure	1.63 (1.56 to 1.71)	1.61 (1.54 to 1.68)	1.82 (1.73 to 1.92)
Percent food-insecure	1.14 (1.05 to 1.24)	1.27 (1.16 to 1.38)	1.17 (1.05 to 1.3)
Percent food-insecure X Food-insecure	0.87 (0.84 to 0.91)	0.88 (0.84 to 0.91)	0.82 (0.77 to 0.87)
Prevalence of food insecurity interaction ^a			
Food-insecure	1.60 (1.56 to 1.71)	1.61 (1.54 to 1.69)	1.83 (1.73 to 1.93)
Percent food-insecure	1.20 (1.09 to 1.33)	1.30 (1.18 to 1.43)	1.19 (1.06 to 1.35)
Percent food-insecure x Food-insecure	0.88 (0.84 to 0.91)	0.88 (0.84 to 0.91)	0.82 (0.77 to 0.87)
Prevalence of food insecurity interaction ^b			
Food-insecure	1.63 (1.55 to 1.72)	1.62 (1.54 to 1.71)	1.84 (1.72 to 1.96)
Percent food-insecure	1.16 (1.05 to 1.29)	1.29 (1.17 to 1.41)	1.26 (1.11 to 1.43)
Percent food-insecure x Food-insecure	0.88 (0.84 to 0.92)	0.88 (0.84 to 0.91)	0.82 (0.76 to 0.88)

^aadjusted for GDP per capita (PPP). ^badjusted for GDP per Capita (PPP) and Gini index.

4.3.3 Sensitivity analyses

4.3.3.1 Analyses limited to countries where all suicidal thoughts and behaviours were measured

Results from the main analysis were robust after limiting the sample to the 68 countries which measured all suicidal thoughts and behaviours. Consequently, any cross-outcome differences are unlikely to be driven by differences in statistical power or the specific countries included in the main analyses for each outcome (Appendix B).

4.3.3.2 Within-country consistency of the RII across time

Within-country comparisons indicated that RIIs were largely consistent over time for all suicidal thoughts and behaviours. This was indicated by the overlapping 95% confidence intervals of effect estimates from different survey years. There was only a single case where the RII for suicidal ideation differed across survey years in the 25 countries that measured suicidal ideation in multiple surveys (Seychelles). The RII was 0.39 (95% CI: 0.35 to 0.43) in the 2007 survey, compared to 0.79 (95% CI: 0.57 to 1.09) in 2015.

There were two cases where the RII for making a suicide plan differed across survey years in the 24 countries that measured the outcome in multiple surveys (Seychelles and the United Arab Emirates). For Seychelles, the RII was 0.49 (95% CI: 0.44 to 0.55) in the 2007 survey, compared to 0.86 (95% CI: 0.65 to 1.14) in 2015. For the United Arab Emirates, the RII was 0.45 (95% CI: 0.36 to 0.57) in the 2005 survey, compared to 0.93 (95% CI: 0.66 to 1.30) in 2010. There were no cases where the RII differed across the 14 countries that measured suicide attempts in multiple surveys.

4.3.3.3 Universal health coverage as a moderator following adjustment of national prevalence of food insecurity in adolescents

I conducted an exploratory analysis to identify potential reasons for the unexpected finding that the association between experiencing food insecurity and increased prevalence of suicidal thoughts and behaviours was stronger in magnitude in countries with greater levels of universal health coverage. I re-ran the meta-regression analyses adjusting for the national prevalence of food insecurity in adolescents due to the moderate correlation with the UHC index ($r=-0.53$), which could partially explain the unexpected finding. This was carried out for both the binary food insecurity variable

and the rdit-transformed food insecurity, despite the tautology between the RII and the national prevalence of food insecurity in adolescents. I report the coefficients for both the UHC index and national prevalence of food insecurity within the meta-regression for analyses of the binary food insecurity variable and coefficients of the UHC index only for analyses of the RII. Analyses were carried out solely using meta-regressions due to their suitability in deriving which indicator of country-level context might be driving the heterogeneity in effect estimates when multiple moderators are modelled.

There was no longer support for a moderating role of universal health coverage after adjusting for the national prevalence of food insecurity in analyses using rdit-transformed food insecurity for all outcomes (Table 4.9). In the analyses of the binary food insecurity variable, national prevalence of food insecurity in adolescents was still associated with the magnitude of log-PRs in models with the UHC index. This suggests that the observed association between the UHC index and country-level RIIs and log-PRs was driven by prevalence of food insecurity in adolescents within countries, which was strongly correlated with the UHC index.

Table 4.9. Meta-regression results of the association between the UHC index and the Relative Index of Inequality and log-prevalence ratios for suicidal ideation, making a suicide plan and suicide attempt after adjustment for national prevalence of food insecurity in adolescents.

	RII			Log-PR		
	Suicidal ideation	Making a suicide plan	Suicide attempt	Suicidal ideation	Making a suicide plan	Suicide attempt
Model 1						
Change in effect estimate per 1-point increase in the UHC index (95% CI)	-0.0092 (-0.015 to -0.0038)	-0.0071 (-0.012 to -0.0022)	-0.0097 (-0.016 to -0.0031)	0.0074 (0.0036 to 0.011)	0.0085 (0.0048 to 0.012)	0.011 (0.0052 to 0.016)
Model 2						
Change in effect estimate per 1-point increase in the UHC index (95% CI)	-0.0030 (-0.0079 to 0.0040)	-0.0014 (-0.0071 to 0.0043)	-0.0008 (-0.0083 to 0.0068)	0.0021 (-0.0020 to 0.0062)	0.0030 (-0.0012 to 0.0073)	-0.0001 (-0.0052 to 0.0050)
Change in effect estimate per 1 percentage point increase in food insecurity prevalence (95% CI)				-0.025 (-0.036 to -0.014)	-0.025 (-0.037 to -0.013)	-0.052 (-0.067 to -0.037)

Model 1: UHC index only. Model 2: UHC index and prevalence of food insecurity.

4.4 Discussion

In this study, I investigated whether the association between food insecurity and suicidal thoughts and behaviours in adolescents varied across 83 countries and whether the association was moderated by different indicators of country-level context.

As hypothesised, the prevalence of suicidal ideation, making a suicide plan and suicide attempts was greater in food-insecure adolescents compared to food-secure adolescents within the pooled sample (hypotheses 4.1, 4.2 and 4.3). I further hypothesised that there would be variability in the strength and direction of the associations between food insecurity and suicidal ideation, making a suicide plan and suicide attempts between countries (hypotheses 4.4, 4.5 and 4.6). Adolescents experiencing food insecurity were more likely than food-secure adolescents to report suicidal thoughts, make a suicide plan or attempt suicide in 78%, 71% and 89% of countries respectively. The magnitude of the association varied between countries. In some countries there were large differences in the prevalence of suicidal thoughts and behaviours between food-insecure and food-secure adolescents and in others there were small differences or no detectable difference. I found no countries where there was evidence of higher levels of suicidal thoughts and behaviours in food-secure adolescents compared to food-insecure adolescents.

I found evidence that differences in the association between food insecurity and suicidal thoughts and behaviours between countries could be due to differing social and economic contexts. As hypothesised, inequalities in suicidal thoughts and behaviours according to food insecurity status were greater in countries with greater levels of economic development (hypothesis 4.7). Contrary to my hypotheses, inequalities in suicidal thoughts and behaviours according to food insecurity status did not differ according to country-level income inequality (hypothesis 4.8). The magnitude of inequalities did not differ according to countries' level of out-of-pocket health expenditure, but surprisingly, inequalities in suicidal thoughts and behaviours were greater in countries with higher coverage of universal health services as indicated by the UHC index (hypothesis 4.9). However, this relationship appeared to be driven by the strong correlation between the UHC index and the national prevalence of food insecurity in adolescents. As hypothesised, inequalities in suicidal thoughts and

behaviours according to food insecurity status were greater in countries with a lower prevalence of food insecurity in school-going adolescents (hypothesis 4.10).

4.4.1 Interpretation

Experiencing food insecurity was associated with a higher prevalence of suicidal ideation, making a suicide plan, or attempting suicide, compared to food-secure adolescents in most countries. The study suggests that food insecurity is a widely observed correlate of suicidal thoughts and behaviours in adolescents across different countries. The heterogeneity in the magnitude of the association across countries suggests that the extent of inequalities in suicidal thoughts and behaviours according to food insecurity status might be linked to the wider societal context that adolescents live in. Under the strong assumption that the observed inequalities are driven from food insecurity leading to these suicide outcomes (rather than reverse causation, or unmeasured confounding), the findings suggest that the causal pathway from food insecurity to suicidal thoughts and behaviours (specifically through pathways of perceived burdensomeness and thwarted belongingness) might be influenced by specific indicators of country-level context.

In support of my hypothesis based on the theory of relative deprivation, food insecurity had a stronger association with all suicidal thoughts and behaviours in countries where the prevalence of food insecurity was low (Runciman, 1966). This replicated previous findings by Koyanagi and colleagues (2019) who found that the association between food insecurity and suicide attempts were greater in countries where food insecurity was less prevalent. This study provides evidence that this finding expands to suicidal ideation and making a suicide plan. The psychological and social effects and correlates of food insecurity might be intensified when food insecurity is rare and is more indicative of a reduced standard of living within a country. This is consistent with the sociologist, Emile Durkheim's theories of suicide (Durkheim, 1951). Durkheim proposed different "types" of suicide, including egoistic suicide that arises in contexts where an individual is not socially integrated with others in society. Therefore, there is likely to be greater cases of egoistic suicide in food-insecure adolescents in settings where food insecurity is rare and is a clear marker of marginalisation and disconnection from the population norms. On the contrary, in countries where food insecurity is common, there might be an increase in social bonds and integration

between food-insecure adolescents through experiencing shared adversity. This may lead to food insecurity having a smaller impact on social disconnection and therefore thwarted belongingness and perceived burdensomeness, and thus suicide risk. The study's finding is consistent with a range of other mental health risk factors, such as negative parenting practices and bullying victimisation, which suggest that adverse experiences have a weaker association with adolescents' mental health outcomes in countries where the adverse experience is more normative (Deater-Deckard & Dodge, 1997; Gershoff et al., 2010; Odigie et al., 2024). Despite the finding of this study, that food insecurity is more strongly associated with suicidal thoughts and behaviours in adolescents in countries where food insecurity is rare, preventing food insecurity in adolescents' remains key to help ensure adolescents are physically and mentally healthy throughout the life course (Society for Adolescent Health and Medicine, 2025). However, policymakers need to ensure actions to reduce food insecurity are equitable so that health inequalities are not exacerbated.

I hypothesised, based on the theory of relative deprivation, that the association between food insecurity and suicidal thoughts and behaviours would be of greater magnitude in countries with higher levels of income inequality (Runciman, 1966). I assumed food-insecure adolescents might experience more negative and salient social comparisons to food-secure peers in economically unequal countries. In turn this may negatively impact food-insecure adolescents' self-esteem, self-worth and psychological distress, and therefore feelings of perceived burdensomeness (Schneider, 2019; Van Orden et al., 2010; Wetherall et al., 2019). I however found no moderating role of income inequality as measured by the Gini index for any outcome. This contrasts with previous studies in high-income countries, primarily in Europe, which found moderation by country-level income inequality for economic inequalities in adolescents' internalising mental health (Dierckens et al., 2020; Elgar et al., 2015; Weinberg et al., 2021). Results from this study indicate that this might not extend to low- and middle-income countries and other world regions, food insecurity, or suicidal thoughts and behaviours.

I used the Universal Health Coverage Index as a proxy measure of health care accessibility and assumed that it would capture inequalities in health care access. Counterintuitively, inequalities in suicidal thoughts and behaviours were higher in countries with greater coverage of universal health services. After adjusting for

country-level prevalence of food insecurity in adolescents there was no longer evidence that the UHC index moderated the association between food insecurity and suicidal thoughts and behaviours. I found no moderating role with another proxy indicator of health care access, the proportion of health expenditure that is out-of-pocket within a country.

The lack of moderating role for health care accessibility might be due to several reasons. I assumed that greater levels of universal health care would be associated with increased access to mental health care in each country and reduced economic inequalities in mental health care access. I further assumed that mental health care would reduce the risk of suicidal thoughts and behaviours in adolescents, potentially from weakening the pathways from thwarted belongingness, perceived burdensomeness and hopelessness to suicidal thoughts and behaviours. Regarding the first assumption, country-level out-of-pocket health expenditure and the UHC index were only weakly correlated ($r=-0.12$). Subsequently, the measures may not be appropriate proxies of health care accessibility due to their discordance with one another, despite it being intuitive that there would be significantly greater levels of out-of-pocket health expenditure in countries where there is little or no universal health care.

Regarding the second assumption, there are large cross-country differences in the extent that mental health problems are an antecedent of suicidal thoughts and behaviours. Mental health problems have a strong association with suicide in adolescents in countries in Europe and North America, where 90% of adolescents who die by suicide have a mental health problem (Bridge et al., 2006; Gili et al., 2019). The association between mental health problems and suicide is comparatively weaker in other world regions, particularly Asia (Cho et al., 2016; Milner et al., 2013). In low- and middle-income countries, 45% of adults that die by suicide have a mental health problem (Knipe et al., 2019). Most research is not adolescent-specific, but a small number of studies have shown that in China and Tunisia adolescents who have died by suicide also have a low prevalence of mental illness (Chérif et al., 2012; X. Y. Li et al., 2008). There are likely to be differences across countries in the effectiveness and suitability of mental health care in preventing and reducing the risk of suicidal thoughts and behaviours in adolescents, as there are cross-country differences regarding how common mental health problems are an antecedent of suicidal thoughts and

behaviours. Furthermore, there are also differences in cultural meanings around life stressors, suicide and expressions of distress across countries (J. Chu et al., 2022; Lester, 2006). The assumption that mental health care access could weaken the pathways from thwarted belongingness, perceived burdensomeness and hopelessness to suicidal thoughts and behaviours in all countries might not be accurate in the countries studied, thus potentially explaining why no moderating role for universal health care was identified.

The study's findings are consistent with research on cross-country physical health inequalities. Studies of adults in Europe have found that health inequalities are not lower in countries with substantial welfare policies and higher expenditure on health services (Eikemo et al., 2008; Mackenbach et al., 2008). Economic inequalities in health care access persist in all countries, even where there is near-universal population coverage of health services (Baeten et al., 2018).

I modelled countries' level of economic development using log-transformed GDP per capita. Results from the meta-regression and mixed-effect analyses for the RII found evidence that log-GDP per capita moderated the association between food insecurity and suicidal ideation. In the mixed-effects analyses there was also evidence that log-GDP per capita moderated the association between food insecurity and making a suicide plan. There was no evidence that the association between food insecurity and suicide attempts varied across countries. However, the between-country variance explained by GDP per capita was a percentage point greater for the association between food insecurity and suicide attempts in comparison to the association between food insecurity and making a suicide plan. The null finding for suicide attempts might be a product of less statistical power compared to the other outcomes, but there was no evidence of this in the sensitivity analyses featuring countries with measures on all suicidal thoughts and behaviours. Alternatively, suicide attempts were slightly rarer than suicidal ideation and making a suicide plan, which could have reduced precision of the within-country associations and subsequently the results from the meta-regression analyses. There was evidence that food insecurity, when modelled as a binary variable, had a greater association with all outcomes in high-income countries. Overall, the study's findings suggest that the association between food insecurity and suicidal thoughts and behaviours is greater in countries with higher levels of GDP, and hence higher levels of economic development.

Previous analyses of the GSHS are inconclusive and contradictory, finding that food insecurity had a stronger association with making a suicide plan and suicide attempts in lower-middle income countries compared to low-income countries (Mahumud et al., 2022). Two further studies assessing suicide attempts found that the association did not vary according to a country's income classification (Koyanagi et al., 2019; Probst et al., 2021). My analyses build on previous work by treating economic development as a continuous variable. Categorisation of economic development, as used in past studies, can lead to a reduction in statistical power and introduce bias (Altman & Royston, 2006). Any potential moderating role of economic development remains unclear, due to the conflicting findings across studies. However, this study provides important evidence that findings from studies investigating the association between food insecurity and adolescents' suicidal thoughts and behaviours in high-income countries might not translate to low- or middle-income countries.

There were differences in the support of countries' economic development moderating the RII for making a suicide plan between the meta-regression and mixed-effects analyses. The direction of the moderation was consistent between both analytic models (greater inequalities in making a suicide plan according to food insecurity status as economic development increases). However, there was only statistical evidence in the mixed-effects analysis. Sampling weights could not be included in the mixed-effects analysis which could have led to the discrepancy in the results between analytical approaches.

I modelled food insecurity on a continuum in the main analyses, contrary to past research. There were some differences in the results dependent on whether the food insecurity variable was rdit-transformed or modelled as a binary variable. There was evidence in a greater number of countries that rdit-transformed food insecurity was associated with suicidal thoughts and behaviours compared to analyses using the binary variable. For instance, in analyses of suicide attempts, there was an observed association with the rdit-transformed variable in 89% of countries, compared to 67% of countries where the binary variable was used. The rdit-transformation is likely to have led to greater statistical power to detect associations within countries compared to the binary categorisation of food insecurity. The arbitrary grouping of adolescents into "food-secure" and "food-insecure" is likely to have led to misclassification bias and

measurement error. This might have attenuated the association between food insecurity and suicidal thoughts and behaviours within countries towards the null.

4.4.2 Strengths and limitations

The research has some limitations that will have introduced biases into the study. First, the study used cross-sectional data and does not provide any evidence of a potential causal relationship between food insecurity and suicidal thoughts and behaviours. The temporal ordering of adolescents' food insecurity and suicidal thoughts and behaviours cannot be established in the cross-sectional data as they are both time-varying. The associations could be driven by reverse causality, where suicidal thoughts and behaviours lead to food insecurity rather than the other way round. There is significant evidence in adults that mental health problems can lead to reduced earnings and potentially food insecurity as a result (de Sousa et al., 2019; Lund & Cois, 2018). The "reverse causation pathway" is less likely in adolescents as they are unlikely to be a key provider of income and food for their household. Reverse causality is plausible if adolescents' suicidal thoughts and behaviours (and possible co-occurring mental health problems) require significant care from parents or other household members that in turn reduces household members' earnings potential and their ability to provide food for the household. Furthermore, the measure of food insecurity referred to a shorter time period (last 30 days) than the measures of suicidal thoughts and behaviours (last year), resulting in a temporal misalignment of these variables. Adolescents' suicidal thoughts and behaviours might have preceded the experience of food insecurity, and the association between food insecurity and suicidal thoughts and behaviours may be spurious. However, consistent findings in longitudinal studies suggest the association between food insecurity and mental health outcomes is unlikely to be wholly spurious (Belsky et al., 2010; McIntyre et al., 2013, 2017; Slopen et al., 2010).

Second, the school-based nature of the study means some adolescents experiencing severe levels of food insecurity and/or suicidal thoughts and behaviours were excluded from the sample, as both food insecurity and mental health problems are linked to reduced school attendance (Epstein et al., 2020; Tamiru & Belachew, 2017). For instance, one study of out-of-school Ethiopian adolescents living or working on the street documented their experience of severe food insecurity. The adolescents

regularly missed meals and their diet mainly consisted of leftover food given away for free from restaurants and spoiled food picked up from waste or vendors (Deressa & Dessein, 2024). Analysing data on school-going adolescents might have introduced collider bias, as both food insecurity and mental health are both determinants of school enrolment and attendance. The associations within countries could be attenuated or inflated estimates of the true underlying population-level association between food insecurity and suicidal thoughts and behaviours in adolescents (Munafò et al., 2018). The extent of this bias might vary across countries dependent on how normative school enrolment is and how strongly associated food insecurity and suicidal thoughts and behaviours are with school attendance.

Third, there was a high prevalence of suicide attempts in the sample. I could only include adolescents who had survived an attempt. This will have introduced a survival bias as adolescents who had attempted suicide and died would not be included in the study (Bauer et al., 2015). As a result, the prevalence of suicide attempts is underestimated in all countries. This might have attenuated the identified associations as suicide attempts were typically more prevalent in food-insecure adolescents across countries.

Fourth, I was unable to control for potential confounders due to the lack of suitable measures within the GSHS. Other socio-economic variables are linked to both food insecurity and suicidal thoughts and behaviours in adolescents and constitute likely confounders. The lack of adjustment for these variables means the within-country associations are likely to overestimate any potential causal relationship between food insecurity and suicidal thoughts and behaviours. The direction and magnitude of this bias might vary across countries as the extent of confounding may not be consistent across contexts. The associations within-countries cannot be interpreted to reflect any potential causal relationship and are instead designed to capture the extent of inequality in suicidal thoughts and behaviours in adolescents according to food insecurity status within each country.

Fifth, I used single-item experiential measures of food insecurity and suicidal thoughts and behaviours. The validity and reliability of the measures of food insecurity and suicidal thoughts and behaviours are unknown in the context of the GSHS. Consequently, the within-country associations could be biased owing to systematic

measurement error of the exposure and outcomes. However, adolescents can accurately assess and report their own food insecurity across a range of different measures (Frongillo et al., 2022). Single-item measures of suicidal thoughts and behaviours, similar to those used in this study, have shown good reliability and validity in samples of US adolescents (May & Klonsky, 2011). However, a study of US adults found that single-item measures of suicidal ideation, suicide planning and suicide attempts are subject to misclassification bias which can lead to false positive or negative statistical conclusions (Millner et al., 2015). Furthermore, the measure of food insecurity solely focused on hunger, neglecting other facets such as reduced food quality that are characteristic of less severe presentations of food insecurity (Cafiero et al., 2018). Measuring food insecurity status based on a single aspect might have led to misclassification and potentially under-represented milder forms of food insecurity where food quality, but not intake, is affected.

Sixth, there might have been different interpretations of the measures between- and within-countries. I found variability in the prevalence of suicidal thoughts and behaviours across countries. Some of this variability is likely to be driven by cross-country differences in measurement interpretation and cultural understandings, societal stigma and national laws regarding suicide. This could have led to over- or under-reporting of suicidal thoughts and behaviours across countries, potentially impacting the identified associations with food insecurity. Health literacy is typically higher in adolescents living in wealthier economic circumstances and the interpretation of the measures might have differed between food-secure and food-insecure participants within countries (Paakkari et al., 2020).

Seventh, I used the Interpersonal Theory of Suicide to guide my conceptual framework of how food insecurity could lead to suicidal thoughts and behaviours and my hypotheses regarding which indicators of country-level context may moderate the within-country associations. This is despite there being a number of other theories of suicide (e.g., the Integrated Motivational-Volitional Model, Three-Step Theory) that might have also been suitable (Klonsky & May, 2015; O'Connor, 2011). The Interpersonal Theory is less complex than other models of suicide as there are just a few theorised pathways of how suicidal thoughts and behaviours may develop. The simplicity within the model made it easier to hypothesise which indicators of country-level context might moderate the association between food insecurity and suicidal

thoughts and behaviours. Importantly, many models share similar hypothesised processes to those proposed in the Interpersonal Theory of Suicide. For instance, thwarted belongingness and perceived burdensomeness are considered key aspects of the development of suicidal thoughts and behaviours in the Integrated Motivational-Volitional Model (O'Connor, 2011). The Three-Step Theory of Suicide also emphasises the importance of social connectedness as a necessary precursor of suicidal ideation and attempts (Klonsky & May, 2015).

More importantly, many, if not all, of the most widely used models and theories of suicide have been developed and based on research findings in high-income countries in Europe, North America or Australia. A systematic review found that over 80% of studies that have tested the hypotheses within the Interpersonal Theory of Suicide have been conducted in Canada or the US (C. Chu et al., 2017). Despite this, I assumed that the theory would be valid across the 83 countries within this study even though its validity is not known in most of them. It is unclear how this may have biased the results within this study. The potential lack of validity of the Interpersonal Theory of Suicide within low- and middle-income countries remains a significant limitation as there might be important pathways in the development of suicidal thoughts or behaviours in these contexts that the model does not consider. Furthermore, the pathways of thwarted belongingness and perceived burdensomeness might not be relevant in some contexts. As found in this study, the prevalence of suicidal thoughts and behaviours and the magnitude of their association with food insecurity varies greatly between countries. Therefore, it may be erroneous to assume that the key pathways leading to these outcomes are consistent between diverse contexts.

The GSHS has numerous strengths, including the use of the same measures and consistent sampling procedures across countries. This reduces the likelihood that the observed cross-country variability in the association between food insecurity and suicidal thoughts and behaviours is driven by artefactual differences in methods within each country. A strength of this work is the rdit-transformation of the food insecurity measure which allowed the estimation of the RII in each country. This approach likely increased precision and reduced bias of the within-country estimates compared to past studies that modelled food insecurity as a categorical variable. Covariates were selected based on their theoretical likelihood to confound the association between food insecurity and suicidal thoughts and behaviours. Previous studies controlled for

variables that are likely to be on the causal pathway, meaning past estimates are likely to underestimate the magnitude of the association between food insecurity and suicidal thoughts and behaviours (Schisterman et al., 2009). Finally, country-level effect estimates were based on prevalence ratios. This contrasts with past studies that have estimated odds ratios, which are affected by the prevalence of the outcome within each sample. Cross-country variability in the association between food insecurity and adolescent suicidal thoughts and behaviours in past studies might have partially been an artefact caused by the differing prevalence of suicidal thoughts and behaviours across countries (Barros & Hiraakata, 2003; Khang et al., 2008).

4.4.3 Conclusion

In this chapter, I have described findings from a cross-national study. I found that in most countries the prevalence of suicidal thoughts and behaviours was greater in food-insecure adolescents compared to food-secure adolescents within a large sample of predominantly low- and middle-income countries. The magnitude of the association varied across countries and different indicators of country-level context. If the association is causal, the extent of food insecurity's impact on suicidal thoughts and behaviours might be context dependent. The study's results contribute to the understanding of country-specific correlates of suicidal thoughts and behaviour in adolescents. Importantly, the study shows that results from one setting cannot be applied to another.

My analysis of 83 countries participating in the GSHS compared the extent of inequalities across a large range of diverse countries including low- and middle-income countries that are understudied in mental health research. Regardless of the social determinant or the mental health outcome of interest, there is still a lack of longitudinal research outside of North America and Europe that has investigated cross-country differences in economic inequalities in adolescents' mental health. The next study in my thesis examines the longitudinal association between different measures of economic circumstances and future internalising symptoms across eight countries.

5 Longitudinal data used in my thesis

In this chapter, I introduce the longitudinal population studies that are analysed in Chapter 6 – a multi-country investigation of economic inequalities in adolescents' internalising mental health. A subset of these studies is also analysed in Chapter 7 – a mediation study investigating whether adolescents' social relations are a mechanism through which their economic circumstances affect their internalising mental health. This chapter will describe the process of study selection and the key sampling and data collection methods of these longitudinal population studies.

5.1 Rationale of approach

The overarching aims of Chapters 6 and 7 are to investigate cross-country differences in the magnitude and mechanisms of economic inequalities in adolescents' internalising mental health. These aims could in theory be addressed through conducting a systematic review and meta-analysis. This would involve comparing effect estimates from different published studies from multiple countries. However, this approach has limitations compared to carrying out parallel analyses across different countries.

As discussed in previous chapters, there is little research on the longitudinal association between adolescents' economic circumstances and their internalising mental health in low- and middle-income countries. In several countries, the resources or infrastructure may be lacking to conduct this research. If research is carried out in these settings, researchers from low- and middle-income countries face lower acceptance rates from journals compared to research conducted in high-income countries (El Khoury et al., 2021; Singh, 2006). This publication bias further limits the extent to which research from a diverse range of countries is accessible through journal databases and therefore a systematic review. This would limit the potential to make comparisons across a wide range of diverse countries. This is shown by the limited range of countries found in a systematic review of 55 studies that investigated economic inequalities in adolescents' mental health (Reiss, 2013). Most studies were conducted in Europe (n=24) or North America (n=19). In comparison, only three studies were conducted in Asia, five in Oceania and four in South America. The review found no studies conducted in Africa.

A further issue relates to publication bias. This is where statistically significant or novel results are selectively published but null findings are less likely to be (Rothstein et al., 2005). Studies that report a null association between adolescents' economic circumstances and their internalising mental health are less likely to be published. In comparison, economic inequalities in adolescents' mental health may be large in magnitude in published papers. Published research identified in a systematic review might not accurately capture the variation and diversity of the direction or magnitude of economic inequalities in adolescents' mental health across countries, leading to an increased risk of a Type II error (i.e., wrongly concluding that there is no cross-country variability).

Furthermore, individual studies are likely to vary in their methodologies and statistical approaches. I would need to restrict comparisons to studies that have comparable effect estimates from a similar estimand of interest (e.g., the exposure, outcome and confounders are modelled in the same way across studies) to be confident that any cross-country differences are not the result of methodological differences between studies. This may not be feasible. Even if studies have suitably similar methods to enable cross-study comparison, researchers are likely to differ in how they approach data management and analysis, leading to potentially different results that are driven solely by different analytical approaches and decisions (Simmons et al., 2011).

By conducting parallel analyses of different longitudinal population studies, I can be more confident that any cross-country differences are not driven by publication bias or differences in methodologies and therefore artefactual. Additionally, countries included within the study will not be limited to countries where there is existing research in economic inequalities in adolescents' internalising mental health using longitudinal data.

5.2 Longitudinal population studies

5.2.1 Selection process

The selection of cohorts was carried out over a period of several months in 2021. Selection was informed by discussions with supervisors, contacting experts in global mental health and searching relevant literature. I identified five longitudinal population studies across eight different countries that met three inclusion criteria.

First, longitudinal population studies were required to have at least one measure of subjective or objective economic circumstances measured in adolescence. Objective economic circumstances were measured as either household income or household consumption expenditure. Objective measures were required to be reported by adolescents' parents or the household head. Subjective economic circumstances were required to be self-reported by adolescents themselves.

Second, longitudinal population studies were required to include adolescent-reported measures of internalising symptoms, with one measurement collected at the same time as the measures of economic circumstances were and another measurement at a future follow-up timepoint. I excluded longitudinal population studies where internalising symptoms were assessed by another informant such as a parent or teacher only, as there is only a moderate correlation between measures of internalising symptoms completed by different informants (Aebi et al., 2017; Booth et al., 2023; Gaete et al., 2018; Johnston et al., 2014). Furthermore, the magnitude of the association between economic circumstances and adolescents' internalising symptoms varies according to the informant. Studies in Australia and the UK have found that there is a stronger association between household income and adolescents' internalising symptoms when internalising symptoms are reported by parents or teachers compared to adolescents' self-reports (Hazell et al., 2022; Johnston et al., 2014). I used adolescent-reported measures of internalising symptoms to reduce the likelihood that any potential cross-country variability in the associations could be due to cross-study differences in the informant.

Third, measures of economic circumstances and internalising symptoms needed to be collected between 2000 and 2019. This was to ensure that longitudinal population studies were carried out at a similar time period. This would limit the potential for

generational or period differences to explain any cross-country differences. I also used data prior to the COVID-19 pandemic due to the impact it had on the everyday life and mental health of adolescents which would complicate cross-country comparisons if survey years differed (Chawla et al., 2021).

Eighteen potential longitudinal population studies were identified in the initial scoping. Selection then followed an iterative process. I aimed to include as many countries as possible where measurements of economic circumstances and internalising symptoms were collected at similar ages and the length of time between the data collection wave in each study was similar. This resulted in a selection of five longitudinal population studies carried out in eight countries with data on economic circumstances in middle-adolescence (age 14 to 17) and on internalising symptoms in middle- and late-adolescence (ages 14 to 17 and 17 to 19 respectively).

A single cross-country longitudinal population study would be preferential for Chapters 6 and 7 as sampling procedures, methodologies and measures would be the same across each country. This would limit the likelihood that any cross-country differences in economic inequalities could be artefactual and due to cross-cohort differences in methods. I identified two longitudinal cross-country studies of adolescents, but none that were fully suitable for achieving the aims of Chapter 6. The first, the Parenting Across Cultures study, includes nine countries from a diverse range of global regions: China, Colombia, Italy, Jordan, Kenya, the Philippines, Sweden, Thailand and the US. The samples within each country are small (1,418 adolescents across the whole study) which limits the statistical power to detect cross-country differences. Adolescents within each country were sampled from schools from one or two urban regions. Therefore, the study samples are not representative of each country's population of adolescents, which may potentially lead to bias in the estimates. The second longitudinal population study, Young Lives, is conducted across Ethiopia, India, Peru and Vietnam. Young Lives was established to assess the long-term impacts of childhood poverty in low- and middle-income countries (Boyden et al., 2019). Young Lives has a larger sample size of adolescents within each country compared to the Parenting Across Cultures study, but the countries included are limited to three world regions.

Chapters 6 and 7 draw upon data from different longitudinal population studies; the Longitudinal Study of Australian Children, the Mexican Family Life Survey, the Millennium Cohort study, the National Income Dynamics Study and the Young Lives study. In the following sections I summarise the designs of the five longitudinal population studies.

5.2.2 The Longitudinal Study of Australian Children

The Kindergarten Cohort of the Longitudinal Study of Australian Children (LSAC) consists of 4,983 participants recruited at age four to five. Recruitment was carried out in 2004. A random selection of 330 postcodes were chosen. Households within these postcodes were then chosen at random (Gray & Sanson, 2005). The sample was stratified to ensure that the number of participants within each state/territory and urban and rural areas approximately matched national figures, thus improving sample representativeness. Data has been collected from the index child, parents and teachers, with informed consent given. Data prior to the COVID-19 pandemic is available across eight waves at ages 4 (2004), 6 (2006), 8 (2008), 10 (2010), 12 (2012), 14 (2014), 16 (2016) and 18 (2018).

5.2.3 Mexican Family Life Survey

The Mexican Family Life Survey (MxFLS) is a nationally representative household panel survey. There have been three waves of data collection in 2002, 2005-6 and 2009-12 (Rubalcava & Teruel, n.d., 2007). Primary sampling units were selected based on pre-specified criteria to ensure national representativeness according to key demographic and economic variables. The MxFLS collected information on a wide range of economic and demographic indicators at the individual, household and community level.

Adolescents were eligible to complete the individual survey and self-report internalising symptoms from the age of 15. Therefore, I included adolescents between the ages of 15 and 16 at the first wave. These adolescents were between 18 and 19 at follow-up. This sampling approach was chosen to maximise sample size, whilst maintaining a sample of adolescents of a similar age to those of the other longitudinal population studies. I did not include adolescents who became eligible (i.e., age 15 or 16) at the second wave of the survey as the time between study entry and follow-up

was much longer than the gap between the first and second wave of the survey. This meant that adolescents would be up to 23 years old at follow-up. This is much older than the age at follow-up compared to adolescents who entered the study at the first wave of the MxFLS and adolescents in the other longitudinal population studies.

Table 5.2. Eligible adolescent sample in the Mexican Family Life Survey.

Age at first wave (2002)	Age at second wave (2005-6)	Age at third wave (2009-12)
16	19	23-26
15	18	22-25
14	17	21-24
13	16	20-23
12	15	19-22
10	14	18-21
9	13	17-20
8	12	16-19

Green shading indicates the cohort of adolescents eligible for Chapter 6 of my thesis.

5.2.4 Millenium Cohort Study

The Millennium Cohort Study (MCS) is a birth cohort of 18,818 children born between 1st September 2000 and 11th January 2002. Participants were living in the UK at nine-months old and were eligible for child benefits. A random sample of electoral wards were disproportionately stratified to ensure sufficient representation of all four UK countries, deprived areas and areas with high numbers of ethnic minorities (Plewis, 2007).

Participants have been followed up on six occasions: at age 3 (2004), 5 (2006), 7 (2008), 11 (2012), 14 (2015) and 17 (2018). Data have been collected from household respondents, teachers and children themselves from age 11. MCS has been granted ethical approval for each wave. All participants have given their informed consent.

5.2.5 National Income Dynamics Study

The National Income Dynamics Study (NIDS) is a household panel study in South Africa (Brophy et al., 2018). At the first wave, 400 primary sampling units (small geographical regions with at least 74 different households) were randomly selected from 53 district councils. Selection probability was proportional to primary sampling unit size. This resulted in 9,600 dwellings eligible to take part. At wave 1 (2008), 28,226 individuals from 7,296 households were recruited. Private households and residents

in workers' accommodation were eligible, but other collective forms of living such as student halls were not.

Four further data collection waves have been carried out in 2010, 2012, 2014-5 and 2017. Due to high levels of attrition of White, Indian/Asian and high-income respondents, a further sample of 2,775 participants was added at wave 5 to maintain the representativeness of the sample. At wave 5 (the most recent wave where data is available), data were collected from 37,368 individuals.

Four questionnaires are administered at each wave: a household questionnaire completed by the oldest woman in the household or by another household member with sufficient knowledge about the household, an adult questionnaire completed by all household members aged 15 or over, a proxy questionnaire for adults unavailable for interview completed by another adult resident and a questionnaire completed by a child's caregiver on information about their child. Consequently, adolescents were able to self-report from age 15 (Table 5.3).

Table 5.3. Eligible adolescent sample in the National Income Dynamics Study.

Age at first wave (2008)	Age at second wave (2010)	Age at third wave (2012)	Age at fourth wave (2014-5)	Age at fifth wave (2017)
16	18	20	22	25
15	17	19	21	24
14	16	18	20	23
13	15	17	19	22
12	14	16	18	21
11	13	15	17	20
10	12	14	16-17	18-19
9	11	13	15-16	17-18
8	10	14	15	17

Green shading indicates the cohorts of adolescents eligible for Chapter 6 of my thesis.

5.2.6 Young Lives

Young Lives is a longitudinal study across four different countries: Ethiopia, India, Peru and Vietnam. The study was established to identify the causes and consequences of childhood poverty across these different countries (Young Lives, 2017). Recruitment was carried out in 2002. Two thousand infants aged 0 to 1 were recruited to the Young Cohort. Approximately 1,000 older children (aged 7 to 8) were recruited to the Older Cohort.

Cohort in each country, except for Peru (n=714) where fewer were sampled owing to resource constraints.

Self-reported measures of internalising mental health prior to COVID-19 have only been collected in the Older Cohort. Data of the Older Cohort is available prior to the COVID-19 pandemic at baseline and across four follow-up waves at ages 12 (2006), 15 (2009), 19 (2013) and 22 (2018).

Recruitment of households was carried out in 20 selected geographical clusters within each country. Clusters were not chosen randomly (except for Peru), as is typical for national longitudinal population studies. Instead, sites were selected through a process of expert consultation and through ranking sites according to how common poverty is across different regions. Site selection procedures differed across each country but all deliberately over-sampled from regions with high levels of poverty (Table 5.1) (Young Lives, 2017). National representativeness was not an aim of the sampling procedures, but each country's sample were deemed sufficiently similar to the wider adolescent population across a range of important variables when compared to national data (Boyden et al., 2019). The samples are viewed by the Young Lives study team to cover the diversity of children and adolescents in each country, and that the samples are "an appropriate and valuable instrument for analysing causal relations" (Boyden et al., 2019).

Table 5.1. Site selection procedure within each Young Lives country.

Country	Site selection procedure
Ethiopia	1. Five regions, which comprised 96 percent of the national population, were selected. 2. Within these regions, three to five districts were chosen. Chosen districts were balanced to include both rural and urban areas. Districts judged as food-deficient were over-sampled. 3. Smaller sub-districts were chosen within these districts. 4. Wards were randomly selected within these sub-districts.
India	1. Site selection aimed to include at least one poor and non-poor district from the states of Andhra Pradesh and Telangana. 2. Twelve districts out of 23 districts were selected. These consisted of poor and non-poor districts according to an index based on economic, human development and infrastructure indicators. 3. Areas which covered between 20 to 40 villages, were sampled within each district. Each area was divided into four geographical areas, with one village randomly selected from each.
Vietnam	1. Five provinces, out of nine within Vietnam, were selected based on the aim to oversample poor households and to ensure coverage across the country's urban, rural and mountainous regions. 2. Communes were ranked according to infrastructure development, the percentage of poor households and child malnutrition status. Within each province, four communes were selected as sites. Forty-eight percent of sites were ranked as poor, 29% were ranked as being average wealth and 23% were ranked as above average wealth.
Peru	1. All districts within Peru were ranked according to a national poverty index derived from infant mortality rates, housing, schooling, roads, access to services and other variables associated with regional development. 2. Twenty districts were randomly sampled. The lowest 5% of districts according to a poverty index (low levels of poverty and high levels of economic development) were excluded. 3. Blocks or clusters of houses were randomly sampled within each district and included as sentinel sites.

Random sampling of households was carried out within each cluster site. Sampling procedures had small adaptations within countries to ensure suitability for the local context and circumstances (Young Lives, 2017). Fifty households were sampled in each cluster, except for Peru.

Data collection has focused on six child-specific outcomes: nutritional status, physical morbidity, mental morbidity, life skills, developmental stage, wellbeing and life-chances. Data on most outcomes are collected across all four countries, and some

country-specific measures have also been administered. Data has been collected from an adult household respondent and the index child in each wave. Young Lives has been granted ethical approval by the ethical committees in each participating country and participants have given their informed consent.

5.3 Conclusion

In this chapter, I have provided an overview of the longitudinal population studies analysed in Chapters 6 and 7. In the two following chapters, I present and discuss the findings of the two studies. The first study uses data from all of the longitudinal population studies, whilst the second study uses data from Young Lives only.

6 Economic inequalities in adolescents' internalising symptoms: comparative analyses of longitudinal population studies across eight countries

A modified version of this chapter was published in the *Lancet Psychiatry*:

Stearns, T., Evans-Lacko, S., Araya, M., Cueto, S., Dang, H.-A. H., Ellanki, R., Garman, E., Lewis, G., Rose-Clarke, K., & Patalay, P. (2024). Economic inequalities in adolescents' internalising symptoms: longitudinal evidence from eight countries. *The Lancet Psychiatry*, 11(11), 890–898.

6.1 Background

In Chapter 4, I found that the magnitude of the association between food insecurity and suicidal thoughts and behaviours in adolescents varied across 83 countries and dependent territories. The magnitude of the association was correlated with the wider country-level context, specifically how prevalent food insecurity was among adolescents in each country and a country's economic development.

The findings of Chapter 4 suggest that how food insecurity might impact adolescents' mental health could be partially contingent on a range of societal factors. Extrapolating results from one setting to another is potentially harmful for public mental health if policies are based on evidence that is unsuitable for that context. However, the cross-sectional nature of the data used in the study prohibits any causal understanding of the association.

As discussed, the association between food insecurity and suicidal thoughts and behaviours could be driven by reverse causation, where adolescents' experiences of suicidality could lead to reduced household earnings. For instance, parents may have to reduce the hours that they work so they can provide care and support to their child experiencing suicidal thoughts or behaviours. Longitudinal data is required where the exposure and outcome are temporally separated for stronger causal inferences. This would reduce the likelihood that the association between economic circumstances and adolescents' mental health is partially or fully due to reverse causation, especially if adolescents' mental health at baseline is adjusted for. The school-based nature of the samples within Chapter 4 limited the representativeness of the samples within all

countries which might have potentially biased the results. Studies analysing datasets that are more representative of a country's adolescent population are likely to provide more accurate insights into the extent of economic inequalities in mental health outcomes within that country. The samples are also more likely to feature adolescents living in a diverse range of economic circumstances rather than potentially conditioning on the exposure of interest.

A main strength of Chapter 4 was the focus on a large number of diverse countries. Building on this, this chapter focuses on a narrower range of eight countries that have high quality longitudinal data on economic circumstances and adolescents' internalising mental health.

6.1.1 Existing longitudinal multi-country research on economic inequalities in adolescents' internalising mental health

There is a lack of research that has investigated the longitudinal association between adolescents' economic circumstances and their internalising mental health across different countries or country groupings. Most research to date has used data from the Parenting Across Cultures study carried out across nine countries. One analysis of data from the study found that higher household income at age 9 was associated with a greater decrease in child-reported internalising symptoms from age 8 to 10 in a pooled sample of 1,190 children from eight countries; Colombia, Italy, Jordan, Kenya, the Philippines, Sweden, Thailand and the US (Lansford et al., 2019). However, the study did not investigate whether the magnitude or direction of the association varied across countries. Both the exposure and outcome were measured in childhood, when there is a reduced risk of experiencing internalising mental health problems compared to in adolescence (M. Solmi et al., 2022). Consequently, the study's findings may not extend to older age groups.

Further analyses of 1,418 adolescents from eight countries (China, Colombia, Italy, Jordan, Kenya, the Philippines, Thailand and the US) modelled the association between (a) parents' perceived material deprivation and (b) household income, with adolescents' internalising symptoms (Schenck-Fontaine et al., 2020). Within the pooled sample, greater levels of material deprivation but not lower levels of equivalised household income (measured by adolescents' parents stating which of the ten income bands reflects their household income) was associated with increased internalising

symptoms, after controlling for one another. After adjustment of confounders, the association attenuated towards the null and again attenuated after further adjustment for adolescents' prior internalising symptoms. Sub-group analyses of adolescents from high-income countries and low- and middle-income countries found no evidence that the association varied across World Bank country-income classifications. This study used data across four different waves, when adolescents were on average age 8 at the first wave and age 13 at the final wave. However, the exposure and outcome were not temporally separated in the analytic model. Instead, the analysis used the variation in values of economic circumstances and internalising symptoms within (i.e., changes over time for the same adolescent) and between-adolescents (i.e., differences between different adolescents) to estimate the extent to which they are associated with one another. This contrasts to analyses that aim to identify the association between adolescents' economic circumstances at one timepoint and future internalising symptoms at subsequent follow-up waves. The results of the study do not fully reflect differences or similarities in the longitudinal association between economic circumstances and internalising symptoms and could be subject to bias owing to reverse causation as temporal ordering of the variables were not specified.

To the best of my knowledge, no multi-country study has investigated the longitudinal association between adolescents' subjective perceptions of their economic circumstances and their internalising mental health. Further investigation of the association between subjective economic circumstances and adolescents' internalising mental health is warranted, particularly in low- and middle-income countries where research is sparse (Quon & McGrath, 2014).

6.1.2 Countries within this chapter

The data analysed in this study come from eight different countries; Australia, Ethiopia, India, Mexico, Peru, South Africa, the United Kingdom and Vietnam (Figure 6.1). As displayed in Table 6.1, these countries are situated across five different WHO World Regions and differ according to a range of country-level social, economic and development indicators.

Figure 6.1. World map detailing the countries included in this chapter.

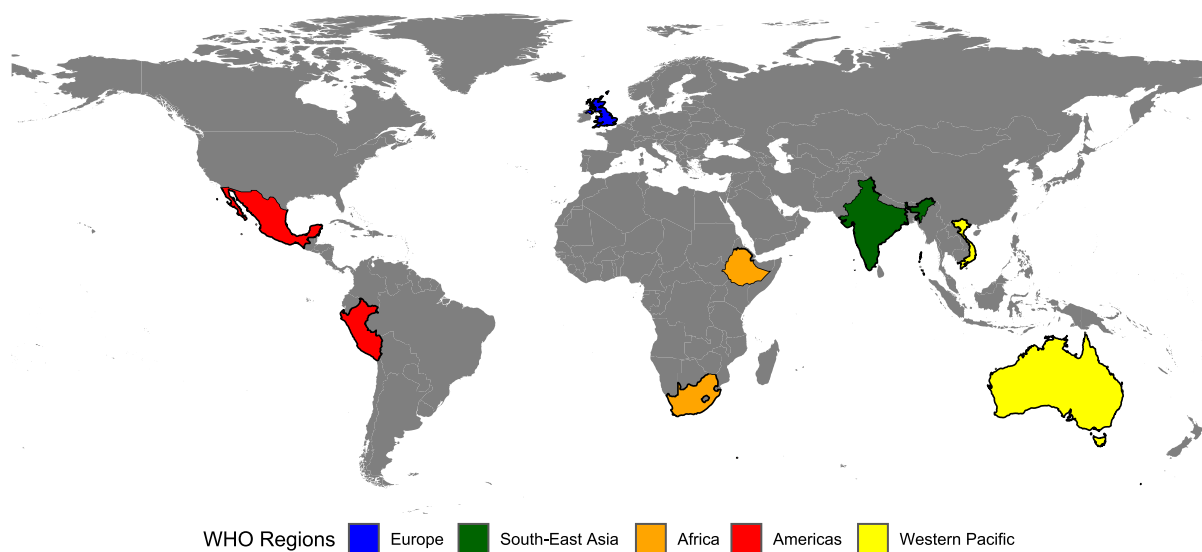


Table 6.1. Summary of key country-level data of included countries.

Country	WHO region	Population of adolescents aged 10 to 19			Social, economic and development indicators					
		Millions	Proportion of country's population (%)	Proportion of global adolescent population (%)	Secondary education enrolment (%)	Fertility rate	Gini index of income inequality	GDP per capita	Population living below the national poverty line (%)	Life expectancy at birth
Australia	Western Pacific	2.9	11.9	0.2	93	1.8	33.7	57,432	13.6	82
Ethiopia	African	21.1	24	1.7	15	5.4	33.2	407	29.6	59
India	South-East Asia	246.7	20	20.2	62	2.7	35.4	1,157	29.8	67
Mexico	Americas	21.3	21	1.7	60	2.6	50.1	9,300	43.6	74
Peru	Americas	5.6	19.4	0.5	78	2.6	47	4,783	33.5	73
South Africa	African	10.9	21.3	0.9	66	2.7	63	6,075	62.1	56
UK	European	7.4	11.3	0.6	98	1.8	33.1	44,964	17	81
Vietnam	Western Pacific	15.7	18.2	1.3	-	1.9	35.6	1,927	20.7	73

All values correspond to the year of the baseline wave within each longitudinal population study, or the closest wave if data for that year was not available. For South Africa the values correspond to 2008, the year that the first group of adolescents were eligible. All country-level data is from the World Bank Data Catalog, except for each country's population of adolescents which was extracted from UNICEF data. GDP per capita is reported in 2015 US\$.

In this section, I provide a summary of the social, cultural and economic contexts that are likely to be relevant to the research question of interest, with the caveat that no short collection of paragraphs can capture the richness of a country's past or present. I have aimed to use the language and terms that are used within each country when discussing demographic factors such as race or ethnicity. I also summarise relevant research on economic inequalities in adolescents' internalising mental health that has been conducted in each country. I do not provide prevalence estimates of internalising mental health problems given the heterogeneity in the assessment methods used across countries, which limits any inferences that can be drawn from cross-country comparisons of prevalence.

6.1.2.1 Australia

Australia is the largest and most populous country in the continent of Oceania. European colonialism, primarily in the 19th century, led to a significant decline in the population of indigenous peoples. This coincided with a surge in migration from European countries, particularly the UK and Ireland. As a result, Australia has one of the largest immigrant populations in the world with nearly a third of population consisting of immigrants (Australian Bureau of Statistics, 2022). Approximately 60% of the population have European ancestry compared to 4% that identify as being indigenous, and there are substantial health and economic inequalities between different ethnic groups (Australian Bureau of Statistics, 2019; Deravin et al., 2018).

There is considerable research interest regarding economic inequalities in adolescents' internalising mental health in Australia. Studies have investigated this using longitudinal data. In a population study of 2,609 children born in a single hospital in the Australian city of Brisbane, measures of income poverty (based on income below the national poverty line) were collected during mothers' pregnancy and at 6 months, 5 years and 14 years (Najman et al., 2010). Internalising symptoms were self-reported by adolescents at ages 14 and 21. Adolescents that scored in the highest 10% for the internalising symptoms measure at each timepoint were classed as "cases". After adjusting for maternal anxiety and depressive symptoms in pregnancy and poverty at the other timepoints there was only evidence that poverty at age 14 was associated with caseness at either 14 or 21. There was also evidence that poverty during pregnancy and at ages 5 and 14 were associated with experiencing caseness at both ages.

In a nationally representative cross-sectional study of adolescents between the ages of 12 and 17, known as Young Minds Matter, the odds of a diagnosis of anxiety were greater in adolescents living below the national poverty line (households whose income was 50% or lower than the median income across Australia) but there was no evidence of an association with depression diagnoses (Johnson et al., 2019). Experiencing more than one internalising mental health problem was more common for adolescents who lived in households with lower levels of income in further analyses of the Young Minds Matter sample. However, there was no association for experiencing a single internalising mental health problem (Islam et al., 2021).

6.1.2.2 Ethiopia

Ethiopia is in Eastern Africa and is the second most populous country in the continent with a population of 123 million. It is classed as a low-income country according to the World Bank. National wealth has increased in recent decades evidenced by Ethiopia's GDP per capita (expressed as 2015 US dollars) rising from \$259 in 2000 to \$445 in 2010 and \$811 in 2020 (World Bank, 2024a). This had led to a reduction in the levels of absolute poverty in the country, but rates remain high with 24% of population living below the national poverty line in 2015 (World Bank, 2024d). Agriculture is the primary employment sector with over 70 percent of the working age population working in this field, contributing to over a third of the country's GDP (International Monetary Fund, 2018; O'Neill, 2024).

Research assessing the association between adolescents' economic circumstances and their internalising mental health in Ethiopia is sparse. A systematic review carried out in 2023 found no such studies (Mitiku et al., 2024). One recent study of adolescents (mean age 19) living in Jimma City and neighbouring areas suggested a potential association (Owens & Hadley, 2023). Adolescents who self-reported high levels of subjective wealth had less psychological distress. This was apparent after adjustment for a range of objective measures of economic circumstances, such as household assets. Analyses of psychological distress at two timepoints (baseline and follow-up) found that higher levels of subjective wealth at baseline were associated with reduced psychological distress on average across both timepoints. Therefore, the study suggests that there may be a potential longitudinal association between adolescents' subjective wealth and psychological distress. Due to the nature of the analyses this

cannot be ascertained as the association might be fully driven by the cross-sectional association at baseline.

A longitudinal study analysed data of 328 adolescents between the ages of 14 and 20 from high schools in the Eastern state of Harari (Hunduma et al., 2024). The study investigated whether adolescents' economic circumstances were associated with the risk of developing an internalising disorder over a 1-year period. Economic circumstances were measured with a composite measure regarding the living standards of adolescents' household. Adolescents whose economic circumstances placed them in the poorest 40% of the sample were classified as "lowest social class", whilst the next 40% were classed as "middle class". Adolescents in the top 20% according to the composite measure were classed as "highest class". In comparison to adolescents from the lowest social class, middle-class adolescents had reduced odds of developing an internalising mental health problem during the one-year follow-up. There was no evidence that the highest-class adolescents had reduced odds of developing an internalising mental health problem compared to adolescents in the other classes.

The few studies suggest that poorer economic circumstances are associated with increased psychological distress and internalising symptoms in Ethiopian adolescents. Studies had small sample sizes and were limited to adolescents living in certain regions. Findings are unlikely to be representative of the wider population.

6.1.2.3 India

India is a country in Asia that consists of 28 different states. It is the most populous country in the world with over 1.4 billion people – equivalent to one sixth of the world's population (National Commission on Population, 2020). It has the largest population of adolescents in the world and approximately 1 in 5 of the world's adolescents live in India (United Nations Children's Fund, 2012).

India was colonised and under British rule for close to two centuries until independence in 1947. India has experienced significant economic growth and a decline in poverty in recent decades, particularly in rural areas where most of the country's adolescents live (Roy & van der Weide, 2022; World Bank, 2024d). Despite this, there is significant inequality partly stemming from complex social hierarchies that include caste and class divisions (Gupta & Coffey, 2020).

To the best of my knowledge, no study has investigated the longitudinal association between any measure of economic circumstances and adolescents' internalising mental health in Indian adolescents. However, there have been a few cross-sectional studies. Studies have featured regional samples owing to the size of India which means whole country studies are impractical.

The largest study to date analysed data from the Understanding the Lives of Adolescents and Young Adults study. The study features a representative sample of over 15,000 adolescents from the states of Uttar Pradesh and Bihar. The association between adolescents' scores on a wealth index based on household assets and depression status measured by the Patient Health Questionnaire-9 was investigated separately across sexes (Scott et al., 2020). The wealth index, split into quartiles, was not associated with depression in either boys or girls. Over 20 variables which were hypothesised to be associated with depression were adjusted for in the analysis. Several of those variables have been theorised to be on the pathway from economic circumstances to poorer mental health in adolescents (e.g., parental and peer relations) (Bukowski et al., 2020; Masarik & Conger, 2017). Therefore, the association between adolescents' economic circumstances and depression might be underestimated in this study (Schisterman et al., 2009).

Another study used data from the Young Lives study carried out in the states of Andhra Pradesh and Telangana. The prevalence of low mood (a common symptom of internalising mental health problems) was greater in adolescents at ages 15 and 19 from the poorest quintile based on a wealth index (Ward & Viner, 2018). However, the study featured no confounder adjustment. A further study of adolescents between the ages of 11 and 19 from a rural village in the state of Kerala investigated the association between socio-economic status and the presence of an anxiety disorder. Socio-economic status, measured with a composite variable of family education-level, occupation and monthly income per capita, was not associated with anxiety (Nair et al., 2013). Finally, in a study of 205 school-going adolescents residing in the state of Karnataka, the monthly income of the household head was associated with adolescents' symptoms of depression and anxiety, but the direction of the association was not specified (Prakash et al., 2024).

In summary, the association between adolescents' economic circumstances and internalising mental health is underexplored in India. Current research shows conflicting findings based on cross-sectional data only.

6.1.2.4 Mexico

Mexico is a large country in central America comprising of 31 states and the country's capital – Mexico City. It is the 10th most populous country in the world. Thirteen-million Mexicans also live abroad, primarily in the US, to financially support their families through employment and subsequent money transfers (Consejo Nacional de Población et al., 2023). Mexico was colonised by the Spanish Empire in the 16th century and was under Spanish rule until independence in 1821.

Mexico has the 12th largest economy in the world which is supported by significant industrial and service sectors (International Monetary Fund, 2024). It is subsequently considered an upper-middle-income country. Despite a strong economy, many people live in poverty, particularly in rural areas of the country (Villagómez Ornelas, 2019). World Bank data from 2016 to 2022 shows that approximately 40% of the Mexican population live below the national poverty line (World Bank, 2024d). Mexico is notable for its social assistance programme, Oportunidades, which is one of the first and largest conditional cash transfer programmes in the world. Approximately 20% of Mexican households receive some form of financial assistance from the government conditional on complying with a range of conditions (Niño-Zarazúa, 2020). These conditions include the use of health services and making sure children and adolescents attend school.

There is limited evidence regarding economic inequalities in adolescents' internalising mental health in Mexico. No association was found between parental income (categorised into tertiles) and whether adolescents met criteria for a mood or anxiety disorder in a representative survey of 3,005 adolescents between the ages of 12 and 17 living in Mexico City (Benjet et al., 2009). A more recent study of 2,082 adolescents from the state of Chiapas investigated whether there were differences in the proportion of adolescents that meet the clinical cut-off scores for depression and anxiety across different levels of economic circumstances (Serván-Mori et al., 2021). Depression and anxiety were assessed with the Patient Health Questionnaire-9 and the Generalised Anxiety Disorder Questionnaire, respectively. In comparison to adolescents who met

criteria for just one disorder, adolescents with both depression and anxiety were more likely to live in a household with poorer economic circumstances as indicated by an asset and housing index.

Finally, one cross-national study analysed data of adolescents and young adults between the ages of 11 and 25 taking part in MxFLS (Zimmerman et al., 2022). The association between multidimensional poverty (based on 15 indicators including child labour, household education and household deprivation) and household income (categorised into quartiles) and depressive symptoms was investigated after adjusting for sex and age. Higher levels of multidimensional poverty were associated with increased depressive symptoms, but there was no association with household income.

Studies to date suggest little to no cross-sectional association between objective measures of economic circumstances and adolescents' internalising mental health in Mexico, although longitudinal evidence is lacking.

6.1.2.5 Peru

Peru is an upper-middle-income country located in South America. Peru was colonised by the Spanish Empire in the 16th Century up until independence in 1824. It has experienced rapid urbanisation and consistent economic growth over the past decades (Mendoza-Quispe et al., 2021; World Bank, 2024a). Despite this, 30 percent of the population live below the national poverty line (World Bank, 2024d). The experience of poverty is far greater in rural areas, leading to regional inequalities in health and educational outcomes (Calvo, 2008; Young Lives, 2021).

Evidence regarding economic inequalities in adolescents' internalising mental health is limited. To the best of my knowledge, only one study has investigated the association between economic circumstances and adolescents' internalising mental health in Peru. The cross-sectional study analysed data from the Young Lives study. The prevalence of low mood did not differ between adolescents from the poorest quintile or richest quintile based on a wealth index at ages 15 or 19 (Ward & Viner, 2018).

6.1.2.6 South Africa

South Africa is a large country on the southern tip of the African continent. It is a middle-income country and according to many metrics, including the Gini index of income inequality, it is the most economically unequal country in the world (Chancel et al., 2022). For instance, the wealthiest 10% of the population (which predominantly consists of White South Africans) earn 67% of all income in the country (Chancel et al., 2022). This high level of inequality stems from a history of European colonisation and race segregation, with the latter most apparent between 1948 and 1994 when apartheid was enforced. However, some scholars identify 1913 as the start of the Apartheid era (Bundy, 1979). Economic inequality is further maintained by a high unemployment rate, particularly for young people (Statistics South Africa, 2024). Although apartheid has ended, stark inequalities between ethnic groups in health, education and living standards remain (Jackson et al., 2010).

For adolescents in South Africa today, prominent stressors include high levels of exposure to violence, that is often gender-based, in schools, the community and the family home, as well as HIV infection of parents or adolescents themselves (Dawes & Ward, 2011; Rao et al., 2007; Seedat et al., 2009). The poverty rate is high; however, the households of over half of the child population under the age of 18 receive money through the Child Support Grant, a government-led unconditional cash transfer programme (SASSA, 2020; World Bank, 2024d).

There is a lack of research that has investigated the longitudinal association between economic circumstances and internalising mental health in adolescents in South Africa. Most studies to date have used data from NIDS. Analyses have used cross-sectional data from a single wave only despite the longitudinal nature of the study. In analyses of adolescents between the ages of 15 and 24, higher levels of household income were associated with increased depressive symptoms, but there was no association with multidimensional poverty (Zimmerman et al., 2022). In further analyses of NIDS, adolescents who perceived that their household income was less than the average of their neighbours and adolescents who perceived that they had reduced social standing had higher rates of depression (Garman, Avendano, et al., 2022). This was based on meeting a cut-off score on the 10-item Centre for

Epidemiological Studies Depression Scale. Adolescents deprived in material assets were also more likely to report depression.

The association between household income and depression was investigated separately for rural and urban adolescents between the ages of 15 and 19 in another cross-sectional analysis of NIDS data (Ajaero et al., 2018). In rural adolescents only, depression was less prevalent in adolescents from the richest households (income greater than 10,000 Rand) compared to adolescents from household with incomes less than 1,000 Rand. Depression was more prevalent in both rural and urban adolescents with a household income between 1,000 and 10,000 Rand compared to adolescents from household with incomes less than 1,000 Rand. Consequently, the study suggests a possible non-linear association between household income and risk of depression in adolescents.

In a cross-sectional study of 1,034 adolescents living in Cape Town, the association between adolescents' economic circumstances (according to ownership of household assets and amenities) and experiencing a common mental disorder (measured through a composite of two scales measuring anxiety and depressive symptoms) was investigated (Das-Munshi et al., 2016). There was no evidence that rates of common mental disorder differed according to quintiles of economic circumstances. However, the magnitude of the association was indicative of a greater prevalence of common mental health disorder in all quintiles that were poorer than the wealthiest quintile, but confidence intervals were wide (e.g., fourth quintile RR = 1.98 [95% CI: 0.98 to 4.00]). The null finding in this study might be driven by a lack of statistical power. Finally, there was no evidence of an association between adolescents' economic circumstances, as measured through ownership of certain assets, and adolescents' anxiety or depression in a cross-sectional study of adolescents between the ages of 13 and 19 from the KwaZulu-Natal province (Rossouw et al., 2024).

In summary, there is mixed evidence that living in poorer economic circumstances is associated with worse internalising mental health in adolescents in South Africa, but all evidence to date has used cross-sectional data only.

6.1.2.7 United Kingdom

The UK is a country in Europe consisting of England, Northern Ireland, Scotland and Wales. It is a high-income country and a significant global influence, with the British Empire once the largest in the world. The UK is a multicultural society as a result of immigration from former colonies, and there are varying differences in health and life chances across ethnicities (Warwick & Safia Mirza, 2022).

Successive governments since the Great Recession of 2009 have enforced significant austerity policies, leading to large cutbacks to public services, including health and social care, welfare support and education (Office for Budget Responsibility, 2013). Rates of child poverty have increased in the UK, contrasting with trends of falling child poverty observed in most high-income countries. According to UNICEF, the UK has seen the greatest increase in child poverty (20% increase) between 2012-2014 to 2019-2021 compared to 38 other middle- and high-income countries (UNICEF Innocenti – Global Office of Research and Foresight, 2023). This has coincided with a worsening of children's health in comparison to the previous generation, including a rise in infant mortality, obesity and tooth decay (The Academy of Medical Sciences, 2024).

There are also concerns of a growing incidence of internalising mental health problems in children and adolescents (Sadler et al., 2018). There is free-to-access care via the National Health Service, however waiting lists are long and secondary mental health services are only available for the most severe cases (Newman et al., 2024). Inequalities in adolescents' internalising mental health have been widely reported across different economic indicators in multiple longitudinal studies in the UK. This includes studies that have analysed longitudinal data from MCS (Adjei et al., 2022; Collishaw et al., 2019; Lai et al., 2019; Wickham et al., 2017). The association between poorer economic circumstances and more severe internalising symptoms in adolescents has strengthened in recent decades (McElroy et al., 2023). This might be due to widening social inequalities within UK society.

6.1.2.8 Vietnam

Vietnam is a lower-middle-income country in Asia. It is the 16th most populous country in the world, where 18% of the population are adolescents between the ages of 10 and 19. It is one of four one-party communist states in the world today, alongside China, Cuba and Laos, albeit with increasingly capitalist economic policies. Since 1990, Vietnam has experienced one of the highest rates of economic growth and reduction in poverty in the world (H.-A. Dang et al., 2023). This progress has not been equitable with growing disparities in poverty rates within regions and between ethnic groups (H.-A. Dang et al., 2023).

To the best of my knowledge, all research that has investigated the association between adolescents' economic circumstances and their internalising mental health in Vietnam has used cross-sectional data. In a study of a national population-based survey in 2003-4 and 2009-10, the cross-sectional association between adolescents' economic circumstances and experiencing low mood was investigated in over 10,000 adolescents aged 14 to 19 (Le et al., 2012). There was no evidence that economic circumstances (as indicated by an index of households' possessions) was associated with the lifetime risk of low mood (feeling sad, helpless, or hopeless). Several variables that might lie on the causal pathway from economic circumstances to low mood were adjusted for within the statistical analysis, including family cohesion and exposure to violence. Consequently, the association in the study might be underestimated (Schisterman et al., 2009).

In another cross-sectional study of 1,368 adolescents between the ages of 11 and 18, interviewer assessment of household wealth was associated with casesness of mental health problems in adolescents (Amstadter et al., 2011). Adolescents living in households that the interviewer deemed to be of rich economic circumstances had a reduced likelihood of an internalising mental health problem as indicted by parent-reported symptoms. Finally, in the cross-national analysis of the Young Lives study, there was no cross-sectional association between scores on a wealth index and low mood at age 15 (Ward & Viner, 2018). However, adolescents from the poorest quartile were more likely to experience low mood compared to adolescents from the wealthiest quartile at age 19.

Cross-sectional studies suggest that poorer economic circumstances are associated with internalising mental health problems in adolescents in Vietnam. However, evidence is inconclusive, and analyses of longitudinal data are lacking.

6.1.3 Methodological limitations of research within the countries

Across all countries, research on economic inequalities in adolescents' internalising mental health problems featured numerous limitations that risk biasing the results. Limitations found in many studies include non-representative sampling, a lack of or inappropriate confounder adjustment and inappropriate measurement or modelling of economic circumstances (e.g., arbitrary grouping or quintiles). These limitations might have potentially biased the effect estimates regarding the association between economic circumstances and internalising mental health problems. As discussed in the previous section, there is a lack of longitudinal multi-country research. I identified no studies that have investigated the longitudinal association between economic circumstances and internalising mental health in five of the six low- and middle-income countries featured in this study, demonstrating the need for further research in these settings.

6.1.4 Study aims and hypotheses

In this study, I investigated in eight countries whether objective and subjective measures of economic circumstances at ages 14-17 are associated with the severity of internalising symptoms at ages 17-19, and the change in internalising symptoms from ages 14-17 to 17-19 years. These countries span a range of different world regions and income-levels.

I tested six hypotheses within this chapter. I hypothesised that increased household income, household consumption expenditure and subjective wealth would be associated with fewer internalising symptoms (hypothesis 6.1) and a greater reduction of internalising symptoms (hypothesis 6.2) in all countries. I also hypothesised that the subjective measure of economic circumstances (subjective wealth) would explain greater variance of future internalising symptoms compared to either objective measure (household consumption expenditure and household income) within countries (hypothesis 6.3), including after adjustment for internalising symptoms at baseline (hypothesis 6.4). Finally, I hypothesised that there will be cross-country

differences in the magnitude of the association between household income, household consumption expenditure and subjective wealth with internalising symptoms (hypothesis 6.5) and the reduction of internalising symptoms (hypothesis 6.6).

6.2 Methods

6.2.1 Study design

The first timepoint within the study refers to the baseline timepoints where economic circumstances are measured in middle adolescence (between the ages of 14 and 17). The second timepoint refers to the follow-up timepoint within each longitudinal population study where internalising symptoms were measured in late adolescence (between the ages of 17 and 19) (Table 6.2). The years the timepoints correspond to vary across each country.

Table 6.2. Profiles of the longitudinal population studies and the baseline and follow-up timepoints.

Country	Longitudinal population study	Baseline timepoint		Follow-up timepoint	
		Year	Age	Year	Age
Australia	Longitudinal Study of Australian Children	2016	16-17	2018	18-19
Ethiopia	Young Lives	2009	15	2013	19
India*	Young Lives	2009	15	2013	19
Mexico	Mexican Family Life Survey	2002	15-16	2005/6	18-19
Peru	Young Lives	2009	15	2013	19
South Africa	National Income Dynamics Study	2008, 2010, 2012 or 2014-5	15-16	2010, 2012, 2014 or 2016-7	17-18
UK	Millenium Cohort Study	2015	14	2018	17
Vietnam	Young Lives	2009	15	2013	19

*states of Andhra Pradesh and Telangana.

6.2.2 Sample selection

In each country, the sample consisted of adolescents who attended data collection at both the baseline and follow-up waves regardless of whether data on exposures, outcomes or confounders were available or missing. The longitudinal population study in South Africa was a household panel study, meaning the sample of adolescents were

drawn from different waves once they became eligible. The approach to sample selection was based on considerations concerning the impact of different approaches on the precision of effect estimates, potential selection bias and the feasibility of multiple imputation to improve precision and reduce bias.

Insufficient precision within the analyses of each single country would lead to greater uncertainty regarding the direction and magnitude for all effect estimates. This would limit the ability to detect any cross-country variability of the magnitude or direction of the association and increase the risk of a Type II error (i.e., wrongly conclude that there is no cross-country variability owing to a lack of precision).

Within the context of sample selection, selection bias would primarily arise within each longitudinal population study due to participant drop-out and attrition prior to the waves of interest. This could lead to over- or under-estimating the exposure-outcome association within each country, particularly if study participation or drop-out are both caused by adolescents' economic circumstances and their internalising mental health (i.e., participation or drop-out is a collider) (Cole et al., 2010; Howe et al., 2013). This could also lead to over- or under-estimation of the cross-country variability of economic inequalities in adolescents' internalising mental health dependent on the direction of bias in each country's estimates.

Participant attrition in longitudinal studies is typically greater in vulnerable populations (Rothenbühler & Voorpostel, 2016). Excluding adolescents who did not attend later waves might lead to a sample that is not representative of adolescents from all economic backgrounds. An alternative approach would be to include all adolescents enrolled in each longitudinal population study regardless of attrition. This would maintain the representativeness of the original sample. However, the approach would feature significant levels of attrition and missing data which multiple imputation techniques may not be able to account for (Kristman et al., 2005). The Missing at Random assumption, central to multiple imputation, states that the probability that data is missing depends on observed data and not on the values of unobserved data. The plausibility that missingness is not related to unobserved factors is limited when imputing data for many participants that have dropped out of a study and have minimal data at the wave of interest (i.e., the baseline and follow-up waves). This violates the Missing at Random assumption. Imputations for missing values could be inaccurate

as the imputation model cannot account for any unobserved influences. This can affect the precision of effect estimates and lead to bias. I concluded that country samples that consisted of adolescents who attended both the baseline and follow-up waves was the best compromise to maintain as high levels of precision as possible whilst aiming to minimise selection bias. Samples would consist of a proportion of adolescents who were originally enrolled in each country's longitudinal population study, but the Missing at Random assumption is less likely to be violated when imputing missing data.

I randomly selected one cohort member and excluded the others within their household in the case that there were multiple eligible adolescents within the same household. Clustering within families and shared genetic and environmental exposures might lead to over- or under-estimation of any associations (F. Solmi et al., 2021). This was only applicable for Mexico (n excluded=38), South Africa (n excluded=1,048) and the UK (n excluded=142). For South Africa, adolescents were drawn from different waves. I included adolescents at the youngest ages possible for them to have mental health outcome data (ages 15 and 16) at each wave. I also randomly selected one adolescent from each household across the entire study. For example, if a household had one adolescent that was eligible at wave 1 (aged 15/16) and a younger adolescent that became eligible at a later wave, I randomly selected one adolescent from that household to be included.

6.2.3 Exposures

Economic circumstances were assessed through household income, household consumption expenditure, or subjective wealth.

6.2.3.1 Annual household income

Household income was measured in Australia, Mexico, South Africa and the UK (Table 6.3).

Table 6.3. Measures of household income across countries.

Country	Measure
Australia	Usual weekly household income, before tax deductions
Mexico	Household income in past 12 months (range of formal/informal sources)
South Africa	What was the total amount of income (after income tax) that this household received last month?
UK	Annual household income

6.2.3.1.1 Australia

Adolescents' parents reported their usual weekly income using a single item in LSAC. One parent also reported the combined usual weekly income of all other adults above the age of 15 in the household that are not the adolescents' parents. Income included earnings from employment and other sources, such as government support, dividends and interest and pensions. These were summed and reported as a total in a single item and were not reported separately by source (Mullan & Redmond, 2011).

Reported income for all respondents referred to values prior to deductions such as tax. This contrasted with other countries that measured household income after deductions. I transformed each respondent's income to take into account the impact of tax deductions according to the tax bands and rates in 2016 – the year of baseline data collection (Australian Taxation Office, 2024). This enabled household income to be comparable with the measures used in other countries. It was not possible to distinguish the source of income. For the purposes of the transformation, I assumed that all income was from labour or employment and subject to income tax assuming the lowest tax threshold was reached. The incomes after tax for both parents and any further adults were summed together to create a variable indicating total household weekly income. This was multiplied by 52 to create a measure of annual household income.

6.2.3.1.2 Mexico

Income from all sources in the past year for each household member were reported by the household head. I summed these together to create a value for total household income.

6.2.3.1.3 South Africa

The household head reported the household monthly income from the labour market, government grants and other government sources, investments, remittances, property and subsistence agriculture. These were summed together to create a variable indicating total household monthly income, before multiplying by twelve to create an annual measure.

As the sample consisted of adolescents from different waves and therefore years, I transformed household income for all waves so that income is expressed in 2015 South African Rand (the final baseline wave). I took into account inflation in each year between the year the participant entered the study and 2015. Yearly inflation data in South Africa was acquired from the World Bank (World Bank, 2022b).

6.2.3.1.4 UK

Household income equivalised to household size was available for each wave in MCS. I was informed of errors in how equivalised income values were derived in the datasets by a statistician involved in the MCS. This meant the values provided in the dataset were likely to be inaccurate. Consequently, I derived annual household income using the income bands reported by each parent as exact values of household income were not reported to preserve anonymity. Parent respondents chose from 19 different bands regarding their joint income with their partner, or their sole income if they were a single parent. The top banding had no upper bracket. Multiple imputation using interval regression was used to impute values to derive continuous values of household income. This took into account the banding reported by respondents (see Appendix C for further details).

6.2.3.2 Annual household consumption expenditure

Household consumption expenditure was measured in Ethiopia, India, Mexico, Peru, South Africa and Vietnam (Table 6.4). In all cases, household consumption expenditure was reported by the household head. I excluded expenditure on food and produce as a proportion of households in each country will produce their own food. By including food consumption expenditure, values might be less reflective of a household's standard of living. Households that produce their own food would have lower food consumption expenditure, but not necessarily owing to reduced financial

resources. Food consumption expenditure could therefore underestimate their living standards.

Total household consumption expenditure was provided within the datasets for Ethiopia, India, Peru and Vietnam. However, I independently calculated total household consumption expenditure in these countries. First, I added all values of expenditure for each individual item within specific domains. This was carried out for domains where there were no missing values for items within them. Next, the expenditure values from each domain were added together to create a value of household consumption expenditure. Total household consumption expenditure was only summed for adolescents' that had available data for all consumption domains (see 6.2.6.2). This method differed to the method carried out by the data providers who replaced any missing values with a zero, which is likely to incorrectly assume that missingness means no expenditure thus likely underestimating household consumption expenditure.

Table 6.4. Individual domains used to inform annual household consumption expenditure within countries.

Country	Expenditure domains	Time period
Ethiopia India Peru Vietnam	Small personal items	Past 30 days
	Clothing Education Medical Home maintenance Entertainment and other	Past year
Mexico	Small personal items	Past seven days
	Clothing, goods, health care and vehicle maintenance	Past three months
	Electronic items, furniture, home maintenance and other expenditures	Past year
South Africa	Small personal items Transport costs Home maintenance Insurance Household items Clothing Health care Education Miscellaneous	Past 30 days

6.2.3.3 Subjective wealth

Subjective wealth was measured in Ethiopia, India, Peru, South Africa and Vietnam. Subjective measures of wealth were available in the UK and Mexico; however, they were asked at either too young an age to be consistent with the other countries (age 11) or at a later wave excluded from the analyses, respectively.

Adolescents' judgments of their household wealth were based on a single item in all countries (Table 6.5). In Ethiopia, India, Peru and Vietnam, adolescents responded to a single item regarding how rich or poor they would describe their household, ranging from "very rich" to "destitute". This item had no comparator in its wording. In South Africa, adolescents reported where they perceive they stand on a six-step ladder. The bottom step of the ladder represented the poorest people in the country and the top step represented the richest people in the country.

Table 6.5. Measures of adolescent-reported subjective wealth across countries.

Country	Measure
Ethiopia India Peru Vietnam	Which of the following best describes your household: 1. Very rich 2. Rich 3. Comfortable - can manage to get by 4. Never have quite enough, struggle to get by 5. Poor 6. Destitute
South Africa	Please imagine a six-step ladder where the poorest people in South Africa stand on the bottom (the first step) and the richest people in South Africa stand on the highest step (the sixth step). On which step are you on today?

6.2.3.4 Transformations to measures of economic circumstances

I made several transformations to all measures of economic circumstances to improve cross-country comparability and model fit.

6.2.3.4.1 Log-transformation of household income and household consumption expenditure

I log-transformed annual household income and consumption expenditure. Household income or consumption expenditure (or individual domains) were zero in a few cases, meaning a log-transformation was not mathematically possible. To counter this, I used a neglog-transformation for all values of household income or consumption expenditure in each country. A value of 1 was added to household income or

consumption expenditure to all participants prior to log-transformation (Whittaker et al., 2005).

The benefits of log-transformation were three-fold. First, applying log-transformations to highly skewed variables, as is the case for household income and consumption expenditure, the variables should have a better fit within each analytic model. Second, evidence across a wide range of health conditions and countries, suggests that increasing levels of economic circumstances is associated with better health. However, there are diminishing health returns from increases in economic circumstances at higher levels of the distribution (Ecob & Davey Smith, 1999; Furnee et al., 2011). The relationship between household income or consumption expenditure with internalising symptoms is likely to be more appropriately modelled when objective economic circumstances are log-transformed as the relationship might be non-linear. Third, coefficients from linear regression analyses in all countries would represent the change in symptoms per log-increase of household income or consumption expenditure. The coefficients are effectively on the same scale making cross-country comparisons easier as the coefficients are not influenced by each country's currency or their relative value. Other cross-country comparisons have converted income into the same currency unit (US dollars). Purchase Power Parity is then commonly applied to account for differences into costs across countries (Schenck-Fontaine et al., 2020). This method relies on PPP values being available, fully accurate and feasible to calculate.

6.2.3.4.2 Equivalisation based on household size

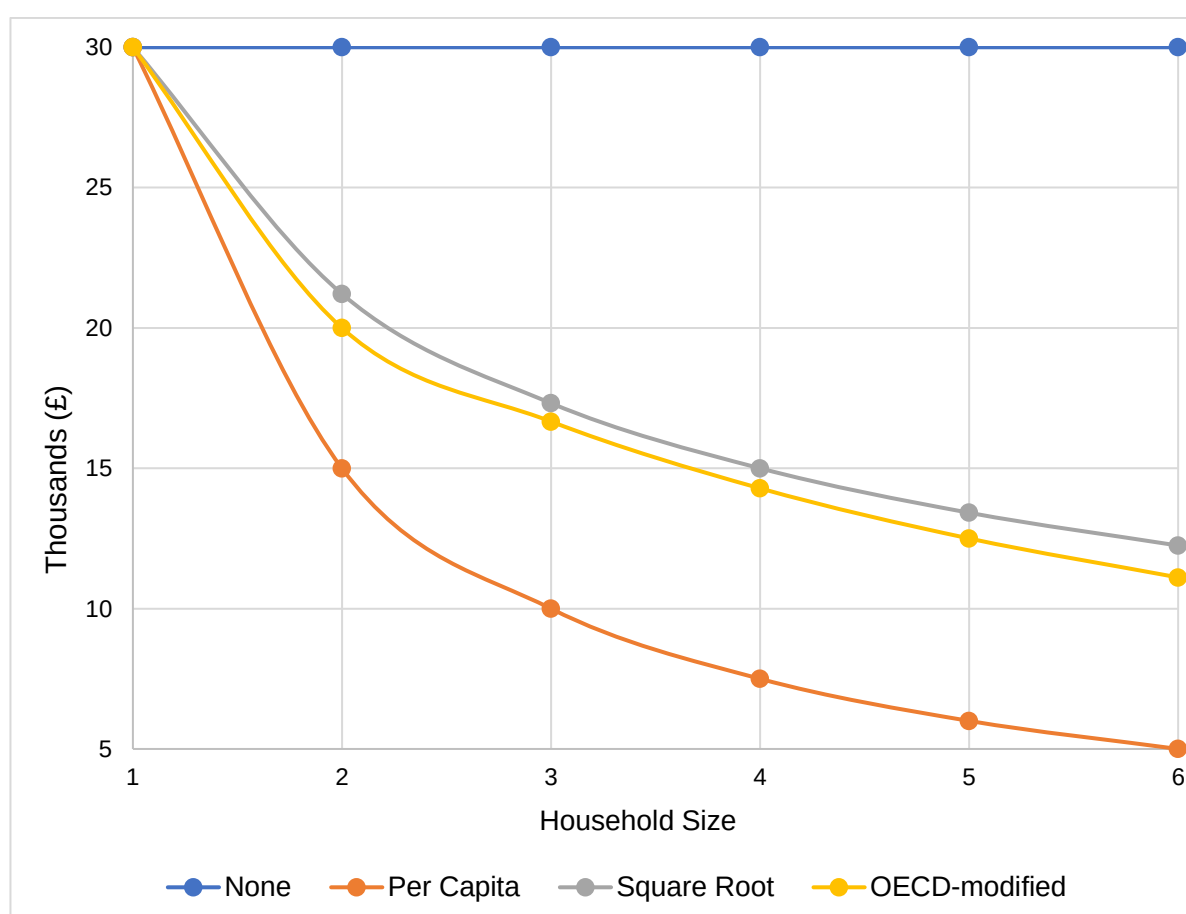
As a secondary analysis, I equivalised household income and consumption expenditure according to the number of residents in adolescents' household. Equivalisation involves dividing total household income or consumption expenditure by a transformation of the household size.

The rationale for equivalisation is two-fold. First, equivalisation might more accurately capture a household's standard of living. A household of two and another household of six might have the same household income, however, they are likely to have different living standards. The household of two is more likely to meet their material needs through their income or consumption expenditure than the household of six. Second, equivalisation according to a transformation of the household size takes into

account that households with differing number of residents have differing economies of scale. That is, larger households can bulk purchase and share expenses leading to reduced expenses per person. This considers that a household of six would not require three-times the income of a household of two to achieve a comparable standard of living.

Numerous scales to equivalise income or consumption expenditure by household size have been developed. Each scale assumes slightly different economies of scale to one another (Figure 6.2). However, all have a negative exponential relationship where changes in the number of residents in small households have a greater impact on equivalised income or consumption expenditure compared to changes in the number of residents in larger households.

Figure 6.2. Illustration of household income according to different equivalisation scales.



Note: The first two scenarios represent income for a household that comprises of one and then two adults. In the following scenarios, an additional child is added to the household, who are weighted differently to adults within the OECD-modified equivalence scale.

Equivalence scales have been criticised as the construction of many are based on arbitrary decisions around how adults and children should be weighted. There are also concerns regarding whether they can be used uniformly across different countries (Mysíková & Želinský, 2019). Cross-national comparisons have shown that the relationship between household size and economies of scale differ across countries, suggesting that no equivalence scale is likely to be universally applicable across contexts (Daley et al., 2020). There is no globally accepted equivalence scale.

Consequently, I equivalised using the square root method, where household income and consumption expenditure was divided by the square root of the number of household residents, excluding members that have permanently moved away. This method is often used in comparative research and is preferable in this study for several reasons (Chanfreau & Burchardt, 2008). Compared to scales where adults and children are weighted differently, such as the OECD-modified scale, I could create an equivalence scale using the square root method regardless of whether the ages of all residents are available. Ages of household members might be missing, wrongly recorded, or not asked (as was the case in Australia) leading to inaccuracies regarding how many adult or child residents there are in the household. The weighting procedures for different household members used in other equivalence scales are also predominantly drawn from research in high-income countries and their suitability across different settings is unknown. The ages when someone is classed as an adult or child and the relative weight that should be assigned to each are entirely arbitrary and are unlikely to be consistent across countries.

I used equivalised values in secondary analyses rather than in the main analysis due to the lack of a clearly suitable approach to equivalisation that is equally accurate across multiple countries.

6.2.3.4.3 Ridit-transformation of subjective wealth

I transformed adolescents' responses on the single item assessing subjective wealth using ridit scoring using the same procedure used for the food insecurity variable in Chapter 4. This created a continuous variable. Ridit-transformed variables estimate the Slope Index of Inequality (SII) when modelled as an exposure in regression analyses of a continuous outcome (Mackenbach & Kunst, 1997). The SII is the difference in the outcome between those with the highest and lowest position on a

hierarchy in a population. In this study, the SII models the difference between adolescents who view themselves as the richest and adolescents who view themselves as the poorest in each country sample. This approach was used to aid measure harmonisation and to avoid arbitrary categorisation of the items, which is likely to lead to a loss of information, reduced power and higher risk of potential type II errors.

6.2.4 Outcome

The primary outcome was adolescents' internalising symptoms at the follow-up timepoint when adolescents were between the ages of 17 and 19. Each longitudinal population study measured internalising symptoms through scales that had previously been validated, although not necessarily in the countries within this study (Table 6.6). For all scales, a higher score is indicative of more severe internalising symptoms. All measures were self-reported by adolescents.

Internalising symptoms were assessed through the emotional symptom subscale of the Strengths and Difficulties Questionnaire (SDQ-E) in Ethiopia, India, Peru, the UK and Vietnam (R. Goodman, 1997). The SDQ is a widely used measure to screen for emotional and behavioural difficulties in children and adolescents. The emotional symptoms subscale consists of five items relating to low mood, worry, fear, nervousness and somatic symptoms. The SDQ was originally developed in English and initially validated in children and adolescents between the ages of 4 and 17 living in London, UK. The SDQ was translated into other languages by the Young Lives research teams for its use in Ethiopia, India, Peru and Vietnam.

The items of the SDQ-E were the same across all included countries. In Ethiopia, India and Vietnam adolescents responded via a 4-point Likert scale whilst in Peru and the UK, responses were via a 3-point Likert scale. The timeframes also differed between these countries. No timeframe was given to the items in Ethiopia, India and Vietnam. In Peru and the UK, adolescents were asked to consider the frequency of these symptoms in the previous six months.

Within a UK sample, the SDQ-E has shown moderate accuracy in discriminating cases of depression throughout adolescence (Armitage et al., 2023). The SDQ-E has shown good internal consistency and discriminant validity in a large sample of Vietnamese

children between the ages of 6 and 16 (H.-M. Dang et al., 2017). The validity of the SDQ-E has been also found to be acceptable in India (Varma et al., 2018). To my knowledge, validity has not been investigated in Ethiopian or Peruvian adolescents.

Internalising symptoms were assessed with measures developed for the general adult population in Australia, South Africa and Mexico. In Australia, internalising symptoms were assessed with the Kessler Psychological Distress Scale (K10) (Kessler et al., 2002). The K10 consists of 10 items to assess non-specific psychological distress. Items capture symptoms commonly experienced in anxiety and depressive disorders. It was developed and validated in the US and has since been widely used in studies featuring samples of adolescents. It has shown excellent predictive validity in identifying cases of depression in Australian adolescents (Smout, 2019).

In South Africa, internalising symptoms were assessed with the 10-item Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977). The scale was developed in English and first validated in samples of adults living in the US. Items refer to whether respondents had experienced a range of different depressive symptoms in the past week. Translated versions of the CES-D have shown good concurrent and construct validity across different language groups (Xhosa, Afrikaans & Zulu) in South Africa (Baron et al., 2017). To the best of my knowledge, it has not been validated in South African adolescents.

In Mexico, internalising symptoms were assessed with the 20-item Clinical Questionnaire for the Diagnosis of Depressive Syndrome (Cuestionario Clínico para el Diagnóstico del Síndrome Depresivo [CCDSD]), specifically designed for and validated in the Mexican context (Calderón, 1997). The CCDSD features 20 items, primarily focused on how often symptoms relating to low mood, anxiety and somatic presentations were experienced in the past four weeks.

Table 6.6. Scales used to assess internalising symptoms at follow-up across countries.

Measure	Example items	Items (n)	Country	Likert response	Timeframe
CCDS-D	"Felt sad or anguished?" * "Felt nervous, sorrowful, anxious or eager more than normal?" "Felt fear of some things, as if you were waiting for something serious to happen to you?" *	20	Mexico	4-point	Past four weeks
CES-D	"I felt depressed" * "I felt hopeful about the future" "I felt fearful" *	10	South Africa	4-point	Past week
K-10	"How often did you feel nervous?" * "How often did you feel so sad that nothing could cheer you up?" * "How often did you feel worthless?"	10	Australia	5-point	Past four weeks
SDQ-E	"I have many fears, I am easily scared" * "I worry a lot" "I am often unhappy, down-hearted or tearful" *	5	Ethiopia India Vietnam	4-point	No timeframe
			Peru	3-point	
			UK	3-point	Past six months

*included in the harmonised scale.

6.2.4.1 Internalising symptoms at baseline

The measures of internalising symptoms at baseline were the same as the measures used at follow-up for all countries except for Australia and the UK. For both Australia and the UK, the Short Mood and Feelings Questionnaire was administered at the baseline wave rather than the K-10 or SDQ-E respectively (Thapar & McGuffin, 1998). The 13-item scale assesses the severity of internalising symptoms in the previous two weeks. It was developed in the UK to specifically detect depression in the general population. No translation of the items was required for its use in Australia or the UK.

6.2.4.2 Harmonised outcome measure

I created a harmonised measure of internalising symptoms across countries for use in a sensitivity analysis. In the main analyses, any cross-country differences in the strength or direction of any association could be artefactual due to cross-country differences in how internalising symptoms were measured. All scales were designed to assess symptoms common in anxiety and depression, but the number of items and

specific symptoms assessed varied between them. Therefore, I created a harmonised scale featuring only items which were similar in content across all measures.

The SDQ-E was used as the foundation of the harmonisation process as it was the outcome measure in five of the eight countries. There were no prespecified item themes of interest and I assumed that all items within the scales were relevant to adolescents' internalising symptoms. Harmonisation was aided using Harmony, a Natural Language Processor which assigns scores based on how well items from different scales match each other (McElroy et al., 2024). A score of 0 represents that the items have no similarity at all, whilst a score of 100 represents that the items are identical. There are no recommended scores for what constitutes a sufficient level of comparability across scales. I first identified items from the other scales that had the best match with each of the five SDQ-E items according to the Harmony score. I then compared the items from the other scales that best matched with each SDQ-E item with one another, to identify if these items were all assessing a similar internalising symptom.

The harmonisation process identified two items within the SDQ-E scale that were sufficiently comparable with other items from each of the three other scales. These items were also sufficiently comparable with each other (Table 6.6). The first item referred to experiences related to feeling sad, unhappy or depressed. The second item referred to anxiety-like experiences, specifically to do with feeling fear. The three remaining items of the SDQ-E, measuring further symptoms of anxiety and psychosomatic symptoms, all had poor matches with at least one other scale. This led to the construction of a two-item scale in each longitudinal population study using the matching items. The harmonised scale leads to an improvement in the comparability of the content assessed by the items, but the harmonised scales still differ in their response scales and their timeframe of reference. The Harmony scores of the items are presented in Appendix C.

I used the harmonised measure as the outcome in a sensitivity analysis rather than the main analysis. In comparison to the complete scales, the brevity of the two-item harmonised measures means they would capture less variance of the outcome and have less precision. As the new measures are novel, their reliability and validity of measuring adolescents' internalising symptoms in any country is unknown.

6.2.4.3 Standardisation

I used standardised scores of the outcome (original scale or harmonised) within each country. This referenced each individuals' value to the population distribution of the measure (specifically the mean and standard deviation). This meant all effect estimates were on a common metric regardless of the measure used. This enabled cross-country comparisons despite the use of different measures of internalising symptoms (i.e., all effect estimates refer to the change of the outcome in standard deviation units according to a unit change of the exposure).

6.2.5 Confounders

I controlled for several potential confounding variables at baseline that were measured in all countries. Confounder adjustment followed a harmonised approach where the same constructs were adjusted for using the most appropriate variables available in each country.

6.2.5.1 Sex

I adjusted for adolescents' sex based on cross-country research showing that adolescent girls typically have greater levels of internalising symptoms than boys, and are also more likely to live in poverty (Campbell et al., 2021; Munoz Boudet et al., 2018). In all countries sex was self-reported, except for South Africa where gender was measured.

6.2.5.2 Household composition

I further adjusted for whether adolescents' parents still lived in their household. Parental separation or death is consistently associated with poorer mental health in children and adolescents (Amato, 2000; Stikkelbroek et al., 2016). Households with a sole parent are also likely to live in poorer economic circumstances compared to households with two parents, owing to having one less adult that can work and earn an income. I used two dummy variables within the analyses indicating whether the adolescent's biological mother and biological father live with them.

6.2.5.3 Wave (South Africa only)

In South Africa, adolescents became eligible for this study at differing waves of the NIDS. I constructed a sample across different waves dependent on when adolescents

become eligible to self-report the outcome (internalising symptoms) at baseline to maximise the sample size. There might be cohort effects as adolescents might be more or less likely to report higher levels of internalising symptoms or experience richer or poorer economic circumstances over time. Therefore, I adjusted for the wave that adolescents entered the analytic sample.

6.2.5.4 Minoritised status

I also controlled for minoritised status, based on adolescents' ethnicity or ethnic group, indigenous status, or caste and according to what measures were appropriate and available for each country (Table 6.7) (Bains & Gutman, 2021; Bayer et al., 2011; Gupta & Coffey, 2020).

Except for Australia, all countries had variables indicating minoritised status that required no further manipulation before being added to the analytic models. Ethnicity is not routinely collected in Australia and was not measured in LSAC. I derived a categorical variable capturing minoritised status based on variables measuring adolescents' parents' country of birth and whether adolescents' parents are Aboriginal or a Torres Strait Islander, following the same procedure used in previous analyses of LSAC (Priest et al., 2011; Terhaag et al., 2021).

Table 6.7. Variables used to capture minoritised status within each country.

Country	Item
Caste	
India	What is the child's caste? 1. Scheduled caste 2. Scheduled tribe 3. Backwards caste 4. Open category
Ethnicity/Ethnic group	
Australia	Derived variable assessing ethnicity • Both parents are non-aboriginal and born in Australia • At least one parent was born outside of Australia in a White majority country and neither are Aboriginal or a Torres Strait Islander • At least one parent was born outside of Australia in a non-White majority country and neither are Aboriginal or a Torres Strait Islander • At least one parent is Aboriginal and/or a Torres Strait Islander
Ethiopia	What is the child's ethnic group? • Agew • Amhara • Gurage • Hadiya • Kambata • Oromo • Sidama • Tigrian • Wolayta
Peru	What is the child's ethnic group? • White • Metstizo • Amazon native • Negro • Asiatic
South Africa	What population group would you describe yourself belonging to? • African • Coloured • Asian/Indian • White
UK	What is your ethnic group? • White • Mixed • Indian • Pakistani and Bangladeshi • Black or Black British • Other ethnic group
Vietnam	What is the child's ethnic group? • Kinh • H'Mong • Cham • Ede • Ba na • Nung • Tay • Dao
Indigenous status	
Mexico	Do you recognise yourself as part of an indigenous ethnic group? • Yes • No

6.2.6 Missing data

Multiple imputation using chained equations was used to impute missing data in the variables used in the analyses. This approach was used due to its suitability for imputing missing values for both categorical and continuous measures within the same imputation model. I included all variables that were used within the estimation models, including the outcome variable, within the imputation models of each country.

6.2.6.1 Imputation of the outcome variable

I included auxiliary variables that were found to be predictors of the outcome, as well as missingness of the outcome where possible in the imputation models. The inclusion of auxiliary variables should increase the plausibility of the Missing At Random assumption and improve the accuracy of imputed values of the outcome (White et al., 2011). These variables were specific to each country (Table 6.8). I first identified a selection of different variables within each country's dataset that I assumed would be associated with adolescents' internalising symptoms based on whether the variables were measuring a similar construct to internalising symptoms (e.g., internalising symptoms at a different timepoint) or past evidence that has found a consistent association between the variables and internalising symptoms (e.g., maternal depressive symptoms). I then ran unadjusted linear regression and logistic regression analyses within each country's analytic sample to identify whether the variable was associated with the outcome and missingness of the outcome respectively.

Given the small proportion of outcome missingness in Ethiopia, India and Vietnam (all <5%), no variable was found to be associated with missingness. Despite a moderate amount of missing outcome data within Mexico and South Africa, I identified no variable which was associated with both the outcome, as well as whether the outcome was missing.

The imputation models included the total scale score and the harmonised scale score of the measures of internalising symptoms. These were set so that they were not used in the imputation of one another.

Table 6.8. Auxiliary variables associated with the outcome included in country-specific imputation models.

Country	Auxiliary variables	Complete cases with available data on all variables (N, % of analytic sample)	Adolescents with missing outcome data at follow-up (N, % of analytic sample)
Australia	Parent 1's depressive symptoms at age 16 Adolescents' socio-economic position at age 4*	1,856 (76.6%)	43 (1.8%)
Ethiopia	Household wealth index score at age 15	863 (95.4%)	1 (0.11%)
India	Access to services index score at age 8	629 (66.1%)	39 (4.1%)
Mexico	Maternal depressive symptoms at baseline Whether adolescent's household own a landline telephone	567 (63.1%)	125 (13.9%)
Peru	Household wealth index score at age 8* Whether household had electricity at age 8* Whether adolescent was enrolled in school at age 15*	507 (80.4%)	64 (10.14%)
South Africa	Whether household had electricity at baseline Adolescents' life satisfaction at follow-up	2,006 (68.7%)	291 (9.97%)
United Kingdom	Adolescents' emotional difficulties at age 11* Parent 1 depressive symptoms at 14*	6,731 (72.3%)	300 (3.22%)
Vietnam	Household wealth index score at age 15	804 (92.1%)	2 (0.23%)

*Also associated with missingness of outcome.

6.2.6.2 Imputation of the exposures

Available data on all individual income and expenditure items was needed to calculate the total values of household income and consumption expenditure respectively. Otherwise, total household income and consumption expenditure were set to missing.

For household income, adolescents might have had available data on some but not all household members. For household consumption expenditure, it was also rare for one household to have no missing responses on any expenditure item. As such, adolescents' may have had missing data on some expenditure domains.

Within the imputation models, the total neglog-transformed values for household income and consumption expenditure and their equivalised values were included. Additionally, neglog-transformed values of income for each household member and the different consumption expenditure domains were also included in the imputation models. These were coded so they were solely used in the imputation of total household income and total consumption expenditure respectively. The total values of

household income and consumption expenditure were then used in the imputation of the other variables within the imputation models.

Given the need to first impute household income through interval regression in the UK, equivalised household income was not included in the imputation models for the UK (see Appendix C). Equivalised household income was calculated following imputation based on the imputed values of household income and household size.

6.2.6.3 Multiple imputation procedure

A total of 50 imputations were used in all countries. Based on Rubin's formula for estimating the efficiency of an estimate based on imputed data " $(1 + (\text{the rate of missing data}/\text{the number of imputations}))^{-1}$ ", fifty imputations would yield at least 99% efficiency across all countries. In other words, for all countries, 50 imputations would be at least 99% as efficient as performing an infinite number of imputations (Rubin, 1987).

I modelled the design stratum of the corresponding longitudinal population study as an auxiliary variable and included the sampling weights in each country's imputation model as recommended for survey data (Carpenter & Kenward, 2013). This also ensured compatibility between the imputation and analysis models, thus reducing the likelihood of biased results from analysing the imputed data (Zhou et al., 2016).

I planned to carry out multiple imputation separately for each wave within South Africa, as missing data patterns might differ across each wave-specific sample. This led to non-convergence of the imputation models. Therefore, missing data was imputed collectively for the whole sample with wave included in the imputation model.

Predictive mean matching was used to impute missing data for all continuous variables, except for household income in the UK where interval regression was used. Predictive mean matching is more suitable than traditional regression-based methods for imputing skewed variables with range limits which is the case for household consumption expenditure, household income and the measures of internalising symptoms (T. P. Morris et al., 2014). Imputation using linear regression can impute implausible values outside of a measures possible range, such as negative consumption expenditure. Binary variables were imputed using logistic regression; ordered categorical variables, such as items with Likert scale responses, were imputed

using ordinal logistic regression; and un-ordered categorical variables (such as minoritised status) were imputed using multi-nominal logistic regression.

6.2.7 Analyses

6.2.7.1 Reliability of measures of internalising symptoms

For each country, I report the Cronbach's alpha of the scales used to assess internalising symptoms at the follow-up timepoint. Cronbach's alpha is a measure of a scales' internal consistency referring to the extent to which items within a scale are inter-correlated and are therefore measuring the same construct (Cronbach, 1951). Cronbach's alpha scores range from 0 to 1, with higher scores indicative of stronger internal consistency in the scale. These analyses used data before multiple imputation and thus only included adolescents with no missing data on the measure of internalising symptoms.

6.2.7.2 Regression analyses within each country

The association between each measure of economic circumstances and internalising symptoms were estimated using linear regression, accounting for confounders. For each country and exposure, standardised internalising symptoms at follow-up were added as the outcome. Household income, consumption expenditure, or subjective status were added as a predictor variable. Confounders were then added to the model. To assess the change in internalising symptoms between the baseline and follow-up timepoints, I also controlled for internalising symptoms at baseline.

Sampling weights, clustering and stratification were taken into account where available for all analyses to produce accurate standard errors for the regression coefficients. Standard errors are often underestimated when the clustering of the data within longitudinal population studies are not considered. This could lead to false positives within each country's estimates. Sampling weights were available for all countries except the Young Lives countries.

To aid interpretation I converted the coefficients (and standard errors) from the regression models so that the coefficients represent the change in standardised internalising symptoms per doubling of household income or consumption expenditure (i.e., $b \cdot \ln(2)$) (Ford, 2018).

6.2.7.3 Meta-analyses

Effect estimates and standard errors from each country were added to separate random-effects meta-analyses for each exposure. This enabled the comparison of effect estimates and the ability to test for between-country heterogeneity of the association. Between-country heterogeneity was investigated within the meta-analyses through the I^2 statistic and the Q-test. Q-tests are statistical tests of heterogeneity based on significance testing. A p -value of 0.05 or less indicates evidence of heterogeneity within a meta-analysis. The I^2 statistic is explained in Chapter 4 (section 4.2.7.2). Countries were judged as having significantly differing associations between one another if the 95% confidence intervals of each country's effect estimate did not overlap.

6.2.7.4 Variance explained by measures of economic circumstances

I extracted the difference in adjusted R^2 values between models with all covariates and the exposure of interest, and models with all covariates without the exposure of interest. This difference represents the additional variance of internalising symptoms explained by adolescents' economic circumstances beyond the variance explained by the confounders.

R^2 values are not available within the traditional multiple imputation regression estimates in Stata. To counter this, I used the user-made programme known as *mibeta* which reports adjusted R^2 values for analyses using multiply imputed datasets (Marchenko, 2010). However, *Mibeta* does not enable the use of the *svyset* command which takes into account the clustering or strata of a survey, meaning the analyses with *mibeta* took into account sampling weights only. This has no impact on the R^2 values which are the same regardless of whether the survey strata and primary sampling units are taken into account.

6.2.7.5 Sensitivity analyses

I carried out two sensitivity analyses. First, the analyses of objective measures of economic circumstances were repeated using household income and consumption expenditure equivalised according to the square-root of household size. In the second sensitivity analysis the harmonised measures of internalising symptoms were used as

the outcome variable in all countries. Internalising symptoms at baseline were not harmonised in the analyses where the outcome was harmonised.

6.3 Results

6.3.1 Descriptives

I analysed data of 18,910 adolescents (9,568 female [50.6%], 9,342 male [49.4%]) across eight countries. Sample sizes ranged from 631 in Peru to 9,310 in the UK (Table 6.9).

Table 6.9. Details of analytic samples across each country.

Country	Sample size at first wave ^a	Attended baseline timepoint	Attended follow-up timepoint	Analytic sample (attended both timepoints) ^b
Australia	4,983	2,813	2,708	2,422
Ethiopia	1,000	973	908	905
India	1,008	976	952	951
Mexico	8,441 households	1,337	1,035	898
Peru	714	678	635	631
South Africa	7,296 households	Eligible at W1: 1,093 Eligible at W2: 840 Eligible at W3: 682 Eligible at W4: 732	Eligible at W1: 935 Eligible at W2: 878 Eligible at W3: 657 Eligible at W4: 685	2,920
UK	18,818	11,717	10,238	9,310
Vietnam	1,000	966	887	873

^aNumber of adolescents unless stated. ^bAfter other eligible adolescents within same household are excluded. W = wave.

6.3.2 Reliability of measures of internalising symptoms

The internal consistency of the measures of internalising symptoms were acceptable across all countries (Table 6.10). The Cronbach's alpha ranged from 0.66 for the SDQ-E in Vietnam to 0.94 for the CCDSD in Mexico.

Table 6.10. Internal consistency of the measures of internalising symptoms within each country.

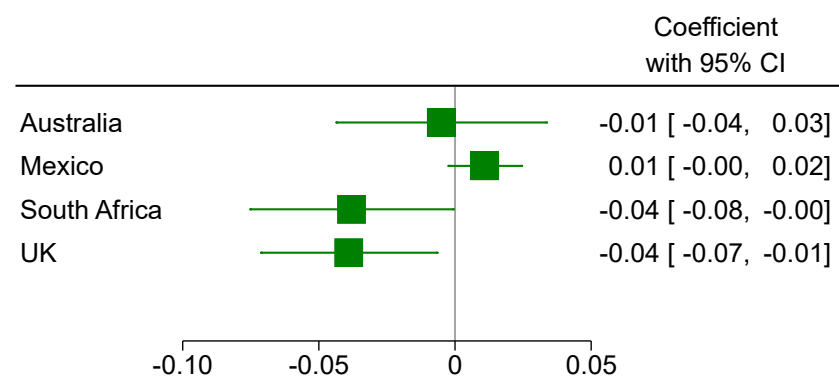
Country	Measure	Number of items	Cronbach's alpha
Mexico	CCDSD	20	0.94
South Africa	CES-D	10	0.69
Australia	K-10	10	0.93
Ethiopia	SDQ-E	5	0.68
India			0.67
Peru			0.74
UK			0.74
Vietnam			0.66

6.3.3 The association between household income and adolescents' internalising symptoms

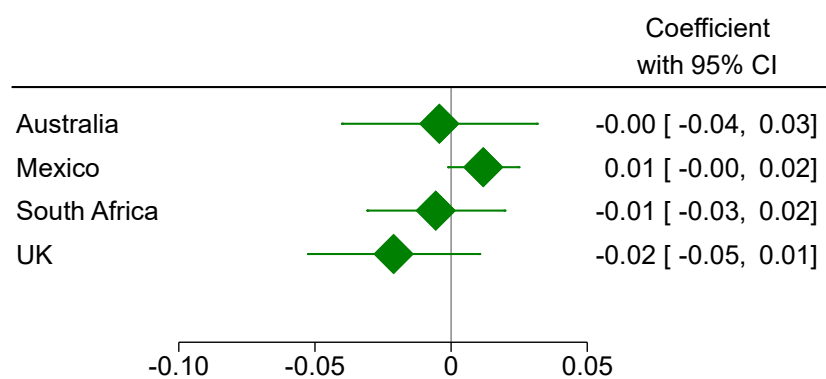
Across the four countries that measured household income the coefficients for future internalising symptoms were small or null (Figure 6.3). As household income doubled future internalising symptoms decreased in South Africa (coefficient = -0.039 [95% CI: -0.075 to -0.001]) and in the UK (coefficient = -0.039 [95% CI: -0.071 to -0.007]). In Australia (coefficient = -0.005 [95% CI: -0.044 to 0.033]) and Mexico (coefficient = -0.011 [95% CI: -0.002 to 0.024]) there was no evidence of an association between household income and future internalising symptoms. There appeared to be some variability in the direction of the association between countries, primarily due to a potential positive association in Mexico. The I^2 statistic was 71.0%, and the Q-test found evidence of heterogeneity between countries ($p=0.0066$).

When adjusting for symptoms at baseline, the association attenuated towards the null for countries with the largest coefficients in the previous analyses (South Africa and the UK; Figure 6.3). Subsequently, there was little variability in the magnitude or direction of the association between household income and change in internalising symptoms across countries. The I^2 statistic was 39.7%, and the Q-test did not indicate between-country heterogeneity ($p=0.20$).

Figure 6.3. Association between log-transformed household income with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.



(a) Internalising symptoms at follow-up (age 17 to 19)



(b) Change in internalising symptoms between ages 14 to 17 and 17 to 19

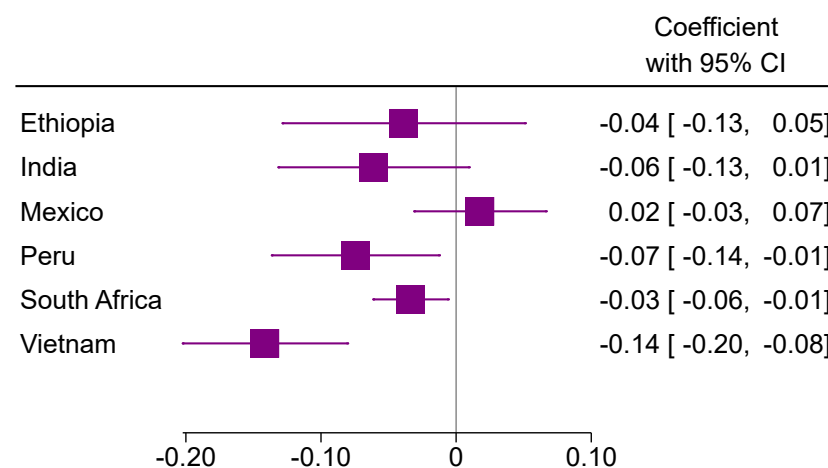
Note: Coefficients represent the change in standardised internalising symptoms per doubling of household income.

6.3.4 The association between household consumption expenditure and adolescents' internalising symptoms

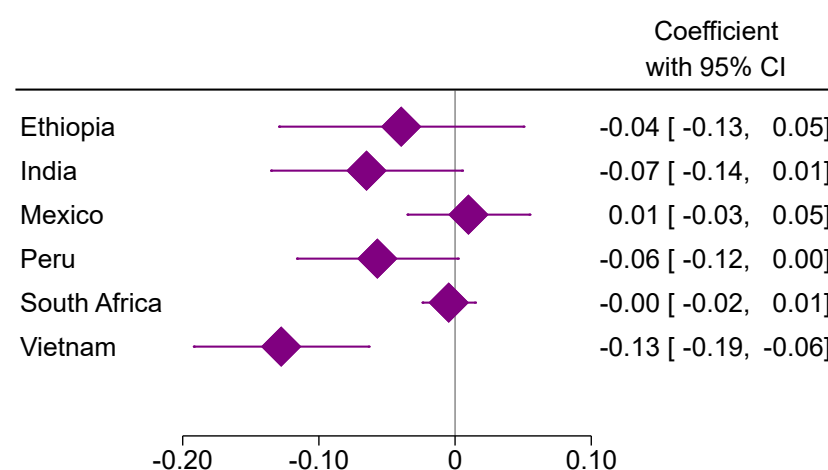
There was evidence that a doubling of household consumption expenditure was associated with fewer internalising symptoms at follow-up in Peru (coefficient = -0.075 [95% CI: -0.14 to -0.013]), South Africa (coefficient = -0.034 [95% CI: -0.061 to -0.006]) and Vietnam (coefficient = -0.14 [95% CI: -0.20 to -0.081]) (Figure 6.4). There was no evidence of an association between household consumption expenditure and adolescents' internalising symptoms in Ethiopia (coefficient = -0.039 [95% CI: -0.13 to 0.051]) or India (coefficient = -0.061 [95% CI: -0.13 to 0.009]) but the coefficients were of similar magnitude to those for Peru and South Africa. The coefficient for Mexico was close to the null (coefficient = 0.018 [95% CI: -0.031 to 0.066]). The I^2 statistic was 74.2% and the Q-test found evidence of heterogeneity between countries ($p=0.0033$).

The coefficients after adjusting for internalising symptoms at baseline remained relatively similar, and there was still observed cross-country variability in the associations (Figure 6.4). The I^2 statistic remained similar (74.8%), and the Q-test found evidence of heterogeneity between countries ($p=0.0027$).

Figure 6.4. Association between log-transformed household consumption expenditure with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.



(a) Internalising symptoms at follow-up (age 17 to 19)



(b) Change in internalising symptoms between ages 14 to 17 and 17 to 19

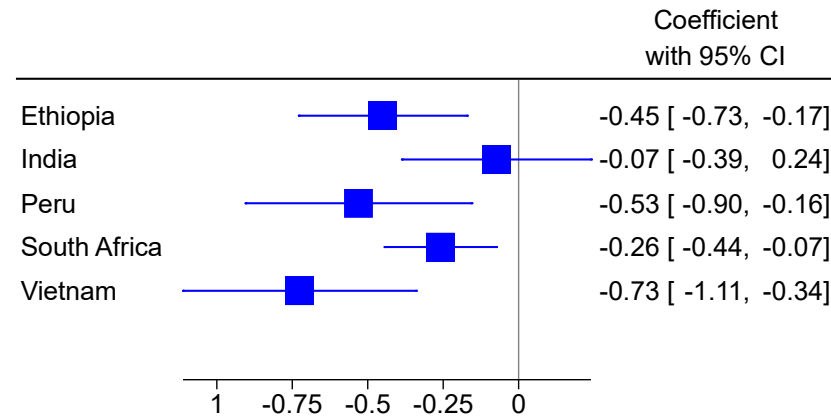
Note: Coefficients represent a change in standardised internalising symptoms per doubling of household consumption expenditure.

6.3.5 The association between subjective wealth and adolescents' internalising symptoms

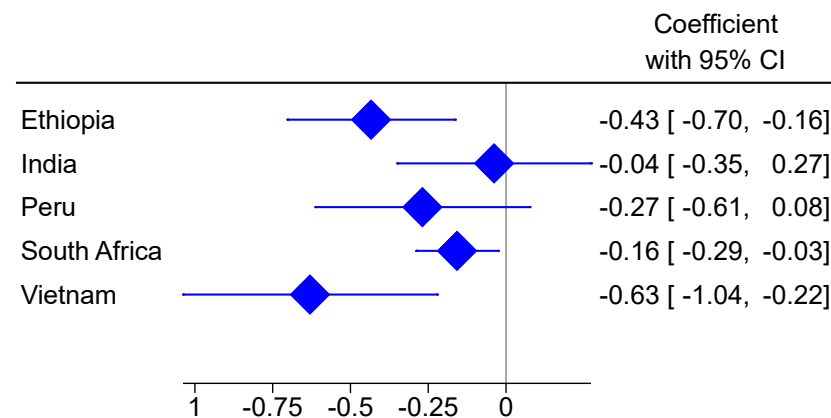
The SII was greatest in Vietnam (Figure 6.5) indicating that adolescents from the richest households had fewer internalising symptoms compared to the poorest adolescents in the country (SII = -0.73 [95% CI: -1.11 to -0.34]). The SII was minimal in South Africa (SII = -0.26 [95% CI: -0.44 to -0.07]) and in India where there was no certainty on the direction of the association (SII = -0.07 [95% CI: -0.39 to 0.24]). The 95% confidence intervals for each country's effect estimate were large and there was considerable overlap between countries. The I^2 statistic was 57.1% but no evidence was found for between-country heterogeneity according to the Q-test ($p=0.063$).

All coefficients were smaller and closer to the null after adjusting for symptoms at baseline (Figure 6.5). The SII remained greatest in Vietnam (SII = -0.63 [95% CI: -1.04 to -0.22]) and smallest in India (SII = -0.04 [95% CI: -0.35 to 0.27]). The I^2 statistic remained similar (53.3%), and no evidence was found for between-country heterogeneity according to the Q-test ($p=0.074$).

Figure 6.5. The Slope Index of Inequality according to adolescents' subjective wealth for internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.



(a) Internalising symptoms at follow-up (age 17 to 19)



(b) Change in internalising symptoms between ages 14 to 17 and 17 to 19

Note: Coefficients represent the difference in standardised internalising symptoms between adolescents with the highest and lowest subjective wealth in their country sample.

6.3.6 Variance of internalising symptoms explained by adolescents' economic circumstances

The variance explained by any measure of economic circumstances was typically small in all countries (all less than 2.5%) (Figure 6.6; Table 6.11). In the four countries where household income was measured, the variance explained was all less than 0.3% (range: -0.03% to 0.29%). This was comparatively less than the variance explained by household consumption expenditure (range: 0.02% to 1.92%) and subjective wealth (range: -0.03 to 2.06%), albeit in mostly different countries. Adding household income and subjective wealth to the regression models led to a poorer fit of the data in Australia and India respectively, compared to the regression models that contained the confounders only. In models where I adjusted for internalising symptoms at baseline, in most cases economic circumstances explained less variance of future internalising symptoms in comparison to the variance explained in the models that did not adjust for internalising symptoms at baseline.

Both objective measures were measured in Mexico and South Africa only. Household income explained greater variance in Mexico and household consumption expenditure explained greater variance in South Africa. Within countries, the variance explained by each measure of economic circumstances were similar to one another, but in Ethiopia, subjective wealth explained close to 1 percentage point more variance of future internalising symptoms than household consumption expenditure.

Within countries with multiple measures of economic circumstances, subjective wealth explained greater variance of internalising symptoms at follow-up over objective measures, except for in India. After adjusting for internalising symptoms at baseline this pattern changed. The variance of future internalising symptoms explained by adolescents' subjective wealth reduced by a large extent. There was typically less of a reduction for objective measures of economic circumstances. This was most apparent in Peru where the variance explained by subjective wealth reduced by over a percentage point, but the variance explained by household consumption expenditure reduced by approximately half a percentage point. Following adjustment of baseline internalising symptoms, objective measures of economic circumstances explained greater variance of internalising symptoms at follow-up over subjective in three of the five countries where both measures were available.

Figure 6.6. Variance of internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline, explained by household income, household consumption expenditure and subjective wealth across countries.

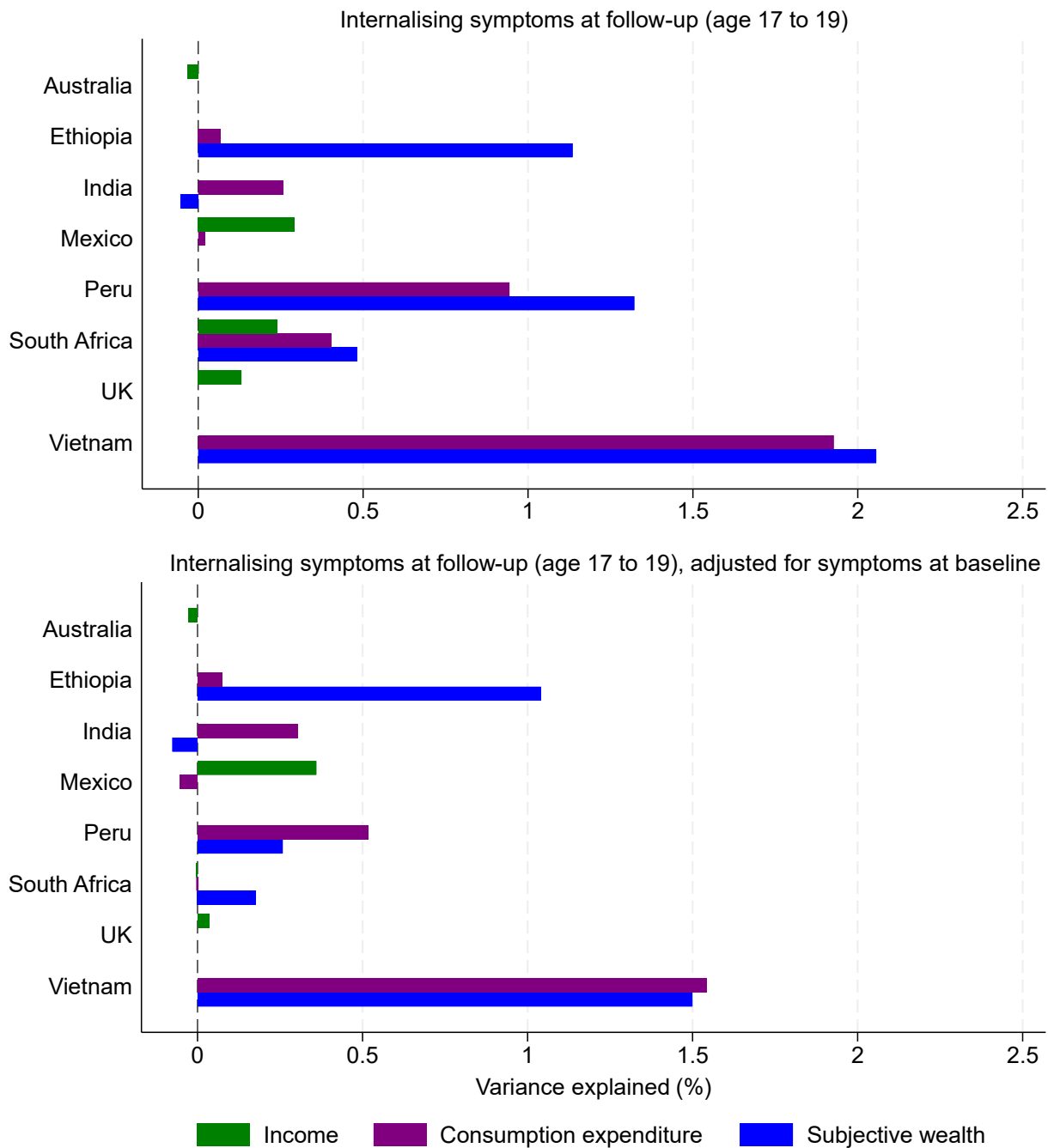


Table 6.11. Variance of internalising symptoms at follow-up explained by each measure of economic circumstances.

Country	Internalising symptoms at follow-up			Internalising symptoms at follow-up, adjusted for internalising symptoms at baseline		
	Household Income	Household consumption expenditure	Subjective wealth	Household Income	Household consumption expenditure	Subjective wealth
Australia	-0.03			-0.03		
Ethiopia		0.07	1.13		0.04	1.04
India		0.26	-0.03		0.30	-0.08
Mexico	0.29	0.02		0.36	-0.05	
Peru		0.94	1.32		0.43	0.26
South Africa	0.24	0.40	0.48	0	0	0.18
UK	0.13			0.03		
Vietnam		1.92	2.06		1.61	1.50

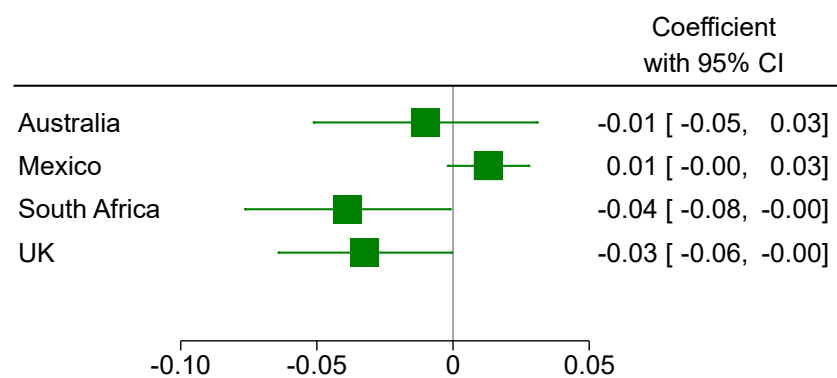
Note: Values are all percentage points.

6.3.7 Sensitivity analyses

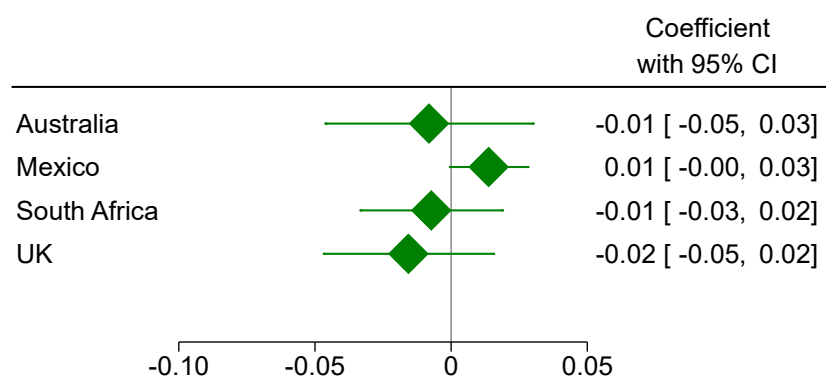
6.3.7.1 The association between equivalised household income and adolescents' internalising symptoms

The coefficients in the analyses of equivalised household income were close to identical to those reported in the main analyses of non-equivalised household income. This was apparent regardless of whether internalising symptoms at baseline were adjusted for or not (Figure 6.7). The I^2 statistic was 68.3% in the analyses not controlling for symptoms at baseline and the Q-test found evidence of heterogeneity between countries ($p=0.011$). In the analyses controlling for symptoms at baseline, the I^2 statistic was 39.0%. The Q-test found no evidence of heterogeneity between countries ($p=0.22$).

Figure 6.7. Association between log-transformed equivalised household income with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.



(a) Internalising symptoms at follow-up (age 17 to 19)



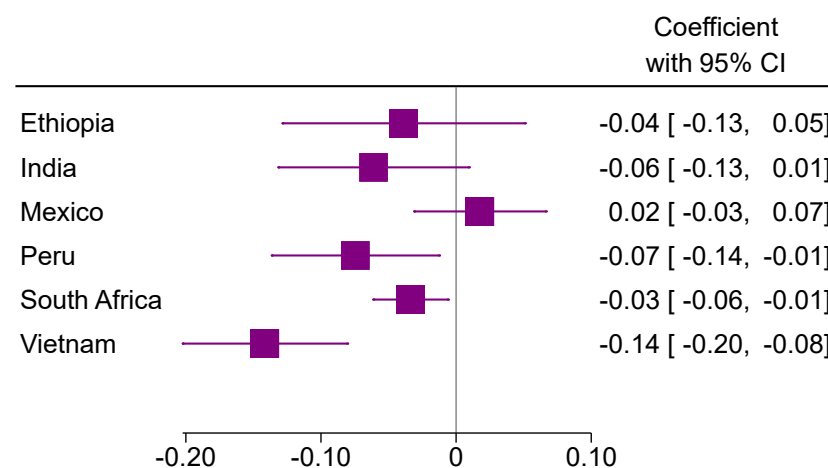
(b) Change in internalising symptoms between ages 14 to 17 and 17 to 19

Note: Coefficients represent the change in standardised internalising symptoms per doubling of equivalised household income.

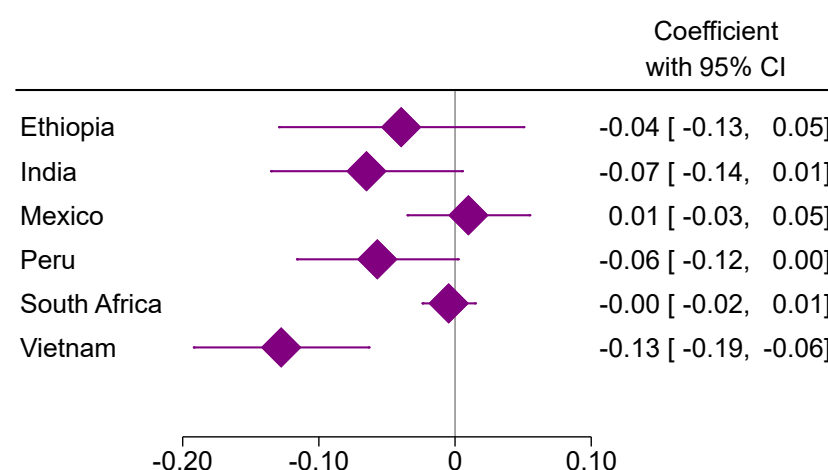
6.3.7.2 The association between equivalised household consumption expenditure and internalising symptoms

The coefficients in the analyses of equivalised household consumption expenditure were close to identical to those reported in the main analyses of non-equivalised consumption expenditure, regardless of whether internalising symptoms at baseline were or were not adjusted for (Figure 6.8). In the analyses not controlling for symptoms at baseline, the I^2 statistic was 78.3% and the Q-test found evidence of heterogeneity between countries ($p=0.0009$). In the analyses controlling for symptoms at baseline, the I^2 statistic was 78.2% and the Q-test found evidence of heterogeneity between countries ($p=0.0022$).

Figure 6.8. Association between log-transformed equivalised household consumption expenditure with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline.



(a) Internalising symptoms at follow-up (age 17 to 19)



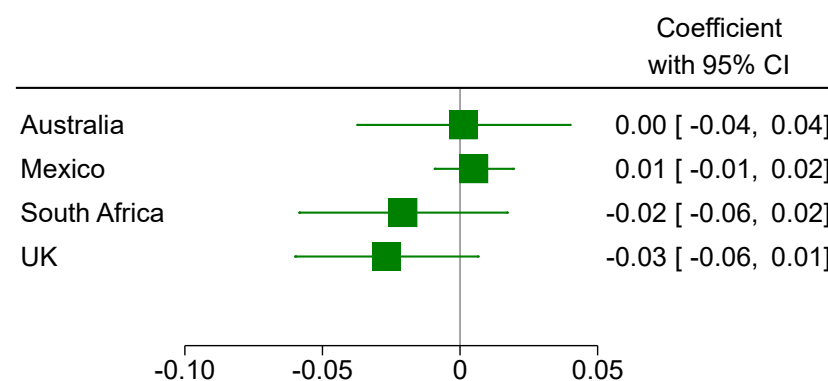
(b) Change in internalising symptoms between ages 14 to 17 and 17 to 19

Note: Coefficients represent a change in standardised internalising symptoms per doubling of equivalised household consumption expenditure.

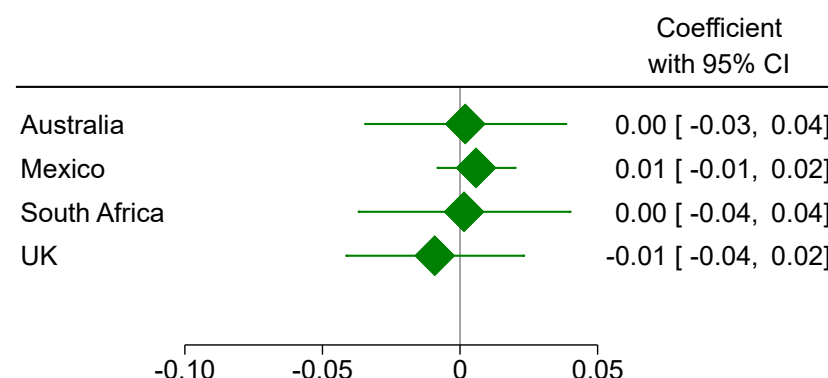
6.3.7.3 The association between economic circumstances and the harmonised outcome measures of internalising symptoms

The association between household income and internalising symptoms was weaker in all countries when the harmonised outcome measure was used in comparison to the country-specific scales (Figure 6.9). The absolute change in the coefficients was minimal but was sufficient to reduce cross-country variability in the effect estimates (I^2 statistic = 33%; Q-test p-value = 0.26). The association was also weaker for all countries when the harmonised measure was used in analyses adjusting for symptoms at baseline. This led to no cross-country variability in the effect estimates (I^2 statistic = 0.11; Q-test p-value = 0.87).

Figure 6.9. Association between log-transformed household income with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline (harmonised measure).



(a) Internalising symptoms at follow-up (age 17 to 19)



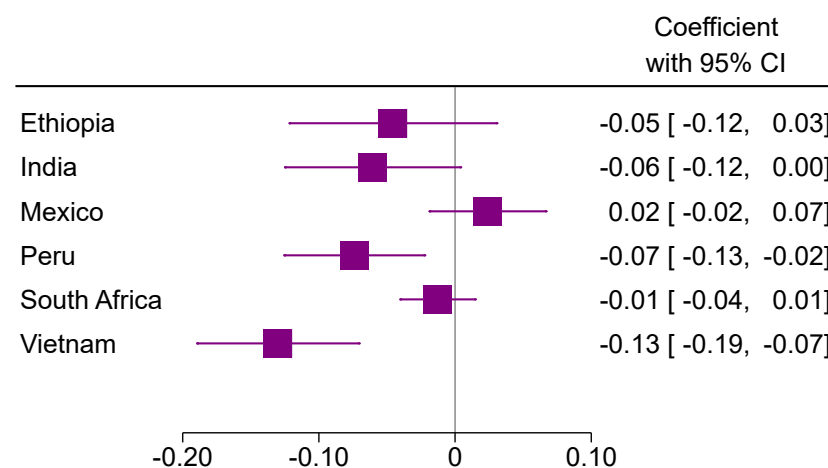
(b) Change in internalising symptoms between ages 14 to 17 and 17 to 19

Note: Coefficients represent the change in standardised internalising symptoms per doubling of household income.

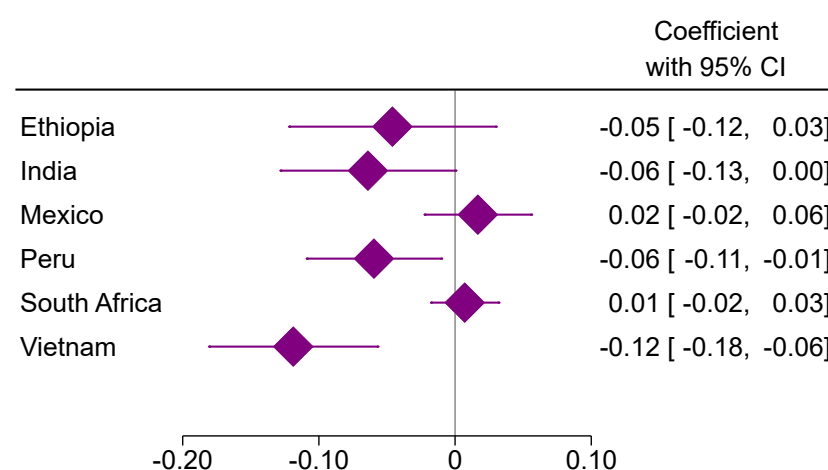
In the analyses using the harmonised scales of internalising symptoms, there was almost no impact on the coefficients for the association between household consumption expenditure and internalising symptoms in any country (Figure 6.10). The association was weaker for South Africa and Vietnam whilst the magnitude of the association was slightly greater in Ethiopia (coefficient = -0.046 [95% CI: -0.12 to 0.030]). The association remained unchanged for India, Mexico and Peru. Cross-country variability was still observed (R^2 statistic =78.8%; Q-test p-value = 0.0004).

In analyses where internalising symptoms at baseline were also controlled for, the strength of the association between household consumption expenditure and internalising symptoms were generally consistent regardless of whether the country-specific measures or the harmonised measures were used. The association remained unchanged for India, Mexico and Peru and cross-country variability was still observed (R^2 statistic =78.5%; Q-test p-value = 0.0004).

Figure 6.10. Association between log-transformed household consumption expenditure with internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline (harmonised measure).



(a) Internalising symptoms at follow-up (age 17 to 19)



(b) Change in internalising symptoms between ages 14 to 17 and 17 to 19

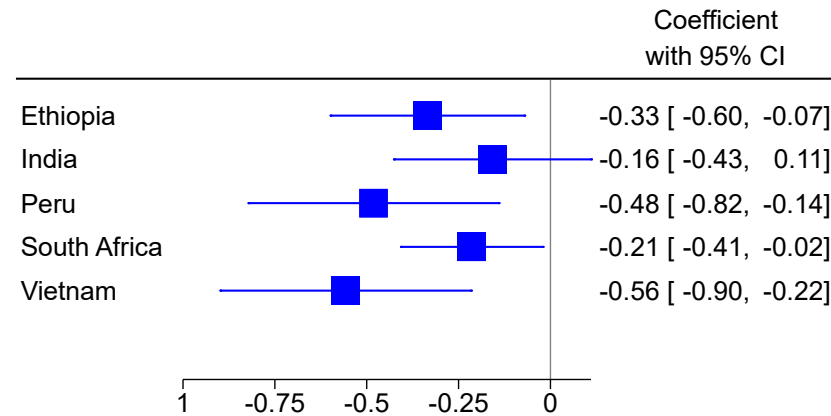
Note: Coefficients represent the change in standardised internalising symptoms per doubling of household consumption expenditure.

In regards to subjective wealth, the effect estimates for the countries with the largest SII in the main analyses – Ethiopia (SII = -0.34 [95% CI: -0.60 to -0.07]), Peru (SII = -0.48 [95% CI: -0.82 to -0.14]), South Africa (SII = -0.21 [95% CI: -0.41 to -0.02]) and Vietnam (SII = -0.56 [95% CI: -0.89 to -0.21]) – were all closer towards the null in analyses using the harmonised measure of internalising symptoms compared to the country-specific measures (Figure 6.11). For India, the SII was greater in the analyses using the harmonised measure (SII = -0.16 [95% CI: -0.43 to 0.11]), but there was still

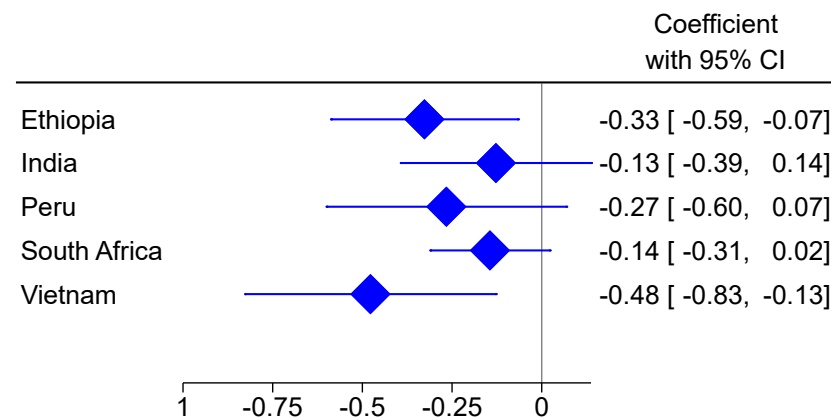
no evidence that subjective wealth was associated with future internalising symptoms. Overall, this led to a substantial reduction in the variability of the SII across countries with a much lower I^2 statistic and non-significant Q-tests in comparison to the country-specific measures (I^2 statistic = 17.8%; Q-test p-value = 0.27).

In analyses where internalising symptoms at baseline were also controlled for, the association between subjective wealth and internalising symptoms was weaker in Ethiopia (SII = -0.33 [95% CI: -0.59 to -0.07]) and Vietnam (SII = -0.48 [95% CI: -0.83 to -0.13]). For India, the SII was greater in the analyses using the harmonised measure (SII = -0.13 [95% CI: -0.39 to 0.14]), however there was still no evidence that subjective wealth was associated with future internalising symptoms. There was minimal change in the SII for Peru or South Africa. This led to close to no variability of the SII across countries with a much lower I^2 statistic in comparison to the country-specific measures (I^2 statistic = 4.4%) and a non-significant Q-test (p-value = 0.40).

Figure 6.11. The Slope Index of Inequality according to adolescents' subjective wealth for internalising symptoms (a) at follow-up, and (b) at follow-up adjusting for internalising symptoms at baseline (harmonised measure).



(a) Internalising symptoms at follow-up (age 17 to 19)



(b) Change in internalising symptoms between ages 14 to 17 and 17 to 19

Note: Coefficients represent the difference in standardised internalising symptoms between adolescents with the highest and lowest subjective wealth in their country sample.

6.4 Discussion

6.4.1 Summary

In this study, I analysed data from eight countries to investigate whether the direction and magnitude of the longitudinal association between economic circumstances and internalising symptoms in adolescents varied across countries and the measure of economic circumstances used.

I hypothesised that greater levels of household income, household consumption expenditure and subjective wealth would be associated with fewer internalising symptoms in all countries (hypothesis 6.1). I found evidence of an association between greater levels of economic circumstances and fewer internalising symptoms in some, but not all countries. Greater levels of household income were associated with fewer internalising symptoms at follow-up in South Africa and the UK, albeit the magnitude of the association was small. There was no evidence of an association in Australia or Mexico. Greater levels of household consumption expenditure were associated with fewer internalising symptoms at follow-up in Peru, South Africa and Vietnam, but not in Ethiopia, India, or Mexico. For the subjective measure of economic circumstances, I found that greater levels of subjective wealth were associated with fewer internalising symptoms at follow-up in Ethiopia, Peru, South Africa and Vietnam. There was no evidence of an association in India.

I also hypothesised that increased household income, household consumption expenditure and subjective wealth would be associated with a greater reduction of adolescents' internalising symptoms from baseline to follow-up in all countries (hypothesis 6.2). I found no evidence in any country that higher levels of household income were associated with a greater reduction in internalising symptoms. In the analyses of household consumption expenditure, the association attenuated slightly in Peru, South Africa and Vietnam after adjusting for internalising symptoms at baseline. There was evidence that higher levels of household consumption expenditure were associated with a greater reduction in internalising symptoms in Vietnam only. Finally, in the analyses of subjective wealth, the association attenuated in all countries after adjusting for internalising symptoms at baseline. The attenuation was negligible in some (e.g., Ethiopia) or by a large magnitude in other countries (e.g., Peru). There was evidence that higher levels of subjective wealth were associated

with a greater reduction in internalising symptoms in Ethiopia, South Africa and Vietnam, but not in India or Peru.

I further hypothesised that within countries where both types of economic circumstances were measured, subjective measure of economic circumstances (subjective wealth) would explain greater variance of future internalising symptoms compared to objective measures (household consumption expenditure and household income) (hypothesis 6.3) and after adjusting for internalising symptoms at baseline (hypothesis 6.4). Consistent with hypothesis 6.3, subjective wealth explained a greater proportion of the variance of future internalising symptoms compared to any objective measure in most countries where both objective and subjective economic circumstances were measured (Ethiopia, Peru, South Africa, Vietnam), except for in India. In the analyses modelling change in internalising symptoms from baseline to follow-up, subjective wealth explained greater variance of internalising symptoms at follow-up in Ethiopia and South Africa, whilst household consumption expenditure explained greater variance in India, Peru and Vietnam.

I hypothesised that there would be cross-country differences in the magnitude of the association between household income, household consumption expenditure and subjective wealth with internalising symptoms (hypothesis 6.5), and in the change in internalising symptoms (hypothesis 6.6). I found evidence of cross-country variability in the magnitude of the association for household consumption expenditure and household income as evidenced by results of the Q-tests. For household income, the magnitude of the association varied, however there was no evidence of cross-country variation in the sensitivity analyses using the harmonised outcome measures. For household consumption expenditure, the magnitude of the association varied and was greatest in Vietnam, whilst the association was close to the null in Mexico and South Africa. The Slope Indices of Inequality for subjective wealth appeared to vary in magnitude, but the wide standard errors limit the ability to draw conclusions about cross-country differences. There was evidence of an interaction at the country-level for only one exposure based on the lack of over-lapping 95% confidence intervals for countries' effect estimates: household consumption expenditure, where the association in Vietnam was greater than the association in Mexico and South Africa.

Finally, I hypothesised that there would be cross-country differences in the magnitude of the association between household income, household consumption expenditure and subjective wealth with the change in internalising symptoms (hypothesis 6.6). After adjusting for internalising symptoms at baseline, the variability of the associations between household income and future internalising symptoms was no longer apparent. The magnitude of the association between household consumption expenditure and internalising symptoms still varied across countries after adjusting for internalising symptoms at baseline. Finally, there was no evidence of cross-country variability in the association between subjective wealth and change in internalising symptoms.

6.4.2 Interpretation

6.4.2.1 Cross-country differences in the association between economic circumstances and internalising symptoms

The study suggests that the longitudinal association between higher levels of economic circumstances and fewer internalising symptoms is common but not universal across countries. Differences in the magnitude of the association demonstrates the potential role that the societal context within countries may have in shaping the extent of economic inequalities in adolescents' internalising symptoms. For instance, there may be differences in countries regarding the form or availability of protective factors that could buffer the negative impact of economic disadvantage on adolescents' internalising mental health.

Under the assumption that findings from analyses of each measure of objective economic circumstances are sufficiently comparable to one another, inequalities according to objective economic circumstances were of the smallest magnitude in the most economically developed countries (indicated by GNI per capita); Australia, Mexico, South Africa and the UK. In comparison, inequalities according to household consumption expenditure were starker in countries with a smaller GNI per capita; Ethiopia, India, Peru and Vietnam. Household income was not measured in these settings. In the high-income countries, the greater provision and accessibility of welfare policies and health care could help buffer the negative mental health effects of having fewer financial resources. In turn this may lead to less stark economic inequalities in adolescents' internalising symptoms (Aizer & Lleras-Muney, 2024).

Customs or cultural factors within countries might also influence the extent to which internalising symptoms may develop in adolescents in response to living in poorer economic circumstances. For example, in Mexico where the association with internalising symptoms was close to the null in analyses of both household income and consumption expenditure, explanations might include the impact of close family ties and high levels of social support that might buffer the stress of experiencing poorer economic circumstances (Diaz-Loving & del Castillo, 2010).

Whilst there may be factors within the high-income countries that could reduce the extent of economic inequalities in adolescents' internalising symptoms, there might also be factors within low- and middle-income countries that exacerbate them. For instance, rates of absolute poverty are higher in low-income countries. Living in absolute poverty means living in economic circumstances where basic and fundamental human needs such as food, water, or shelter cannot be secured (Salmeron Gomez et al., 2023). It has significant consequences for adolescents such as leaving education early to work and limited access to essential services (Poole et al., 2013; Viner et al., 2012). This experience of absolute poverty is associated with far more material disadvantages compared to poverty within a high-income country such as the UK or Australia, where poverty is primarily defined in relation to the rest of the population and absolute poverty is considerably rarer (Poole et al., 2013). Being poorer in low- and middle-income countries is likely to predispose adolescents to a greater number of material stressors and other determinants of worse internalising mental health, compared to experiencing poverty in a high-income country. This study suggests that adolescents living in low-income countries, who are more likely to live in poverty, might also be more likely to experience poorer internalising mental health as a result of living in poorer economic circumstances (Salmeron Gomez et al., 2023).

Some of the cross-country differences in the association between objective economic circumstances and internalising symptoms in this study might be due to comparing results between countries that have used different measures to capture economic circumstances: household income or household consumption expenditure. In the high-income countries, objective economic circumstances were primarily assessed through the measurement of household income, whilst household consumption expenditure was the main measure of objective economic circumstances in the low- and middle-income countries, likely reflecting differences in each measures' suitability in different

contexts (Howe et al., 2012). Household consumption expenditure might be a more accurate long-term marker of economic circumstances compared to household income. Consumption expenditure is typically more stable than income, as households base their consumption on their current income (which can vary throughout the year) and their expectations regarding their future income (Friedman, 1957). Consumption expenditure can also be supplemented through borrowing or the use of savings. Therefore, adolescents' economic circumstances might be more accurately measured in countries that assessed household consumption expenditure compared to in the countries that measured household income. In turn, this could have led to the cross-country differences in the association between objective economic circumstances and internalising symptoms when different measures were used. However, in Mexico and South Africa, the sole countries where both income and consumption expenditure were measured, the coefficients were almost identical across the two measures potentially suggesting that comparisons between these measures might be valid.

Surprisingly, the association between adolescents' economic circumstances and their internalising symptoms were less pronounced in the countries with the highest levels of income inequality in this study; Mexico and South Africa. This finding contrasts with cross-sectional research in high-income countries where economic inequalities in internalising mental health were greatest in more economically unequal countries (Dierckens et al., 2020; Elgar et al., 2015). The proposed impact of country-level income inequality on exacerbating mental health inequalities in high-income countries might not extend unilaterally to low- and middle-income settings. The findings for South Africa and Mexico are consistent with cross-sectional studies in both countries that have found no or only a small association between adolescents' economic circumstances and their internalising symptoms (Benjet et al., 2009; Das-Munshi et al., 2016; Zimmerman et al., 2022).

Inequalities in adolescents' internalising symptoms according to household consumption expenditure and subjective wealth were greatest in Vietnam. The speed of economic growth in the country since 1990, many of which has been unequal, has led to increasing inequalities in poverty rates within regions and between ethnic groups (H.-A. Dang et al., 2023). The psychological impacts of living in poorer economic circumstances might be exacerbated in this context, as poorer adolescents and

households may feel further disenfranchised and marginalised as the wealth and living standards of others increase at a comparatively faster rate.

6.4.2.2 Objective and subjective measures of economic circumstances

Within countries, the magnitude of inequalities in internalising symptoms according to both objective and subjective measures of economic circumstances were correlated. In other words, in countries where the magnitude of the association between subjective wealth and adolescents' internalising symptoms was of a large magnitude, commonly so too was the magnitude of the association between objective economic circumstances and adolescents' internalising symptoms. Economic inequalities in internalising symptoms according to both objective and subjective measures might be influenced by similar contextual factors within each country.

Subjective wealth explained the most variance of internalising symptoms at follow-up in the countries it was measured in, except for in India. Consistent with past research in high-income settings, the finding suggests that subjective measures of economic circumstances might have a greater association with adolescents' mental health compared to objective measures (McLaughlin et al., 2012; Rivenbark et al., 2020; Weinberg et al., 2019). Economic inequalities in adolescents' internalising mental health are subsequently likely to arise through psychosocial and comparative processes, as well as being driven by the direct impact of material disadvantage. After adjustment for baseline symptoms however, subjective wealth explained greater variance of internalising symptoms compared to objective economic circumstances in only two countries.

Although not investigated in this study, many studies have found that the association between subjective economic circumstances and adolescents' mental health remains even after adjusting for objective measures of economic circumstances (McLaughlin et al., 2012; Owens & Hadley, 2023; Schenck-Fontaine et al., 2020). The correlation between subjective wealth and objective economic circumstances was generally weak within countries demonstrating that adolescents' objective economic circumstances and how they perceive them are often disparate.

6.4.3 Strengths and limitations

The study features several limitations that can be grouped into two main themes: cross-country differences in methods and limitations within the analyses.

Regarding cross-country differences in methodology, I made effort to ensure I included longitudinal population studies that were similar as possible regarding the study design, the measures used and the measurement timepoints. There were still methodological differences meaning the cross-country and cross-measure variability in economic inequalities in adolescents' internalising symptoms might be partially an artefact of different study methods or measures.

The first key methodological difference across countries refers to the measurement of internalising symptoms and economic circumstances. Differences in the associations observed across countries may be artefactual and partially due to potential differences in what construct the outcome measures were measuring. The most widely used measure within this study, the SDQ-E, was primarily developed to measure internalising symptoms within children and adolescents. In other countries, measures such as the CES-D and the CCDSD were developed to measure depressive symptoms, primarily in adults, and as such there is only some overlap in the symptoms these measures aim to capture. As identified in the sensitivity analysis, cross-country variability in the associations between internalising symptoms and (a) household income and (b) subjective wealth was reduced when the harmonised outcome measures were used. This suggests that the cross-country variability in economic inequalities in adolescents' internalising mental health could partially be an artefact of the different outcome measures used. However, measures with fewer items typically capture less variance of a construct compared to those with more items which have a wider range of possible scores. The brevity of the two-item harmonised measures could have reduced the precision and magnitude of each countries' effect estimates compared to the original measures of internalising symptoms (number of items ranged from 5 up to 20). This could have potentially led to the smaller coefficients observed within countries and the reduced variability between countries in the analyses using the harmonised measures. All measures, except for the CCDSD that was used in Mexico, were developed and initially validated in high-income countries, specifically the UK or the US. The validity of measuring internalising symptoms through these

scales might be reduced in the low- and middle-income countries in this study, where expressions and symptoms of psychological distress may differ (Desai & Chaturvedi, 2017; Kirmayer, 2001). To summarise, cross-country variability may be partially driven by differences in the outcome measures across countries. There is some support for this claim from the sensitivity analysis where measures of internalising symptoms were harmonised.

There might have also been differential measurement error of adolescents' economic circumstances across countries. Measurement error of an exposure variable can lead to the attenuation of the regression coefficient for that variable. This can lead to underestimating the magnitude of an exposure-outcome association; a phenomenon known as regression dilution bias (Hutcheon et al., 2010). Differences in the magnitude of the association between economic circumstances and internalising symptoms across countries could be partially driven by differences in measurement error of objective and subjective economic circumstances.

As an illustration, the magnitude of the coefficient for household consumption expenditure might “match the true value” in country A where there is no measurement error of the exposure (observed coefficient = -0.15. true value of coefficient = -0.15). In comparison, in country B there is a high level of measurement error of household consumption expenditure in this country's sample. As such the observed coefficient is an underestimate of the “true value” of this association in country B (observed coefficient = -0.10. true value of coefficient = -0.15). The true association between household consumption expenditure and internalising symptoms is the same across the two example countries. However, country-level differences in the extent of measurement error of household consumption expenditure leads to artefactual differences in the magnitude of the association.

The suitability of specific objective measures of economic circumstances, and therefore the extent of measurement error, is likely to vary across countries (Howe et al., 2012). Household income is likely to be harder to report accurately in countries where income is variable throughout the year (e.g., when agriculture is a main source of income), there are multiple income sources, there are many adults earning an income within the household, and income might consist of money, goods, or payments-in-kind. In comparison, there is likely to be less measurement error of

household income in countries where income is consistent throughout the year (e.g., salaried), income primarily comes from one form of employment, the household earners are likely to be solely comprised of one or two parents, and income is in monetary form only. The level of measurement error of household income is likely to vary across countries dependent on these factors. Measurement error in objective economic circumstances might be greater in low- and middle-income countries but lower in high-income countries, where income is more likely to remain stable throughout the year.

The second key methodological difference across countries refers to the time period that data collection was conducted in. The year of data collection for the outcome varied from 2005 (Mexico) to 2018 (Australia, the UK). Mexico in particular is an outlier, as six countries carried out the follow-up data collection between 2013 and 2018, whilst in South Africa the follow-up timepoint ranged from 2010 to 2017. Between 2005 and 2018, there has been significant economic, societal and technological changes that have impacted adolescents' lives. The global financial crisis that started in 2008 led to significant job losses, high unemployment rates, austerity policies, increases in economic inequality and worsening population health and health inequalities within countries (Chancel et al., 2022; Naik et al., 2019). There is evidence that the magnitude of economic inequalities in adolescents' mental health, including internalising symptoms, have increased in many countries in the previous decades (Elgar et al., 2015; Langton et al., 2011; McElroy et al., 2023). This could be potentially due to the global increase in economic challenges that have significant adverse impacts on parents and their children (Masarik & Conger, 2017).

There has been extensive effort in recent years to increase public awareness of mental health problems, particularly in high-income countries (Foulkes & Andrews, 2023). This has led to small improvements in mental health literacy and a reduction in mental health-related stigma (Sampogna et al., 2017; Schomerus et al., 2012). Adolescents might have higher levels of mental health literacy and better recognition of their own symptoms in countries where the corresponding longitudinal population studies were conducted more recently. This could also be the case in adolescents in the high-income countries of this study as there is increased awareness of mental health problems compared to low- and middle-income countries (Renwick et al., 2022). Adolescents in less recent longitudinal population studies in low- or middle-income

countries might have responded less accurately to the measures of internalising symptoms. Within countries this would have increased measurement error of the outcome and decreased the ability to detect an association. Additionally, there may be differential mental health literacy across different economic groups which could artificially conflate (if less wealthy adolescents comparatively underreport) or deflate (if less wealthy adolescents comparatively overreport) any association between economic circumstances and internalising symptoms within countries. Due to changes in society and mental health literacy over the past two decades, any cross-country differences might in fact represent period- rather than cohort-effects in cases where the surveys were conducted a long time apart.

There are further limitations of the study that also need to be considered when interpreting the results. First, interpretation of cross-country differences based on the results of the *Q*-tests should be taken with caution. *Q*-tests are typically underpowered to detect heterogeneity when there are only a few effect estimates within a meta-analysis. Consequently, there are some recommendations to use a 10% significance level instead of 5% (Berman & Parker, 2002). However, the *Q*-test is often overpowered to detect heterogeneity in meta-analyses of many effect estimates. The *Q*-test might indicate the presence of heterogeneity based on its *p*-value, but the heterogeneity itself may be an insignificant amount. The interpretation of the *Q*-tests are likely to be conservative in the context of this study given the small number of effect estimates (between four and six) within each meta-analysis and the use of significance testing at the 5% level. The greater evidence of between-country heterogeneity observed for household consumption expenditure could partially be driven by increased power to detect heterogeneity owing to there being six countries that measured consumption expenditure. In comparison, household income and subjective wealth were measured in four and five countries respectively. However, meta-analyses with larger numbers of countries included within them also have a greater likelihood of detecting cross-country differences owing to chance as more cross-country comparisons are made.

Second, the longitudinal population studies included within this study might have featured samples that were too small to detect cross-cross differences in the magnitude of the association. Analyses require significant power to detect interactions between different groups such as countries. The samples sizes may have been

sufficient to detect an association between economic circumstances and internalising symptoms within each country, but the precision of the effect estimates might have not been adequate to detect cross-country differences in the magnitude of the association. The ability to detect cross-country differences is limited in cases when the within-country effect of the exposure on the outcome is generally small (as was the case for household income and consumption expenditure) or the standard errors of country's effect estimates are large (as was the case for subjective wealth). In many cases, heterogeneity across countries was observed according to the I^2 statistic and the Q-test, but there was statistical evidence that the association differed between two countries in only a few cases. The sample size of some of the longitudinal population studies may have been too small to identify cross-country interactions, therefore increasing the likelihood that lack of evidence of differences in the magnitude between two countries could be due to limited power.

I also did not adjust for multiple comparisons. This study features eight different countries and three different exposures of interest leading to a large number of possible between-country comparisons. The stronger association between household consumption expenditure and internalising symptoms in Vietnam compared to South Africa and Mexico might be a product of chance. Adjustments such as Bonferroni corrections are often conservative which can increase the risk of Type II errors (Rothman, 1990). The method used to assess whether there were significant differences across countries in this study (identifying whether confidence intervals of each country's estimate overlap) has also been criticised for being conservative as there are conditions where this approach might not detect significant differences between estimates, but formal statistical testing could (Greenland et al., 2016). Regardless, any significant difference between countries should be interpreted with caution as they might be a property of chance.

Third, except for Mexico where the sample was drawn from the first wave of the MxFLS, all longitudinal population studies were subject to attrition prior to the data I analysed. Study attrition is typically greater in more vulnerable populations such as people living in absolute poverty. The samples within each country might not have been representative of adolescents from all economic backgrounds (Rothenbühler & Voorpostel, 2016). Except for the Young Lives studies (Ethiopia, India, Peru and Vietnam) the longitudinal population studies aimed to be nationally representative.

However, the longitudinal population studies are likely to be unable to capture all population groups within their samples. All sampling was carried out at the household-level for each longitudinal population study. Therefore, the samples may not include adolescents experiencing homelessness or living without stable housing at the time of study enrolment. The included longitudinal population studies are also unlikely to include the wealthiest households within each country (e.g., the wealthiest 1%) given that they are a small population group and are often less willing to take part in longitudinal population studies than the wider population (Schröder et al., 2020). It is possible that the effect estimates within each country could be upwardly or downwardly biased due to participant attrition and the sampling strategies that were used. This meant the samples are unlikely to capture the whole distribution of adolescents' economic circumstances within each country.

Fifth, I included eight countries from five different world regions, but I was unable to identify suitable longitudinal population studies from specific regions such as the Caribbean or Middle East. Furthermore, I found no country where there was evidence of a greater level of internalising symptoms in wealthier adolescents. In a cross-sectional study across Kenya, Indonesia and Vietnam, there was limited evidence regarding the association between adolescents' household wealth and prevalence of a mental disorder in the past 12 months (Erskine et al., 2024). However, in Kenya, mental disorders were most common in the 4th wealthiest quintile and were least common in the poorest quintile. Subsequently, this study is unlikely to capture the potential range of economic inequalities in adolescents' internalising mental health globally.

The study has several strengths. The use of longitudinal data temporally separates the exposure and outcome. I was also able to adjust for internalising symptoms at baseline in the analyses of change in internalising symptoms. This will have reduced the likelihood that estimates are primarily driven by reverse causality; where adolescents' internalising symptoms lead to their economic circumstances.

6.4.4 Conclusion

In this chapter I have described findings from a multi-country study providing evidence that the longitudinal association between adolescents' economic circumstances and internalising symptoms varies both between-countries and within-countries dependent on the measure of economic circumstances. As was the case with Chapter 4, the cross-country variability in economic inequalities in adolescents' mental health demonstrates the likely importance of societal context in how these inequalities are generated.

To the best of my knowledge, analyses within the study represent the first time the longitudinal association between economic circumstances and adolescents' internalising symptoms have been investigated within a number of the low- and middle-income countries; India, Mexico, Peru, South Africa and Vietnam. This study demonstrates the need for further research to identify the drivers and mechanisms of economic inequalities in low-income countries, given the observation that economic inequalities in adolescents' internalising symptoms were starker in these settings. The results also caution against using findings from one country to infer about another. The next study in my thesis examines whether adolescents' social relationships may be a mechanism through which their economic circumstances affect their future internalising mental health in Ethiopia, India, Peru and Vietnam.

7 Economic inequalities in adolescents' internalising symptoms across four countries: mediating roles of adolescents' positive relations with their parents and peers

7.1 Background

As shown in Chapter 3, the causal mechanisms through which economic circumstances might affect adolescents' internalising mental health are likely to be numerous and complex. In my systematic search, I identified only a single study that investigated whether causal mechanisms of the association between economic circumstances and internalising symptoms varied in strength across different countries. This is despite the fact that causal mechanisms represent two associations, the first between the exposure and mechanism, and the second, between the mechanism and outcome. These associations are both likely to be influenced and moderated by different contextual factors within countries meaning causal mechanism are likely to vary across contexts. The overarching implication is that causal mechanisms of the association between economic circumstances and internalising symptoms need to be investigated across multiple countries as mechanisms cannot be assumed to be universal across settings. Identifying causal mechanisms that are specific to countries would help increase understanding of how different contexts affects the development of economic inequalities in adolescents' mental health. Furthermore, it could help inform culturally appropriate strategies and interventions that could improve the mental health of adolescents living in poorer economic circumstances. Ultimately, increased awareness is vital to help reduce economic inequalities in adolescents' internalising mental health and consequently improve population mental health within countries (Maselko, 2017).

Chapters 2 and 3 identified significant research and theoretical interest regarding the role adolescents' social relationships with their parents and peers might have in the development of mental health problems in those living in poorer economic circumstances (Bukowski et al., 2020; Masarik & Conger, 2017). Adolescents' social relationships with their parents and peers have also been hypothesised as a potential causal mechanism through which receipt of cash transfer might lead to an improvement in adolescents' mental health (Evans-Lacko et al., 2023). Therefore, the

study in this chapter investigates adolescents' relations with their parents and peers within a mediation study of four low- and middle-income countries.

7.1.1 The mediating role of adolescents' relationships with their parents

The two most influential theories of economic inequalities in adolescents' health, the Family Stress Model of Economic Hardship and the Family Investment Model, theorise that parenting practices of adolescents' parents are causal mechanisms through which economic circumstances affect adolescents' outcomes (Duncan et al., 2017; Masarik & Conger, 2017). According to the Family Stress Model, economic disadvantage leads to heightened stress experienced by adolescents' parents. This stress is theorised to lead to increased conflict between parents and to fewer supportive and nurturing parenting behaviours towards their children, which has a negative impact on adolescents' emotional development and their mental health (Masarik & Conger, 2017). The Family Stress Model theorises no further mechanisms through which economic circumstances may impact adolescents' internalising symptoms. In comparison, parenting practices are one of many potential mechanisms theorised in the Family Investment Model (Duncan et al., 2017). Economic circumstances are theorised to impact the quality of resources an adolescent is provided, including the extent to which parents invest their time engaging with their children. Specifically, parents living in poorer economic circumstances are theorised to have less time to spend with their children as they are more likely to be the sole caregiver or work inflexible or non-standard working hours. In summary, parenting practices and adolescents' and parents' relationship with one another are plausible mechanisms through which economic circumstances might affect adolescents' internalising mental health.

According to the results of the systematic search in Chapter 3, there have been nineteen longitudinal studies that have assessed whether variables concerning adolescents' parents (e.g., parental mental health, parenting practices, parental conflict) mediate the association between adolescents' economic circumstances and their internalising symptoms. All but two studies were conducted in Europe or North America. The two studies outside of these regions analysed data from the cross-

national Parenting Across Cultures study featuring a range of low-, middle- and high-income countries.

As discussed in Chapter 3, the study by Zietz and colleagues (2022) found support for the Family Stress Model in eight of the ten cultural groups recruited from seven different countries. There was no supporting evidence for the Family Stress Model in the white American or Kenyan samples. The authors only adjusted for adolescents' gender and internalising and externalising symptoms at baseline, meaning the X-M, M-Y and X-Y associations might be biased as potential confounders such as household composition are not accounted for.

Further analyses of the Parenting Across Cultures study have used a pooled sample of adolescents drawn from all countries. The study investigated whether the association between adolescents' economic circumstances (perceived material deprivation reported by the household head and household income) and their internalising symptoms were mediated by parents' disciplinary practices (Schenck-Fontaine et al., 2020). Adolescents were followed up from age 8 to age 13, and data on the exposures, mediators and outcome was collected at each of the four waves. Both adolescents and their parents reported parents' disciplinary practices relating to physical and psychological aggression and adolescents' internalising symptoms. There was no evidence that physical or psychological aggression mediated the association between perceived material deprivation and internalising symptoms in the analyses using adolescent-reported measures of the mediators and outcome. There was evidence that parents' level of psychological aggression towards the adolescent partially mediated the association between perceived material deprivation and adolescents' internalising symptoms in the analyses using parent-reported measures (proportion mediated = 7.2%). There was no evidence that physical or psychological aggression mediated the association between household income and internalising symptoms, regardless of the measure-informant.

These two studies provide mixed evidence regarding whether factors relating to parenting partially mediate the longitudinal association between adolescents' economic circumstances and their internalising symptoms across a diverse range of countries. In the study by Zietz and colleagues (2022) there was support for the Family Stress Model in most but not all countries, demonstrating that causal mechanisms of

an association vary across countries. There was evidence in the pooled sample of adolescents across all countries that parents' level of psychological aggression towards the adolescent might partially mediate the association between perceived material deprivation and adolescents' internalising symptoms, but there was no evidence in analyses where household income was used to measure economic circumstances (Schenck-Fontaine et al., 2020). However, the design of the Parenting Across Cultures study features several limitations that could have influenced results. Adolescents were only eligible for the study if they were from the largest ethnic group in their country and attended school. Consequently, the country samples exclude adolescents who are likely to be living in poorer economic circumstances and could also have poorer mental health – ethnic minorities and adolescents not in school (Benjet et al., 2012; Das-Munshi et al., 2016; Imai et al., 2011; Putnick & Bornstein, 2015). This could have led to a selection bias affecting the associations between economic circumstances, parenting and internalising symptoms (Munafò et al., 2018). Sampling was carried out within one or two single regions within each country (i.e., a single city) further impacting the generalisability of the studies' findings.

As reported in Chapter 3, factors related to adolescents' parents, such as their mental health or interparental conflict, as well as their parenting practices have been found to mediate the longitudinal association between adolescents' economic circumstances and their internalising mental health. However, most studies have been carried out in high-income countries. Further research in low- and middle-income countries is needed to identify whether parenting factors might be a causal mechanism within the development of economic inequalities in adolescents' mental health in these settings.

7.1.2 The mediating role of adolescents' relationships with their peers

Factors regarding adolescents' parents have been widely theorised and investigated regarding whether they mediate the association between adolescents' economic circumstances and their internalising mental health. Significantly less attention has been given to the potential mediating role of adolescents' relationships with their peers. This is surprising given the importance of positive peer relationships for adolescents' personal, social and psychological development as well as their mental health

(Alsarrani et al., 2022; Foulkes & Blakemore, 2016; Sebastian et al., 2010; Tomova et al., 2021).

Five cross-sectional studies, four of which were carried out in China and one in the Republic of Korea, have investigated the potential mediating role of aspects relating to adolescents' relationships with their peers. In two studies there was evidence that living in poorer economic circumstances was associated with a greater likelihood of peer conflict or victimisation, which in turn was associated with increased psychological distress and internalising symptoms (Jiang, 2020; Lee et al., 2023; Wang et al., 2022). In two further studies, social support (a composite measure relating to support from classmates, parents and friends) mediated the association between living in poorer economic circumstances and increased internalising symptoms (C. Li & Zhang, 2023; Zou et al., 2020). As the mediator was not specific to support received from peers, the two studies do not provide clear evidence regarding whether the observed mediation was driven by adolescents' peer relationships or by social support from other sources. Furthermore, the study by Zou and colleagues (2020) adjusted for no confounders meaning that results are likely to be biased.

The cross-sectional nature of mediation studies to date limit conclusions regarding whether aspects of adolescents' relationships with their peers are a causal mechanism within the association between their economic circumstances and internalising mental health. The temporal ordering of the exposure, mediator and outcome cannot be ascertained meaning the results are likely to be biased (Maxwell & Cole, 2007). Biased mediation is particularly likely in cross-sectional studies of peer relationships given that mental health problems can impact adolescents' social functioning and their peer relationships (Kochel et al., 2012). To the best of my knowledge, no study has used longitudinal data to investigate whether adolescents' peer relationships mediate the association between their economic circumstances and internalising symptoms.

7.1.3 General limitations of evidence

The evidence base regarding whether adolescents' social relations with their parents or peers mediates the association between their economic circumstances and internalising symptoms has further limitations.

First, mediation analyses have not been carried out across multiple countries, except in the Parenting Across Cultures study. The broader societal and cultural context that adolescents are embedded in (i.e., countries) shapes and influences adolescents' interactions with others, such as their parents and peers, as theorised in the Ecological Systems Theory (Bronfenbrenner & Morris, 2006). Factors that vary across countries, such as culture, parenting norms and economic inequality, might influence the extent to which (a) economic circumstances are associated with adolescents' relationships with their parents and peers, and (b) adolescents' relationships with their parents and peers are associated with internalising symptoms. The association between negative parenting practices and mental health problems in adolescents is weaker in countries where physical disciplinary practices are more normative and commonly practiced (Gershoff et al., 2010; Lansford, 2022). As a result, the extent to which factors relating to adolescents' relationships with their parents or peers are a causal mechanism of the association between economic circumstances and adolescents' internalising symptoms are unlikely to be universal across countries. As shown in Chapter 3, most mediation studies have been carried out in a small number of high-income countries. Further research is needed in countries that are culturally and economically different from high-income countries to identify the causal mechanisms apparent in those contexts.

Second, studies have primarily investigated the mediating role of adolescents' relationships with their parents or peers in early- or middle-adolescence (Jiang, 2020; Lee et al., 2023; C. Li & Zhang, 2023; Schenck-Fontaine et al., 2020; Wang et al., 2022; Zietz et al., 2022; Zou et al., 2020). The strength of adolescents' relationships with their parents or peers as a causal mechanism within economic inequalities in internalising mental health might differ across adolescence. The nature of adolescent-parent relationships changes throughout adolescence; however, evidence of this is drawn from research in European countries and the US. In early-adolescence, aspects such as parental warmth, support and authority are high, but decrease throughout

adolescence (Hadiwijaya et al., 2017; Hafen & Laursen, 2009). By middle-adolescence, adolescent-conflict with parents peak (De Goede et al., 2009; Hadiwijaya et al., 2017). In late-adolescence, adolescent-parent relationships are more egalitarian and adolescents perceive greater relationship quality with their parents compared to middle-adolescence (Hadiwijaya et al., 2017; Meeus, 2016).

Adolescents also report changes in their relationships with their peers, with increases in friendship quality and intimacy throughout adolescence (McNelles & Connolly, 1999; Way & Greene, 2006). During adolescence, adolescents also develop an increased motivation for acceptance from and affiliation with peers and increasingly evaluate their own social and personal worth based on what other peers think about them. These changes coincided with reduced perceived importance regarding opinions from their family members (Foulkes & Blakemore, 2016; Larson & Richards, 1991; Sebastian et al., 2010). The extent to which adolescents' relationships with their parents and peers are a causal mechanism within the association between economic circumstances and internalising symptoms may vary across age groups, owing to differences in the nature of social relationships as adolescents develop. Research in late adolescence is warranted as the risk of developing internalising mental health problems, particularly depression, is greater compared to early- or middle-adolescence (M. Solmi et al., 2022). Existing research on social relationships as a causal mechanism linking economic circumstances to internalising symptoms is limited in this age group.

Third, no study has investigated both adolescents' relationships with their parents and peers within the same study. Conclusions from comparing different studies that have separately investigated either adolescents' relationships with their parents or with their peers can be false. Differences in study designs, samples or measures might instead explain any cross-study differences in the extent to which adolescents' relationships with their parents or with their peers may be a mediator. Studies that investigate both adolescents' relationships with their parents and peers enable cross-mediator comparisons that can inform whether different types of social relationships vary in the extent to which they are a causal mechanism within the association between economic circumstances and internalising symptoms. This would inform theoretical understanding of how economic inequalities in adolescents' mental health develop. This could also potentially indicate the most salient causal social mechanism that

could be targeted through intervention to reduce economic inequalities in adolescents' internalising mental health.

Fourth, past studies have primarily investigated the association between objective measures of economic circumstances and adolescents' internalising symptoms. The causal mechanisms linking economic circumstances to internalising symptoms might vary according to the measure of economic circumstances (Braveman et al., 2005). Findings from mediation studies of objective economic circumstances cannot be assumed to automatically translate to subjective measures of economic circumstances, and vice versa. This is shown in the sole longitudinal study that investigated parent-related mediators using both subjective and objective measures of economic circumstances. In the study parents' psychological aggression mediated the association when economic circumstances were measured subjectively but when measured not objectively (Schenck-Fontaine et al., 2020). To note, both measures were self-reported by adolescents' parents rather than by adolescents themselves. Further research using different measures of economic circumstances could identify different pathways through which objective and subjective economic circumstances affect mental health outcomes.

Fifth, no study has adjusted for intermediate confounders – variables caused by the exposure, and themselves cause the mediator and outcome, therefore confounding the mediator-outcome association. The lack of adjustment for intermediate confounders increases the likelihood that any observed mediation is the result of bias (Sheikh et al., 2016). Past studies are likely to provide biased estimates regarding the extent to which adolescents' social relationships might be a causal mechanism through which adolescents' economic circumstances affect their internalising mental health.

7.1.4 Study aims and hypotheses

In this study, I investigated whether adolescents' positive relations with their parents and peers mediate the longitudinal association between their objective and subjective economic circumstances and internalising symptoms in four low- and middle-income countries.

I hypothesised that in all countries, adolescents' positive relations with their parents would partially mediate the association between their objective (hypothesis 7.1) and subjective economic circumstances (hypothesis 7.2) and their future internalising symptoms. I further hypothesised that in all countries, adolescents' positive relations with their peers would partially mediate the association between their objective (hypothesis 7.3) and subjective economic circumstances (hypothesis 7.4) and their future internalising symptoms.

I also aimed to investigate whether there were differences between countries in the extent that adolescents' positive relations with their parents and peers mediated the association between adolescents' economic circumstances and their internalising symptoms. I further aimed to investigate whether adolescents' positive relations with their parents or peers mediate a greater proportion of the association within countries. I made no hypotheses regarding potential cross-country or cross-mediator differences in the extent to which adolescents' positive relations with their parents or peer may mediate the association between adolescents' economic circumstances and internalising symptoms, given the vast and complex reasons why mediators might vary within- and between-countries.

7.2 Methods

7.2.1 Dataset

I analysed data from the Young Lives cross-national longitudinal study. Young Lives has been carried out across Ethiopia, India (states of Andhra Pradesh and Telangana), Peru and Vietnam. Data relating to the exposures, mediators and outcome were measured when adolescents were aged 15 (T1), 19 (T2) and 22 (T3) respectively.

I analysed Young Lives data for two main reasons. First, the standardised methodologies and measures used within each of the Young Lives countries enable between-country comparisons of results from mediation analyses. This limits the likelihood that any differences in results could be driven by methodological differences across countries. Second, Young Lives features four low- and middle-income countries. There is a clear need to identify how economic inequalities in adolescents' mental health develop in these settings, evidenced by three main reasons. First, 90% of the world's adolescents live in low- and middle-income countries (Blum & Boyden, 2018). Second, evidence from Chapter 6 suggests that the association between adolescents' economic circumstances and their internalising symptoms might be greater in low- and middle-income countries. Third, most mediation studies that have investigated causal mechanisms within the association between adolescents' economic circumstances and their internalising mental health have been conducted in high-income countries. Findings may not translate to low- and middle-income settings. The Young Lives study is therefore a suitable dataset to investigate causal mechanisms through which economic circumstances may affect internalising mental health in countries where (a) most adolescents live, (b) economic inequalities in internalising mental health might be most stark, and (c) there is limited understanding of causal mechanisms.

7.2.2 Sample selection

For each country, the sample consisted of adolescents who attended data collection at T1, regardless of whether data on exposures, the outcome or confounders were available or missing and whether adolescents attended any further timepoints (i.e., T2 or T3).

7.2.3 Exposures

Economic circumstances were measured at T1 using the same measures used in Chapter 6 (section 6.2.3).

7.2.3.1 Household consumption expenditure

At T1, the household head reported annual household consumption expenditure in the previous year. Expenditure on food was not included in the measure. I log-transformed household consumption expenditure to improve model fit given a likely log-linear association with adolescents' internalising symptoms (Ecob & Davey Smith, 1999; Furnee et al., 2011).

7.2.3.2 Subjective wealth

I used adolescents' perceptions of their household's wealth based on a single item as a measure of subjective economic circumstances. I binarised the subjective wealth variable; (a) adolescents who viewed themselves as poor based on responses "destitute", "poor", or "never have quite enough, struggle to get by" and (b) adolescents who viewed themselves as comfortable or rich based on responses "comfortable – can manage to get by", "rich" and "very rich". These categories referred to "low" or "high" subjective wealth.

This approach contrasts to how I modelled the variable in the previous chapter. In Chapter 6, I rdit-transformed responses on this item so that the measure could be treated as a continuous variable within the analyses. When rdit-transforming a variable, rdit scores for each participant are assigned based on the distribution of responses on the item for the whole sample and are bound between 0 and 1. Rdit-transformation was not possible in this study due to the way variables are handled within the statistical approach used. In this study I analysed the data using a counterfactual framework. In the analyses of a continuous exposure the mediators and outcome are simulated based on the observed value of the exposure and the observed value of the exposure plus a value of 1. The modelling of any rdit-transformed exposure variable within the mediation analyses would violate the natural boundaries of the variable (0 to 1). A counterfactual value of a rdit-transformed variable greater than 1 is not theoretically possible. Results from analyses that compare the observed and counterfactual values of a rdit-transformed variable are likely to be

uninterpretable. In comparison, binary exposures within the analyses are simulated to take the value of either 0 or 1.

Categorical variables with more than two categories can also be modelled as exposures within the analyses. In these scenarios, separate comparisons are made between one reference group and each of the other categories within the subjective wealth item (e.g., carrying out separate comparisons between adolescents that reported “very rich” and adolescents that reported being (a) “destitute”, (b) “poor”, (c) “never have quite enough”, (d) “comfortable”, and (e) “rich”). Consequently, this approach might reduce statistical power and complicate cross-country comparisons due to the multiple effect estimates generated. Therefore, binarisation of the subjective wealth item is the most suitable approach in this study.

7.2.4 Mediators

Adolescents’ positive relations with their parents and peers were measured when adolescents were aged 19 (T2). These were assessed using the *parents* and *peer relationships* subscales of the Self-Description Questionnaire I and the Self-Description Questionnaire II respectively (H. Marsh et al., 1984). The Self-Description Questionnaires were developed to measure self-concept, concerning individuals’ perception of themselves. The parent and peer positive relations subscales have previously been used as measure of positive social relationships in analyses of all four countries in the Young Lives study (Pells et al., 2016).

The scales were originally developed in English and were translated for use in the Young Lives study. Each scale consists of eight items. Adolescents rated the extent to which they agree with each item on a 4-item Likert scale. A higher score on the parents and peer relationships subscale represents more positive relations with adolescents’ parents and peers, respectively.

7.2.4.1 Positive relations with parents

The scale was only administered to adolescents who had at least one living parent at T2. The items within the positive parent relations subscale captured adolescents’ perceived relationship quality with their parents. Example items include “I like my parents”, “my parents understand me” and “my parents and I have a lot of fun together”.

7.2.4.2 Positive relations with peers

The items within the positive peer relations subscale captured adolescents' perceived number of friends, their popularity with peers and their ability to get on with others their age. Example items include "I am popular with kids my own age", "I get along with other kids" and "I have lots of friends".

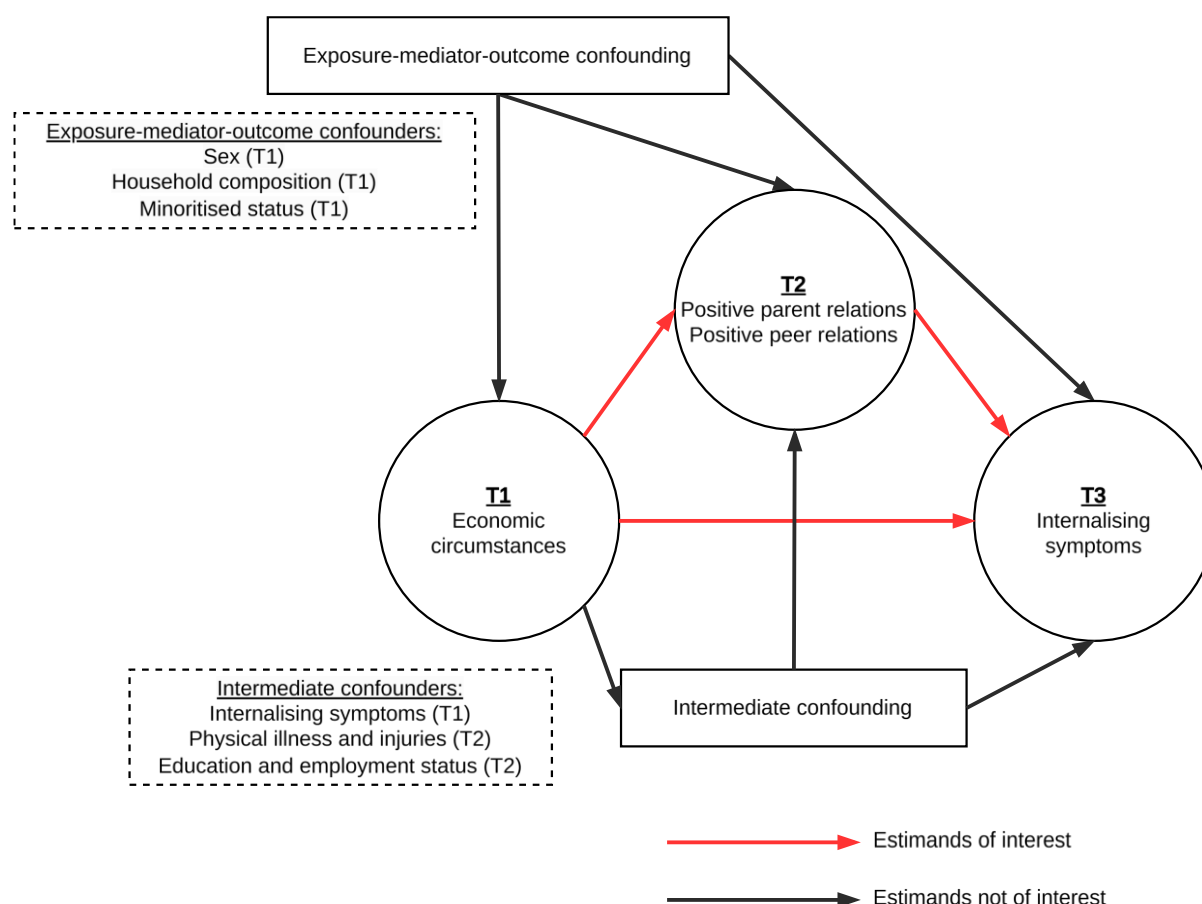
7.2.5 Outcome

Adolescents' internalising symptoms were measured using the SDQ-E when adolescents were age 22 (T3) (R. Goodman, 1997). The SDQ-E was originally developed in English and was translated for use in the Young Lives study. The scale consists of five items, with a higher score indicative of more severe internalising symptoms. Adolescents in the Ethiopian, Indian and Vietnamese samples rated the extent to which they agree with each item on a 4-item Likert scale. In Peru, adolescents responded on a 3-point Likert scale. I used standardised scores of the outcome within each country to enable cross-country comparisons despite the different scale ranges of the SDQ-E across countries.

7.2.6 Confounders

I controlled for several potential confounding variables measured at baseline (T1) and intermediate confounders measured at T2 (Figure 7.1). Confounder adjustment followed a harmonised approach where the same constructs were adjusted for in each country.

Figure 7.1. Conceptual model linking adolescents' objective and subjective economic circumstances with their internalising symptoms.



7.2.6.1 Baseline confounders

I adjusted for the same variables that were adjusted for in Chapter 6: adolescents' sex, household composition and country-specific measures of minoritised status (section 6.2.5). Evidence suggests all variables are associated with both adolescents' economic circumstances and their mental health outcomes (Amato, 2000; Campbell et al., 2021; Gupta & Coffey, 2020; Munoz Boudet et al., 2018; Stikkelbroek et al., 2016).

7.2.6.2 Intermediate confounders

I adjusted for several intermediate confounders: physical illnesses or injuries, education and employment status and internalising symptoms at baseline. I assumed these variables could be caused by adolescents' economic circumstances at T1 and also effect adolescents' future relations with their parents and peers as well as their future internalising symptoms.

7.2.6.2.1 Physical illnesses and injuries

Studies in low- and middle-income countries, including those using Young Lives data report that experiencing a serious illness or injury is a common antecedent of mental health problems across the life course, including in adolescence (Costa et al., 2020; Dessauvagie et al., 2020; Morrow et al., 2014; Tegethoff et al., 2016). The experiences of a serious or chronic illness or injury such as increased pain or fatigue and reduced mobility can limit adolescents' opportunities to socialise with peers or family. Experiencing a physical health problem, particularly if commonly stigmatised, can also increase the risk of bullying victimisation from peers (James et al., 2024; Pittet et al., 2010).

I controlled for two separate variables that indicated whether adolescents had experienced a serious illness or injury between T1 and T2. These were informed by two single-item measures that were measured at T2. The first measure assessed whether adolescents had experienced a serious illness between T1 and T2. Adolescents responded either "yes" or "no". The second measure assessed the number of times adolescents had experienced a serious injury between T1 and T2. For this measure I binarised responses. Any responses of zero were categorised as "no" and responses that indicated one or more times were categorised as "yes".

7.2.6.2.2 Education and employment status

In many countries, adolescents living in poorer economic circumstances are more likely to leave education early, primarily so that they can find work and help financially support their household (Putnick & Bornstein, 2015). Adolescents enrolled and attending education have more opportunities to socialise with peers and in turn might have more positive social relations in comparison to adolescents' that are no longer attending secondary or higher education (Gutiérrez-García et al., 2017). Adolescents who are no longer enrolled in education and are in paid work are likely to have fewer opportunities to socialise with peers, therefore negatively impacting the extent of their positive relations with peers (Gutiérrez-García et al., 2017; Presler-Marshall et al., 2021).

Additional years of education have been found to be associated with fewer anxiety and depressive symptoms in early-, mid- and later-life (Benjet et al., 2012; Bjelland et al., 2008; Kondirolli & Sunder, 2022). Adolescents in work may have comparatively

greater levels of internalising symptoms as they have missed out on further years of education or they might be exposed to low-skilled or precarious work that may be in unsafe conditions (Benjet, 2010; Benjet et al., 2012).

Adolescents who are neither in education or employment might have the least positive social relationships and the greatest levels of internalising symptoms. They may experience heightened social exclusion and a perceived failure to meet parental or societal expectations (Benjet et al., 2012). Studies in Bangladesh and Colombia have also found that adolescents who are studying and working at the same time have increased mental health problems, potentially due to the dual burden and stress of doing both activities simultaneously (Díaz et al., 2022; Izutsu et al., 2006).

I created two variables based on three items to adjust for adolescents' education and employment status at T2. I categorised adolescents' as being in education if they reported attending full- or part-time. I classed adolescents' as being in employment if they responded to either one of two items indicating they have done at least one hours paid work in the past week, or that they have a full- or part-time job.

7.2.6.2.3 Internalising symptoms at baseline

Adolescents' own internalising mental health might affect their relationships with their parents and peers, as well as impacting their future internalising mental health (Kochel et al., 2012). I adjusted for adolescents' internalising symptoms at baseline (T1) as measured with the SDQ-E.

I adjusted for internalising symptoms measured at baseline as an intermediate confounder, rather than internalising symptoms at T2 when adolescents' positive relations were measured as I assumed that adolescents' internalising symptoms at T2 may lie on the causal pathway between positive relations at T2 and internalising symptoms at T3. I also did not model internalising symptoms at T1 as a baseline confounder as I assumed internalising symptoms at T1 might lie on the causal pathway between adolescents' economic circumstances at T1 and their positive social relations at T2.

7.2.7 Analyses

7.2.7.1 Mediation analyses within the counterfactual framework

Traditional approaches to investigating mediation have several limitations, as discussed in Chapter 3. In most scenarios there is likely to be an interaction between the exposure and mediator (Valeri & VanderWeele, 2013). Traditional statistical approaches cannot model interactions which might lead to invalid inferences. Additionally, these approaches are also unable to adjust for intermediate confounders. Studies that use these approaches risk producing biased estimates of potential mediation. Findings might be driven by unaccounted confounding between the mediator and outcome by variables that are caused by the exposure.

I carried out mediation analyses using the counterfactual framework. This enabled the modelling of exposure-mediator interactions and adjustment of intermediate confounders. Analyses were counterfactual mediation using Monte Carlo simulation (Daniel et al., 2011). In these analyses all individuals are modelled to have a particular value of the exposure and realistic values of variables that are consequences of the exposure (intermediate confounders, mediators and the outcome) are simulated under different hypothetical scenarios.

The analyses provide three outputs. The first is the total causal effect. For cases where the exposure is continuous, the total causal effect refers to the difference between the mean value of the potential outcome if all individuals' value of the exposure was set to one value higher, and the mean value of the potential outcome if all individuals' value of the exposure was set to their observed value. For cases where the exposure is binary, it refers to the difference between the mean value of the potential outcome if all individuals were set as experiencing the exposure (i.e., high subjective wealth), and mean value of the potential outcome if all individuals were set as not experiencing the exposure (i.e., low subjective wealth). In this study, estimates of the total causal effect refer to the mean score on the SDQ-E in the whole sample that would change by X standard deviation units if household consumption expenditure was set to one unit higher, or if all adolescents had high levels of subjective wealth.

The second is the natural direct effect. The natural direct effect refers to the effect of the exposure on the outcome through pathways that do not involve the mediator(s). The natural direct effect is estimated in a similar way to the total causal effect; however,

the values of the mediator are the true observed values and are not simulated. In this study, estimates of the natural direct effect refer to the mean score on the SDQ-E in the whole sample that would change by X standard deviation units if household consumption expenditure was set to one unit higher, or if all adolescents had high levels of subjective wealth, excluding any pathways through adolescents' positive social relations.

The third is the natural indirect effect. The natural indirect effect refers to the effect of the exposure on the outcome solely through pathways that involve the mediator(s). It is the difference between the total causal effect and the natural direct effect. The natural direct effect is estimated through setting the mediator(s) to values it would have in the presence of being exposed and the values it would have if unexposed. Values of the baseline and intermediate confounders are held constant. In this study, estimates of the natural indirect effect refer to the mean score on the SDQ-E in the whole sample that would change by X standard deviation units if household consumption expenditure was set to one unit higher, or if all adolescents had high levels of subjective wealth, solely through pathways involving adolescents' positive social relations.

The proportion mediated (PM) can be calculated by dividing the natural indirect effect by the total causal effect. The PM refers to the percentage of the total causal effect that is through pathways involving the mediator(s). The PM therefore has no estimated standard error value. The PM can be negative which indicates the total causal effect and natural indirect effect are in opposing directions.

7.2.7.2 Reliability of the mediator and outcome measures

For each country, I estimated the Cronbach's alpha of the parent and peer subscales of the Self-Description Questionnaire at T2 and the SDQ-E which was used to assess internalising symptoms at T3 (R. Goodman, 1997; H. Marsh et al., 1984). I also conducted confirmatory factor analyses for the parent and peer subscales of the Self-Description Questionnaire in each country to assess whether the items were best explained by a single factor model. This established if total scores from the subscales would be suitable to use in the mediation analyses. These analyses used data before multiple imputation and only included adolescents within each country sample that had no missing data on the variable of interest.

7.2.7.3 Missing data

I accounted for missing data by using multiple imputation to reduce the impact of biased attrition and non-response. I used multiple imputation using chained equations prior to running the mediation analyses. Across all countries a total of 40 imputations were used. The imputation models followed the same approach as that used in Chapter 6 (section 6.2.6).

I included auxiliary variables within the imputation model to aid imputation of the outcome (White et al., 2011). Auxiliary variables were associated with adolescents' internalising symptoms and in some cases associated with whether data on internalising symptoms was missing or available (Appendix D). These auxiliary variables were specific to each country. I included the SDQ-E total score (measure of internalising symptoms) at T1 and T2 within the imputation models regardless of whether they were associated with the values of or missingness of the SDQ-E at T3. I also included a range of auxiliary variables that were associated with the measures of adolescents' positive relations with parents and peers in the imputation models of each country.

7.2.7.4 Primary analyses

I performed mediation analyses using g-computation formula to evaluate whether the association between adolescents' economic circumstances and their internalising symptoms was mediated by adolescents' positive relations with their parents and peers. I carried out the analyses in Stata 18 using the *gformula* statistical programme (Daniel et al., 2011). Values of the mediators, intermediate confounders and outcome were simulated through Monte Carlo simulations (10,000 simulations) under varying values of the exposures. Normal-based confidence intervals (CIs) were obtained using 50 bootstraps.

I ran three separate models that had different combinations of the mediators for each exposure (household consumption expenditure and subjective wealth) and country. The first model included both adolescents' positive relations with their parents and peers as mediators. I expected that adolescents' positive relations with their parents and their peers would be strongly correlated with one another as the two measures are likely to capture similar information regarding adolescents' social experiences. Inferences made if mediators are only modelled separately can overestimate the

extent to which adolescents' positive relations mediate the association between their economic circumstances and internalising mental health, given the likely co-variance between the two mediators. The conceptual overlap between both mediators might mean the PM in the analyses where both mediators are in the model is less than the sum of the PM of each mediator when analysed separately. I had no assumptions regarding the causal ordering between the two mediators. Therefore, I did not specify any sequential ordering of the mediators within the analyses. In the next stage, the mediation models were re-run featuring only one of the mediators.

In all analyses, I included an interaction between adolescents' economic circumstances and the mediator(s). Analyses were carried out across each of the 40 imputations. I then combined results from each imputation using Rubin's rules. In analyses where household consumption expenditure was the exposure, I converted the total causal effect, natural direct effect and natural indirect effect so that they represented a change in standardised internalising symptoms per doubling of household consumption expenditure (i.e., $b \cdot \ln(2)$).

I report the estimates of the total causal effect and natural indirect effect alongside their standard errors in the results section. I only report the PM in the main text in cases where there is certainty regarding the direction of the natural indirect effect, and therefore statistical evidence of mediation, except for the results of a sensitivity analysis. Presenting the PM where there is no evidence of mediation might be misleading as the PM has no measure of uncertainty. The PM is reported in Appendix D for scenarios where there is no evidence of mediation. The natural direct effect is reported in Appendix D only.

7.2.7.4.1 Comparisons across countries, exposures and mediators

I narratively discuss notable differences within- and between-countries informed by the magnitude of the natural indirect effect and the PM when suitable. The natural indirect effect will differ in the same country across the exposures. Therefore, cross-exposure comparisons are made using the PM only but only for cases where there is evidence of the natural indirect effect. I did not carry out any formal comparison tests.

7.2.7.5 Secondary analyses

For each country, I ran linear regression analyses to identify the association between each exposure with each mediator, and each mediator with internalising symptoms. This was to investigate potential reasons for differences in mediation across countries. Baseline confounders were adjusted for in the exposure–mediator regression analyses, and baseline and intermediate confounders and the exposures were adjusted for in the mediator–outcome regression analyses.

7.2.7.6 Sensitivity analyses

I performed three sensitivity analyses. First, I modelled adolescents' economic circumstances according to equivalised values of their household consumption expenditure. To calculate equivalised household consumption expenditure, I divided the total value by the square root of the household size. Results from the main analyses using raw household consumption expenditure and the sensitivity analyses using equivalised household consumption expenditure were compared.

Second, I re-ran the analyses of adolescents' positive relations with peers, but I included adolescents who were previously excluded from the main sample as they had no living parents. Excluding adolescents with no living parents may have led to bias within the mediation estimates, particularly the total causal effect. Adolescents who have lived in poorer economic circumstances in childhood or adolescence are likely to be an increased risk of having no living parents at T2, as parents are at a greater risk of serious illnesses, injuries and early morbidity (Di Cesare et al., 2013). In turn, this is likely to impact the risk of experiencing internalising mental health problems (Stikkelbroek et al., 2016). Therefore, having no living parents might lie on the causal pathway from poorer economic circumstances to higher levels of internalising symptoms. The total causal effects in the main analyses could be underestimated by excluding adolescents with no living parents, which in turn might impact the wider results of the mediation analyses. It is also possible that adolescents with no living parents live in poorer economic circumstances because of having fewer adults in the household that can work and earn. In this scenario, having no living parents is no longer on the causal pathway from economic circumstances to internalising symptoms. It could also be considered a confounder as it might be a direct cause of both adolescents' economic circumstances and their internalising symptoms

(Böckerman et al., 2023; Stikkelbroek et al., 2016). If this is the case, the exclusion of adolescents with no living parents in the main analyses might have had little impact on the total causal effect as I already adjusted for household composition in all analyses. Taken together, the temporal ordering of having no living parents and adolescents' economic circumstances is likely to be complex and variable for adolescents. Regardless, potential bias from excluding adolescents with no living parents cannot be discounted.

Third, I re-ran the main analyses without adjusting for the intermediate confounders (physical illnesses or injuries, education and employment status and internalising symptoms at baseline). None of the previous mediation studies that have investigated adolescents' relations with their parents or peers have adjusted for intermediate confounders. These studies are likely to overestimate the extent to which adolescents' positive relations mediate the association between their economic circumstances and internalising symptoms. Potential differences in results between past studies and this study, which adjusted for intermediate confounders, could be due to differences in the robustness of the analysis rather than reflecting potential differences in causal mechanisms across contexts.

7.3 Results

7.3.1 Descriptives

I analysed data of 3,529 adolescents (1,741 female [49.3%], 1,788 male [50.7%]) across four countries. Sample sizes ranged from 675 in Peru to 963 in Vietnam (Table 7.1). Attrition from T1 to T3 was highest in Ethiopia and lowest in India where 83.5% and 94.3% of the country samples within this study attended T3 respectively.

Table 7.1. Sample attrition through the study period.

Country	First wave of study (age 8)	T1 (age 15)	T2 (age 19)	T3 (age 22)
Ethiopia	1,000	931	869	777
India	1,008	960	936	905
Peru	714	675	629	597
Vietnam	1,000	963	870	886

N for T1, T2 and T3 refer to adolescents with at least one living parent at T2 that attended each respective timepoint.

The number of adolescents excluded from the study for not having any living parents was greatest in Ethiopia (n=42) and smaller in India (n=16), Peru (n=3) and Vietnam (n=3). Descriptive statistics for key variables are presented in Table 7.2.

Table 7.2. Descriptive statistics of key variables for adolescents in the main analyses (imputed samples).

	Ethiopia	India	Peru	Vietnam
T1				
<i>Gender</i>				
Male	51.6% (0.14)	49.1% (0.02)	53.3% (0.02)	49.5% (0.02)
Female	48.4% (0.14)	50.9% (0.02)	46.7% (0.02)	50.5% (0.02)
<i>Household composition</i>				
Father in household	68.4% (0.03)	88.5% (0.14)	69.8% (0.02)	92.9% (0.01)
Mother in household	88.1% (0.01)	96% (0.01)	90.8% (0.01)	96.9% (0.01)
<i>Subjective wealth</i>				
Low	35.9% (0.03)	36.9% (0.02)	26.5% (0.03)	17.2% (0.02)
High	64.1% (0.03)	63.1% (0.02)	73.5% (0.03)	82.8% (0.02)
Annual household consumption expenditure ^a (Median [IQR])	4,163 (2,640 to 7,237)	36,311 (24,444 to 56,515)	4,321 (2,461 to 8,826)	21,022 (12,474 to 33,897)
T2				
Positive relations with parents ^b	26.3 (0.15)	27.3 (0.20)	24.0 (0.19)	25.4 (0.16)
Positive relations with peers ^b	23.8 (0.18)	24.8 (0.16)	22.8 (0.19)	22.3 (0.11)
T3				
Internalising symptoms ^c	6.54 (0.14)	6.45 (0.19)	3.98 (0.13)	6.42 (0.10)

Mean (standard error) unless specified. ^aLocal currency units. Ethiopia = ETB. India = INR. Peru = PEN. Vietnam = VND in thousands. ^bRange: 8 to 32. ^cRange for Ethiopia, India and Vietnam: 0 to 15. Range for Peru: 0 to 10.

There was a moderate positive correlation between adolescents' positive relations with their peers and with their parents in each country (Ethiopia $r=0.44$; India $r=0.42$; Peru $r=0.31$, Vietnam $r=0.39$).

7.3.2 Reliability of mediator and outcome measures

The internal consistency of the SDQ-E was acceptable across all countries (Table 7.3). The Cronbach's alpha ranged from 0.62 for the SDQ-E in Ethiopia to 0.78 in India. The internal consistency of the parent and peer subscales of the Self-Description Questionnaire was acceptable across all countries. The Cronbach's alpha was greater than 0.7 for either subscale in all countries. Factor analyses identified that the parent and peer subscales of the Self-Description Questionnaire were best fitted by a single factor in all countries (Appendix D).

Table 7.3. Internal consistency of the Self-Description Questionnaire parent and peer relations subscales at T2 and the SDQ-E at T3 within each country.

	T2		T3
	Parent relations	Peer relations	Internalising symptoms
Ethiopia	0.74	0.78	0.62
India	0.81	0.79	0.78
Peru	0.82	0.81	0.76
Vietnam	0.81	0.74	0.68

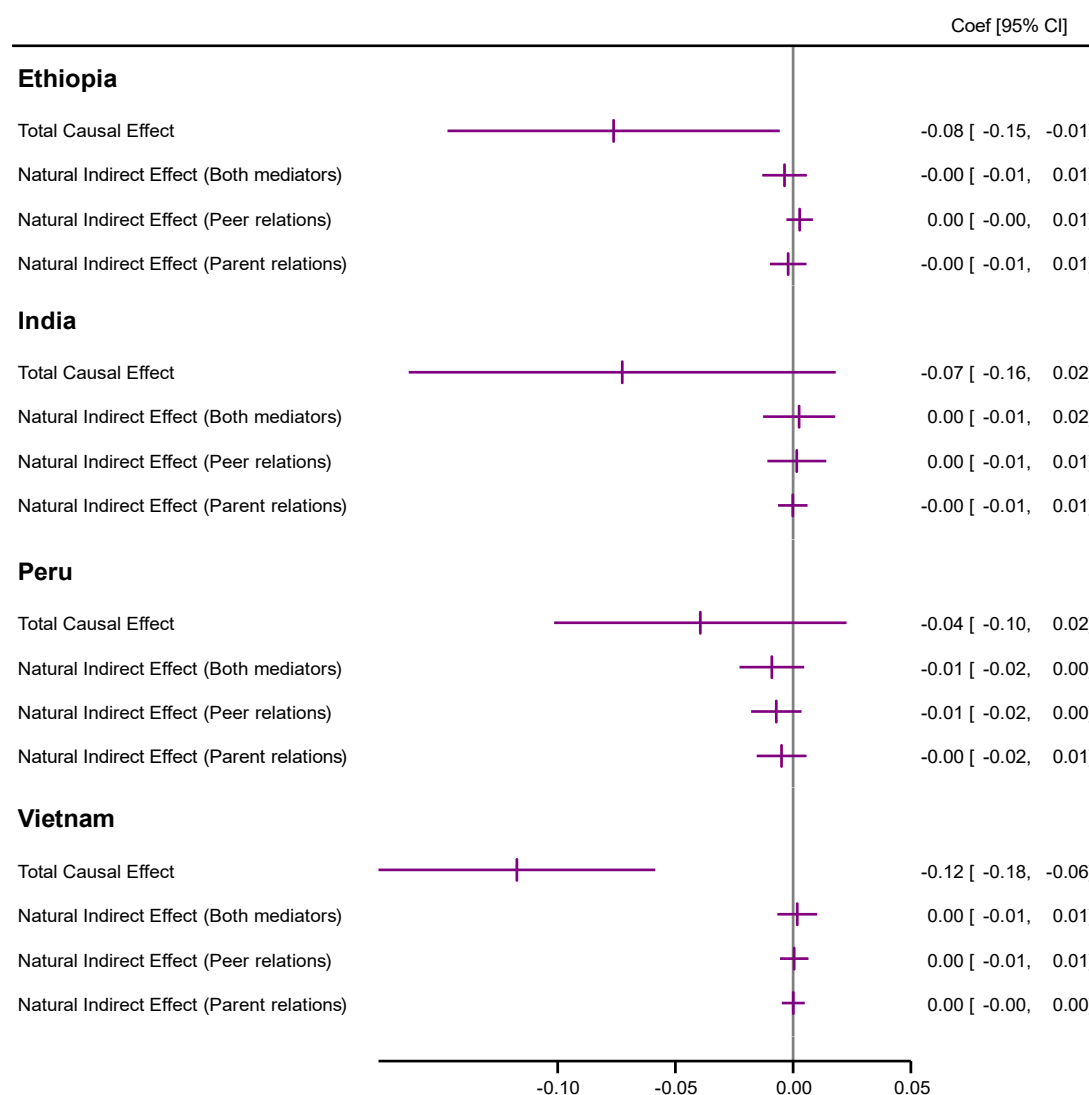
7.3.3 The association between household consumption expenditure and internalising symptoms: mediation through adolescents' positive relations with their parents and peers

The total causal effect was -0.076 (95% CI: -0.15 to -0.006) in Ethiopia and -0.12 (95% CI: -0.18 to -0.059) in Vietnam, which translates to a reduction in mean internalising symptoms at the population-level at T3 if adolescents' household consumption expenditure at T1 were doubled (Figure 7.2). The total causal effect was slightly smaller in India (0.073 [95% CI: -0.16 to 0.018]) and Peru (-0.039 [95% CI: -0.10 to 0.023]), and there was uncertainty regarding the direction of the total causal effect in both countries.

Based on the natural indirect effect for any combination of mediators, there was no evidence of mediation through adolescents' positive relations with their parents or peers in any country in analyses where household consumption expenditure was the exposure. In all cases, the natural indirect effect was close to the null and there was uncertainty regarding its direction. When both mediators were modelled together, the natural indirect effect was largest in Peru (-0.009 [95% CI: -0.023 to 0.0047]), but there appeared to be minimal variation across countries (Figure 7.2; Appendix D).

Within countries, there was minimal difference in the magnitude of the natural indirect effect across the different mediators. The most notable difference was in Peru where the natural indirect effect was slightly larger for analyses of positive peer relations (-0.0071 [95% CI: -0.018 to 0.0036]) in comparison to the natural indirect effect for positive parent relations (-0.0049 [95% CI: -0.016 to 0.0057]). There appeared to be no difference in the magnitude of the natural indirect effects for the different mediators in Ethiopia, India or Vietnam.

Figure 7.2. Total causal effect and the natural indirect effect of the association between household consumption expenditure and internalising symptoms, for analyses of (a) both mediators, (b) positive relations with parents, and (c) positive relations with peers.



Note: The total causal effect that is displayed is estimated from analyses where both mediators were included. There are negligible differences in the total causal effect between the different analytic models (mediators modelled together or separately) within each country.

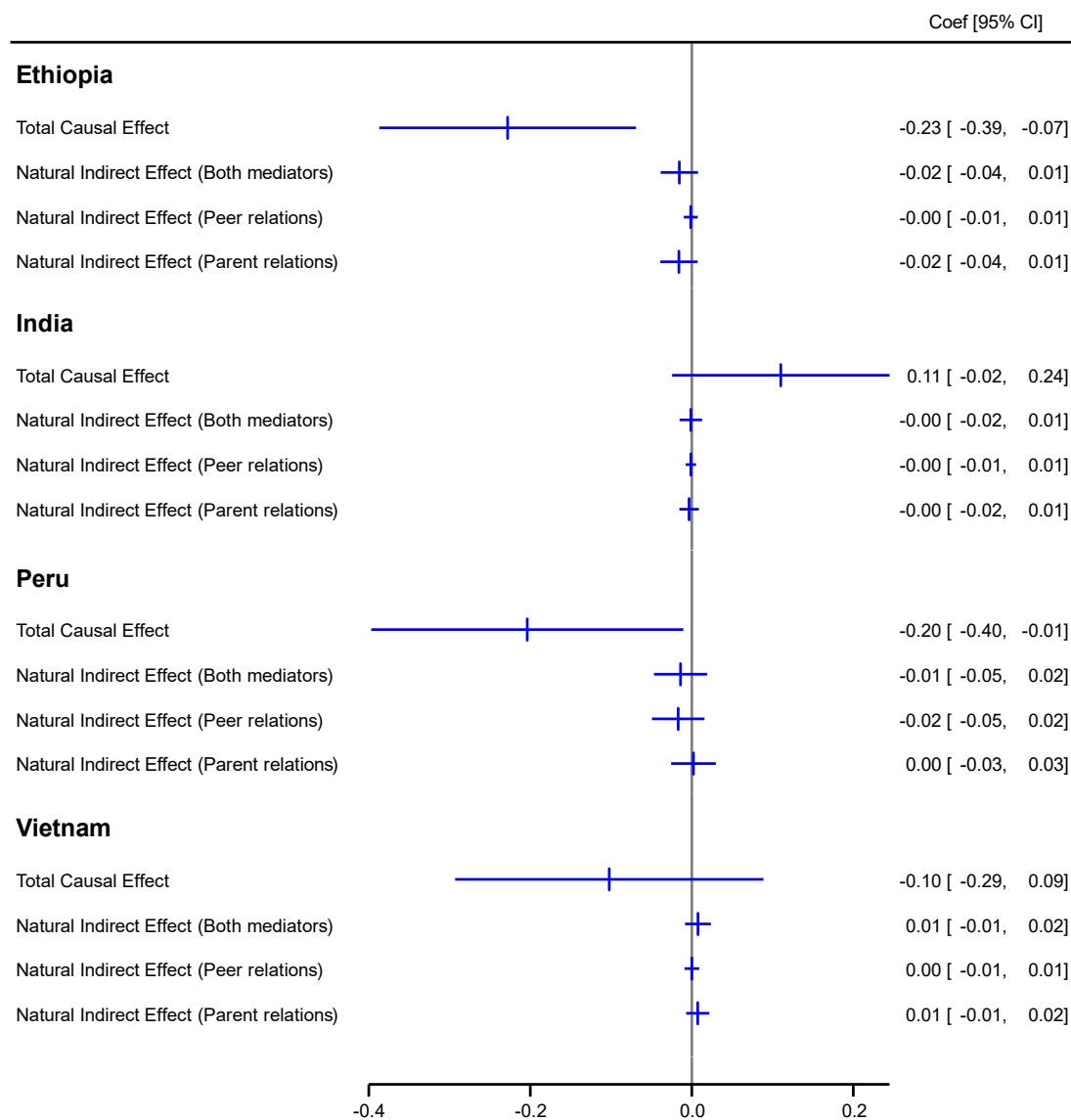
7.3.4 The association between subjective wealth and internalising symptoms: mediation through adolescents' positive relations with their parents and peers

The total causal effect was -0.23 (95% CI: -0.39 to -0.069) in Ethiopia and -0.20 (95% CI: -0.40 to -0.0011) in Peru, which translates to a reduction in mean internalising symptoms at the population-level at T3 if all adolescents had high subjective wealth at T1 (Figure 7.3, Appendix D). The total causal effect was smaller in Vietnam (total causal effect = -0.10 [95% CI: -0.29 to 0.090]) and had a positive direction in India (total causal effect = 0.11 [95% CI: -0.024 to 0.25]), which indicates a potential increase in mean internalising symptoms at the population-level at T3 if all adolescents had high subjective wealth at T1.

Based on the natural indirect effect for any combination of mediators, there was no evidence of mediation through adolescents' positive relations with their parents or peers in any country in analyses where adolescents' subjective wealth was the exposure. In all cases, the natural indirect effect was close to the null and there was uncertainty regarding its direction. The magnitude of the natural indirect effects when both positive parent and peer relations were included in the same model was largest in Ethiopia (-0.015 [95% CI: -0.039 to 0.008]) and Peru (-0.014 [95% CI: -0.047 to 0.019]) respectively. Regardless, there appeared to be minimal variation across countries (Figure 7.3; Appendix D).

Within countries, there was minimal difference in the magnitude of the natural indirect effect across the different mediators. In Ethiopia, the magnitude of the natural indirect effect for positive parent relations (-0.016 [95% CI: -0.039 to 0.0072]) was slightly larger than that for positive peer relations (-0.0013 [95% CI: -0.0099 to 0.0074]). In Peru, the magnitude of the natural indirect effect for positive peer relations (-0.017 [95% CI: -0.049 to 0.016]) was slightly larger than that for positive parent relations (0.0020 [95% CI: -0.026 to 0.030]). There appeared to be no difference in the magnitude of the natural indirect effects for the different mediators in India or Vietnam.

Figure 7.3. Total causal effect and the natural indirect effect of the association between subjective wealth and internalising symptoms, for analyses of (a) both mediators, (b) positive relations with parents, and (c) positive relations with peers.



Note: The total causal effect that is displayed is estimated from analyses where both mediators were included. There are negligible differences in the total causal effect between the different analytic models (mediators modelled together or separately) within each country.

7.3.5 Secondary analyses

There appeared to be differences in the magnitude of the association between adolescents' economic circumstances and their positive relations with their parents or peers across the four countries (Table 7.4). Living in wealthier economic circumstances (particularly subjective economic circumstances) in Ethiopia or Vietnam was associated with more positive relations with parents, however there appeared to be no association between economic circumstances and positive peer relations. The opposite was found was found in India. Living in wealthier economic circumstances was associated with more positive peer relations, but there was no association with positive parent relations. In Peru, increased household consumption expenditure was associated with more positive relations with both adolescents' parents and peers, however subjective wealth was associated with neither. There was uncertainty about the direction of most exposure-mediator associations and statistical evidence of an association was found in only four of the sixteen regression analyses.

Table 7.4. Linear regression coefficients for the association between adolescents' economic circumstances at T1 and their positive relations with their parents and peers at T2.

Country	Predictor variable	Outcome variable	Coefficient (95% CI)
Ethiopia	Household consumption expenditure	Positive parent relations	0.17 (-0.022 to 0.36)
	Household consumption expenditure	Positive peer relations	-0.030 (-0.22 to 0.16)
	Subjective wealth	Positive parent relations	0.49 (0.042 to 0.93)
	Subjective wealth	Positive peer relations	0.12 (-0.33 to 0.56)
India	Household consumption expenditure	Positive parent relations	0.078 (-0.14 to 0.30)
	Household consumption expenditure	Positive peer relations	0.26 (0.069 to 0.45)
	Subjective wealth	Positive parent relations	0.10 (-0.30 to 0.53)
	Subjective wealth	Positive peer relations	0.38 (-0.19 to 0.95)
Peru	Household consumption expenditure	Positive parent relations	0.22 (0.012 to 0.43)
	Household consumption expenditure	Positive peer relations	0.20 (0.020 to 0.38)
	Subjective wealth	Positive parent relations	-0.024 (-0.68 to 0.64)
	Subjective wealth	Positive peer relations	-0.020 (-0.035 to -0.004)
Vietnam	Household consumption expenditure	Positive parent relations	-0.005 (-0.21 to 0.20)
	Household consumption expenditure	Positive peer relations	-0.015 (-0.18 to 0.15)
	Subjective wealth	Positive parent relations	0.48 (-0.042 to 1.01)
	Subjective wealth	Positive peer relations	0.12 (-0.34 to 0.58)

Note: Coefficients for where household consumption expenditure is the predictor variable represent a change in the outcome variable per doubling of household consumption expenditure.

There also appeared to be differences in the extent to which adolescents' positive relations with their parents or peers were associated with their internalising symptoms across the four countries (Table 7.5). The association between increased positive relations with parents and peers and fewer internalising symptoms was greatest in

magnitude in Peru compared to all other countries. Across the other countries, there appeared to be only a small or null association between adolescents' positive relations with parents and peers and their internalising symptoms. There was uncertainty about the direction of the mediator-outcome associations in most countries. Statistical evidence of an association between adolescents' positive relations with their parents or peers and internalising symptoms was found only in Peru.

Table 7.5. Linear regression coefficients for the association between adolescents' positive relations with their parents and peers at T2 and internalising symptoms at T3.

Country	Predictor variable	Coefficient (95% CI)
Ethiopia	Positive parent relations ^a	-0.016 (-0.039 to 0.006)
	Positive parent relations ^a	-0.019 (-0.042 to 0.004)
	Positive peer relations ^b	-0.012 (-0.027 to 0.004)
	Positive peer relations ^b	-0.014 (-0.030 to 0.002)
India	Positive parent relations ^a	-0.010 (-0.024 to 0.004)
	Positive parent relations ^a	-0.014 (-0.036 to 0.006)
	Positive peer relations ^b	-0.003 (-0.021 to 0.014)
	Positive peer relations ^b	-0.007 (-0.031 to 0.018)
Peru	Positive parent relations ^a	-0.035 (-0.059 to -0.011)
	Positive parent relations ^a	-0.030 (-0.052 to -0.008)
	Positive peer relations ^b	-0.024 (-0.041 to -0.007)
	Positive peer relations ^b	-0.020 (-0.035 to -0.004)
Vietnam	Positive parent relations ^a	-0.005 (-0.031 to 0.021)
	Positive parent relations ^a	0.016 (-0.007 to 0.039)
	Positive peer relations ^b	-0.003 (-0.021 to 0.015)
	Positive peer relations ^b	0.011 (-0.005 to 0.027)

^aAdjusted for household consumption expenditure. ^bAdjusted for subjective wealth.

7.3.6 Sensitivity analyses

7.3.6.1 Equivalised household consumption expenditure

Results using equivalised household consumption expenditure were comparable to the main analyses that used the raw household consumption expenditure values (Appendix D). For India, Peru and Vietnam the magnitude of the total causal effect was slightly larger in analyses using equivalised values. The natural indirect effects remained similar for all countries and mediators.

7.3.6.2 Mediation through peer relations in samples including adolescents with no living parents

Results were broadly comparable for analyses of adolescents' peer relations regardless of whether adolescents with no living parents were excluded or included from the sample (Appendix D). In the sensitivity analysis of the Peru sample, the natural indirect effect regarding adolescents' positive peer relations was slightly smaller in magnitude in the analyses of household consumption expenditure (-0.005 [95% CI: -0.018 to 0.008]) and subjective wealth (-0.016 [95% CI: -0.047 to 0.025]).

7.3.6.3 No adjustment for intermediate confounders

The magnitude of the natural indirect effect was of slightly larger magnitude compared to the main analyses in several analyses where household consumption expenditure was the exposure in analyses where I did not adjust for intermediate confounders (Table 7.6). This was most apparent in Peru where the PM by adolescents' positive relations with their parents and peers was approximately 5 and 4 percentage points greater in the analyses that did not adjust for intermediate confounders compared to the main analyses. In all cases, there was still no evidence of mediation through any mediator as shown by the uncertainty of the natural indirect effect.

Table 7.6. Natural indirect effect and PM for pathways from household consumption expenditure to internalising symptoms, with and without adjustment for intermediate confounders.

Country	Mediators	With adjustment		Without adjustment	
		Natural indirect effect (95% CI)	PM (%)	Natural indirect effect (95% CI)	PM (%)
Ethiopia	Both	-0.0036 (-0.013 to 0.0058)	4.8	-0.0032 (-0.013 to 0.0063)	4.2
	Peers	0.0028 (-0.0029 to 0.0084)	-4.0	-0.000 (-0.0049 to 0.0043)	0.4
	Parents	-0.0021 (-0.0099 to 0.0057)	3	-0.0060 (-0.015 to 0.0025)	4.2
India	Both	0.0026 (-0.013 to 0.018)	-3.5	0.0026 (-0.016 to 0.021)	-3.5
	Peers	0.0016 (-0.011 to 0.014)	-2.0	0.001 (-0.015 to 0.017)	-1.0
	Parents	-0.000 (-0.0064 to 0.0061)	0.2	-0.0025 (-0.012 to 0.0066)	3.2
Peru	Both	-0.0090 (-0.023 to 0.0047)	22.9	-0.010 (-0.023 to 0.0033)	24.6
	Peers	-0.0071 (-0.018 to 0.0036)	16.6	-0.0089 (-0.019 to 0.0011)	21.7
	Parents	-0.0049 (-0.016 to 0.0057)	12.2	-0.0063 (-0.015 to 0.0026)	16.0
Vietnam	Both	0.0018 (-0.0067 to 0.010)	-1.5	0.0012 (-0.0039 to 0.0063)	-1.0
	Peers	0.000 (-0.0056 to 0.0065)	-0.4	-0.001 (-0.0040 to 0.0029)	0.5
	Parents	0.000 (-0.0048 to 0.0049)	-0.1	-0.000 (-0.0028 to 0.0025)	0.1

In analyses where subjective wealth was the exposure however, there was minimal impact on the magnitude of the natural indirect effect for any mediator after no longer adjusting for intermediate confounders (Table 7.7).

Table 7.7. Natural indirect effect and PM for pathways from subjective wealth to internalising symptoms, with and without adjustment for intermediate confounders.

Country	Mediators	With adjustment		Without adjustment	
		Natural indirect effect (95% CI)	PM (%)	Natural indirect effect (95% CI)	PM (%)
Ethiopia	Both	-0.015 (-0.039 to 0.0078)	6.8	-0.015 (-0.040 to 0.016)	6.7
	Peers	-0.0013 (-0.0099 to 0.0074)	0.6	-0.0017 (-0.010 to 0.0043)	0.7
	Parents	-0.016 (-0.039 to 0.0072)	7.0	-0.017 (-0.038 to 0.011)	7.3
India	Both	-0.0012 (-0.015 to 0.013)	-1.1	-0.0016 (-0.017 to 0.0099)	-1.5
	Peers	-0.0011 (-0.0075 to 0.0052)	-1.0	-0.0021 (-0.0094 to 0.0037)	-1.9
	Parents	-0.0034 (-0.015 to 0.0087)	-3.0	-0.0038 (-0.018 to 0.0073)	-3.5
Peru	Both	-0.014 (-0.047 to 0.019)	6.8	-0.014 (-0.053 to 0.016)	6.6
	Peers	-0.017 (-0.049 to 0.016)	8.2	-0.019 (-0.046 to 0.014)	9.4
	Parents	0.0020 (-0.026 to 0.030)	-1.0	0.0016 (-0.024 to 0.013)	-0.8
Vietnam	Both	0.0076 (-0.0084 to 0.024)	-7.5	0.0079 (-0.011 to 0.0069)	-8.1
	Peers	0.000 (-0.0091 to 0.0092)	-0.1	-0.001 (-0.010 to 0.0050)	0.6
	Parents	0.0074 (-0.0070 to 0.022)	-7.4	0.0065 (-0.0097 to 0.0083)	-6.8

7.4 Discussion

7.4.1 Summary

In this study, I analysed data from India, Ethiopia, Peru and Vietnam to investigate whether adolescents' positive relations with their parents and peers mediated the longitudinal association between their economic circumstances at age 15 and internalising symptoms at age 22.

I hypothesised that in all countries, adolescents' positive relations with their parents would partially mediate the association between their objective (hypothesis 7.1) and subjective economic circumstances (hypothesis 7.2) and their future internalising symptoms. I found no evidence that adolescents' positive relations with their parents mediated the association regardless of the measure of economic circumstances. Notably, there was only evidence in Ethiopia and Peru that living in wealthier economic circumstances was associated with more positive relations with parents in the secondary analyses. Experiencing more positive relations with parents was associated with fewer internalising symptoms in Peru only.

I further hypothesised that in all countries, adolescents' positive relations with their peers would partially mediate the association between their objective (hypothesis 7.3) and subjective economic circumstances (hypothesis 7.4) and their future internalising symptoms. I found no evidence that adolescents' positive relations with their peers mediated the association regardless of whether economic circumstances were measured objectively or subjectively. There was only evidence in India and Peru that living in wealthier economic circumstances was associated with more positive relations with peers in the secondary analyses. Experiencing more positive relations with peers was associated with fewer internalising symptoms in Peru only.

Overall, there was no statistical evidence of mediation through adolescents' positive relations with their parents or peers in any country. This meant I was unable to carry out within- and between-country comparisons using values of the proportion mediated. Comparisons were made through comparing the magnitude of the natural indirect effects only. There appeared to be minimal difference across countries in the extent of mediation by adolescents' social relations for any mediator, based on the natural indirect effect.

7.4.2 Interpretation

7.4.2.1 Adolescents' positive relations with their parents

The lack of evidence of mediation through adolescents' positive relations with their parents contrasts with other longitudinal studies that have investigated similar variables. The lack of mediation in this study might be due to differences in the study methodology used or the societal context of the countries within this study.

Regarding methodological differences, I used a general measure of adolescents' positive relations with their parents as a mediator. Other studies have predominately focused on the parenting practices or emotional difficulties of adolescents' parents. The choice of mediator within this study was informed by the Family Stress Model and the Family Investment Model, but no measures were available within the Young Lives study that directly captured the mediators hypothesised in these theories (e.g., parental mental health, parenting practices, parental involvement (Duncan et al., 2017; Masarik & Conger, 2017)). The measure used in this study, adolescents' positive relations with their parents, is likely influenced by factors such as parental mental health, parenting practices and parent involvement. Therefore, the measure is a potentially suitable proxy measure of these variables. However, a general measure of adolescent-parent relationships may be less influenced by economic circumstances and less impactful for adolescents' internalising mental health compared to the variables theorised in the Family Stress Model and the Family Investment Model. It is feasible that measures capturing more adverse experiences relating to adolescent-parent relationships might mediate the association between adolescents' economic circumstances and their internalising symptoms in the countries studied.

Additionally, the scale used to assess adolescents' positive relations with their parents was developed in Australia, a context that is societally and culturally different from the four countries in this study (H. Marsh et al., 1984). Consequently, the scale may not accurately measure adolescents' positive relations with parents in this study. Cultural aspects that are important in adolescent-parent relationships in the countries studied are not measured as part of the scale, such as parents' gender norms, parents' expectations regarding adolescents' education or employment, or shared faith and religious practices (Ortiz et al., 2023; Vermeer, 2014). In summary, the lack of evidence

of mediation through adolescents' relations with their parents could be driven by the mediator used in this study.

Another difference in methodologies between this study and past research is the age at which factors relating to adolescent-parent relationships and adolescents' mental health outcomes were measured. In this study, adolescents' positive relations with their parents were measured at age 19. Research, primarily in high-income countries, suggest that adolescents' relationships with parents are of greater quality and more egalitarian at this age compared to in early adolescence. In late adolescence, adolescents can also meet many of their own needs and carry out daily activities and tasks without parental support or involvement (Hadiwijaya et al., 2017; Meeus, 2016). In previous studies, factors relating to adolescent-parent relationships have been primarily measured in middle adolescence, when conflict with parents is at its peak and adolescents are not fully independent (De Goede et al., 2009; Hadiwijaya et al., 2017). Consequently, adolescents are less dependent on their parents as they age, and therefore their relations with their parents may be less important for their mental health in late adolescence. Furthermore, adolescents develop more adaptive ways to solve conflicts with parents as they become older (Van Doorn et al., 2011). These more positive conflict resolution skills have been found to moderate the association between adolescent-parent conflict and adolescents' internalising symptoms. Specifically, experiencing conflict with parents is more strongly associated with internalising symptoms in adolescents with maladaptive skills, which are more common in younger adolescents. There is a much smaller association between conflict with parents and internalising symptoms for adolescents who have more adaptive conflict resolution skills, that are more typical in older adolescents (Branje et al., 2009). The lack of association between adolescents' positive relations with their parents and internalising symptoms in three of the four countries in this study might be partially due to the sample consisting of older adolescents for whom positive relations with their parents has only a minimal impact on their internalising mental health. This may be due to older adolescents having more power in their relationship with their parents, as well as increased ability to handle any conflicts (Branje et al., 2009).

The final key methodological difference between this study and past literature refers to the analysis approach. I adjusted for intermediate confounders, whereas none of the previous mediation analyses did. Previous studies are likely to be biased and

overestimate the extent of mediation by parent-related factors. When I no longer adjusted for intermediate confounders, the magnitude of the natural indirect effect and the proportion mediated was greater in several cases compared to the main analyses. Despite this, there was still no evidence of mediation for any combination of exposures or mediators in any country. The null findings in this study cannot be fully explained using more robust methods in comparison to past studies. However, the findings from the sensitivity analysis demonstrate that intermediate confounders need to be accounted for in further research to produce less biased estimates of the natural indirect effect.

The null findings might reflect the context of the countries within this study. Adolescents' relations with their parents might be a less important mechanism through which economic circumstances affect their internalising mental health in contexts outside of Western, white-majority, high-income countries where the vast evidence supporting the Family Stress Model and the Family Investment Model originates. The weak association between adolescents' positive relations with their parents and their internalising symptoms in this study may be due to specific factors within countries that might buffer the negative impact of having less positive relations with parents. In the four countries studied, childrearing roles and responsibilities are often distributed across parents, grandparents, older siblings and other family members (Castro Torres et al., 2022). Any negative impact on adolescents' mental health owing to relationship difficulties with their parents might be buffered by strong social ties with other caregivers, extended family members and members of the local community. In comparison, nearly all caregiving for children and adolescents is carried out by their parents within a nuclear family in high-income countries in Europe and North America. In these countries, the extended family and local community only have a small role in childrearing (OECD, 2011). Consequently, adolescent-parent relationships might have a greater impact on adolescents' mental health in high-income countries compared to the countries in this study. This may be due to the larger role parents typically have in their upbringing and the fewer social ties with extended family members that might protect against the adverse effects of economic adversity and strained parental relationships.

7.4.2.2 Adolescents' positive relations with their peers

To the best of my knowledge, this study was the first to investigate whether factors linked to adolescents' peer relationships mediated the association between their economic circumstances and their internalising symptoms using longitudinal data. There was no evidence in this study that positive peer relations mediated the association between adolescents' economic circumstances and internalising symptoms in any of the four countries. The lack of evidence contrasts the findings of past studies.

All past studies have analysed cross-sectional data. Past findings could be upwardly biased and overestimate the extent to which peer-related factors act as a mediator, as the temporal order of the exposures, mediators, and outcome cannot be ascertained (Maxwell & Cole, 2007). Additionally, none of the cross-sectional studies adjusted for intermediate confounders. As shown in the sensitivity analysis, the lack of adjustment of intermediate confounders means the likelihood that adolescents' positive peer relations are a mediator is likely to be overestimated in these studies.

I had expected that adolescents' positive relations with their peers would be associated with fewer internalising symptoms in all countries. There is consistent evidence that peer victimisation and loneliness are associated with poorer mental health, whilst friendships and social support are associated with better mental health in adolescents, including in the countries studied (Alsarrani et al., 2022; Guillén Zambrano et al., 2024; Minh Dao et al., 2025). Only in Peru was there evidence of an association. The lack of association across the other three countries might be due to the measure that was used to assess adolescents' peer relations. The items within the measure primarily assessed the quantity of adolescents' friendships and did not feature the aforementioned factors known to be influential for adolescents' internalising mental health (H. Marsh et al., 1984). Studies, albeit all in the US, have found that friendship quality has a greater association with internalising symptoms compared to friendship quantity in adolescents (Demir & Urberg, 2004; Letkiewicz et al., 2023). The measure used in this study may not be widely associated with mental health problems in most contexts, meaning the lack of evidence of mediation might be driven by the measure used to assess adolescents' peer relations. It is feasible that measures capturing more positive or adverse social experiences relating to adolescents' relationships with their

peers could mediate the association between adolescents' economic circumstances and their internalising symptoms in the countries studied.

Studies to date are too few to meaningfully compare results across different societal contexts. The lack of uncertainty in the direction of the natural indirect effect in this study also reduces the ability to compare results between the four countries studied. Although I made no explicit hypotheses, I had anticipated that mediation through adolescents' positive peer relations might be greatest in Peru, the most economically unequal country within this study (World Bank, 2024b). Economic inequality within countries is linked to reduced social and community cohesion and can lead to increased social stratification within a population according to different levels of wealth (Schneider, 2019). Economic inequality may also reinforce wealth-based societal divisions and poverty-related stigma. This might potentially hamper poorer adolescents' ability to be accepted by wealthier peers and therefore negatively impact peer relationships (Bukowski et al., 2020). In economically unequal countries, the cost and accessibility of social activities are also likely to vary greatly, as the population will consist of wealthier households that can afford high levels of consumption and poorer households that cannot. Adolescents living in poorer economic circumstances will not be able to partake in expensive social events or activities, leading to stark differences in adolescents' opportunities to bond and connect with peers dependent on their economic circumstances. The strength of the association between higher levels of household consumption expenditure and more positive peer relations was of moderate magnitude in Peru (only in India was the magnitude larger). The association between richer subjective wealth and more positive peer relations was strongest in Peru compared to all other countries in this study.

7.4.3 Strengths and limitations

The study featured several limitations, some of which have already been mentioned. First, the measures used to assess adolescents' relationships with their parents and peers were general assessments. It is plausible that specific adverse social experiences such as negative parenting practices or bullying victimisation are more strongly associated with both adolescents' economic circumstances and their internalising symptoms in the countries studied (Bukowski et al., 2020; Masarik & Conger, 2017). These variables may be causal mechanisms through which

adolescents' economic circumstances affect their internalising mental health in these countries, but I did not investigate these due to data availability. Additionally, the measures of the mediators were constructed in a high-income country and their validity within the study context and relevance to the participants is unknown (Hapsari et al., 2023; H. W. Marsh et al., 1984). The potential lack of validity could have increased measurement error of the mediators.

Second, adolescents' perception of their subjective wealth was measured with a single item which I binarised. The binarisation may have aided the interpretability of the results but reduced the statistical power and possibly led to misclassification bias and therefore measurement error. Measurement error of both adolescents' subjective wealth and adolescents' positive social relations might have obscured any potential mediation due to regression dilution bias (Hutcheon et al., 2010). Due to potential measurement error of subjective wealth, the magnitude of the association between subjective wealth and adolescents' positive relations might be underestimated. Furthermore, the potential lack of validity of the measures of adolescents' positive relations in the countries studied could have led to high measurement error of the mediators. As a result, the association between adolescents' social relations and their internalising symptoms may be biased towards the null. In turn, this would have biased the natural indirect effect towards the null, consequently underestimating the extent of potential mediation by adolescents' positive relations in all countries.

Third, the study may have lacked sufficient power and precision to detect mediation effects within each country. In Peru, twenty-three percent of the association between household consumption expenditure and adolescents' internalising symptoms might be through pathways involving adolescents' positive relations with their parents and peers. However, the study did not detect statistical evidence of mediation despite the large magnitude of the PM, which should be interpreted as an approximation. The potential lack of statistical power is demonstrated when comparing the results of this study to the results of another which used the same statistical approach (counterfactual mediation using *gformula* and all continuous variables) but with a larger sample. In the analysis of over 13,000 adolescents from the MCS, the mediating role of body dissatisfaction in the longitudinal association between body mass index and depressive symptoms was investigated (Blundell et al., 2024). The proportion mediated was twenty-six percent and there was statistical evidence of mediation. In

comparison, there was no statistical evidence of mediation in the Peru sample in this study (n=675) despite the proportion mediated being of a similar magnitude (23%) to the proportion mediated (26%) reported by Blundell and colleagues (2024). In some cases, the null findings within this study could be partially due to the small sample size and resultant reduced statistical power to detect mediation within each country. I did not carry out any power analyses as approaches to determine the sufficient sample size needed to detect mediation with adequate statistical power are limited for counterfactual mediation analyses (VanderWeele, 2020). This is particularly the case for analyses that model intermediate confounders (Qin, 2023).

Fourth, the study included four low- and middle-income countries but did not investigate mediation in countries that are high-income or are in Europe and North America. This prevents the ability to compare findings across a diverse range of countries using standardised comparable methods. This reduces confidence that the differences between this study's findings and findings in past research in high-income countries are due to differences in contexts rather than methods. This is highlighted in the sensitivity analysis where, consistent with past studies, I did not adjust for intermediate confounders. As a result, the natural indirect effect increased in magnitude in a few cases, suggesting that cross-country differences in mediators might be partially due to differences in the robustness of methods across studies.

A strength of the study is the use of longitudinal data where the exposures, mediators and outcome were measured at separate timepoints, therefore reducing the potential impact of reverse causation on the findings. I adjusted for intermediate confounders, unlike previous studies in this area which are subsequently at a greater risk of bias.

7.4.4 Conclusion

In this chapter I have described findings from a longitudinal mediation study across Ethiopia, India, Peru and Vietnam. I found no evidence that either adolescents' positive relations with their parents or peers mediated the association between their economic circumstances and their internalising symptoms in any country. In these contexts, how economic circumstances affects mental health in adolescents is open to further research.

Past research and theory, primarily from high-income countries, propose that adolescents' social relationships with their parents and peers are an important causal mechanism through which economic circumstances impact their internalising mental health. This study demonstrates that this might not be the case in the low- and middle-income countries examined in this study.

8 General discussion

In this chapter, I first summarise the aims of my thesis and the findings of each study. Next, I discuss how my findings further current understanding of economic inequalities in adolescents' mental health. I then discuss the limitations of the research within my thesis. Following this, I discuss key considerations that are specific to multi-country research. Finally, I discuss the potential policy and research implications of the research in my thesis.

8.1 Summary of the aims and findings of my thesis

The aim of my thesis was to investigate the magnitude and mechanisms of economic inequalities in adolescents' mental health in multiple countries. I purposefully analysed data primarily from low- and middle-income countries, where most of the world's adolescents live yet awareness of economic inequalities in adolescents' mental health is limited (Blum & Boyden, 2018; Reiss, 2013; Rose-Clarke et al., 2024).

I first developed a conceptual model that proposed causal mechanisms through which adolescents' economic circumstances might impact their internalising mental health. I also analysed secondary data as part of three multi-country studies. In the first study, I investigated the cross-sectional association between food insecurity and suicidal thoughts and behaviours in 83 countries. In the second study, I investigated the longitudinal association between adolescents' economic circumstances and their internalising symptoms in a further eight countries. In the third study, I investigated whether adolescents' positive relations with their parents and peers mediated the longitudinal association between their economic circumstances and future internalising symptoms in four low- and middle-income countries.

Chapter 2 comprised a summary of the key theories of how health inequalities develop within a population. I discussed whether these theories are suitable for understanding how adolescents' economic circumstances could impact their internalising mental health.

I identified two key foundations that are considered prerequisites for health inequalities to be present in a population. The first foundation of health inequalities refers to the presence of social stratification in a population. This is where people differ in their status and societal privileges. Economic inequalities in adolescents' internalising

mental health can only exist in countries where adolescents' economic circumstances differ from one another. The second foundation of health inequalities refers to the presence of causal mechanisms through which social position directly impacts health. Most causal mechanisms that were proposed in the theories of health inequalities involved someone's social position influencing their access to health-promoting resources and the extent to which they are exposed to other determinants of ill health (differential exposure). Some theories proposed causal mechanisms where individuals with a lower social position had a greater susceptibility to the negative impact of the determinants of ill health (differential vulnerability). Therefore, economic inequalities in adolescents' internalising mental health can only be present if there are causal mechanisms through which adolescents' economic circumstances affect their internalising mental health. There might still be an association between economic circumstances and internalising mental health in the absence of the second foundation, but the association would be due to non-causal explanations such as confounding or social selection (Department of Health and Social Security, 1980).

I identified two theories of health inequalities that were specific to economic circumstances and children and adolescents: the Family Stress Model of Economic Hardship and the Family Investment Model. Both theories propose causal mechanisms through which economic circumstances might impact a variety of outcomes in adolescents, including health, educational and social outcomes (Duncan et al., 2017; Masarik & Conger, 2017). The proposed mechanisms primarily concern the parenting practices of adolescents' parents and the availability and quality of material resources that support child and adolescent development. Both theories propose causal mechanisms that are narrow in scope and neglect a range of other potential causal mechanisms such as those outside the immediate family or household.

All theories of health inequalities had limitations that impacted their usefulness in understanding how economic circumstances might affect adolescents' mental health. Most theories viewed health as a singular outcome, were developed by researchers from high-income countries in Europe and North America and focused on social position only. Except for the Family Stress Model of Economic Hardship and the Family Investment Model, the theories of health inequalities focused on inequalities in adults only (Duncan et al., 2017; Masarik & Conger, 2017). The theorised drivers of health

inequalities may not apply to internalising mental health, low- and middle-income countries, economic circumstances or adolescents.

Chapter 3 consisted of a systematic search of mediation studies and an expert consultation to map and categorise candidate causal mechanisms through which economic circumstances might impact adolescents' internalising mental health. Motivation for this chapter stemmed from the limitations of existing theories of health inequalities in explaining how economic inequalities in adolescents' internalising mental health develop. This study is the first review to systematically identify what variables have been investigated as potential mediators of the association between adolescents' economic circumstances and their internalising mental health.

I identified eighty-seven mediation studies in the systematic search. These studies investigated whether specific variables lie on the causal pathway from adolescents' economic circumstances to their internalising mental health. Mediation studies were primarily conducted in high-income countries and there were fewer in low- and middle-income countries. Studies from Africa and South America were especially limited. I did not formally appraise study quality, but many studies were cross-sectional and did not adjust for intermediate confounders. Studies could have overestimated any reported mediation of the association by the variables of interest due to these limitations. I also received suggestions of candidate causal mechanisms from 13 experts with interest in how economic circumstances affect mental health (out of the 34 I contacted via email). Candidate causal mechanisms were also proposed and discussed in an online meeting with six researchers based at University College London.

Based on the findings from the systematic search and expert consultation, I created a conceptual model outlining the potential pathways through which economic circumstances impact adolescents' internalising mental health. The conceptual model theorises complex bi-directional relationships between candidate causal mechanisms from six different domains: social, psychological, material, biological, environmental and behavioural.

Chapter 4 reports on a multi-country study that investigated the magnitude of inequalities in adolescents' suicidal thoughts and behaviours according to food insecurity status. This involved the analysis of cross-sectional data of over 300,000 school-going adolescents across eighty-three countries and dependent territories.

Experiencing food insecurity was associated with an increased risk of suicidal ideation (hypothesis 4.1), making a suicide plan (hypothesis 4.2) and attempting suicide (hypothesis 4.3) in the pooled sample of adolescents from all countries. The association between experiencing food insecurity and all three outcomes varied in magnitude across countries (hypotheses 4.4, 4.5 and 4.6). In most countries, but not all, there was evidence that food insecurity was associated with an increased risk of suicidal thoughts and behaviours. For some countries, the association was close to the null with no statistical evidence of an association.

I also investigated whether the magnitude of inequalities in adolescents' suicidal thoughts and behaviours according to food insecurity status varied across different quantitative indicators of country-level context. I hypothesised that being food-insecure would have a stronger association with experiencing suicidal thoughts and behaviours in countries that had greater levels of economic development as indicated by a country's GDP per capita (hypothesis 4.7). There was inconclusive evidence for this hypothesis. Food insecurity was more strongly associated with suicidal ideation in countries with greater GDP per capita in the meta-regression and mixed-effects analyses. Food insecurity was more strongly associated with making a suicide plan in high-income countries in the mixed-effects analyses only. There was no evidence that the association between food insecurity and attempting suicide varied across countries according to their economic development.

The association between food insecurity and increased risk of suicidal thoughts and behaviours was also stronger in magnitude in countries where food insecurity in school-going adolescents was less prevalent (hypothesis 4.10). Adolescents who experience food insecurity in national contexts where it is uncommon might experience greater levels of social disconnection and perceived burdensomeness as a result. This might increase the likelihood that food-insecure adolescents experience suicidal thoughts and behaviours, leading to more stark inequalities in suicidal thoughts and behaviours according to food insecurity status.

The strength of the association between food insecurity and suicidal thoughts and behaviours did not vary according to the level of income inequality within countries (hypothesis 4.8) or according to the proportion of a country's health expenditure that is out-of-pocket (hypothesis 4.9). Contrary to my hypothesis, being food-insecure had

a greater association with an increased risk of suicidal thoughts and behaviours in countries that had greater levels of universal health coverage (hypothesis 4.9). This finding was primarily explained by co-occurring low levels of food insecurity within countries that had high levels of universal health coverage.

Chapter 5 summaries the designs of the longitudinal population studies that are analysed in subsequent chapters and the search and selection process of these studies.

Chapter 6 is a multi-country study investigating the longitudinal association between three measures of economic circumstances and future internalising symptoms. Data were drawn from five longitudinal population studies carried out in eight countries: Australia, Ethiopia, India, Mexico, Peru, South Africa, the UK and Vietnam. Economic circumstances were measured with objective measures (household income and household consumption expenditure) and a subjective measure concerning adolescents' perceived wealth.

I found evidence that greater levels of objective or subjective economic circumstances were associated with fewer internalising symptoms at follow-up in some countries, but not all (hypothesis 6.1). After adjustment for internalising symptoms at baseline, there was evidence that greater levels of objective or subjective economic circumstances were associated with a greater reduction in internalising symptoms in some countries (hypothesis 6.2).

Adolescents' subjective perception of their household's wealth explained greater variance of future internalising symptoms compared to objective measures of economic circumstances in four of the five countries which measured both forms of economic circumstances (hypothesis 6.3). The variance of future internalising symptoms explained by subjective wealth reduced substantially in two countries after adjustment for internalising symptoms at baseline. As a result, adolescents' subjective wealth explained greater variance of future internalising symptoms compared to measures of objective economic circumstances in only two of the five countries. This was contrary to my hypothesis (hypothesis 6.4).

I found evidence that the association between adolescents' objective economic circumstances, as indicated by household income and consumption expenditure, and their future internalising symptoms varied in magnitude between countries (hypothesis

6.5). There was no evidence that the association between adolescents' subjective wealth and future internalising symptoms varied across countries.

After adjustment for internalising symptoms at baseline, I found evidence that the association between adolescents' household consumption expenditure and future internalising symptoms varied across countries (hypothesis 6.6). There was no evidence that the association between adolescents' household income or subjective wealth and future internalising symptoms varied across countries after adjustment for internalising symptoms at baseline.

Chapter 7 consisted of mediation analyses across Ethiopia, India, Peru and Vietnam. Motivation for this study stemmed from the lack of research that has investigated causal mechanisms of the association between adolescents' economic circumstances and their internalising mental health in low- and middle-income countries, as identified in Chapter 3.

I investigated whether adolescents' positive relations with their parents and peers mediated the longitudinal association between their economic circumstances and future internalising symptoms in each country. Contrary to my hypotheses, the study found no evidence in any country that adolescents' positive relations with their parents or peers were a mediator of the association (hypotheses 7.1, 7.2, 7.3 and 7.4). This null finding was apparent when economic circumstances were measured objectively or subjectively. The results contrast to findings from past studies in high-income countries that are contextually different from the countries within this study.

8.2 Themes throughout my thesis

In the following section I discuss key findings that emerged from my thesis. Where relevant I refer to how these findings fit with the broader literature.

8.2.1 The generalisability of economic inequalities in adolescents' mental health across countries

As theorised in the Ecological Systems Theory, the wider macro-level context that adolescents are embedded in influences their development (Bronfenbrenner & Morris, 2006). How adolescents' economic circumstances are associated with their mental health might be influenced by the societal context that they live in. I found that the magnitude of the association between economic circumstances and mental health outcomes is not consistent across countries. This was observed for the cross-sectional association between food insecurity and suicidal thoughts and behaviours (Chapter 4) and the longitudinal association between objective economic circumstances (household income and household consumption expenditure) and internalising symptoms (Chapter 6).

Previous studies have found heterogeneity in the association between adolescents' economic circumstances and psychosomatic symptoms, but these studies used cross-sectional data from countries primarily in Europe (Dierckens et al., 2020; Elgar et al., 2015; Weinberg et al., 2021). These studies could be biased, and findings might not generalise to other world regions. My thesis suggests that economic inequalities in adolescents' internalising mental health vary across diverse countries from multiple world regions. This heterogeneity is evident in analyses of longitudinal data that are more suited to identifying potential causal relationships compared to cross-sectional analyses. There was also evidence in my thesis that the magnitude of these associations differed according to quantitative indicators of country-level context.

8.2.1.1 Variation according to countries' level of economic development and the prevalence of the exposure

There is a lack of mental health research in adolescence in low- and middle-income countries. This is particularly apparent for studies that feature samples that are representative at the national level (Erskine et al., 2024; Reiss, 2013). In the absence of local research in these countries, awareness of the determinants of adolescents'

mental health are sometimes drawn from high-income countries that differ in economic development and by a variety of cultural and societal factors. The magnitude of economic inequalities in adolescents' mental health varied according to the economic development of countries in Chapters 4 and 6.

In Chapter 4, there was evidence that the association between experiencing food insecurity and the risk of suicidal ideation was greater in countries with higher levels of economic development according to continuous values of GDP per capita. I also found evidence that the magnitude of the association between experiencing food insecurity and the risk of making a suicide plan was greater in high-income countries in the mixed-effects analyses only. These findings are partly consistent with a past study that modelled economic development according to World Bank income classifications. In the study by Mahumud and colleagues (2022), there was evidence that the associations between severe food insecurity and suicidal ideation, and severe food insecurity and making a suicide plan were stronger in lower-middle-income countries compared to low-income countries. There was no evidence of variation across the other World Bank income classifications. Finally, I found no evidence that the association between experiencing food insecurity and the risk of attempting suicide varied according to countries' level of economic development. The null finding replicated two past studies that modelled countries' economic development according to World Bank income classifications (Koyanagi et al., 2019; Probst et al., 2021).

In Chapter 6, the association between living in poorer objective economic circumstances and increased internalising symptoms appeared stronger in the low-income countries compared to the high-income countries. I used no statistical tests to investigate this, and inferences were made based on observing the magnitude of the associations in different countries. The finding is consistent with cross-sectional analyses of the HBSC study, where economic inequalities in adolescents' psychosomatic symptoms were greater in European and North American countries with lower levels of economic development as indicated by GNI per capita (Elgar et al., 2015). However, two further studies have reported no evidence that the association between adolescents' economic circumstances and their internalising symptoms differed across countries' levels of economic development as indicated by GDP per capita or World Bank income classifications (Schenck-Fontaine et al., 2020; Weinberg et al., 2021).

The study in Chapter 6 is the first to investigate economic inequalities in adolescents' internalising mental health across multiple countries using longitudinal data. Furthermore, comparisons are made between countries of varying economic development from multiple world regions. This contrasts to analyses of the HBSC study, where comparisons have been made across economically similar countries primarily from Europe and North America. Compared to past studies, the measures of objective economic circumstances differed across countries according to World Bank income classifications. Household consumption expenditure was measured in the low- and middle-income countries and household income was measured in the middle- and high-income countries. The assumption that findings from analyses of each measure of economic circumstances are sufficiently comparable to one another may not hold (Friedman, 1957). This limits the confidence one can draw from the finding that economic inequalities in internalising mental health differed across country income-levels.

Interestingly, findings differed between Chapters 4 and 6. The cross-sectional association between experiencing food insecurity and suicidal thoughts and behaviours was greater in magnitude in countries with greater levels of economic development. However, the longitudinal association between adolescents' objective economic circumstances and internalising symptoms was greater in magnitude in countries with lower levels of economic development.

The magnitude of economic inequalities in adolescents' mental health also varied according to the extent of food insecurity and absolute poverty in adolescents within countries – experiences that are negatively correlated with countries' economic development. In Chapter 4, the association between experiencing food insecurity and increased prevalence of suicidal thoughts and behaviours was greater in countries where food insecurity was rare. This finding was consistent with my hypothesis which was informed by the theory of relative deprivation and by Durkheim's theories of suicide (Durkheim, 1951; Runciman, 1966). The phenomenon in which an adverse exposure is more strongly associated with worse health outcomes in settings where the exposure is rare has been termed the *healthy context paradox* (Salmivalli, 2018). In theory, mental health at the population-level should be better in contexts where there are fewer stressors that are negative for mental health outcomes. Yet, in some scenarios, the negative impact of experiencing an adverse exposure on adolescents'

mental health is commonly greater in populations where adverse exposures are rare (Gershoff et al., 2010; Odigie et al., 2024).

I found the opposite pattern in Chapter 6. The association between living in wealthier objective economic circumstances and reduced internalising symptoms was stronger in the countries with lower GNI per capita. Internalising mental health should be worse at the population-level in low-income countries as more adolescents are exposed to severe economic disadvantage compared to high-income countries. Contrary to the healthy context paradox, the association between experiencing economic disadvantage and more severe internalising symptoms was greater in low-income countries where absolute poverty is more common compared to high-income countries. Living in poorer economic circumstances is likely to be more detrimental for adolescents' mental health in low-income countries as they experience more adverse material stressors as a result of their economic disadvantage (Poole et al., 2013). In comparison, adolescents living in poorer economic circumstances in high-income countries may be considered relatively poor, but they are unlikely to be living below a financial threshold where basic life necessities cannot be secured (i.e., absolute poverty) (Salmeron Gomez et al., 2023).

In summary, I found that food insecurity had a stronger association with the risk of suicidal thoughts and behaviours in high-income countries where food insecurity in adolescents is uncommon. This could be due to the psychological and social effects of food insecurity being potentially greater in settings where it is rare and therefore an indicator of marginalisation and a reduced standard of living within a country. In comparison, I found that poorer objective economic circumstances had a stronger association with greater levels of internalising symptoms in countries with a lower GDP per capita and where absolute poverty is more prevalent compared to high-income countries. This may be because living in poorer economic circumstances in low-income countries, compared to in high-income countries, predisposes adolescents to more severe disadvantages that have a negative effect on adolescents' internalising mental health.

This discrepancy in findings between chapters could be due to differences in the exposures (food insecurity vs. objective economic circumstances), the outcomes of interest, the study design, the approaches to analyses, the type of effect estimates

produced (prevalence ratios vs. linear coefficients) or the specific countries included in each study. Alternatively, they may indicate that how contextual factors influence inequalities in adolescents' mental health varies dependent on the exposures or outcomes of interest. There is support for the latter explanation in one analysis of the HBSC study. Economic inequalities in adolescents' psychosomatic symptoms were greater in countries with high income inequality when economic circumstances were measured according to ownership of assets (Weinberg et al., 2021). However, economic inequalities in adolescents' psychosomatic symptoms were greater in countries with low levels of income inequality when economic circumstances were measured through adolescents' subjective perception of their wealth. In the same study, differences in how economic circumstances were measured led to contrasting findings regarding how economic inequalities in adolescents' internalising mental health varied across an indicator of country-level context.

However, the reasons for the differing findings in my thesis cannot be established without further multi-country research that investigates economic circumstances, food insecurity, internalising mental health problems and suicidal thoughts and behaviours in the same samples within countries. Regardless, both Chapters 4 and 6 demonstrate that the magnitude of the association between indicators of adolescents' economic circumstances and mental health outcomes is variable according to countries' level of economic development. Findings from high-income countries are unlikely to be generalisable to low- and middle-income countries or to contexts where being food insecure or living in poorer economic circumstances is experientially different.

8.2.1.2 Variation according to countries' level of economic inequality

It is theorised that economic inequality within countries either increases or reduces the magnitude of economic inequalities in health. According to the income inequality hypothesis, the association between living in poorer economic circumstances and heightened mental health problems may be stronger in countries where there are large economic inequalities between adolescents. This might be due to negative social comparisons and status anxiety that are heightened in economically unequal countries. For adolescents living in poorer economic circumstances, negative social comparisons with wealthier peers are proposed to lead to perceptions of inferiority, shame and distrust and increased stress reactions and therefore an increased risk of

internalising mental health problems (Layte, 2012; Pickett & Wilkinson, 2015; Schneider, 2019).

In contrast, the mixed neighbourhood hypothesis theorises the association between living in poorer economic circumstances and heightened mental health problems might be less stark in countries with higher levels of economic inequality. Populations that consist of much wealthier individuals compared to the rest of the population, and thus have high economic inequality, are theorised to lead to greater investments in health-promoting public infrastructure. These health-promoting services and infrastructures are theorised to benefit the entire population regardless of an individual's economic circumstances and may reduce economic inequalities in health as a result (Tibber et al., 2022).

In Chapter 4, there was no evidence that the magnitude of the association between experiencing food insecurity and adolescents' suicidal thoughts or behaviours differed according to the Gini index of income inequality in countries. In Chapter 6, the association between adolescents' economic circumstances and their internalising symptoms were typically smallest in the countries that were the most economically unequal; Mexico and South Africa. Subsequently, I found no support for the income inequality hypothesis and limited support for the mixed neighbourhood hypothesis. These processes might have both been present, but their effects on the magnitude of economic inequalities in adolescents' mental health may have cancelled each other out.

The findings of my thesis contrast to cross-sectional analyses of high-income countries in Europe and North America. Two studies found that the association between adolescents' wealth and psychosomatic symptoms was stronger in countries with higher levels of economic inequality (Dierckens et al., 2020; Elgar et al., 2015). A further study found support for both the income inequality hypothesis and the mixed neighbourhood hypothesis dependent on how adolescents' economic circumstances were assessed (Weinberg et al., 2021). The relationship between country-level economic inequality and the association between economic circumstances and adolescents' mental health might not extend to low- and middle-income countries.

8.2.2 The generalisability of causal mechanisms through which economic circumstances impact adolescents' internalising mental health

In Chapter 3, I identified 87 mediation studies that investigated causal mechanisms through which adolescents' economic circumstances might impact their internalising mental health. These studies were predominantly conducted in high-income countries. Notably, close to half of all mediation studies were carried out in North America.

There has been an overwhelming focus on adolescent-parent relationships as a potential causal mechanism through which economic circumstances impact their internalising mental health within mediation studies. This dominance of research on causal mechanisms that are social in nature is primarily a consequence of the Family Stress Model. Support for the model has been routinely found in high-income countries for a variety of different mental health outcomes. Consequently, the role of parenting practices and parental stress in the development of economic inequalities in adolescents' outcomes are generally accepted in these countries (Masarik & Conger, 2017).

I did not investigate the exact variables that are theorised as causal mechanisms in Family Stress Model owing to data availability. However, my mediation study that investigated adolescents' relations with their parents and peers as potential causal mechanisms was strongly informed by it. I found no evidence that adolescents' positive relations with their parents or peers mediated the association between their economic circumstances and their future internalising symptoms in Ethiopia, India, Peru and Vietnam. The lack of evidence suggests that some causal mechanisms that have well-established theory and empirical evidence in high-income countries, like adolescent-parent relationships, might be less relevant in low- and middle-income countries.

Chapter 3 highlights that there is a lack of research on causal mechanisms that might be more important in low- and middle-income countries. Based on the results of a systematic search of mediation studies and expert consultation, I constructed a model that featured six domains of causal mechanisms: social, psychological, material, biological, environmental and behavioural. Social mechanisms might be important in high-income countries as evidenced by support for the Family Stress Model (Masarik & Conger, 2017). However, causal mechanisms from the other domains could be more

important in low- and middle-income countries. As previously discussed, starker economic inequalities in adolescents' internalising mental health in low-income countries, as found in Chapter 6, might be due to the increased exposure to more adverse material stressors for adolescents living in poorer economic circumstances in those countries (Poole et al., 2013). Biological mechanisms may also be more important in low- and middle-income countries, owing to the greater prevalence of severe physical health problems that are associated with living in poverty (e.g., HIV, undernutrition, poor sexual health) and reduced access to health care (Patton et al., 2016). In contrast, social mechanisms might be more important in high-income countries where material deprivations are less extreme.

My thesis suggests that different contexts might affect how internalising mental health problems develop in adolescents in response to exposure to economic disadvantage. Therefore, theories of health inequalities which primarily draw on research from high-income countries may not be applicable in low- and middle-income countries as the causal mechanisms through which economic circumstances affect health outcomes may differ across countries. This is particularly the case for adolescent-specific theories that propose causal mechanisms that are commonly social in nature and neglect candidate causal mechanism from other domains (Conger & Donnellan, 2007; Duncan et al., 2017; Masarik & Conger, 2017).

8.2.3 The generalisability of economic inequalities in adolescents' mental health across different measures of economic circumstances

My thesis indicates that economic inequalities in adolescents' internalising mental health vary according to how economic circumstances are assessed. In Chapter 6, the association between adolescents' economic circumstances and their internalising symptoms varied according to whether economic circumstances were measured objectively or subjectively. In analyses that did not adjust for baseline internalising symptoms, adolescents' subjective perception of their wealth explained greater variance of future internalising symptoms than objective measures of economic circumstances did in most countries. This study replicates the findings of studies in high-income countries with the analysis of longitudinal data in low- and middle-income countries (McLaughlin et al., 2012; Rivenbark et al., 2020; Weinberg et al., 2019).

The stronger association between subjective economic circumstances and internalising symptoms could be because subjective assessments might be more precise measures of economic circumstances compared to objective indicators. In Chapter 6, the correlation between adolescents' objective and subjective economic circumstances was generally weak within countries, demonstrating that adolescents' objective economic circumstances and how they perceive them are often disparate and that each measure might be capturing different aspects of adolescents' living standards. The hierarchical nature of subjective measures mean they capture both relative and absolute aspects of adolescents' economic circumstances, unlike objective measures, which in turn might be more consequential for adolescents' mental health (Singh-Manoux et al., 2005). Subjective measures of economic circumstances might also be more accurate than objective measures as they are likely to be influenced by past, present and anticipated future economic circumstances and are less influenced by short-term changes and fluctuations (Netemeyer et al., 2018).

The stronger association between subjective economic circumstances and adolescents' internalising mental health compared to when economic circumstances are measured objectively could also reflect different processes through which they impact adolescents' internalising mental health (Braveman et al., 2005; Ding & Huang, 2024). I intended to investigate whether causal mechanisms relating to adolescents' social relationships differed across objective and subjective measures of economic circumstances in Chapter 7; however, cross-mediator comparisons were not possible. Alternatively, differences in economic inequalities in adolescents' internalising mental health across different measures might be due to the extent of common method bias.

Common method bias refers to the artificial covariance between two variables that are measured using the same self-report methods, such as using the same respondent or data collection procedure (Podsakoff et al., 2024). This can lead to artificial covariation between participants' responses and subsequently inflate associations between variables. In the context of my thesis, the associations between adolescents' food insecurity and suicidal thoughts and behaviours and adolescents' subjective wealth and their internalising symptoms could be overestimates as the variables were all self-reported by adolescents. Objective economic circumstances were reported by the household head in Chapters 6 and 7 meaning the association with adolescent-reported internalising symptoms is not influenced by common method bias.

The potential artificial covariance could occur for several reasons including social desirability bias (adolescents want to appear wealthy and mentally healthy), acquiescence bias (the tendency for participants to agree with all statements), or adolescents' emotional states influencing whether their self-perceptions are positive or negative (Podsakoff et al., 2024). Adolescents' perceptions of their food insecurity or economic circumstances might be influenced by their mental health at the time of self-report. Adolescents with internalising mental health problems commonly have systematic cognitive biases that result in interpreting themselves or events as overly negative (Orchard et al., 2017). Self-reports of perceived wealth by adolescents with heightened internalising symptoms, particularly for measures that have a comparative element, could be overly negative and an inaccurate reflection of their economic circumstances. As a result, the association between adolescents' subjective wealth and their internalising mental health is likely to be explained by internalising symptoms causing lower perceptions of subjective wealth, as well the reverse (subjective wealth impacting internalising symptoms).

The extent of common method bias can be partially investigated from observing differences in the longitudinal association between adolescents' economic circumstances and their internalising symptoms before and after adjusting for symptoms at baseline. In Chapter 6, subjective wealth explained greater variance of future internalising symptoms compared to objective measures of economic circumstances prior to adjustment of baseline symptoms in four of the five countries where both were measured. After adjustment for internalising symptoms at baseline, this trend was no longer apparent. Adolescents' subjective wealth then explained greater variance of internalising symptoms than objective economic circumstances in only two of the five countries. The finding suggests that after adjusting for adolescents' internalising symptoms that were measured at the same timepoint they made a subjective assessment of their wealth; subjective wealth had a much smaller association with future internalising symptoms.

This finding is consistent with a past study that investigated the extent to which common method bias might account for the association between subjective measures of socio-economic status and internalising symptoms (Rivenbark et al., 2020). The cross-sectional association between UK adolescents' self-reported subjective socio-economic status and anxiety and depressive symptoms was stronger in magnitude

when symptoms were reported by adolescents themselves compared to when symptoms were reported by adolescents' parents, which eliminates the possibility of common method bias. However, the difference in the strength of the association between the two measures might not be due to the differences in common method bias, but due to differences in the accuracy of reporting mental health symptoms between adolescent- and parent-informants which may impact resultant effect estimates (Aebi et al., 2017; Booth et al., 2023; Gaete et al., 2018; Johnston et al., 2014). As such, the study does not provide conclusive evidence of the role common method bias might have in explaining subjective economic inequalities in adolescents' internalising mental health.

Strong associations between adolescents' subjective economic circumstances and internalising mental health in past cross-sectional studies might be driven by common method bias (McLaughlin et al., 2012; Weinberg et al., 2019). Accurate estimation of the association between adolescents' subjective wealth and internalising mental health may only be possible using longitudinal data that allows for the adjustment of baseline symptoms. Others have argued that adjusting for health at baseline might underestimate the association between subjective wealth and health outcomes, as baseline health may be on the causal pathway from subjective wealth to future health (Adler et al., 2000). Even after adjusting for baseline internalising symptoms in Chapter 6, associations between living in poorer economic circumstances and greater internalising symptoms remained in many cases. The attenuation of coefficients towards the null, particularly for analyses of subjective wealth, indicate that some of the association between adolescents' subjective economic circumstances and their internalising mental health could be driven by common method bias.

In summary, my thesis found that the magnitude of economic inequalities in adolescents' internalising mental health is dependent on whether economic circumstances are measured objectively or subjectively. This might be due to differences in how different forms of economic circumstances affect internalising mental health, the different aspects of economic circumstances and living standards that the measures capture or the presence of common method bias in the analyses of subjective economic circumstances but not in analyses of objective economic circumstances.

8.3 Limitations of my thesis

In the following section I provide an overview of the limitations present throughout my thesis. Specific strengths and limitations of each individual study were described in their corresponding chapters.

8.3.1 Age of adolescents when economic circumstances were measured

The findings in my thesis could be influenced by the age adolescents were when their economic circumstances were measured. Inequalities in adolescents' mental health were estimated according to their economic circumstances or levels of food insecurity during adolescence. Countries' samples within Chapter 4 consisted of adolescents between the ages of 11 and 18. Therefore, food insecurity was assessed between these ages. In Chapter 6, adolescents' economic circumstances were measured at a timepoint between the ages of 14 and 17 dependent on the country. In Chapter 7, economic circumstances were measured at age 15 in all four countries.

Studies in Europe and the US have shown that inequalities in internalising mental health emerge in childhood and are apparent before the onset of adolescence (Cadman et al., 2024; Vallejo-Torres et al., 2014; Wickrama et al., 2009). There is also mixed evidence that the cross-sectional association between economic circumstances and internalising mental health is strongest during childhood but weakens throughout adolescence, a phenomenon known as *equalisation* (Emerson et al., 2006; Vallejo-Torres et al., 2014; Ward & Viner, 2018; Wickrama et al., 2009). Adolescents' mental health is therefore potentially less impacted by their current economic circumstances compared to the impact that is experienced in younger children. It is theorised that this may be due to adolescents having greater autonomy from their parents and increased social mixing with peers, which might reduce the importance of economic circumstances on mental health outcomes (West, 1997). Furthermore, economic disadvantage in childhood, a critical period for neurological development, can impact the development of the neural functions and structures that have a significant influence on future cognitive, social, emotional and health outcomes (Jensen et al., 2017; Noble et al., 2015). Therefore, economic disadvantage in adolescence has fewer consequences on neural development and potentially mental health.

The potential impact of measuring food insecurity in adolescence rather than in childhood on the findings of Chapter 4 is unclear, as there is limited research on the association between food insecurity and suicidal thoughts and behaviours in childhood as suicide is rare at this age (Bertolote & Fleischmann, 2002). However, the associations between adolescents' economic circumstances and their internalising mental health in Chapters 6 and 7 may be weaker in magnitude than if economic circumstances had been measured in childhood.

The association between living in poorer economic circumstances and increased internalising symptoms could be an artefact of persisting economic circumstances and internalising mental health problems from childhood. In Chapters 6 and 7, internalising symptoms might have developed prior to adolescence and the measurement of economic circumstances. A longitudinal study in the US found that adolescents who experienced poorer economic circumstances at the time of their birth had greater levels of internalising symptoms at age 15 (McFarland, 2017). This association was driven by the impact that poorer economic circumstances had on internalising symptoms at earlier timepoints in childhood. Economic inequalities in adolescents' internalising mental health were primarily a result of the continuation of poorer economic circumstances and worse internalising mental health that was first experienced in childhood. In my thesis, the associations between adolescents' economic circumstances and their mental health could be spurious and driven by the experience of both poorer economic circumstances and mental health problems in childhood that persist into adolescence.

8.3.2 Modelling of economic circumstances

I modelled adolescents' economic circumstances at a single timepoint in all studies in my thesis. This was primarily due to data availability within the datasets analysed. Measurements of objective economic circumstances at a single timepoint are influenced by short-term fluctuations. As a result, the measures may not accurately capture long-term economic circumstances that are likely to be more influential for adolescents' development and mental health compared to transient economic circumstances that the single timepoint measures may be capturing.

Modelling economic circumstances based on data from multiple timepoints may have more accurately captured adolescents' economic circumstances (Cutuli et al., 2024).

Subjective measures of economic circumstances at a single timepoint might be more accurate than single timepoint measures of objective economic circumstances, as perceptions of subjective wealth are likely to be influenced by past, present and anticipated future economic circumstances (Netemeyer et al., 2018). Regardless, economic circumstances that are measures at a single timepoint are likely to be subject to greater measurement error. This could have led to bias or reduced the precision of the associations between adolescents' economic circumstances and their mental health.

By modelling economic circumstances solely as a static construct, my thesis neglects the potential impacts of household economic volatility on adolescents' mental health. This is problematic as significant income losses within households are associated with worsening internalising mental health in adolescents and thus income volatility is an important social determinant of mental health (P. Miller et al., 2021). An alternative approach where trajectories of economic circumstances are mapped across childhood and adolescence could have more accurately captured the complexity of the association between adolescents' economic circumstances and their mental health (Cutuli et al., 2024).

8.3.3 Confounding

I adjusted for several variables that might confound the association between adolescents' economic circumstances and their mental health in all studies. In the mediation analyses in Chapter 7, I also adjusted for intermediate confounders that might be caused by adolescents' economic circumstances and themselves affect their positive relations with their parents and peers and internalising mental health.

The decisions I made regarding what variables to adjust for and the use of a harmonised approach to confounder adjustment might have led to bias in the within-country associations. The specific variables that confound the association between adolescents' economic circumstances and their mental health may not be consistent across countries. Consequently, the extent of residual confounding and the likelihood of over-adjustment might vary across the countries in the empirical studies. This might have led to artificial cross-country differences in the magnitude of economic inequalities in internalising mental health and suicidal thoughts and behaviours.

8.3.3.1 Harmonised approach to confounder adjustment

I used a harmonised approach to confounder adjustment throughout my thesis. This involved adjusting for the same constructs with the most suitable variables that were available in the dataset of each country.

I did not use an approach where confounder adjustment varied across countries based on country-specific assumptions regarding what might confound the association between adolescents' economic circumstances and their mental health. Such an approach would require sufficient and comparable awareness of the confounders in each country. This is not the case as mental health research and awareness of confounders of the association between adolescents' economic circumstances and their mental health is limited in low- and middle-income countries (Reiss, 2013). A country-specific approach to confounder adjustment in Chapter 6 would also have been dependent on the data that was available in each longitudinal population study, which was highly variable between countries. As a result, a country-specific approach would have meant there would be differences in the robustness of confounder adjustment across countries. This might have led to artefactual cross-country differences in the magnitude of the association between adolescents' economic circumstances and their internalising mental health.

However, the harmonised approach to confounder adjustment that I used throughout my thesis is not without issues. The confounders adjusted for were primarily informed by research conducted in high-income countries. I may have accurately identified and adjusted for confounders apparent in the high-income countries, but I could have missed key confounders that are relevant in the low- and middle-income countries analysed in my thesis. In all chapters, it is likely that the associations between economic circumstances and mental health outcomes could be biased due to residual confounding. The extent of bias due to unmeasured confounders might vary across countries and could be greatest in the low-and middle-income countries. This impacts the inferences that can be drawn from any cross-country differences in economic inequalities in adolescents' mental health.

Additionally, the specific variables I adjusted for could have led to overadjustment within the analyses for some countries. As an example, I adjusted for whether adolescents' parents lived in the adolescent's household in Chapters 6 and 7. I had

assumed that parents' residential status would be a confounder due to its associations with both adolescents' economic circumstances and their internalising mental health in many countries (Amato, 2000). However, it is common for parents to work and live away from where their children live in South Africa, a country that was included in Chapter 6. Other family members, such as grandparents, therefore, play a larger role in the caregiving of children and adolescents (Hall & Wright, 2010). Parents living away from home is a common experience for adolescents and might not have a significant impact on their internalising mental health. Parents' residential status might not constitute a confounder of the association between adolescents' economic circumstances and their internalising symptoms in South Africa, but it was still adjusted for. I might have impacted the precision and standard errors of the effect estimates in my thesis by adjusting for variables that may not be confounders in certain countries (Schisterman et al., 2009).

8.3.3.2 Unadjusted confounders

The lack of adjustment for certain variables, such as genetic liability and parents' education level, is also a further limitation that might bias the results in my thesis. Analyses of adults in the UK Biobank study have found genetic variants that are jointly associated with higher levels of household income and better mental health outcomes, such as greater subjective wellbeing and lower depression risk (Hill et al., 2016, 2019). Individuals living in wealthier economic circumstances, at least in the UK, have a reduced genetic liability of experiencing mental health problems (G. Liu et al., 2023). If specific genotypes are a common cause of both adolescents' economic circumstances and their mental health, they might confound the association between them. The genetic correlations may also arise due to the causal impact of economic circumstances on mental health, or vice versa. The extent to which associations between adolescents' economic circumstances and their internalising mental health might be due to genetic confounding is unclear, particularly in low- and middle-income countries where research on the heritability of economic circumstances and mental health is sparse. The lack of adjustment for genetic liability could mean that the associations between adolescents' economic circumstances and their mental health are spurious if there is genetic confounding within countries. I was not able to account for genetic influences on adolescents' economic circumstances or their mental health

outcomes, either through adjustment or study design in any empirical study due to the datasets that were used.

I also did not adjust for the education level of adolescents' parents or guardians. This is despite evidence that parents' education level might determine both adolescents' economic circumstances and their internalising mental health and thus constitute a confounder of the association between them (Psacharopoulos & Patrinos, 2018; Reiss, 2013). However, the importance of the education level of adolescents' parents for adolescents' mental health outcomes is open to debate. Up to 70% of the association between one's own level of education and future health outcomes across the life course are through the impact education level has on one's own economic circumstances (Lahelma et al., 2004; Lynch, 2006; Veenstra & Vanzella-Yang, 2021). These studies show how education determines one's economic circumstances and therefore health. Adolescents with parents that have a high level of education might have better mental health outcomes as their parents' education was influential in determining the wealthier economic circumstances of their household. There are also only a few plausible mechanisms through which parents' level of education could impact adolescents' mental health independent of the impact on a households' economic circumstances. Theorised mechanisms include adults with higher levels of education giving greater priority to the development of their children's academic and social competence and using health services more effectively to meet their children's health needs, all of which could reduce the likelihood of mental health problems in adolescents (Conger & Donnellan, 2007; Duncan et al., 2017; McLaughlin et al., 2011).

Due to the strong correlation between a households' economic circumstances and the education level of its members, modelling both variables within the same regression model may have led to multicollinearity (Psacharopoulos & Patrinos, 2018). This could have resulted in an increase in the standard error of estimates which would have limited the feasibility to compare findings across countries (J. H. Kim, 2019). Overall, the decision not to adjust for parents' level of education could have led to bias if it confounds the association between adolescents' economic circumstances and their mental health in any of the countries studied in my thesis.

As discussed in section 8.3.1, childhood economic circumstances are also a potential confounder of the association between adolescents' economic circumstances and

their mental health. I did not adjust for childhood economic circumstances owing to unavailability of data.

8.3.4 Indicators of country-level context

I investigated how different indicators of country-level context might influence the extent adolescents' economic circumstances are associated with their mental health. In Chapter 4, I investigated country-level indicators which I hypothesised might influence the pathways theorised in the Interpersonal Theory of Suicide that may be implicated when adolescents experience food insecurity (Joiner, 2005). In Chapter 6, I narratively discussed cross-country differences in reference to countries' levels of economic development or economic inequality. Potentially more suitable country-level indicators such as those on social protection policies, national suicide prevention or mental health strategies, or cultural variables are either limited to a small number of countries or timepoints or are too complex to reduce to a single meaningful indicator (World Bank, 2018). Therefore, these country-level indicators were not explored.

Culture refers to the social behaviours, values, attitudes, customs and norms found within different groups and populations (Hwang et al., 2008). Culture therefore has a significant role in the development and expression of suicidal thoughts and behaviours and mental health problems (J. Chu et al., 2022; Kohrt et al., 2014). However, I did not investigate the role of culture in my thesis. This is partly due to the problematic practice of equating country with culture. Countries contain a multitude of different cultural groups. Assuming cultural homogeneity within the countries studied would ignore the cultural nuances and differences in cultures within the same country (Spector et al., 2015). Furthermore, there is a lack of accurate data on cultural factors that are widely available across diverse countries (Gerlach & Eriksson, 2021). Evidence from the HBSC study suggests that economic inequalities in adolescents' psychosomatic symptoms vary across European countries dependent on the meritocratic beliefs held by the population, referring to the extent to which the population believes that "people get what they deserve" (Weinberg et al., 2021). Consequently, aspects of culture could partially explain the extent to which adolescents' economic circumstances are associated with their mental health within countries, but I did not investigate this.

Importantly, the indicators of country-level context that I analysed or discussed are all modifiable in theory through national and international policymaking, increasing the

usefulness of the findings of my thesis. Cross-country differences in economic inequalities in adolescents' mental health may be partially explained by cultural differences, which could explain the differences observed according to countries' economic development and other country-level indicators in my thesis.

8.3.5 Differences in exposures and outcomes across chapters

Another limitation of my thesis is the use of different measures of exposures and outcomes, which limits the validity of comparisons made across chapters. The dataset analysed in Chapter 4, the GSHS, has no measure of economic circumstances or internalising mental health. Therefore, I investigated adolescents' experiences of food insecurity, which is strongly determined by a household's economic circumstances (de Sousa et al., 2019). Data on internalising mental health is not routinely available in the GSHS countries, but adolescents' suicidal thoughts and behaviours have been widely measured. Other multi-country studies, such as the HBSC study and the 2018 Programme for International Student Assessment, are suitable for investigating economic inequalities in adolescents' internalising mental health but primarily feature countries that are high-income and located in Europe or North America. In comparison, countries participating in the GSHS come from a diverse range of regions which are typically under-represented in mental health research. The analysis of the GSHS enabled the investigation of inequalities in suicidal thoughts and behaviours in countries where most of the world's adolescents live but mental health research is scarce (Blum & Boyden, 2018; Kieling et al., 2011).

Comparing the findings of Chapter 4 with the findings of the other studies within my thesis might not be valid due to the differences in the exposures and outcomes used (Braveman et al., 2005; Zaneva et al., 2024). As shown in Chapter 6, different measures of economic circumstances are differently associated with adolescents' internalising symptoms, limiting the validity of cross-measure comparisons of economic inequalities in mental health.

8.4 Multi-country research considerations

In the following section I discuss and reflect on different challenges that have been apparent in the multi-country research in my thesis. I also provide some considerations that might be helpful in further multi-country epidemiological research and discuss the value multi-country research can have.

8.4.1 The value of multi-country research

I have highlighted numerous challenges that impact the strength of conclusions that can be made from the multi-country research in my thesis, such as the threats to validity when comparing results between countries. Despite these challenges, multi-country research has numerous advantages over research carried out in a single country.

As discussed in Chapter 5, the extent that results from individual studies can be compared is limited by the different approaches regarding study design, data management, and analysis (Simmons et al., 2011). Comparing results between single studies is subject to even greater threats of validity, compared to multi-country studies, as any differences or similarities of results may be a product of the different methods used rather than reflecting real differences in a phenomenon across contexts. The lack of consistency in methods across studies is likely to be a partial cause of the replicability crisis that is apparent in several disciplines (Munafò et al., 2017). Multi-country research that uses standardised methodologies in multiple samples are suitable for identifying whether a phenomenon is found across diverse settings and is generalisable or replicable (O'Connor et al., 2022). Multi-country research can also investigate the structural and contextual influences and determinants of health, which is not generally possible in research in single countries (Freese & Peterson, 2017).

Importantly, multi-country research can expand our knowledge beyond the contexts we are most familiar with and help identify good practice and strategies that might be beneficial if applied to a different setting (Baistow, 2000). For instance, multi-country research can also evaluate how population health may differ across countries which have different forms of governance or policy approaches (McLeod et al., 2012). This can be informative in understanding the potential impacts of policy decisions when trials are not feasible.

8.4.2 Harmonisation of longitudinal population studies and measures

In Chapter 6, I conducted parallel analyses of five longitudinal population studies conducted in eight countries. I purposefully selected studies that had similar designs to one another, and I harmonised measures of economic circumstances to allow comparisons of effect estimates from different countries. I used a novel approach to model objective economic inequalities in adolescents' internalising symptoms where each countries' effect estimates referred to a doubling of household income or consumption expenditure. This enabled cross-country comparisons on a scale that is not influenced by differences in purchasing power or values of currencies across countries. As shown in section 6.1.2, studies commonly categorise objective economic circumstances into discrete bands according to arbitrary cut-offs or quintiles. These cut-offs vary between studies complicating cross-study comparisons (Reiss, 2013). Further research, even if in a single sample, should consider modelling economic circumstances so that effect estimates are interpreted as the change in the outcome according to a doubling of income or consumption expenditure. This would enable cross-study comparisons of economic inequalities in health which are not influenced by arbitrary groupings of individuals' income or consumption expenditure or a country's currency value.

Multi-country mental health research, including the work in my thesis, commonly does not account for the role culture has on the conceptualisation of suicidal thoughts and behaviours and mental health problems (Kohrt et al., 2014). In Chapter 4, there was wide variation in the reported prevalence of suicidal thoughts and behaviours across countries. This could have been an artefact of differences in the measure's validity across different countries, particularly in low- and middle-income countries where research on measure validation is limited. The prevalence of suicidal thoughts and behaviours is also likely to be influenced by reporting differences across countries, potentially owing to societal stigma or national laws regarding suicide, which might influence the extent adolescents under-report suicidal thoughts and behaviours.

In Chapters 6 and 7, the measures of internalising symptoms in Ethiopia, India, Peru, South Africa and Vietnam were developed in high-income countries and there was no cultural adaptation of items to the local context. In several countries, this lack of cultural

adaptation was due to copyright conditions that prevented the local research team from applying any modifications to the original measures (Boyden & Walnicki, 2020). The validity of the measures of internalising symptoms might be limited in these countries. More culturally specific measures were not available for these countries in the longitudinal population studies analysed. As a result, my thesis is not suitable for comparing prevalence or mean scores of symptoms across countries as the measures used might not be invariant across different populations.

In Chapter 6, I used four different measures of adolescents' internalising symptoms across the eight countries. Scores on these measures were standardised to enable cross-country comparisons as the potential range of scores varied across each measure. I also used Harmony, a Natural Language Processor, to help create harmonised measures of internalising symptoms that assessed similar symptoms to one another (McElroy et al., 2024). Harmonisation was only possible for two out of five items, demonstrating the differences in specific internalising symptoms that were assessed by the four measures that, in theory, are measuring the same or a similar construct.

Recent initiatives by research funders to standardise the measures to assess mental health outcomes might enable more valid comparisons across different population studies (International Alliance of Mental Health Research Funders, n.d.). Valid comparisons across countries might only be possible if the standardised measure that has been proposed for adolescents, the Revised Child Anxiety and Depression Scale, is shown to be valid and reliable in adolescents across diverse settings (Patalay & Fried, 2021). Where possible, future multi-country research should carry out analyses where adolescents' mental health is assessed with the same measure in all countries (assuming there has been transcultural translation and validation) and with measures that are the most suitable for each country. This would enable comparisons where cross-country differences are not influenced by differences in the items that are assessed across measures in one case, and by the potential lack of validity of the measures of internalising symptoms within countries in another.

8.4.3 Awareness of the context and culture of countries

I have aimed to draw on research from low-, middle- and high-income countries to inform the design of studies and interpretation of findings that are in my thesis. As someone born and living in the UK, my assumptions about adolescents' mental health and economic inequalities are primarily shaped by my awareness of these issues in the UK. As discussed in section 8.3.3, this might have influenced what variables I considered to be potential confounders of the association between adolescents' economic circumstances and their mental health. Furthermore, the theories that guided the research in my thesis, such as the Ecological Systems Theory, the Family Stress Model and the Interpersonal Theory of Suicide, were developed in high-income countries (Bronfenbrenner, 1979; Joiner, 2005; Masarik & Conger, 2017). This results in a contradiction where my thesis emphasises the lack of generalisability of research findings between contexts, yet I have made assumptions based on theories that may not generalise across countries to inform this research. The use of theories solely from high-income countries was not deliberate and was primarily a function of the imbalance between world regions regarding the number of accessible research outputs.

Insights from international collaborators throughout the conduct of the research in my thesis have been vital in broadening my perspectives and have helped ensure the research is relevant and applicable to the countries studied. Visits to field sites of the Young Lives study in India also provided valuable context regarding how the study has been conducted and insights into the lives of the participants. Further multi-country research, as a minimum, must involve collaborators from low- and middle-income countries to ensure studies are informed and guided by local experts. This could help reduce power imbalances between researchers in high-income countries, like myself, who have the capacity and resources to analyse global data and publish research that results from the data, and researchers in low- and middle-income countries, who have fewer opportunities to analyse data they helped collect in contexts they are more knowledgeable about (Chaccour, 2018).

8.5 Implications and future directions

The research in my thesis has implications for policy, further research and theories of economic inequalities in adolescents' internalising mental health, despite the limitations of my thesis.

8.5.1 Policy

The findings in my thesis suggest that inferring the extent of economic inequalities in adolescents' internalising mental health and suicidal thoughts and behaviours from one country to another is likely to be flawed. Consequently, the success of policies in reducing economic inequalities in adolescents' mental health in one country might not translate to others. Interventions and actions to improve adolescents' economic circumstances need to consider the local context and culture, and where data are available, the extent of economic inequalities in adolescents' mental health.

Chapter 6 found that economic inequalities in adolescents' internalising mental health were greater in countries where absolute poverty is more prevalent. This acts as a reminder of the need for poverty alleviation worldwide and the wide-reaching benefits that improving adolescents' economic circumstances could have. If the associations between adolescents' economic circumstances and internalising symptoms are causal, improving adolescents' economic circumstances might have greater success in preventing mental health problems in low-income countries compared to high-income countries. Worldwide, 120 million adolescents aged 10 to 17 live in extreme poverty, 90% of whom live in Sub-Saharan Africa or South Asia (Salmeron Gomez et al., 2023). The benefits to population mental health in low-income countries from improving adolescents' economic circumstances could be substantial. Poverty alleviation as a means to improve adolescents' mental health is also likely to be important in low- and middle-income countries due to the lack of evidence for other interventions that can prevent internalising mental health problems in these settings (Skeen et al., 2019). Consequently, my thesis emphasises that in many countries, achieving SDG 1 of the United Nations, the eradication of extreme poverty by 2030, remains key in achieving SDG 3, achieving healthy lives and wellbeing for all, including adolescents.

One of the main avenues to improve adolescents' economic circumstances and reduce poverty, particularly in low- and middle-income countries, are cash-transfer programmes (Zaneva et al., 2022). In Chapter 6, the association between adolescents' economic circumstances and future internalising symptoms was close to the null in two countries that have two of the largest cash transfer programmes in the world; Mexico and South Africa (Niño-Zarazúa, 2020; SASSA, 2020). It is possible that the provision of a large-scale cash transfer programme could reduce economic inequalities in adolescents' mental health within a country (Zimmerman et al., 2025). However, several studies have also found no effect or an adverse effect of cash transfers on adolescents' mental health outcomes (Baird et al., 2025; Garman, Eyal, et al., 2022). To potentially increase the likelihood that cash transfers are effective in improving adolescents' mental health, they need to be generous enough so that adolescents' living standards improve and that adolescents acquire the capabilities to achieve and pursue outcomes that they value (e.g., education, socialisation) (McGuire et al., 2022; Sen, 2001; Yoshino et al., 2023).

The feasibility of cash transfer programmes is dependent on the economic resources within countries as well as political will (Lund, 2023). Other approaches to reduce economic inequalities in adolescents' mental health need to be developed as well. One potential approach is to intervene on causal mechanisms that link economic circumstances to mental health outcomes. In Chapter 3, I proposed a multitude of candidate causal mechanisms. Efforts to intervene on these mechanisms might have limited success in reducing economic inequalities in adolescents' mental health, as the extent to which they mediate the association between adolescents' economic circumstances and their internalising symptoms may be overestimated in existing studies. This is due to the biases in cross-sectional mediation studies (over 70% of studies identified in Chapter 3 were cross-sectional) and the lack of adjustment for intermediate confounders in the few longitudinal studies that have been conducted. Furthermore, causal mechanisms might not translate from high-income countries, where most studies have been conducted, to low- and middle-income countries.

Preventive interventions that focus on changing variables on the causal pathway between economic circumstances and mental health outcomes may only have success if they focus on changing multiple causal mechanisms across many or all domains (social, psychological, material, biological, environmental and behavioural).

Targeting upstream causal mechanisms, such as adolescents' material resources and their wider environment might be more effective as these are likely key determinants of the downstream social, biological, behavioural and psychological mechanisms. It could also be argued that actions to directly improve adolescents' economic circumstances remain the most likely approach to have success in reducing economic inequalities in adolescents' mental health, due to the complex relationships between causal mechanisms. This approach is also preferential from an ethical perspective as it would reduce the number of adolescents living in poverty, which would have further benefits across a wide range of health, economic and social outcomes at the individual- and societal-level. Furthermore, this approach is in line with the Fundamental Cause Theory, that emphasises that strategies should focus on improving distal factors, such as adolescents' economic circumstances, that drive exposure to more proximal causes of illness (i.e., specific causal mechanisms), rather than focusing on the proximal causes themselves, to generate substantial population health benefits (Link & Phelan, 1995).

In Chapter 4, inequalities in suicidal thoughts and behaviours according to food insecurity were greater in countries where food insecurity is a rare experience. The finding demonstrates that well-meaning policies, such as those described in this section, might exacerbate health inequalities if the benefits are inequitable across demographic or economic groups. As well as population-wide policies, interventions are needed to improve adolescents' economic circumstances which specifically target marginalised groups to ensure policies and actions do not exacerbate health inequalities.

This also extends to economic growth within countries, where the economic circumstances of the population might increase on average, but a minority may be left behind and further marginalised. This was shown in Chapter 6, where economic inequalities in adolescents' internalising symptoms were greatest in Vietnam, a country that has experienced one of the highest rates of economic growth and reduction in poverty worldwide (H.-A. Dang et al., 2023). Attention must be made to ensure economic inequalities in adolescents' mental health do not widen as low- and middle-income countries experience economic growth.

As demonstrated in my thesis, economic inequalities in adolescents' mental health are linked to the wider societal context that adolescents are embedded in. New social and economic policies (e.g., policies regarding housing, social protection, education) could inadvertently affect economic inequalities in adolescents' mental health, even if health inequalities are not a primary policy focus (Papola et al., 2024; Song et al., 2024). Policymakers, including those outside the health sector, need to consider the impacts of all future policies on inequality and mental health outcomes within the population. Consequently, a coordinated sector-wide approach where mental health and inequality is considered by all policymakers and organisations could help promote population mental health and reduce economic inequalities in adolescents' mental health (Papola et al., 2024).

8.5.2 Research

8.5.2.1 Further research in low- and middle-income countries

The research in my thesis found that economic inequalities in adolescents' mental health vary in magnitude across low-, middle- and high-income countries. Ninety percent of the world's adolescents live in low- and middle-income countries, and findings from high-income countries are unlikely to translate to these settings (Blum & Boyden, 2018). As shown in Chapter 4, the magnitude of the association between adolescents' food insecurity status and suicidal thoughts and behaviours varied across different low- and middle-income countries. This highlights that economic inequalities in adolescents' mental health vary within the same World Bank country income classification and WHO world region as well as between them. Consequently, country-specific knowledge of economic inequalities is needed in low- and middle-income countries rather than extrapolating from another country from the same country income classification or region.

Mental health research in low- and middle-income countries is often limited owing to a lack of funding, resource constraints and limited research capacity (Razzouk et al., 2010). Further research in countries where mental health data is currently scarce would provide contextually relevant evidence regarding the aetiology and distribution of mental health problems in adolescents. This could inform country-specific prevention efforts as well as inform planning of health services.

In Chapter 3, I found few mediation studies that investigated causal mechanisms through which economic circumstances might affect internalising mental health in low- and middle-income countries. This research would be most informative in low- and middle-income countries as it could help optimise the design and effectiveness of cash transfer programmes in improving adolescents' mental health by identifying causal mechanisms that could also be targeted (Evans-Lacko et al., 2023). Randomised controlled trials of cash transfer programmes or other economic interventions within low- and middle-income countries are likely to be suitable for assessing causal mechanisms given the longitudinal nature of the data and the elimination of baseline confounding.

8.5.2.2 Investigating causal mechanisms in mediation studies

In Chapter 3, I identified 28 secondary domains of causal mechanisms through which economic circumstances may impact adolescents' internalising mental health from six broader domains: social, psychological, material, biological, environmental and behavioural. These were identified through a systematic search of mediation studies and a consultation with experts. Consequently, there are a multitude of pathways through which adolescent' economic circumstances may impact their internalising mental health but many of these have not been formally investigated.

I found issues that were present in the design and analyses of many mediation studies. Namely, these were the lack of adjustment for intermediate confounders, the use of cross-sectional data, and the tendency to investigate a single mediator. The importance of adjusting for intermediate confounders was shown in the sensitivity analysis in Chapter 7. When I no longer adjusted for intermediate confounders, the magnitude of the natural indirect effect and the proportion mediated was greater in several cases compared to the main analyses. Adjustment for intermediate confounders is vital to help produce less biased estimates of the natural indirect effect and reduce the likelihood of a Type I error (i.e., wrongly concluding a variable is a mediator of the association). Intermediate confounders need to be accounted for in future mediation studies. Studies should also analyse longitudinal data where the exposure, mediator and outcome are measured at separate timepoints. Otherwise, studies risk biased findings (Maxwell & Cole, 2007). Biased studies could lead to resources being allocated to strategies that target factors that do not actually represent

causal mechanisms. Therefore, these strategies would have limited effectiveness in reducing economic inequalities in adolescents' mental health and thus be an insufficient use of financial resources and staff capacity. Studies, like the one in Chapter 7, that focus on a single mediator are also likely to underestimate the complexity of how economic inequalities in mental health develop. They might overestimate mediation by a certain variable as other correlated mediators are not included within the models.

In Chapter 6, economic inequalities in adolescents' internalising mental health were greater in the countries with lower GNI per capita. Being economically disadvantaged may have a worse impact on adolescents' mental health in low-income countries as the experience of poverty is likely to predispose adolescents to more severe forms of material disadvantage and fewer essential resources (Poole et al., 2013). There is some evidence from a trial of an economic intervention in Uganda that found that the association between exposure to the intervention and fewer internalising symptoms was mediated by the level of family assets such as livestock and transport (Cavazos-Rehg et al., 2021). Cross-national mediation studies could test whether adolescents' material resources are a stronger causal mechanism in low- and middle-income countries compared to high-income countries.

Finally, the conceptual model developed in Chapter 3 proposes six different domains of causal mechanisms through which economic circumstances might impact adolescents' internalising mental health. Future mediation studies could include composite variables that represent each domain as mediators to identify whether specific types of causal mechanisms may explain a greater proportion of the association between economic circumstances and internalising mental health. This might identify the most salient pathways through which economic circumstances impact adolescents' internalising mental health. Studies could also test the assumption that material and environmental mechanisms primarily link adolescents' economic circumstances to social, biological, behavioural and psychological mechanisms. One potential approach would involve comparing the model fit between a model where mechanisms are sequential ordered and another model where mechanisms are investigated in parallel (Gunzler et al., 2013). The model also proposes a bidirectional relationship between causal mechanisms. However, these cannot be modelled within

mediation analyses unless there are repeated measurements of mediators, which is uncommon in many studies and datasets.

8.5.2.3 Modelling economic circumstances

Further studies investigating economic inequalities in adolescents' mental health should consider measuring economic circumstances in childhood as well as in adolescence. Childhood might be a more sensitive period to the negative mental health effects of living in poorer economic circumstances, and economic inequalities in adolescents' mental health may differ according to when economic circumstances are measured (Chaudry & Wimer, 2016; West, 1997). Awareness of when economic circumstances are most important for mental health would help inform at what age strategies to improve economic circumstances are best placed to prevent the onset of mental health problems in adolescence.

Researchers should also be explicit about the specific economic measure to which their findings relate to, as findings in Chapter 6 varied according to whether economic circumstances were measured objectively or subjectively. This is particularly relevant to studies assessing socio-economic status, which commonly use measures of economic circumstances such as household income as proxy measures (Zaneva et al., 2024). Given the findings in Chapter 6, it is highly likely that the association with adolescents' internalising mental health differs according to different indicators of socio-economic status (e.g., economic circumstances, parents' education level, parents' occupation) (Braveman et al., 2005).

8.5.2.4 Intersectionality

I investigated inequalities in adolescents' mental health based on a single characteristic – their economic circumstances. Therefore, my thesis does not provide a complete picture of social inequalities in adolescents' mental health within countries. It is theorised that being in multiple marginalised social groups (e.g., living in poverty, being an ethnic minority, being a gender minority) leads to a multiplicative negative impact on mental health (King, 1988). In other words, the mental health impacts of belonging to multiple marginalised groups is greater than the sum of the individual impacts of each marginalised group. Therefore, adolescents' economic circumstances are likely to have a greater impact on mental health outcomes dependent on whether adolescents are marginalised in other ways, but I did not investigate this in my thesis.

The exact forms of marginalisation that interact within one another to impact adolescents' mental health are likely to vary across countries (Kern et al., 2020).

Further research investigating the mental health impacts of economic circumstances from an intersectional perspective might identify adolescents who are most at risk of mental health problems. This could inform prevention strategies that are better targeted compared to basing need solely on adolescents' economic circumstances (Strompolis et al., 2019). The lack of effectiveness of cash transfer programmes in some studies might be due to adolescents' experiencing persistent co-occurring disadvantages alongside living in poorer economic circumstances (L. Graham et al., 2019). Many inequalities, such as those according to gender or race, are unlikely to be modifiable solely through improving adolescents' economic circumstances. Intersectional research can help identify whether cash transfers could be a suitable tool to reduce inequalities in adolescents' mental health in a particular country, or whether broader interventions that tackle the causes of multiple inequalities might be more effective. Research that uses an intersectional perspective also ties in with calls to conceptualise poverty according to a multi-dimensional perspective rather than solely understanding poverty as a disadvantage based on someone's economic circumstances (Ridley et al., 2020).

8.5.2.5 Qualitative research

All research within my thesis consists of analyses or reviews of quantitative data. This includes the use of quantitative indicators of societal contexts within countries. My thesis lacks the contextual insights from qualitative data which could further understanding of how the country-level context that an adolescent lives in affects their economic circumstances, their mental health and the relationship between the two. Cross-country qualitative research in economic inequalities is limited but would be valuable in exploring findings from my thesis. Qualitative studies could investigate what adolescents from different countries perceive to be the causal mechanisms through which their economic circumstances impact their mental health.

8.5.2.6 Outcome-wide investigations

Within my thesis I have focused on a narrow set of outcomes: adolescents' suicidal thoughts and behaviours and internalising mental health. This neglects the wide array of health outcomes in adolescents that are associated with their economic

circumstances (Adjei et al., 2022). As discussed in section 8.3.5, suicidal thoughts and behaviours and internalising mental health were investigated separately in different datasets with different methodologies. This limited the ability to compare findings across studies.

Future single- and multi-country research should examine the association between adolescents' economic circumstances with multiple mental health outcomes within the same datasets. This would help facilitate nuanced public health recommendations and planning regarding adolescents' economic circumstances as there would be awareness of the association between economic circumstances and many outcomes from a single high-quality study (VanderWeele, 2017). In comparison, policymakers primarily rely on findings from multiple studies that are heterogenous in design, methods and analytic approach, which complicates decision-making.

Outcome-wide studies could also reveal further cross-country differences beyond a single outcome and help further understand context-specific economic inequalities in adolescents' mental health. This has been done for gender differences in four mental health outcomes across seventy-three countries in a cross-sectional study (Campbell et al., 2021). However, this could be a challenge for investigating economic inequalities in adolescents' mental health in longitudinal data in low- and middle-income countries, as many longitudinal population studies feature only a single measure of adolescents' mental health (typically internalising mental health).

8.5.3 Theories of economic inequalities in adolescents' internalising mental health

Further research in low- and middle-income countries can be used to inform the development of theories of economic inequalities in adolescents' internalising mental health that are more applicable to the local context. Leading theories (the Family Stress Model of Economic Hardship and the Family Investment Model) are based on research in high-income countries which may not generalise to other settings, as highlighted by the findings of my mediation study (Duncan et al., 2017; Masarik & Conger, 2017). In developing new theories, researchers should focus on causal mechanisms that are relevant to economic circumstances, mental health outcomes and adolescents, rather than solely drawing on mechanisms proposed for social position, general health outcomes and adults. Theories should also consider how the

wider context may influence which causal mechanisms are apparent and relevant in different settings.

Several potential causal mechanisms are proposed in Chapter 3. These are not considered within existing theories and could be incorporated into future ones. It is likely that mediation studies that contribute to the current awareness of the causal mechanisms through which adolescents' economic circumstances impact their internalising mental health are misleading. This is due to limitations in the design and analysis of many mediation studies (see section 8.5.2.2). New theories, which may be partially informed by the results of mediation studies, should consider that any evidence of a potential causal mechanism could be biased in mediation studies that are cross-sectional, do not adjust for confounders, or investigate a single mediator only.

8.6 Conclusion

The key finding of my thesis is that economic inequalities in adolescents' mental health are found in many settings but vary in magnitude across countries. These health inequalities are likely shaped by different societal factors within countries. Findings differed according to countries' level of economic development. Therefore, the vast body of research from high-income countries is unlikely to generalise to low- and middle-income countries where mental health research is more limited. My thesis also showed that the magnitude of economic inequalities in adolescents' mental health is influenced by the measure used to assess adolescents' economic circumstances. Economic inequalities in adolescents' mental health are therefore not generalisable across different measures of economic circumstances. My thesis demonstrates that findings in one country or with a certain measure of economic circumstances cannot be used to infer about another. Findings from my thesis demonstrate the need for further mental health research in low- and middle-income countries. This includes studies that aim to identify the causal mechanisms through which economic inequalities in adolescents' mental health might develop in these contexts.

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Appendices

Appendix A: Systematic search of mediation studies

Supplementary Table 3.1. Search terms used for each academic database.

Database(s)	Search terms
Child Development and Adolescent Studies; EconLit	TI ("adolescen*" OR "youth*" OR "teen*" OR "young people" OR "young person*" OR "child" OR "children*") OR AB ("adolescen*" OR "youth*" OR "teen*" OR "young people" OR "young person*" OR "child" OR "children*") AND TI ("poverty" OR "low-income" OR (("income*" OR "earning*" OR "debt*" OR "occupation*" OR "education*" OR "employed" OR "employment" OR "unemploy*" OR "expenditure*" OR "consumption expenditure*" OR "financ*" OR "assets") N1 ("parent*" OR "household*" OR "famil*" OR "personal*" OR "equivali?ed" OR "low*" OR "high*" OR "carer*" OR "guardian*" OR "caregiver*" OR "father*" OR "mother*" OR "caretaker*")) OR "wealth*" OR (("social" OR "socioeconomic" OR "socio-economic" OR "subjective" OR "economic*" OR "financ*" OR "material" OR "relative" OR "advantage*" OR "disadvantage*") N1 ("class*" OR "status" OR "background" OR "circumstanc*" OR "standing" OR "position" OR "hierarch*" OR "condition*" OR "hardship" OR "rank" OR "depriv*" OR "context" OR "disadvantage*" OR "order*" OR "ladder*")) OR (("inequalit*" OR "disparit*" OR "inequit*") N1 ("class*" OR "status" OR "background" OR "circumstanc*" OR "financ*" OR "income" OR "social" OR "socioeconomic" OR "socio-economic" OR "subjective" OR "economic*" OR "financ*" OR "material" OR "relative")) OR (("resource*" OR "means" OR "stress*" OR "strain*" OR "asset*" OR "pressure" OR "stability" OR "volatility" OR "loss" OR "security" OR "wellbeing" OR "well-being") N1 ("financ*" OR "money" OR "monetary" OR "economic" OR "income")) OR (("people" OR "parent*" OR "household*" OR "famil*" OR "adolescen*" OR "youth*" OR "teens" OR "teenagers" OR "young people" OR "children*") N1 ("poor*" OR "rich*" OR "marginali*" OR "advantaged*")) OR "living standard*" OR "standard# of living" OR "living condition*" OR "condition# of living" OR "destitut*") OR AB ("poverty" OR "low-income" OR (("income*" OR "earning*" OR "debt*" OR "occupation*" OR "education*" OR "employed" OR "employment" OR "unemploy*" OR "expenditure*" OR "consumption expenditure*" OR "financ*" OR "assets") N1 ("parent*" OR "household*" OR "famil*" OR "personal*" OR "equivali?ed" OR "low*" OR "high*" OR "carer*" OR "guardian*" OR "caregiver*" OR "father*" OR "mother*" OR "caretaker*")) OR "wealth*" OR (("social" OR "socioeconomic" OR "socio-economic" OR "subjective" OR "economic*" OR "financ*" OR "material" OR "relative" OR "advantage*" OR "disadvantage*") N1 ("class*" OR "status" OR "background" OR "circumstanc*" OR "standing" OR "position" OR "hierarch*" OR "condition*" OR "hardship" OR "rank" OR "depriv*" OR "context" OR "disadvantage*" OR "order*" OR "ladder*")) OR (("inequalit*" OR "disparit*" OR "inequit*") N1 ("class*" OR "status" OR "background" OR "circumstanc*" OR "financ*" OR "income" OR "social" OR "socioeconomic" OR "socio-economic" OR "subjective" OR "economic*" OR "financ*" OR "material" OR "relative")) OR (("resource*" OR "means" OR "stress*" OR "strain*" OR "asset*" OR "pressure" OR "stability" OR "volatility" OR "loss" OR "security" OR "wellbeing" OR "well-being") N1 ("financ*" OR "money" OR "monetary" OR "economic" OR "income")) OR (("people" OR "parent*" OR "household*" OR "famil*" OR "adolescen*" OR "youth*" OR "teens" OR "teenagers" OR "young people" OR "children*") N1 ("poor*" OR "rich*" OR "marginali*" OR "advantaged*")) OR "living standard*" OR "standard# of living" OR "living condition*" OR "condition# of living" OR "destitut*")

AND

TI ("depress*" OR "distress*" OR "dysthmi*" OR "low mood" OR (("internalising" OR "internalizing") N1 ("problem*" OR "symptom*" OR "disorder*" OR "behav*" OR "ill*")) OR (("psychological" OR "psychosocial" OR "psychiat*" OR "psychosomatic" OR "mood" OR "emotion*" OR "affect*" OR "anxiet*") N1 ("problem*" OR "issue*" OR "symptom*" OR "disorder*" OR "health*" OR "diagnosis" OR "ill*" OR "wellbeing" OR "well-being" OR "behav*"))) OR AB ("depress*" OR "distress*" OR "dysthmi*" OR "low mood" OR (("internalising" OR "internalizing") N1 ("problem*" OR "symptom*" OR "disorder*" OR "behav*" OR "ill*")) OR (("psychological" OR "psychosocial" OR "psychiat*" OR "psychosomatic" OR "mood" OR "emotion*" OR "affect*" OR "anxiet*") N1 ("problem*" OR "issue*" OR "symptom*" OR "disorder*" OR "health*" OR "diagnosis" OR "ill*" OR "wellbeing" OR "well-being" OR "behav*")))

AND

TI ("pathway*" OR "mechanis*" OR "mediat*" OR "structural equation model*" OR "path analys*" OR "indirect effect*" OR "family stress model" OR "investment model" OR "investments model" OR "reserve capacity" OR ("differen*" N2 ("expos*" OR "susceptib*" OR "vulnerab*" OR "resilien*"))) OR AB ("pathway*" OR "mechanis*" OR "mediat*" OR "structural equation model*" OR "path analys*" OR "indirect effect*" OR "family stress model" OR "investment model" OR "investments model" OR "reserve capacity" OR ("differen*" N2 ("expos*" OR "susceptib*" OR "vulnerab*" OR "resilien*")))

NOT

TI ("older adult*" OR (("review" OR "synthesis") N1("systematic" OR "rapid" OR "qualitative" OR "narrative" OR "conceptual" OR "realist" OR "scoping" OR "umbrella" OR "integrat*" OR "evidence")) OR "meta-analysis" OR "meta analysis" OR "protocol" OR "overview" OR "rodent*" OR "rat" OR "rats" OR "mice" OR "animal model*" OR "proceedings")

LIMIT TO:

English language

Global Health,
Medline; PsycINFO

("adolescen*" OR "youth*" OR "teen*" OR "young people" OR "young person*" OR "child" or "children*").ti,ab.

AND

("poverty" or "low-income" OR (("income*" or "earning*" or "debt*" or "occupation*" OR "education*" OR "employed" OR "employment" OR "unemploy*" OR "expenditure*" or "consumption expenditure*" or "financ*" or "assets") adj1 ("parent*" or "household*" or "famil*" or "personal*" or "equival?ed" or "low*" or "high*" OR "carer*" OR "guardian*" OR "caregiver*" OR "father" OR "mother*" or "caretaker*")) OR "wealth*" OR ("social" or "socioeconomic" or "socio-economic" or "subjective" or "economic*" or "financ*" or "material" or "relative" or "advantage*" or "disadvantage*") adj1 ("class*" or "status" or "background" or "circumstanc*" or "standing" or "position" or "hierarch*" or "condition*" or "hardship" or "rank" or "depriv*" or "context*" OR "disadvantage*" or "order*" or "ladder")) OR (("inequalit*" or "disparit*" or "inequit*") adj1 ("class*" or "status" or "background" or "circumstanc*" or "financ*" or "income" or "social" or "socioeconomic" or "socio-economic" or "subjective" or "economic*" or "financ*" or "material" or "relative")) OR (("resource*" OR "means" OR "stress*" OR "strain*" OR "asset*" OR "pressure" or "*stability" or "volatility" or "loss" or "*security" or "wellbeing" or "well-being") adj1 ("financ*" OR "money" or "monetary" or "economic" or "income")) OR (("people" or "parent*" OR "household*" OR "famil*" OR "adolescen*" OR "youth*" OR "teens" OR

"teenagers" OR "young people" or "children") adj1("poor*" OR "rich*" or "marginali*" or "*advantaged")) OR "living standard*" or "standard\$ of living" or "living condition*" or "condition\$ of living" OR "destitut*").ti,ab.

AND

("depress*" or "distress*" or "dysthmi*" or "low mood" or (("internalising" or "internalizing") adj1 ("problem*" or "symptom*" or "disorder*" or "behav*" or "ill*")) or (("psychological" or "psychosocial" or "psychiat*" or "psychosomatic" or "mood" or "emotion*" or "affect*" or "anxiet*") adj1 ("problem*" or "issue*" or "symptom*" or "disorder*" or "health*" or "diagnosis" or "ill*" or "wellbeing" or "well-being" or "behav*")))).ti,ab.

AND

("pathway*" or "mechanis*" or "mediat*" or "structural equation model*" or "path analys*" or "indirect effect*" or "family stress model" or "investment model" or "investments model" or "reserve capacity" or ("differen*" adj2 ("expos*" or "susceptib*" or "vulnerab*" or "resilien*")))).ti,ab.

NOT

("older adult*" or (("review" or "synthesis" or "mapping") adj1("systematic" or "rapid" or "qualitative" or "narrative" or "conceptual" or "realist" or "scoping" or "umbrella" or "integrat*" or "evidence*")) or "meta-analysis" or "meta analysis" or "protocol" or "overview" or "rodent*" or "rat" or "rats" or "mice" or "animal model*" or "proceedings").ti.

LIMIT TO:

English language

Web of Science

TI=("adolescen*" OR "youth*" OR "teen*" OR "young people" OR "young person*" OR "child" or "children*") or AB=("adolescen*" OR "youth*" OR "teen*" OR "young people" OR "young person*" OR "child" or "children*")

AND

TI=("poverty" or "low-income" OR (("income*" or "earning*" or "debt*" or "occupation*" OR "education*" OR "employed" OR "employment" OR "unemploy*" OR "expenditure*" or "consumption expenditure*" or "financ*" or "assets") NEAR/1 ("parent*" or "household*" or "famil*" or "personal*" or "equivali?ed" or "low*" or "high*" OR "carer*" OR "guardian*" OR "caregiver*" OR "father*" OR "mother*" or "caretaker*")) OR "wealth*" OR (("social" or "socioeconomic" or "socio-economic" or "subjective" or "economic*" or "financ*" or "material" or "relative" or "advantage*" or "disadvantage*") NEAR/1 ("class*" or "status" or "background" or "circumstanc*" or "standing" or "position" or "hierarch*" or "condition*" or "hardship" or "rank" or "depriv*" or "context*" OR "disadvantage*" or "order*" or "ladder*")) OR (("inequalit*" or "disparit*" or "inequit*") NEAR/1 ("class*" or "status" or "background" or "circumstanc*" or "financ*" or "income" or "social" or "socioeconomic" or "socio-economic" or "subjective" or "economic*" or "financ*" or "material" or "relative")) OR (("resource*" OR "means" OR "stress*" OR "strain*" OR "asset*" OR "pressure" or "*stability" or "volatility" or "loss" or "*security" or "wellbeing" or "well-being") NEAR/1 ("financ*" OR "money" or "monetary" or "economic" or "income*")) OR (("people" or "parent*" OR "household*" OR "famil*" OR "adolescen*" OR "youth*" OR "teens" OR "teenagers" OR "young people" or "children*") NEAR/1("poor*" OR "rich*" or "marginali*" or "*advantaged")) OR "living standard*" or "standard\$ of living" or "living condition*" or "condition\$ of living" OR "destitut*") OR AB= ("poverty" or "low-income" OR (("income*" or "earning*" or "debt*" or "occupation*" OR "education*" OR "employed" OR "employment" OR "unemploy*" OR "expenditure*" or "consumption expenditure*" or "financ*" or "assets") NEAR/1 ("parent*" or "household*" or "famil*" or "personal*" or "equivali?ed" or "low*" or "high*" OR "carer*" OR "guardian*" OR "caregiver*" OR "father*" OR

"mother*" or "caretaker*") OR "wealth*" OR (("social" or "socioeconomic" or "socio-economic" or "subjective" or "economic*" or "financ*" or "material" or "relative" or "advantage*" or "disadvantage*") NEAR/1 ("class*" or "status" or "background" or "circumstanc*" or "standing" or "position" or "hierarch*" or "condition*" or "hardship" or "rank" or "depriv*" or "context" OR "disadvantage*" or "order*" or "ladder*)) OR (("inequalit*" or "disparit*" or "inequit*") NEAR/1 ("class*" or "status" or "background" or "circumstanc*" or "financ*" or "income" or "social" or "socioeconomic" or "socio-economic" or "subjective" or "economic*" or "financ*" or "material" or "relative")) OR (("resource*" OR "means" OR "stress*" OR "strain*" OR "asset*" OR "pressure" or "stability" or "instability" or "volatility" or "loss" or "security" or "insecurity" or "wellbeing" or "well-being") NEAR/1 ("financ*" OR "money" or "monetary" or "economic" or "income")) OR (("people" or "parent*" OR "household*" OR "famil*" OR "adolescen*" OR "youth*" OR "teens" OR "teenagers" OR "young people" or "children*") NEAR/1("poor*" OR "rich*" or "marginali*" or "advantaged" or "disadvantaged")) OR "living standard*" or "standard\$ of living" or "living condition*" or "condition\$ of living" OR "destitut*")

AND

TI=("depress*" or "distress*" or "dysthmi*" or "low mood" or (("internalising" or "internalizing") NEAR/1 ("problem*" or "symptom*" or "disorder*" or "behav*" or "ill*")) or (("psychological" or "psychosocial" or "psychiat*" or "psychosomatic" or "mood" or "emotion*" or "affect*" or "anxiet*") NEAR/1 ("problem*" or "issue*" or "symptom*" or "disorder*" or "health*" or "diagnosis" or "ill*" or "wellbeing" or "well-being" or "behav*")) OR AB=("depress*" or "distress*" or "dysthmi*" or "low mood" or (("internalising" or "internalizing") NEAR/1 ("problem*" or "symptom*" or "disorder*" or "behav*" or "ill*")) or (("psychological" or "psychosocial" or "psychiat*" or "psychosomatic" or "mood" or "emotion*" or "affect*" or "anxiet*") NEAR/1 ("problem*" or "issue*" or "symptom*" or "disorder*" or "health*" or "diagnosis" or "ill*" or "wellbeing" or "well-being" or "behav*")))

AND

TI=("pathway*" or "mechanis*" or "mediat*" or "structural equation model*" or "path analys*" or "indirect effect*" or "family stress model" or "investment model" or "investments model" or "reserve capacity" or ("differen*" NEAR/2 ("expos*" or "susceptib*" or "vulnerab*" or "resilien*")) OR AB=("pathway*" or "mechanis*" or "mediat*" or "structural equation model*" or "path analys*" or "indirect effect*" or "family stress model" or "investment model" or "investments model" or "reserve capacity" or ("differen*" NEAR/2 ("expos*" or "susceptib*" or "vulnerab*" or "resilien*")))

NOT

TI=("older adult*" or (("review" or "synthesis") NEAR/1("systematic" or "rapid" or "qualitative" or "narrative" or "conceptual" or "realist" or "scoping" or "umbrella" or "integrat*" or "evidence")) or "meta-analysis" or "meta analysis" or "protocol" or "overview" or "rodent*" or "rat" or "rats" or "mice" or "animal model*" or "proceedings")

LIMIT TO:

English language

Supplementary Table 3.2. Key characteristics of mediation studies identified in the systematic search.

Study	Country	Sample size	Design	Exposure	Domains of mediators
Amone-P'Olak et al., 2009	Netherlands	2,149	Cross-sectional	Objective socio-economic status	Social
Barch et al., 2020	US	167	Longitudinal	Income	Biological; Psychological
Barnhart et al., 2022	US	5,510	Longitudinal	Income	Social
Barrera et al., 2002	US	300	Cross-sectional	Financial stress	Social
Benner & Kim, 2010	US	444 families	Cross-sectional	Financial stress	Social
Bøe, Serlachius, et al., 2018	Norway	2,043	Cross-sectional	Objective socio-economic status	Social
Bøe, Dearing, et al., 2018	Norway	9,166	Cross-sectional	Income	Psychological
Bøe et al., 2014	Norway	2,041	Cross-sectional	Objective socio-economic status	Social
Brody et al., 1994	US	90	Cross-sectional	Income	Social
Caño González & Rodríguez-Naranjo, 2024	Spain	636	Cross-sectional	Objective socio-economic status	Social
J. Cao et al., 2024	China	1,384	Longitudinal	Income	Psychological
M. Cao et al., 2021	China	724	Cross-sectional	Objective socio-economic status	Psychological
Cavazos-Rehg et al., 2021	Uganda	702	Longitudinal	Economic intervention	Material
J. H. Chen et al., 2024	US	752	Longitudinal	Income	Social
J. H. Chen et al., 2023	US	643	Longitudinal	Income	Social; Material
J. J. L. Chen & Liu, 2012	China	2,000	Cross-sectional	Wealth	Social
J. K. Chen et al., 2021	Hong Kong	792	Cross-sectional	Income	Material; Social
Chen Wang & McLeroy, 2023	US	3,444	Cross-sectional	Income	Social
Cheung et al., 2018	Hong Kong & Macau	804	Cross-sectional	Financial stress	Social; Psychological
Chigogora et al., 2020	UK	6,493	Longitudinal	Income	Behavioural
Conger et al., 2002	US	422	Cross-sectional	Financial stress	Social
Conger et al., 1999	US	377	Longitudinal	Financial stress	Psychological
Culpin et al., 2015	UK	8,803	Longitudinal	Multidimensional poverty	Psychological
De France et al., 2023	Canada	164	Longitudinal	Income	Social; Psychological
Forkel & Silbereisen, 2001	East and West Germany	Not stated	Cross-sectional	Financial stress	Social
Ge, 2020	China	19,487	Cross-sectional	Objective socio-economic status	Social; Material
Goosby, 2007	US	854	Cross-sectional	Financial poverty	Social
Grant et al., 2005	US	105	Cross-sectional	Income	Social
Gu et al., 2023	China	2,304	Cross-sectional	Income	Social; Material; Environment
Gutman et al., 2005	US	305	Cross-sectional	Income	Social
Hammack et al., 2004	US	1,704	Cross-sectional	Financial stress	Social
Ip et al., 2022	US	4,038	Longitudinal	Multidimensional poverty	Biological
Jiang, 2020	China	1,280	Cross-sectional	Multidimensional poverty	Social; Psychological

Keegan Eamon, 2002	US	898	Longitudinal	Financial poverty	Material; Social; Environment
J. Kim, 2021	US	13,027	Longitudinal	Income	Psychological
P. Kim et al., 2016	US	185	Longitudinal	Financial poverty	Psychological
Landers-Potts et al., 2015	US	422	Longitudinal	Financial stress	Social
J. Lee et al., 2023	Republic of Korea	7,333	Cross-sectional	Subjective socio-economic status	Social
J. Lee et al., 2021	Republic of Korea	328	Cross-sectional	Subjective socio-economic status	Psychological
T. K. Lee et al., 2013	US	451	Longitudinal	Financial stress	Social
W. K. Lee & Joo, 2022	US	1,384	Cross-sectional	Multidimensional poverty	Social
Lehman & Koerner, 2002	US	62	Cross-sectional	Financial stress	Social
Lempers et al., 1989; Lempers & Clark-Lempers, 1990	US	622	Cross-sectional	Financial stress	Social
Lempers & Clark-Lempers, 1997	US	398	Cross-sectional	Financial stress	Social
Lengua et al., 2022	US	226	Longitudinal	Income	Social
Lepe et al., 2021	Netherlands	1,217	Longitudinal	Income; Objective socio-economic status	Social
Li et al., 2018	China	1,314	Cross-sectional	Multidimensional poverty	Social
Li & Zhang, 2023	China	626	Cross-sectional	Multidimensional poverty	Social
Low & Mounts, 2022	US	272	Cross-sectional	Financial stress	Social
Maiya et al., 2024	US	1,364	Longitudinal	Financial stress	Social
Martinez et al., 2015	Chile	1,119	Cross-sectional	Objective socio-economic status	Social; Material; Psychological
Meilstrup et al., 2016	Denmark	3,652	Cross-sectional	Objective socio-economic status	Psychological
Mo et al., 2023	China	913	Longitudinal	Objective socio-economic status	Psychological
Near, 2022	US	953	Longitudinal	Income	Social; Material
Oh & Thomas, 2024	US	2,096	Longitudinal	Financial stress	Environment
Oude Groeniger et al., 2022	Netherlands	6,842	Longitudinal	Objective socio-economic status	Social
Palacios-Barrios et al., 2021	US	78	Longitudinal	Income	Biological
Peng, 2023	China	863	Cross-sectional	Subjective socio-economic status	Social
Piko et al., 2013	Hungary	881	Cross-sectional	Objective socio-economic status	Social; Psychological
Rodriguez et al., 2015	US	338	Longitudinal	Objective socio-economic status	Social
Romens et al., 2015	US	123	Longitudinal	Financial stress	Biological
Schenck-Fontaine et al., 2020	China, Colombia, Italy, Jordan, Kenya, the Philippines, Sweden, Thailand, and the US	1,418	Longitudinal but not temporally separated	Income; Subjective socio-economic status	Social
Stepanous et al., 2023	Germany, UK, France, Ireland	1,950	Cross-sectional	Financial stress	Biological
Sun et al., 2015	China	1,419	Cross-sectional	Multidimensional poverty	Social
Swartz et al., 2017	US	183	Longitudinal	Subjective socio-economic status	Biological
Taylor et al., 2004	US	200	Cross-sectional	Financial stress	Social

Tracy et al., 2008	US	457	Cross-sectional	Income	Social; Environment
Vandewater & Lansford, 2005	US	755	Cross-sectional	Subjective socio-economic status	Social
Wadsworth & Compas, 2002	US	364	Cross-sectional	Subjective socio-economic status' Financial stress	Psychological
Wadsworth et al., 2013	US	275	Longitudinal	Financial stress	Social
Walper, 2009	Germany	358	Longitudinal	Financial stress	Social
Wang et al., 2022	China	2,467	Cross-sectional	Objective socio-economic status	Social
Weinberg, Stevens, Peeters, Visser, Frankenhuis, et al., 2023	Netherlands	1,429	Longitudinal	Subjective socio-economic status	Psychological
Weinberg, Stevens, Peeters, Visser, Tigchelaar, et al., 2023	Netherlands	848	Cross-sectional	Subjective socio-economic status; Wealth	Psychological
Weissman et al., 2022	US	177	Longitudinal	Income	Social; Material
Wen et al., 2023	Singapore	462	Longitudinal	Financial stress	Psychological
Xiong et al., 2022	China	1,573	Cross-sectional	Multidimensional poverty	Psychological
Xu et al., 2019	China	1,220	Cross-sectional	Objective socio-economic status	Psychological; Social
Yang et al., 2021	China	1,905	Cross-sectional	Subjective socio-economic status	Social
Ying et al., 2023	China	437	Cross-sectional	Objective socio-economic status	Social
Yuan et al., 2023	China	1582	Longitudinal	Objective socio-economic status	Psychological
L. Zhang & Han, 2021	US	9,250	Longitudinal	Financial poverty	Social; Material
L. Zhang et al., 2024	US	3,437	Longitudinal	Financial poverty	Social
X. Zhang et al., 2020	China	777	Cross-sectional	Financial stress	Social
Y. Zhang, 2021	China	9,449	Cross-sectional	Objective socio-economic status	Social; Material; Environment
Zietz et al., 2022	Colombia, Italy, Jordan, Kenya, the Philippines, Thailand, and the US	1,082	Longitudinal	Financial stress	Social
Zou et al., 2020	China	652	Cross-sectional	Objective socio-economic status	Psychological; Social

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Appendix B: Supplementary results from Chapter 4

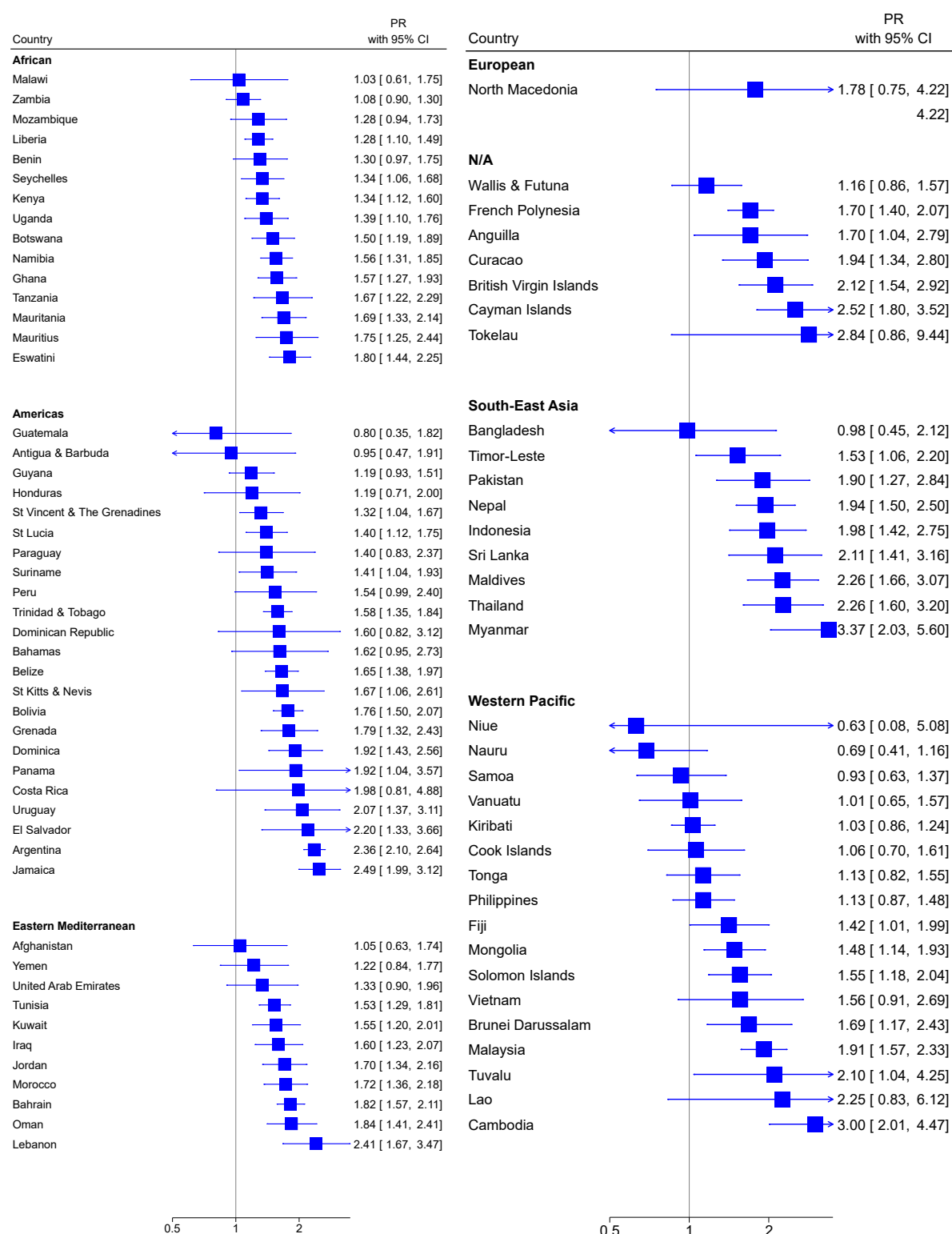
Supplementary Table 4.1. Country-level prevalence of suicidal thoughts and behaviours and food insecurity and country-level indicators data, grouped by WHO region.

Country	Reporting suicidal ideation (%)	Reporting making a suicide plan (%)	Reporting suicide attempt (%)	Food insecure (%)	GDP per capita (PPP)	Gini index	OOP health expenditure (%)	UHC Index
African								
Benin	13.8	15.6	15.6	18.4	3,005	47.8	43	37
Botswana	23.1	29.4		14	10,345	64.7	8.8	46
Eswatini	17	21	16.2	8.6	8,708	51.5	10.5	52
Ghana	19.9	23.2	26.4	14.6	3,782	42.4	38.3	34
Kenya	27.9	29.5		14.7	1,916	45	45	30
Liberia	26.3	35.5	32.9	16.6	1,564	35.3	48	39
Malawi	12.9	19.8	10.8	18.5	1,380	39.9	11.2	31
Mauritania	17.8	15.2	16.7	10.4	4,093	35.7	62.6	33
Mauritius	16.1	14.5	12.8	7.5	21,415	36.8	48.1	64
Mozambique	18.6	19.2	19	11.3	1,291	54	11.3	43
Namibia	19.4	25.2	25.6	9.9	9,736	61	9.9	54
Seychelles	21.4	21.9	19.8	12.5	24,740	46.8	28.9	66
Tanzania	13.9	9.2	10.9	6.7	2,244	37.8	26	37
Uganda	19.6	21.7		9.3	1,339	45.2	45.4	22
Zambia	31.9	41.2		28.7	2,030	54.3	25	30
Americas								
Antigua & Barbuda	17.3	17.8	12.5	7.4	22,430		25.3	65
Argentina	21.5	17	15	2	23,291	41.3	27.7	74
Bahamas	18.3	15.5	13.9	6.9	31,856		27.9	64
Belize	14.2	16.7	12.7	7.2	7,619		24.5	64
Bolivia	22.1	19.5	21.5	4.1	8,862	42.6	22	65
Costa Rica	10.8	7.2	8.3	1.4	12,217	50.6	26.4	69
Dominica	21.1	19.7	15	5.7	9,838		42.2	60
Dominican Republic	18.1	14.9	15.5	2.7	12,632	45.5	44.6	63
El Salvador	13.7	11.2	13	3.6	6,877	43.4	28.2	69
Grenada	22.5	22.3		8.1	11,565		55.2	61

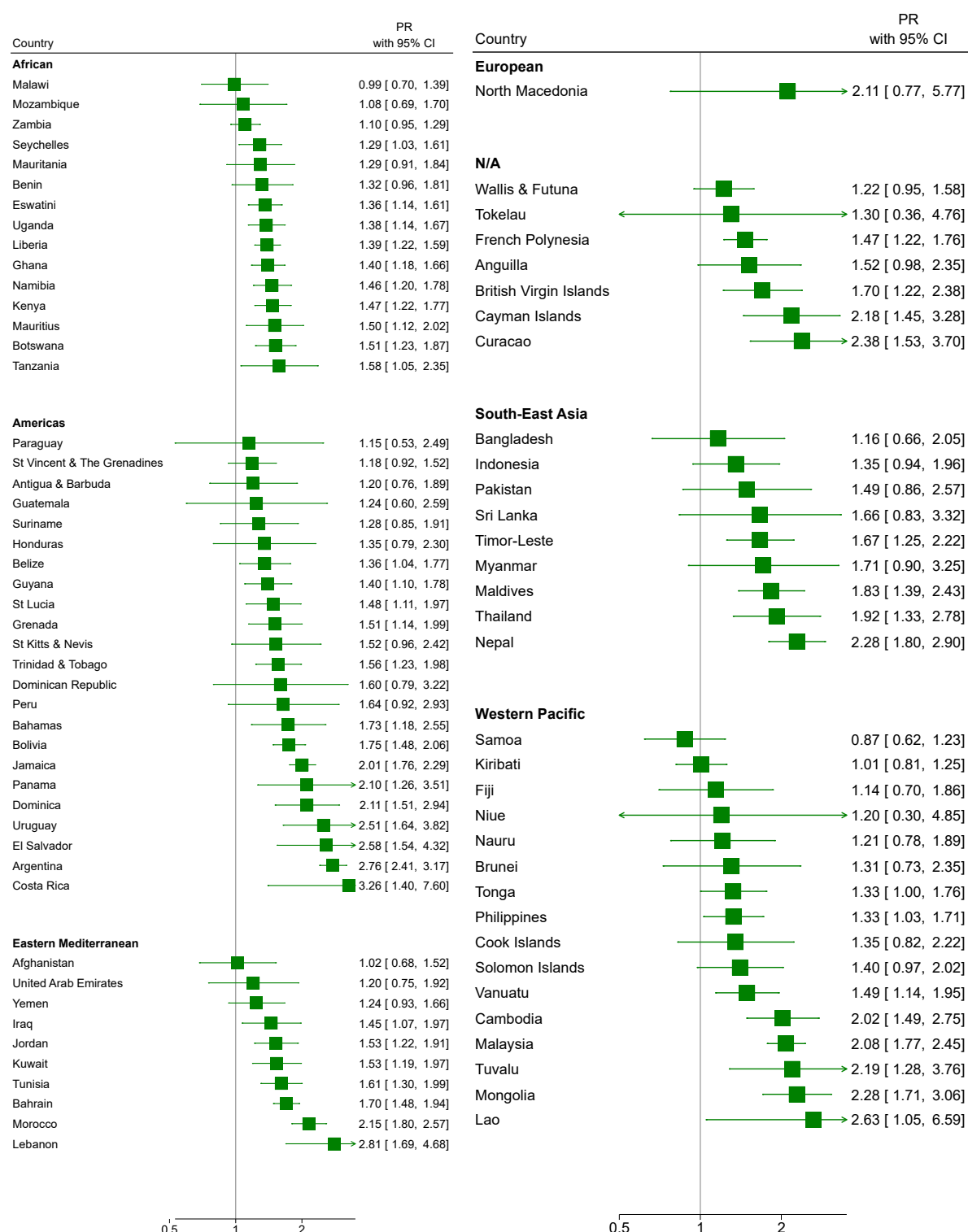
Country	Reporting suicidal ideation (%)	Reporting making a suicide plan (%)	Reporting suicide attempt (%)	Food insecure (%)	GDP per capita (PPP)	Gini index	OOP health expenditure (%)	UHC Index
Guatemala	18	13.6	16	3.2	8,194	48.3	55.7	57
Guyana	23.5	22.9		7.8	8,895		32.8	63
Honduras	19.5	18.9	17.3	3.9	4,033	53.4	49.9	57
Jamaica	24.9	24.9	17.8	6.8	9,600	45.5	16.8	69
Panama	18.8	15.2	14.3	2.3	31,781	49.2	28.7	76
Paraguay	13.8	12.9	10.7	2.5	12,591	48.5	43.8	60
Peru	20	15.3	17.3	3.2	9,731	45.5	39.5	72
St Kitts & Nevis	16.3	16.2	13.4	4.8	22,642		55.2	68
St Lucia	24.1	20.1	16.2	9.5	15,651	51.2	49.2	70
St Vincent & The Grenadines	27	24.4	18	7.2	13,776		28.9	72
Suriname	16.5	14	11.6	11.8	15,062		21.8	67
Trinidad & Tobago	22.7	21.8	13.6	8.1	27,278		40.8	72
Uruguay	12.3	11.3	10.2	1.5	18,192	39.9	18.5	74
Eastern Mediterranean								
Afghanistan	18.8	16.3	13.8	19.8	2,069		73.1	28
Bahrain	15.2	14.2	13.1	11.2	44,769		28	72
Iraq	17.6	16.3	16.1	8.8	15,163	29.5	61.7	47
Jordan	18	17.9		14.1	9,183	33.9	36	59
Kuwait	17.1	16.9	17.4	7.9	47,231		13.7	67
Lebanon	13.5	8.5	9.7	3.3	15,954	31.8	33.1	69
Morocco	16	13.7	13.2	9.2	7,113	39.5	54.3	70
Oman	21.9			4.9	35,804		5.7	67
Tunisia	20.8	14		8.2	10,095	37.7	42.8	57
United Arab Emirates	16.5	15.8	13.8	5.6	64,890		17.9	74
Yemen	16.7	14.7	13.3	10.8	3,689	36.7	76.4	41
European								
North Macedonia	8.6	5.6		1.9	9,351		37.3	57
N/A								
Anguilla	23.4	22.5	17.3	5.5				
British Virgin Islands	14.7	16.2	12.1	6.4				
Cayman Islands	18.1	15		5.1	71,483			

Country	Reporting suicidal ideation (%)	Reporting making a suicide plan (%)	Reporting suicide attempt (%)	Food insecure (%)	GDP per capita (PPP)	Gini index	OOP health expenditure (%)	UHC Index
Curacao	11.3	9	10.5	3.8	24,221			
French Polynesia	14	16.7	9.7	11.1				
Tokelau	24.1	24.5	27	4.4				
Wallis & Futuna	23.7	28.6	14.4	14.8				
South-East Asia								
Bangladesh	4.9	7.3	6.7	13.1	3,368	32.1	69.9	37
Indonesia	5.2	5.6	3.9	4.1	10,247	39.7	43	51
Maldives	13.3	18	12.7	5.9	15,993	38.4	28.1	62
Myanmar	8.9	6.4	8.5	2.5	4,031	38.1	76.7	54
Nepal	13.9	13.8	10.2	4.7	2,996	32.8	59.4	45
Pakistan	7.2	7.6		5.8	4,353	29.7	72.3	32
Sri Lanka	9.4	6.3	6.6	3.2	12,224	39.3	50.1	60
Thailand	12.2	13.7	12.9	3.9	15,822	36	12.5	63
Timor Leste	9.6	9.1	8.6	11.7	2,913	28.7	7.4	49
Western Pacific								
Brunei	9.3	6.6	5.9	6.7	81,371		7.3	73
Cambodia	6.4	8.8	6.8	6.3	3,046		61.2	53
Cook Islands	15.3	14.6	13.5	10				
Fiji	17.6	20.9		10.7	7,915	40.4	22.4	56
Kiribati	34.7	33.6	31.4	12.8	1,739	37	0.1	44
Lao	2.9	4.3	5.1	1.2	6,168	36	45.4	45
Malaysia	7.9	6.4	6.8	4.9	22,986	43.9	33	68
Mongolia	23	14.7	9.9	1.9	10,550	33.8	37.3	54
Nauru	28.7	23.4		14	6,662		1.9	47
Niue	10.2	10.1	9.5	11.9				
Philippines	11.3	10.6	16.2	7.5	7,187	44.6	51.2	49
Samoa	22.9	22.3	22.1	12.5	6,486	38.7	11.3	43
Solomon Islands	27.7	26	33.5	10.9	2,324	46.1	2.4	45
Tonga	12.6	13.7	16.4	11.1	6,466	37.6	9.8	55
Tuvalu	7.8	11.2	8.3	7	3,341	39.1	0.6	47
Vanuatu	15.1	20.9	22.3	8.1	2,918	37.4	11	49
Vietnam	16.9			1.1	6,689	35.6	41.3	59

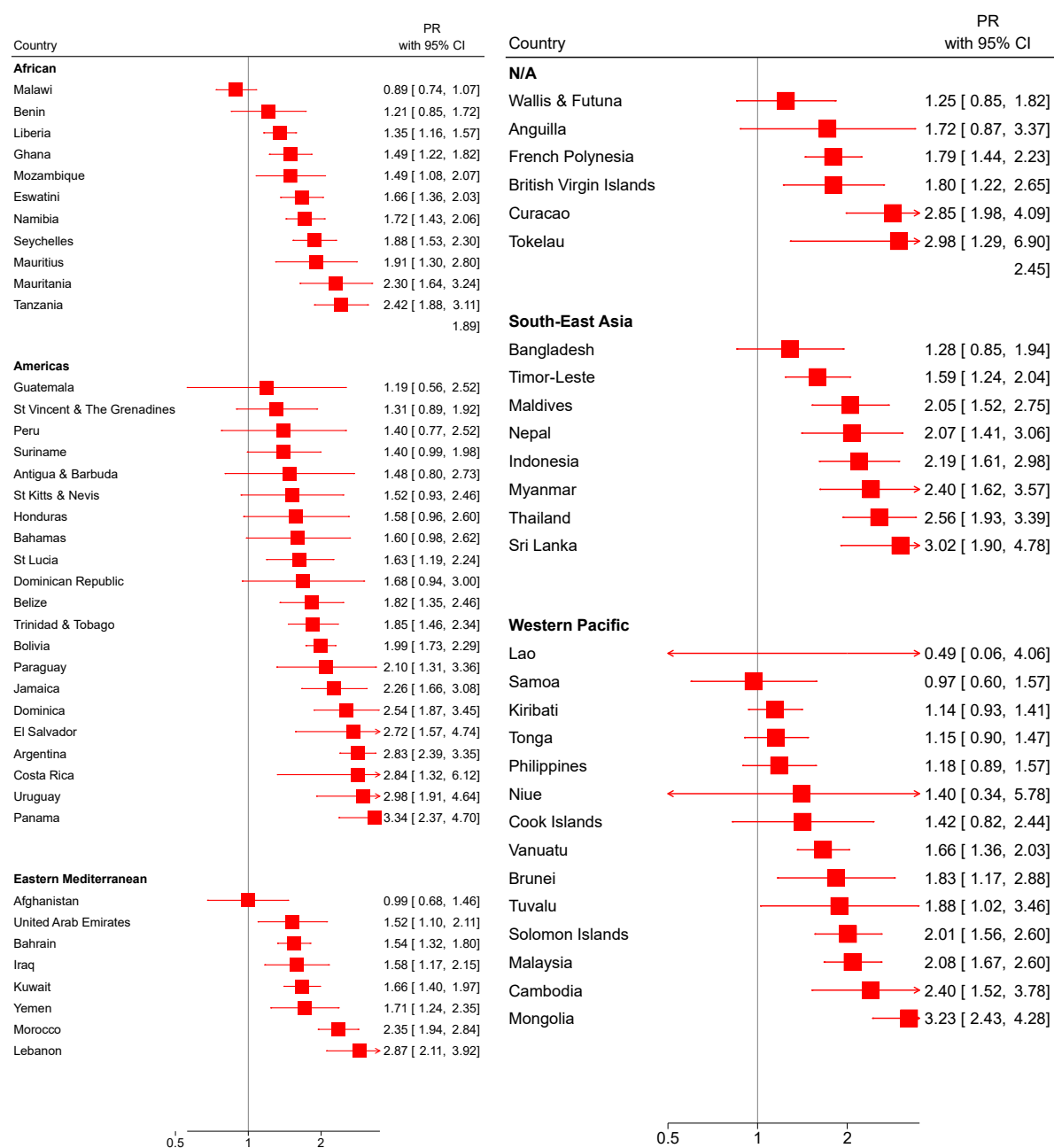
Supplementary Figure 4.1. Prevalence ratios for suicidal ideation according to food insecurity status, across countries and WHO World Regions.



Supplementary Figure 4.2. Prevalence ratios for making a suicide plan according to food insecurity status, across countries and WHO World Regions.



Supplementary Figure 4.3. Prevalence ratios for suicide attempts according to food insecurity status, across countries and WHO World Regions.



Supplementary Table 4.2. Meta-regression results of the association between country-level factors and log-PRs for suicidal ideation, suicide plans, and suicide attempt (binary food insecurity variable).

	Suicidal ideation	Suicide plans	Suicide attempt
GDP per capita			
Countries	76	74	61
Change in log-PR per increase in log dollars in GDP per capita (95% CI)	0.096 (0.046 to 0.15)	0.092 (0.036 to 0.15)	0.10 (0.03 to 0.18)
Between-country variance explained	28.4%	20.1%	15.6%
Gini index			
Countries	55	54	46
Change in log-PR per 1-point increase in the Gini index (95% CI)	-0.0058 (-0.015 to 0.0031)	-0.0058 (-0.015 to 0.0036)	-0.0024 (-0.017 to 0.011)
Between-country variance explained	1%	1.5%	0%
Change in log-PR per 1-point increase in the Gini index ^a (95% CI)	-0.0061 (-0.013 to 0.0013)	-0.0072 (-0.015 to 0.0010)	-0.0067 (-0.018 to 0.0050)
UHC Index			
Countries	74	72	60
Change in log-PR per 1-point increase in the UHC index (95% CI)	0.0074 (0.0036 to 0.011)	0.0085 (0.0048 to 0.012)	0.011 (0.0052 to 0.016)
Between-country variance explained	30.3%	35.3%	27.6%
Change in log-PR per 1-point increase in the UHC index ^a (95% CI)	0.0074 (0.00042 to 0.014)	0.012 (0.0052 to 0.019)	0.014 (0.0039 to 0.024)
OOP health expenditure			
Countries	74	72	60
Change in log-PR per 1 percentage point increase in out-of-pocket health expenditure (95% CI)	0.0021 (-0.0011 to 0.0052)	0.0012 (-0.0020 to 0.0044)	0.0013 (-0.0028 to 0.0053)
Between-country variance explained	0.1%	0.5%	0%
Change in log-PR per 1 percentage point increase in out-of-pocket health expenditure ^a (95% CI)	0.0021 (-0.0011 to 0.0051)	0.0018 (-0.0013 to 0.0048)	0.0017 (-0.0021 to 0.0056)
Prevalence of food insecurity			
Countries	83	81	68
Change in log-PR per 1 percentage point increase in food insecurity prevalence (95% CI)	-0.030 (-0.039 to -0.021)	-0.031 (-0.040 to -0.022)	-0.052 (-0.063 to -0.041)
Between-country variance explained	56.5%	54.2%	77.8%
Change in log-PR per 1 percentage point increase in food insecurity prevalence ^a (95% CI)	-0.026 (-0.036 to -0.015)	-0.029 (-0.040 to -0.018)	-0.054 (-0.067 to -0.040)
Change in log-PR per 1 percentage point increase in food insecurity prevalence ^b (95% CI)	-0.021 (-0.033 to -0.009)	-0.025 (-0.038 to -0.012)	-0.051 (-0.066 to -0.037)

^aadjusted for GDP per capita (PPP). ^badjusted for GDP per Capita (PPP) and Gini index.

Supplementary Table 4.3. Prevalence ratios coefficients with 95% confidence intervals from the mixed-effects Poisson regression models (binary food insecurity variable).

	Suicidal ideation	Suicide plans	Suicide attempt
Model A: Food insecurity only			
Food insecure	1.58 (1.49 to 1.66)	1.56 (1.48 to 1.64)	1.79 (1.68 to 1.91)
Model B: Individual-level confounders			
Food insecure	1.59 (1.5 to 1.68)	1.57 (1.49 to 1.65)	1.8 (1.69 to 1.93)
Model C: GDP per capita			
Food insecure	1.6 (1.51 to 1.69)	1.57 (1.49 to 1.66)	1.82 (1.7 to 1.96)
GDP per capita	1.07 (1.03 to 1.11)	0.97 (0.93 to 1)	0.95 (0.92 to 0.99)
Model D: GDP per capita interaction			
Food insecure	0.77 (0.56 to 1.06)	0.82 (0.65 to 1.04)	0.81 (0.6 to 1.11)
GDP per capita	1 (0.96 to 1.04)	0.91 (0.88 to 0.95)	0.91 (0.86 to 0.96)
GDP per capita X Food insecure	1.08 (1.05 to 1.12)	1.08 (1.05 to 1.1)	1.09 (1.06 to 1.13)
Model E: Gini index			
Food insecure	1.59 (1.49 to 1.7)	1.58 (1.48 to 1.69)	1.85 (1.7 to 2.02)
Gini	1.16 (1.04 to 1.29)	1.19 (1.07 to 1.32)	1.18 (1.03 to 1.34)
Model F: Gini index interaction			
Food insecure	1.59 (1.49 to 1.7)	1.59 (1.49 to 1.69)	1.85 (1.7 to 2.01)
Gini	1.19 (1.07 to 1.34)	1.23 (1.1 to 1.38)	1.19 (1.04 to 1.37)
Gini X Food insecure	0.95 (0.9 to 1.02)	0.96 (0.9 to 1.02)	0.98 (0.89 to 1.07)
Model G: Gini index interaction ^a			
Food insecure	1.6 (1.5 to 1.7)	1.58 (1.48 to 1.69)	1.85 (1.69 to 2.01)
Gini	1.19 (1.07 to 1.32)	1.23 (1.11 to 1.23)	1.2 (1.05 to 1.38)
Gini X Food insecure	0.95 (0.9 to 1.01)	0.96 (0.9 to 1.02)	0.98 (0.89 to 1.07)
Model H: UHC index			
Food insecure	1.6 (1.51 to 1.69)	1.57 (1.49 to 1.66)	1.82 (1.69 to 1.95)
UHC index	1.12 (1.02 to 1.23)	1.02 (0.92 to 1.12)	1.02 (0.91 to 1.14)
Model I: UHC index interaction			
Food insecure	1.6 (1.52 to 1.68)	1.57 (1.5 to 1.65)	1.8 (1.68 to 1.92)
UHC index	1.03 (0.93 to 1.14)	0.94 (0.84 to 1.04)	0.95 (0.85 to 1.07)
UHC index X Food insecure	1.09 (1.04 to 1.14)	1.1 (1.05 to 1.15)	1.13 (1.05 to 1.2)
Model J: UHC index interaction ^a			
Food insecure	1.6 (1.52 to 1.68)	1.58 (1.5 to 1.66)	1.8 (1.69 to 1.92)
UHC index	1.06 (0.95 to 1.19)	0.98 (0.87 to 1.11)	1.02 (0.89 to 1.17)
UHC index X Food insecure	1.09 (1.04 to 1.14)	1.1 (1.05 to 1.15)	1.12 (1.05 to 1.2)
Model K: OOP health expenditure			
Food insecure	1.58 (1.5 to 1.68)	1.56 (1.48 to 1.65)	1.81 (1.69 to 1.95)
OOP health expenditure	0.91 (0.83 to 0.99)	0.88 (0.8 to 0.96)	0.89 (0.8 to 0.98)
Model L: OOP health expenditure interaction			
Food insecure	1.59 (1.5 to 1.69)	1.56 (1.48 to 1.65)	1.81 (1.69 to 1.95)
OOP health expenditure	0.9 (0.81 to 0.99)	0.87 (0.78 to 0.96)	0.89 (0.8 to 0.99)
OOP health expenditure X Food insecure	1.02 (0.96 to 1.08)	1.02 (0.97 to 1.08)	0.99 (0.93 to 1.07)
Model M: OOP health expenditure interaction ^a			
Food insecure	1.59 (1.5 to 1.69)	1.56 (1.48 to 1.65)	1.81 (1.68 to 1.95)
OOP health expenditure	0.9 (0.82 to 0.99)	0.85 (0.75 to 0.94)	0.87 (0.78 to 0.97)
OOP health expenditure X Food insecure	1.02 (0.96 to 1.08)	1.02 (0.97 to 1.08)	0.99 (0.92 to 1.07)
Model N: Prevalence of food insecurity			
Food insecure	1.58 (1.5 to 1.67)	1.54 (1.46 to 1.62)	1.79 (1.68 to 1.92)
Percent food insecure	1.05 (0.95 to 1.17)	1.22 (1.09 to 1.35)	1.09 (0.96 to 1.24)
Model O: Prevalence of food insecurity interaction			
Food insecure	1.63 (1.56 to 1.71)	1.61 (1.54 to 1.68)	1.82 (1.73 to 1.92)
Percent food insecure	1.14 (1.05 to 1.24)	1.27 (1.16 to 1.38)	1.17 (1.05 to 1.3)
Percent food insecure X Food insecure	0.87 (0.84 to 0.91)	0.88 (0.84 to 0.91)	0.82 (0.77 to 0.87)
Model P: Prevalence of food insecurity interaction ^a			
Food insecure	1.60 (1.56 to 1.71)	1.61 (1.54 to 1.69)	1.83 (1.73 to 1.93)
Percent food insecure	1.20 (1.09 to 1.33)	1.30 (1.18 to 1.43)	1.19 (1.06 to 1.35)
Percent food insecure x Food insecure	0.88 (0.84 to 0.91)	0.88 (0.84 to 0.91)	0.82 (0.77 to 0.87)
Model Q: Prevalence of food insecurity interaction ^b			
Food insecure	1.63 (1.55 to 1.72)	1.62 (1.54 to 1.71)	1.84 (1.72 to 1.96)
Percent food insecure	1.16 (1.05 to 1.29)	1.29 (1.17 to 1.41)	1.26 (1.11 to 1.43)
Percent food insecure x Food insecure	0.88 (0.84 to 0.92)	0.88 (0.84 to 0.91)	0.82 (0.76 to 0.88)

^aadjusted for GDP per capita (PPP). ^badjusted for GDP per Capita (PPP) and Gini index.

Supplementary Table 4.4. Meta-regression results of the association between country-level factors and the Relative Index of Inequality for suicidal ideation, suicide plans, and suicide attempt for the 68 countries where all outcomes were measured.

	Suicidal ideation	Suicide plan	Suicide attempt
GDP per capita			
Countries	61	61	61
Change in RII per increase in log dollars in GDP per capita (95% CI)	-0.091 (-0.18 to -0.0001)	-0.067 (-0.15 to 0.015)	-0.081 (-0.17 to 0.023)
Between-country variance explained	6.6%	2.4%	4.7%
Gini index			
Countries	46	46	46
Change in RII per 1-point increase in the Gini index (95% CI)	-0.0091 (-0.025 to 0.0068)	-0.0071 (-0.021 to 0.0066)	-0.0019 (-0.018 to 0.014)
Between-country variance explained	0%	0%	0%
Change in RII per 1-point increase in the Gini index ^a (95% CI)	-0.0060 (-0.021 to 0.0092)	-0.0043 (-0.017 to 0.0088)	0.0022 (-0.013 to 0.017)
Universal Health Coverage index			
Countries	60	60	60
Change in RII per 1-point increase in the UHC index (95% CI)	-0.010 (-0.017 to -0.0039)	-0.0021 (-0.0063 to 0.0019)	-0.0097 (-0.016 to -0.0031)
Between-country variance explained	17.2%	20.9%	16.7%
Change in RII per 1-point increase in the UHC index ^a (95% CI)	-0.010 (-0.017 to -0.0039)	-0.017 (-0.027 to -0.0076)	-0.016 (-0.027 to -0.0041)
Out-of-pocket health expenditure			
Countries	60	60	60
Change in RII per 1 percentage point increase in out-of-pocket health expenditure (95% CI)	-0.0021 (-0.0068 to 0.0026)	-0.0096 (-0.015 to -0.0038)	-0.0036 (-0.0083 to 0.0012)
Between-country variance explained	0%	1%	3.3%
Change in RII per 1 percentage point increase in out-of-pocket health expenditure ^a (95% CI)	-0.0026 (-0.0072 to 0.0020)	-0.0026 (-0.0067 to 0.0015)	-0.0040 (-0.0087 to 0.00066)

^aadjusted for GDP per capita (PPP).

Supplementary Table 4.5. Meta-regression results of the association between country-level factors and log-PRs for suicidal ideation, suicide plans, and suicide attempt for the 68 countries where all outcomes were measured (binary food insecurity variable).

	Suicidal ideation	Suicide plan	Suicide attempt
GDP per capita			
Countries	61	61	61
Change in log-PR per increase in log dollars in GDP per capita (95% CI)	0.078 (0.015 to 0.14)	0.083 (0.015 to 0.15)	0.10 (0.03 to 0.18)
Between-country variance explained	16.7%	13.2%	15.6%
Gini index			
Countries	46	46	46
Change in log-PR per 1-point increase in the Gini index (95% CI)	-0.0037 (-0.015 to 0.008)	-0.0054 (-0.018 to 0.0070)	-0.0024 (-0.017 to 0.011)
Between-country variance explained	0%	0%	0%
Change in log-PR per 1-point increase in the Gini index ^a (95% CI)	-0.0057 (-0.016 to 0.0044)	-0.0095 (-0.020 to 0.0015)	-0.0067 (-0.018 to 0.0050)
Universal Health Coverage index			
Countries	60	60	60
Change in log-PR per 1-point increase in the UHC index (95% CI)	0.0077 (0.0030 to 0.012)	0.0098 (-0.0051 to 0.015)	0.011 (0.0052 to 0.016)
Between-country variance explained	23.4%	33.5%	27.6%
Change in log-PR per 1-point increase in the UHC index ^a (95% CI)	0.0090 (0.0030 to 0.017)	0.015 (0.0067 to 0.023)	0.014 (0.0039 to 0.024)
Out-of-pocket health expenditure			
Countries	60	60	60
Change in log-PR per 1 percentage point increase in out-of-pocket health expenditure (95% CI)	0.0015 (-0.0020 to 0.005)	0.00094 (-0.0027 to 0.0046)	0.0013 (-0.0028 to 0.0053)
Between-country variance explained	0%	0%	0%
Change in log-PR per 1 percentage point increase in out-of-pocket health expenditure ^a (95% CI)	0.0019 (-0.0015 to 0.0052)	0.0014 (-0.0021 to 0.0048)	0.0017 (-0.0021 to 0.0056)
Prevalence of food insecurity			
Countries	68	68	68
Change in log-PR per 1 percentage point increase in food insecurity prevalence (95% CI)	-0.037 (-0.049 to -0.025)	-0.041 (-0.053 to -0.029)	-0.052 (-0.063 to -0.041)
Between-country variance explained	57.8%	59.8%	77.8%
Change in log-PR per 1 percentage point increase in food insecurity prevalence ^a (95% CI)	-0.034 (-0.048 to -0.020)	-0.042 (-0.057 to -0.027)	-0.054 (-0.067 to -0.040)
Change in log-PR per 1 percentage point increase in food insecurity prevalence ^b (95% CI)	-0.031 (-0.048 to -0.013)	-0.039 (-0.057 to -0.021)	-0.051 (-0.066 to -0.037)

^aadjusted for GDP per capita (PPP). ^badjusted for GDP per Capita (PPP) and Gini index.

Supplementary Table 4.6. Relative Index of Inequality with 95% confidence intervals from the mixed-effects Poisson regression models, for the 68 countries where all outcomes were measured.

	Suicidal ideation	Suicide plans	Suicide attempt
Model A: Food insecurity only			
Food insecure	0.49 (0.46 to 0.53)	0.54 (0.5 to 0.58)	0.44 (0.41 to 0.47)
Model B: Individual-level confounders			
Food insecure	0.49 (0.45 to 0.52)	0.53 (0.5 to 0.57)	0.43 (0.4 to 0.47)
Model C: GDP per capita			
Food insecure	0.48 (0.45 to 0.52)	0.53 (0.49 to 0.57)	0.43 (0.4 to 0.46)
GDP per capita	1.02 (0.97 to 1.08)	0.94 (0.88 – 1)	0.92 (0.89 to 0.95)
Model D: GDP per capita interaction			
Food insecure	0.88 (0.65 to 1.2)	0.85 (0.61 to 1.2)	0.72 (0.44 to 1.17)
GDP per capita	1.05 (1 to 1.10)	0.96 (0.9 to 1.01)	0.93 (0.88 to 0.98)
GDP per capita X Food insecure	0.94 (0.9 to 0.97)	0.95 (0.91 to 0.99)	0.95 (0.9 to 1)
Model E: Gini index			
Food insecure	0.48 (0.44 to 0.52)	0.52 (0.48 to 0.57)	0.42 (0.38 to 0.45)
Gini	1.18 (1.03 to 1.36)	1.19 (1.04 to 1.37)	1.19 (1.04 to 1.37)
Model F: Gini index interaction			
Food insecure	0.48 (0.44 to 0.52)	0.52 (0.48 to 0.57)	0.42 (0.38 to 0.45)
Gini	1.21 (1.04 to 1.4)	1.21 (1.05 to 1.4)	1.19 (1.04 to 1.37)
Gini X Food insecure	0.95 (0.86 to 1.05)	0.94 (0.86 to 1.04)	0.99 (0.9 to 1.1)
Model G: Gini index interaction ^a			
Food insecure	0.48 (0.44 to 0.52)	0.52 (0.48 to 0.57)	0.42 (0.38 to 0.45)
Gini	1.21 (1.04 to 1.41)	1.23 (1.06 to 1.41)	1.21 (1.05 to 1.39)
Gini X Food insecure	0.95 (0.86 to 1.05)	0.94 (0.86 to 1.04)	0.99 (0.9 to 1.09)
Model H: UHC index			
Food insecure	0.49 (0.45 to 0.52)	0.54 (0.5 to 0.58)	0.43 (0.4 to 0.47)
UHC index	1.1 (0.98 to 1.24)	0.98 (0.87 to 1.11)	0.97 (0.86 to 1.1)
Model I: UHC index interaction			
Food insecure	0.5 (0.46 to 0.53)	0.55 (0.51 to 0.58)	0.44 (0.41 to 0.47)
UHC index	1.13 (1.01 to 1.28)	1.02 (0.91 to 1.15)	0.99 (0.89 to 1.11)
UHC index X Food insecure	0.89 (0.82 to 0.96)	0.9 (0.84 to 0.96)	0.9 (0.83 to 0.97)
Model J: UHC index interaction ^a			
Food insecure	0.5 (0.46 to 0.53)	0.55 (0.51 to 0.58)	0.44 (0.41 to 0.47)
UHC index	1.19 (1.02 to 1.38)	1.07 (0.93 to 1.25)	1.07 (0.93 to 1.22)
UHC index X Food insecure	0.89 (0.82 to 0.96)	0.9 (0.83 to 0.97)	0.9 (0.83 to 0.97)
Model K: OOP health expenditure			
Food insecure	0.49 (0.45 to 0.53)	0.54 (0.5 to 0.58)	0.43 (0.4 to 0.47)
OOP health expenditure	0.92 (0.83 to 1.02)	0.88 (0.79 to 0.98)	0.89 (0.8 to 0.99)
Model L: OOP health expenditure interaction			
Food insecure	0.49 (0.45 to 0.53)	0.54 (0.5 to 0.58)	0.43 (0.4 to 0.47)
OOP health expenditure	0.92 (0.82 to 1.03)	0.89 (0.8 to 0.99)	0.9 (0.81 to 1)
OOP health expenditure X Food insecure	0.98 (0.91 to 1.07)	0.97 (0.9 to 1.05)	0.96 (0.89 to 1.04)
Model M: OOP health expenditure interaction ^a			
Food insecure	0.49 (0.45 to 0.53)	0.54 (0.5 to 0.58)	0.43 (0.4 to 0.47)
OOP health expenditure	0.92 (0.82 to 1.03)	0.87 (0.78 to 0.97)	0.88 (0.79 to 0.98)
OOP health expenditure X Food insecure	0.98 (0.91 to 1.06)	0.97 (0.9 to 1.05)	0.96 (0.89 to 1.04)

^aadjusted for GDP per capita (PPP).

Supplementary Table 4.7. Prevalence ratios coefficients with 95% confidence intervals from the mixed-effects Poisson regression models where all suicidal thoughts and behaviours were measured.

	Suicidal ideation	Suicide plans	Suicide attempt
Model A: Food insecurity only			
Food insecure	1.6 (1.51 to 1.69)	1.57 (1.48 to 1.67)	1.79 (1.68 to 1.91)
Model B: Individual-level confounders			
Food insecure	1.61 (1.52 to 1.71)	1.58 (1.49 to 1.68)	1.8 (1.69 to 1.93)
Model C: GDP per capita			
Food insecure	1.63 (1.53 to 1.73)	1.59 (1.5 to 1.7)	1.82 (1.7 to 1.96)
GDP per capita	1.06 (1.02 to 1.1)	0.98 (0.95 to 1.01)	0.95 (0.92 to 0.99)
Model D: GDP per capita interaction			
Food insecure	0.93 (0.65 to 1.32)	0.9 (0.62 to 1.30)	0.81 (0.6 to 1.11)
GDP per capita	1.02 (0.98 to 1.06)	0.94 (0.9 to 0.97)	0.91 (0.86 to 0.96)
GDP per capita X Food insecure	1.06 (1.02 to 1.11)	1.07 (1.02 to 1.11)	1.09 (1.06 to 1.13)
Model E: Gini index			
Food insecure	1.63 (1.51 to 1.75)	1.62 (1.5 to 1.74)	1.85 (1.7 to 2.02)
Gini	1.17 (1.02 to 1.34)	1.15 (1.01 to 1.31)	1.18 (1.03 to 1.34)
Model F: Gini index interaction			
Food insecure	1.63 (1.51 to 1.75)	1.62 (1.5 to 1.74)	1.85 (1.7 to 2.01)
Gini	1.18 (1.03 to 1.36)	1.19 (1.04 to 1.36)	1.19 (1.04 to 1.37)
Gini X Food insecure	0.97 (0.9 to 1.05)	0.96 (0.88 to 1.03)	0.98 (0.89 to 1.07)
Model G: Gini index interaction ^a			
Food insecure	1.63 (1.51 to 1.75)	1.62 (1.5 to 1.74)	1.85 (1.69 to 2.01)
Gini	1.17 (1.02 to 1.35)	1.19 (1.03 to 1.36)	1.2 (1.05 to 1.38)
Gini X Food insecure	0.97 (0.9 to 1.05)	0.96 (0.88 to 1.03)	0.98 (0.89 to 1.07)
Model H: UHC index			
Food insecure	1.63 (1.53 to 1.73)	1.6 (1.5 to 1.7)	1.82 (1.69 to 1.95)
UHC index	1.16 (1.04 to 1.29)	1.06 (0.95 to 1.19)	1.02 (0.91 to 1.14)
Model I: UHC index interaction			
Food insecure	1.61 (1.52 to 1.71)	1.58 (1.49 to 1.67)	1.8 (1.68 to 1.92)
UHC index	1.08 (0.96 to 1.21)	0.98 (0.87 to 1.1)	0.95 (0.85 to 1.07)
UHC index X Food insecure	1.09 (1.03 to 1.15)	1.11 (1.05 to 1.17)	1.13 (1.05 to 1.2)
Model J: UHC index interaction ^a			
Food insecure	1.62 (1.53 to 1.71)	1.58 (1.5 to 1.68)	1.8 (1.69 to 1.92)
UHC index	1.20 (1.01 to 1.44)	1.05 (0.92 to 1.2)	1.02 (0.89 to 1.17)
UHC index X Food insecure	1.09 (1.03 to 1.15)	1.11 (1.05 to 1.17)	1.12 (1.05 to 1.2)
Model K: OOP health expenditure			
Food insecure	1.62 (1.52 to 1.72)	1.59 (1.49 to 1.69)	1.81 (1.69 to 1.95)
OOP health expenditure	0.92 (0.83 to 1.02)	0.89 (0.81 to 0.98)	0.89 (0.8 to 0.98)
Model L: OOP health expenditure interaction			
Food insecure	1.62 (1.52 to 1.73)	1.59 (1.49 to 1.69)	1.81 (1.69 to 1.95)
OOP health expenditure	0.92 (0.82 to 1.02)	0.88 (0.79 to 0.98)	0.89 (0.8 to 0.99)
OOP health expenditure X Food insecure	1 (0.94 to 1.07)	1.02 (0.96 to 1.08)	0.99 (0.93 to 1.07)
Model M: OOP health expenditure interaction ^a			
Food insecure	1.62 (1.52 to 1.72)	1.59 (1.49 to 1.69)	1.81 (1.68 to 1.95)
OOP health expenditure	0.92 (0.83 to 1.02)	0.87 (0.78 to 0.96)	0.87 (0.78 to 0.97)
OOP health expenditure X Food insecure	1 (0.94 to 1.07)	1.02 (0.96 to 1.08)	0.99 (0.92 to 1.07)
Model N: Prevalence of food insecurity			
Food insecure	1.61 (1.52 to 1.71)	1.57 (1.48 to 1.66)	1.79 (1.68 to 1.92)
Percent food insecure	1.01 (0.9 to 1.14)	1.15 (1.01 to 1.31)	1.09 (0.96 to 1.24)
Model O: Prevalence of food insecurity interaction			
Food insecure	1.64 (1.56 to 1.72)	1.61 (1.54 to 1.69)	1.82 (1.73 to 1.92)
Percent food insecure	1.1 (0.99 to 1.23)	1.23 (1.1 to 1.36)	1.17 (1.05 to 1.3)
Percent food insecure X Food insecure	0.86 (0.81 to 0.91)	0.85 (0.8 to 0.89)	0.82 (0.77 to 0.87)
Model P: Prevalence of food insecurity interaction ^a			
Food insecure	1.64 (1.55 to 1.73)	1.61 (1.54 to 1.69)	1.83 (1.73 to 1.93)
Percent food insecure	1.15 (1.02 to 1.31)	1.30 (1.18 to 1.43)	1.19 (1.06 to 1.35)
Percent food insecure x Food insecure	0.87 (0.82 to 0.92)	0.88 (0.84 to 0.91)	0.82 (0.77 to 0.87)
Model Q: Prevalence of food insecurity interaction ^b			
Food insecure	1.63 (1.53 to 1.74)	1.62 (1.53 to 1.72)	1.84 (1.72 to 1.96)
Percent food insecure	1.17 (1.02 to 1.34)	1.31 (1.16 to 1.48)	1.26 (1.11 to 1.43)
Percent food insecure x Food insecure	0.86 (0.81 to 0.91)	0.84 (0.79 to 0.89)	0.82 (0.76 to 0.88)

^aadjusted for GDP per capita (PPP). ^badjusted for GDP per Capita (PPP) and Gini index.

Appendix C: Supplementary methods from Chapter 6

Imputation of household income using interval regression in MCS

For the UK, where household income was reported in bands, interval regression was used to impute continuous values of household income within the imputation model. In interval regression the continuous imputed value falls within the lower and upper bands reported for that variable for each observation, with information from other variables in the imputation model used to inform where within that banding the continuous value may be. Where household income data was missing entirely, the lower interval was set as 0, whilst there was no upper interval, consequently extending to infinity. To improve the imputation of household income in the UK sample, variables associated with household income were also added to the imputation model: (a) whether the adolescents' household is owned by their parents, privately rented, or rented from a local authority or housing association, and (b) adolescents' parents' employment status (employed or unemployed). Further variables within the imputation model were also associated with household income in simple interval regression models of the analytic sample including, adolescents' ethnicity, baseline and follow-up symptoms, the number of residents within the household, and the sampling strata. Additionally, the lower and upper bands were all neglog-transformed (i.e., for a band of £5,000 and £10,999 the lower band was specified as the log of "5,000+1" (8.52) and the upper band was specified as the log of "10,999+1" (9.31)) to ensure imputation compatibility between the imputation and analytic models.

Harmonisation of the outcome measures of internalising symptoms

Supplementary Table 6.1. Items from each countries' outcome measure of internalising symptoms included in the harmonised measures and their corresponding Harmony score.

Items within the harmonised measures					
Measure	Item	Match with SDQ-E item	Match with CCDSD item	Match with CES-D item	Average Harmony score across items
SDQ-E	I have many fears, I am easily scared				59.8
CCDSD	Have you felt fear of some things, as if you were waiting for something serious to happen?	62			
CES-D	I felt fearful	72	72		
K-10	How often did you feel nervous?	44	58	51	
SDQ-E	I am often unhappy, depressed, or tearful				71.7
CCDSD	Have you felt sad or anguished?	72			
CES-D	I felt depressed	79	71		
K-10	How often did you feel so sad that nothing could cheer you up?	66	77	65	

Table displays the two items of the SDQ-E that had an acceptable match with an item from each of other measures. Values refer to scores from the Harmony tool, with numbers closer to 100 representing a closer semantic match between the two items.

Appendix D: Supplementary methods and results from Chapter 7

Supplementary Table 7.1. Auxiliary variables included in country-specific imputation models, and whether they were associated with the values of the mediators and outcomes and missingness of the outcome.

		Mediators		Outcome	
		Positive parent relations	Positive peer relations	Internalising symptoms	
Ethiopia					
	Wave	Associated with variable	Associated with variable	Associated with variable	Associated with missingness
Able to speak their views and feelings to parents or guardians	3	Y	Y		
Young people have tried to break or damage something of theirs	3		Y		
Young people have tried to make them feel uncomfortable by staring at them	3		Y		
Wealth index	1			Y	Y
SDQ-E	3				
SDQ-E	4		Y	Y	
India					
Able to speak their views and feelings to parents or guardians	3	Y	Y		
Parents or guardians treat them fairly when they have done something wrong	3	Y	Y		
Been physically hurt by family	3	Y		Y	
Young people have stolen from them	3		Y	Y	
Young people have made fun of them	3	Y	Y		
Wealth index	1	Y	Y		
SDQ-E	3			Y	
SDQ-E	4	Y		Y	
Peru					
Able to speak their views and feelings to parents or guardians	3	Y			Y
Been physically hurt by family	3	Y			
Other young people have tried to make them feel uncomfortable by staring at them	3	Y	Y	Y	
Been physically hurt by young people	3		Y	Y	
SDQ-E	3			Y	Y
SDQ-E	4	Y	Y	Y	
Vietnam					
Able to speak their views and feelings to parents or guardians	3	Y			
Been physically hurt by family	3	Y			
Young people have tried to get them in trouble with friends	3		Y	Y	
Young people have tried to break or damage something of theirs	3		Y		
Wealth index	1	Y		Y	
SDQ-E	3			Y	
SDQ-E	4		Y	Y	

Supplementary Table 7.2. Factor loadings for items within the parents subscale of the Self-Description Questionnaire I for each country.

Country	Ethiopia	India		Peru		Vietnam
Factor	I	I	II	I	II	I
Item 1	0.38	0.50	0.30	0.54		0.47
Item 2	0.49	0.62		0.43		0.55
Item 3	0.47	0.49		0.57	-0.36	0.49
Item 4	0.56	0.71		0.69		0.66
Item 5	0.61	0.64		0.67		0.69
Item 6	0.44	0.52		0.63		0.56
Item 7	0.56	0.62		0.63		0.59
Item 8	0.65	0.66		0.67		0.66

Factor loadings are displayed if ≥ 0.3 .

Supplementary Table 7.2. Factor loadings for items within the peer relationships subscale of the Self-Description Questionnaire II for each country.

Country	Ethiopia	India	Peru	Vietnam
Factor	I	I	I	I
Item 1	0.41	0.43	0.55	0.44
Item 2	0.70	0.59	0.69	0.57
Item 3	0.68	0.63	0.61	0.60
Item 4	0.45	0.53	0.52	0.52
Item 5	0.56	0.59	0.54	0.49
Item 6	0.59	0.62	0.57	0.52
Item 7	0.53	0.58	0.62	0.45
Item 8	0.50	0.552	0.59	0.53

Factor loadings are displayed if ≥ 0.3 .

Supplementary Table 7.4. Mediating pathways from household consumption expenditure to internalising symptoms.

Country	Mediators	Total Causal Effect (95% CI)	Natural Direct Effect (95% CI)	Natural Indirect Effect (95% CI)	PM (%)
Ethiopia	Both	-0.076 (-0.15 to -0.006)	-0.073 (-0.14 to -0.004)	-0.0036 (-0.013 to 0.0058)	4.8
	Peers	-0.069 (-0.13 to -0.007)	-0.072 (-0.13 to -0.010)	0.0028 (-0.0029 to 0.0084)	-4.0
	Parents	-0.070 (-0.13 to -0.009)	-0.068 (-0.130 to -0.008)	-0.0021 (-0.0099 to 0.0057)	3.0
India	Both	-0.073 (-0.16 to 0.018)	-0.075 (-0.16 to 0.014)	0.0026 (-0.013 to 0.018)	-3.5
	Peers	-0.076 (-0.16 to 0.003)	-0.078 (-0.16 to 0.002)	0.0016 (-0.011 to 0.014)	-2.0
	Parents	-0.077 (-0.16 to 0.001)	-0.077 (-0.16 to 0.001)	-0.000 (-0.0064 to 0.0061)	0.2
Peru	Both	-0.039 (-0.10 to 0.023)	-0.030 (-0.093 to 0.032)	-0.0090 (-0.023 to 0.0047)	22.9
	Peers	-0.043 (-0.10 to 0.018)	-0.036 (-0.098 to 0.026)	-0.0071 (-0.018 to 0.0036)	16.6
	Parents	-0.040 (-0.10 to 0.023)	-0.035 (-0.099 to 0.029)	-0.0049 (-0.016 to 0.0057)	12.2
Vietnam	Both	-0.12 (-0.18 to -0.059)	-0.12 (-0.18 to -0.060)	0.0018 (-0.0067 to 0.010)	-1.5
	Peers	-0.12 (-0.18 to -0.048)	-0.12 (-0.18 to -0.050)	0.000 (-0.0056 to 0.0065)	-0.4
	Parents	-0.12 (-0.18 to -0.049)	-0.12 (-0.18 to -0.050)	0.000 (-0.0048 to 0.0049)	-0.1

Supplementary Table 7.5. Mediating pathways from subjective wealth to internalising symptoms.

Country	Mediators	Total Causal Effect (95% CI)	Natural Direct Effect (95% CI)	Natural Indirect Effect (95% CI)	PM (%)
Ethiopia	Both	-0.23 (-0.39 to -0.069)	-0.21 (-0.37 to -0.051)	-0.015 (-0.039 to 0.0078)	6.8
	Peers	-0.23 (-0.37 to -0.088)	-0.23 (-0.36 to -0.088)	-0.0013 (-0.0099 to 0.0074)	0.6
	Parents	-0.23 (-0.37 to -0.091)	-0.21 (-0.35 to -0.074)	-0.016 (-0.039 to 0.0072)	7.0
India	Both	0.11 (-0.024 to 0.25)	0.11 (-0.023 to 0.25)	-0.0012 (-0.015 to 0.013)	-1.1
	Peers	0.11 (-0.028 to 0.25)	0.11 (-0.027 to 0.25)	-0.0011 (-0.0075 to 0.0052)	-1.0
	Parents	0.11 (-0.028 to 0.25)	0.11 (-0.023 to 0.25)	-0.0034 (-0.015 to 0.0087)	-3.0
Peru	Both	-0.20 (-0.40 to -0.011)	-0.19 (-0.39 to 0.008)	-0.014 (-0.047 to 0.019)	6.8
	Peers	-0.21 (-0.42 to 0.011)	-0.19 (-0.41 to 0.030)	-0.017 (-0.049 to 0.016)	8.2
	Parents	-0.20 (-0.42 to 0.015)	-0.20 (-0.42 to 0.016)	0.0020 (-0.026 to 0.030)	-1.0
Vietnam	Both	-0.10 (-0.29 to 0.089)	-0.11 (-0.30 to 0.083)	0.0076 (-0.0084 to 0.024)	-7.5
	Peers	-0.10 (-0.28 to 0.075)	-0.10 (-0.27 to 0.074)	0.000 (-0.0091 to 0.0092)	-0.1
	Parents	-0.10 (-0.28 to 0.076)	-0.11 (-0.28 to 0.068)	0.0074 (-0.0070 to 0.022)	-7.4

Supplementary Table 7.6. Mediating pathways from equivalised household consumption expenditure to internalising symptoms.

Country	Mediators	Total Causal Effect (95% CI)	Natural Direct Effect (95% CI)	Natural Indirect Effect (95% CI)	PM (%)
Ethiopia	Both	-0.075 (-0.15 to -0.005)	-0.071 (-0.14 to -0.002)	-0.0041 (-0.014 to 0.0058)	5.5
	Peers	-0.069 (-0.13 to -0.006)	-0.071 (-0.13 to -0.009)	0.0024 (-0.0031 to 0.0080)	-3.5
	Parents	-0.069 (-0.13 to -0.008)	-0.067 (-0.13 to -0.005)	-0.0025 (-0.011 to 0.0059)	3.6
India	Both	-0.080 (-0.16 to -0.002)	-0.082 (-0.16 to -0.005)	0.0020 (-0.013 to 0.017)	-2.5
	Peers	-0.080 (-0.16 to -0.001)	-0.082 (-0.16 to -0.000)	0.0022 (-0.010 to 0.015)	-2.8
	Parents	-0.081 (-0.16 to -0.001)	-0.081 (-0.16 to -0.001)	0.000 (-0.0063 to 0.0063)	0
Peru	Both	-0.044 (-0.11 to 0.018)	-0.035 (-0.097 to 0.027)	-0.0089 (-0.022 to 0.0042)	20.4
	Peers	-0.047 (-0.11 to 0.014)	-0.040 (-0.10 to 0.022)	-0.0071 (-0.017 to 0.0031)	14.9
	Parents	-0.044 (-0.11 to 0.020)	-0.039 (-0.10 to 0.025)	-0.0048 (-0.016 to 0.0059)	10.9
Vietnam	Both	-0.13 (-0.19 to -0.067)	-0.13 (-0.19 to -0.069)	0.0016 (-0.0080 to 0.011)	-1.2
	Peers	-0.13 (-0.19 to -0.061)	-0.13 (-0.19 to -0.062)	0.000 (-0.0061 to 0.0060)	0.0
	Parents	-0.13 (-0.19 to -0.061)	-0.13 (-0.19 to -0.062)	0.000 (-0.0049 to 0.0051)	-0.1

Supplementary Table 7.7. Mediating pathways through peer connectedness from household consumption expenditure and subjective wealth to internalising symptoms including adolescents with no living parents.

Country	Exposure	Total Causal Effect (95% CI)	Natural Direct Effect (95% CI)	Natural Indirect Effect (95% CI)	PM (%)
Ethiopia	Consumption expenditure	-0.074 (-0.13 to -0.015)	-0.076 (-0.14 to -0.017)	0.0016 (-0.0035 to 0.0068)	-2.2
	Subjective wealth	-0.23 (-0.35 to -0.10)	-0.23 (-0.36 to -0.10)	-0.001 (-0.010 to 0.0085)	0.4
India	Consumption expenditure	-0.077 (-0.15 to 0.000)	-0.078 (-0.15 to -0.003)	0.0012 (-0.012 to 0.014)	-1.5
	Subjective wealth	0.10 (-0.043 to 0.25)	0.10 (-0.043 to 0.25)	0.001 (-0.0063 to 0.0081)	0.9
Peru	Consumption expenditure	-0.039 (-0.096 to 0.017)	-0.034 (-0.092 to 0.024)	-0.0052 (-0.018 to 0.0079)	13.2
	Subjective wealth	-0.21 (-0.39 to -0.025)	-0.19 (-0.38 to -0.007)	-0.016 (-0.047 to 0.015)	7.7
Vietnam	Consumption expenditure	-0.12 (-0.18 to -0.052)	-0.12 (-0.18 to -0.051)	-0.0013 (-0.0072 to 0.0046)	1.1
	Subjective wealth	-0.099 (-0.32 to 0.12)	-0.098 (-0.32 to 0.12)	-0.0011 (-0.011 to 0.0091)	1.1