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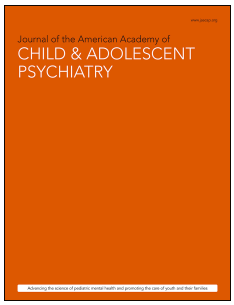

Adolescents' Relationships With Their Parents and Peers as Mediators Between Economic Circumstances and Emotional Symptoms: A Multicountry Longitudinal Analysis

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Adolescents' Relationships With Their Parents and Peers as Mediators Between Economic Circumstances and Emotional Symptoms: A Multicountry Longitudinal Analysis

RH = Social Mechanisms in Adolescent Mental Health Inequalities

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ABSTRACT

Objective: Adolescents' social relationships might partly explain the increased risk of mental health problems in adolescents living in poorer economic circumstances. There are few studies in low- and middle-income countries where most of the world's adolescents live. We investigated whether adolescents' relationships with their parents and peers mediated the association between their economic circumstances and emotional symptoms in Ethiopia, India, Peru and Vietnam.

Method: We analyzed longitudinal data of 3,529 adolescents from the Young Lives study (1,741 female [49.3%]). Household consumption expenditure and adolescents' subjective assessment of household wealth were measured at age 15. The mediators – adolescents' positive relations with their parents and peers – were measured at age 19. The outcome – emotional symptoms, characterized by low mood and anxiety – was measured at age 22. Mediation was assessed through counterfactual *g*-computation formula, adjusting for baseline and intermediate confounders.

Results: We found no evidence that adolescents' positive relations with their parents or peers mediated the association between economic circumstances and emotional symptoms in any country. Living in poorer economic circumstances was typically associated with more severe emotional symptoms.

Conclusion: Adolescents' parent and peer relationships might not mediate the effects of poorer economic circumstances on emotional symptoms in these countries, contrasting with previous studies that highlight an important role in high-income countries. Further research is needed that addresses our study limitations and to also explore other potential mechanisms, including different aspects of social relationships, that might influence mental health outcomes for adolescents living in poverty across different settings.

Study registration information: Socio-economic inequality in adolescent mental health: Mediating roles of adolescents' relationships with their peers and parents across four countries; https://osf.io/sb67c/overview

Key words: poverty; inequalities; mediation; social relationships

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INTRODUCTION

Approximately 13% of adolescents have a mental health disorder, with internalizing mental health problems, such as depression and anxiety, the most common.[1] Preventing mental health problems is a key target of the United Nation's Sustainable Development Goal to promote health and well-being.[2] There is evidence that anxiety and depression are more severe in poorer adolescents, however the strength of this association varies across countries.[3] A greater understanding of the mechanisms through which economic circumstances impact adolescents' mental health could help further understand how health inequalities develop and inform development and delivery of preventative interventions to reduce them.[4]

A potential mechanism through which adolescents' economic circumstances might impact their mental health is adolescents' social relationships.[5,6] According to the Family Stress Model, economically-disadvantaged adolescents might have less positive parental relationships owing to the effect economic stress has on parents themselves.[5] Economic strain could lead to increased parental stress and conflict, which is theorized to lower parents' propensity to provide supportive and nurturing parenting.[5] This might negatively impact adolescents as their relationships with their parents play an important role in promoting or undermining their wellbeing and short- and long-term health outcomes.[7] Longitudinal studies that have assessed the potential mediating role of variables concerning adolescents' parents have predominantly been carried out in Europe or North America, except for one study that investigated the Family Stress Model in adolescents from ten different cultural groups across seven countries.[8] There was support for the model in eight of the ten cultural groups, suggesting that economic circumstances impact adolescents' emotional symptoms through influencing parenting practices in many but not all settings. However, the study

adjusted for only two potential confounders (gender and symptoms at baseline), meaning the results could be biased.

Relationships with peers are crucial for adolescents' personal, social and psychological development.[9] Economic disadvantage might limit adolescents' opportunities to develop and maintain friendships. This could occur because of reduced means to access social activities (e.g., financial and practical barriers), increased stigma or exclusion from peers due to being of lower social status.[6,10] In turn, economically-disadvantaged adolescents might have a greater risk of being bullied, experiencing loneliness and having reduced social support, all of which are associated with mental health problems.[11,12] Mediation studies to date have used cross-sectional data only, which cannot model the complex temporal relationship between exposures, mediators and outcomes.[13–16]

Most research that has investigated how adolescents' economic circumstances might impact emotional symptoms has been carried out in high-income countries. This is problematic given that 90% of the world's adolescents live in low- and middle-income countries,[17] where poverty rates are greater and economic inequalities in adolescents' emotional symptoms may be starker.[3] Mechanisms through which economic circumstances might affect adolescents' mental health in one setting might not translate to another. Further research in countries that better represent the majority of the world's adolescents is needed.

Past mediation studies have primarily investigated the objective measures of economic circumstances, such as household income. Objective and subjective measures of economic

circumstances have different associations with adolescents' emotional symptoms and are likely to have different mechanisms through which they impact adolescents' mental health.[3,18] Findings from mediation studies of objective economic circumstances cannot be assumed to translate to subjective measures of economic circumstances, and vice versa.

In this longitudinal mediation study, we investigate whether adolescents' positive relations with their parents and peers are mechanisms through which economic circumstances impact future emotional symptoms. We analyze data across four countries (Ethiopia, India, Peru and Vietnam), where there is only limited awareness of the mechanisms of mental health inequalities.

METHOD

We pre-registered our protocol on the Open Science Framework (REDACTED), with minor deviations reported online (Supplement 1). We report our study in line with the Guideline for Reporting Mediation Analyses of Randomized Trials and Observational Studies (AGReMA) and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline (available online).[19,20]

Study design and participants

The study uses data from the Older Cohort within the Young Lives longitudinal study across Ethiopia, India (states of Andra Pradesh and Telangana), Peru and Vietnam.[21–23] The Young Lives samples entered the study at 8 years of age (year 2002), and have been followed up at ages 12, 15, 19 and 22. Further surveys were carried out during the COVID-19 pandemic. In each country, participants were randomly sampled from 20 geographical clusters. The clusters were deliberately

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selected to ensure over-sampling of households experiencing poverty. Each country's sample has been deemed similar to the wider national adolescent population across a range of important variables.[24] Further details of the Young Lives study design are in the cohort profile.[25] The Young Lives study has received ethical approval before each wave of data collection from the Central University Research Ethics Committee at the University of Oxford and from institutions in each of the countries in the study. Informed consent was given by participants prior to data collection at each wave.

We use data at ages 15 (data collected in 2009), 19 (2013) and 22 (2016), representing the time-points of our exposures (T1), mediators (T2) and outcome (T3) respectively. In each country, the analytic sample consisted of adolescents who attended data collection at T1 regardless if data on exposures, outcomes, or confounders were available or missing, or if they attended any further time-points. The measure assessing adolescents' relationship with their parents was not administered to adolescents that had no living parents. We therefore excluded adolescents with no living parents at T2 in the main analyses. We did not carry out a sample size calculation.

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Study setting

The countries in this study are located in Africa (Ethiopia), Asia (India, Vietnam), and South America (Peru). All are considered low- or middle-income countries with the countries' GDP per Capita (expressed in 2015 US$) ranging from 407 for Ethiopia to 4,783 for Peru in 2009 (the baseline year of our study; Table S1, available online). The Gini coefficients indicate that Ethiopia, India, and Vietnam have relatively lower income inequality (ranging from 33.2 to 35.6) compared to Peru (47).

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Measures

Objective economic circumstances were measured through household consumption expenditure on non-food goods, items and services, as reported by the household head at T1. It is common for households to produce some of their own food or acquire food in kind in the countries in this study.[26,27] We could not ascertain the market value of own-produced or gifted food consumption from the data, meaning consumption (and subsequently living standards and financial resources) would be underestimated in these households if food consumption expenditure were included in our measure. Failure to measure the value of consumption of own-produced food is proposed to overstate the extent of poverty and economic inequality, and would therefore affect the validity of our measure.[27] The approach of using household consumption expenditure on non-food goods, items and services has been previously used in a cross-country study investigating economic inequalities in adolescents' mental health, which included analyses of the Young Lives study.[3] In each country, household consumption expenditure was captured through expenditure on six domains: small personal items, clothing, education, medical, home maintenance and entertainment and other expenditures. Total household consumption expenditure was summed for adolescents with available data for all consumption domains.

Subjective economic circumstances were self-reported by adolescents regarding how wealthy they would describe their household on a six-point scale at T1. We coded responses into a binary variable of subjective wealth (low = "destitute", "poor", or "never have quite enough, struggle to get by" and high = "comfortable – can manage to get by", "rich", and "very rich"). We binarized this variable, as variables within mediation models that have more than two categories would

complicate cross-country comparisons due to the multiple effect estimates that would be produced and might also limit statistical power.

Mediators were self-reported by adolescents at T2. Adolescent's positive relations with peers were measured with the 8-item peer relationships subscale of the Self-Description Questionnaire I.[28] Items captured adolescents' number of friends, their own popularity and their ability to get on with others their age. Adolescents' positive relations with their parents were measured with the 8-item parent subscale of the Self-Description Questionnaire II.[28] Items captured adolescents' relationships quality with their parents and various parenting behaviors and activities. The subscales were primarily designed to measure adolescents' self-concept, but have been used previously as measures of adolescents' relationships with their parents and peers in the Young Lives cohorts.[29]

We adjusted for several potential confounding variables at T1: adolescents' gender, whether adolescents lived with their biological parents and country-specific measures of minoritized status (Figure 1). Minoritized status was defined by ethnicity or ethnic group in Ethiopia, Peru and Vietnam, and by caste in India.

We adjusted for intermediate confounders, which we theorized to be caused by adolescents' economic circumstances and could confound the association between their social relationships and emotional symptoms. The first concerned whether adolescents had any serious illnesses or injuries between T1 and T2 as self-reported at T2. We used two binary variables, separately indicating whether adolescents had experienced (a) a serious illness, or (b) a serious injury. The second

intermediate confounder concerned whether adolescents were in education or employment at T2. We used two binary variables, separately indicating whether adolescents were in employment at T2 and whether they were in education in T2, based on adolescents' self-reports. We classed adolescents to be in employment or education if they reported either full- or part-time employment/attendance. Finally, we modelled adolescents' emotional symptoms at T1 (as assessed by the emotional symptoms subscale of the Strengths & Difficulties Questionnaire [SDQ-E]) as an intermediate confounder.

Emotional symptoms were measured using the SDQ-E at T3.[30] The SDQ-E consists of five items relating to low mood, worry, fear, nervousness and somatic symptoms. Adolescents responded on a 4-point Likert scale in Ethiopia, India and Vietnam, and a 3-point Likert scale in Peru. We standardized outcomes where each individual's score on the SDQ-E was referenced to the population distribution of the measure (specifically the mean and standard deviation) within their country. This enabled cross-country comparisons of the results as the range of the original scales differed between Ethiopia, India, and Vietnam (0 to 15; response options of "strongly disagree", "disagree", "agree" or "strongly agree") and Peru (0 to 10; response options of "not true for you", "a little true for you" or "certainly true for you").

Statistical analysis

All analyses were run using Stata 18.[31] Multiple imputation using chained equations (40 imputations) was used to impute missing data on the variables included in the analyses (exposures, mediators, outcome, and baseline and intermediate confounders) for each country. Data availability for all variables used in the analytic models is presented in Table S2, available online

(missing data: 4.5% in Ethiopia, 4.0% in India, 6.8% in Peru and 5.6% in Vietnam). We included auxiliary variables associated with the outcome at T3, including measures of emotional symptoms at T1 and T2, and if possible, also associated with whether the outcome was missing, in the imputation models. Prior to multiple imputation, total household consumption expenditure and the individual domains were neglog-transformed, where a value of 1 was added prior to log transformation.[32,33] This was done to improve model fit, to account for the likely non-linear association between economic circumstances and emotional symptoms, and to ensure that log-transformation was mathematically possible in cases where expenditure in any domain was zero.[34] Missing values of annual household consumption were imputed, with neglog-transformed consumption expenditure for any non-missing domain included in the imputation models to aid imputation.

Following multiple imputation, we first carried out exploratory linear regression analyses to establish whether there was an association between (a) each exposure with each mediator, and (b) each mediator with the outcome (emotional symptoms at T3), for each country. Baseline confounders were adjusted for in analyses estimating exposure–mediator associations, and the exposures and baseline and intermediate confounders were adjusted for in analyses estimating the mediator–outcome associations. This provided awareness of the strength of the different pathways from economic circumstances to adolescents' social relationships, and from adolescents' social relationships to emotional symptoms in each country, which would aid interpretation of the findings with our mediation analyses.

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We then performed mediation analyses using a counterfactual framework using *g*-computation formula (g-formula) to evaluate whether the association between adolescents' economic circumstances and emotional symptoms is mediated by their positive relations with their parents and peers.[35] For each country, we ran six separate models featuring different combinations of the exposures and mediators, owing to our use of two measures of economic circumstances and two measures of social relationships. For each exposure, we first included adolescents' positive relations with their parents and peers as mediators in the same model, as we expected that these would be correlated and capture similar information regarding adolescents' social experiences. We did not specify any sequential ordering of the mediators in these models, as we had no assumptions regarding the causal ordering between mediators. This was followed by models containing each mediator separately. We included interactions between the exposure and mediator(s) in all models. In each model, we estimated the Total Causal Effect (TCE) which represents the magnitude of association between the exposure and outcome, the Natural Direct Effect (NDE) which represents the association between the exposure and outcome that is not through any pathways involving the mediators, and the Natural Indirect Effect (NIE) representing the association between the exposure and outcome that is solely through the mediator(s). We report the Proportion Mediated (PM) in the main text in cases where there is certainty regarding the direction of the NIE, and therefore statistical evidence of mediation. The PM is the percentage of the association between the exposure and outcome that is accounted for by pathways through the mediators. The PM is calculated through dividing the NIE by the TCE then converting into a percentage. The PM therefore has no confidence intervals or measures of uncertainty. We converted the TCE, NDE, and NIE for mediation models where household consumption expenditure was the exposure, so that they

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represent a change in standardized emotional symptoms per doubling of household consumption expenditure (i.e. *b**ln(2)).]

Mediation analyses were carried out using the *gformula* command.[35] Values of the mediators, intermediate confounders and outcome were simulated through Monte Carlo simulations (10,000 simulations) under varying values of the exposures. Confidence intervals (CIs) were obtained using 50 bootstraps and calculated according to the normal-approximation method.[36]

We performed multiple sensitivity analyses. First, we equivalized household consumption expenditure by dividing by the square root of the household size, prior to neg-log transformation. Equivalization takes into account that larger households need greater levels of consumption to maintain a similar standard of living to smaller households. In theory, equivalization should approximate households' economic circumstances more accurately than raw values. Second, we re-ran the analyses where adolescents' positive relations with peers was the sole mediator, including adolescents previously excluded from the main analytical sample due to having no living parents. Finally, we conducted post-hoc analyses using less stringent mediation approaches to better understand whether our findings might be due to the robust mediation methods used.

RESULTS

We analyzed 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 S3, available online). The number of adolescents excluded from the sample for not having any living parents was highest in Ethiopia (n=42) and lower in India (n=16), Peru (n=3) and Vietnam (n=3). In Vietnam, 82.9% of the sample reported high levels of subjective wealth, whilst this was 63.1% in India (Table 1).

The internal consistency of the SDQ-E and the parent and peer subscales of the Self-Description Questionnaire was acceptable in all countries (Table S4, available online). Factor analyses identified that the parent and peer subscales of the Self-Description Questionnaire were best fitted by a single factor in all countries (Table S5 and S6, available online). Scores on the parent and peer relations subscales were moderately correlated in each country (range: 0.31 to 0.44 [Table S7, available online]).

There was no evidence that either adolescents' positive relations with their parents or peers at age 19 mediated the association between their economic circumstances at age 15 and emotional symptoms at age 22 in any of the four countries. Economic circumstances were associated with adolescents' emotional symptoms in Ethiopia and Vietnam when economic circumstances were measured objectively, and in Ethiopia and Peru when they were measured subjectively. The mediators, adolescents' positive relations with their parents or peers, were only associated with adolescents' emotional symptoms in Peru.

In analyses of objective economic circumstances, greater levels of household consumption expenditure were associated with fewer emotional symptoms in Ethiopia and Vietnam (Figure 2; Table S8, available online). There was no evidence of an association in India or Peru. There was no evidence that adolescents' positive relations with their parents or peers mediated the association between household consumption expenditure and emotional symptoms in any country, based on the NIE. In all analyses, the NIE was close to the null and there was uncertainty regarding its direction. The NIE was largest in Peru when both mediators were modelled together (-0.009 [95% CI: -0.023 to 0.0047]), but there appeared to be minimal variation across countries.

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In analyses of subjective economic circumstances, adolescents with high subjective wealth had fewer emotional symptoms in Ethiopia and Peru (Figure 3; Table S9, available online). There was no evidence of an association in India or Vietnam. There was no evidence that adolescents' positive relations with their parents or peers mediated the association between subjective wealth and emotional symptoms in any country, based on the NIE. In all analyses, the NIE was close to the null and there was uncertainty regarding its direction. The magnitude of the NIE 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.

In the secondary analyses, household consumption expenditure at T1 was associated with higher levels of positive relations with peers at T2 in India (coefficient=0.26 [95%CI: 0.07 to 0.45]) and Peru (coefficient=0.20 [95%CI: 0.02 to 0.38]), and higher levels of positive relations with parents at T2 in Peru only (coefficient=0.22 [95%CI: 0.01 to 0.43]) (Tables S10 and S11). Household consumption expenditure was not associated with either mediator in Ethiopia or Vietnam. Subjective wealth at T1 had no association with adolescents' positive relations with peers at T2 in any country, but high subjective wealth at T1 was associated with increased adolescent-parent relationship at T2 in Ethiopia (coefficient=0.49 [95%CI: 0.04 to 0.93]) (Tables S10 and 11). Subjective wealth had no association with either mediator in India, Peru, or Vietnam. Higher levels of positive relations with (a) parents, and (b) peers at T2 was associated with fewer emotional symptoms at T3 in Peru only. There was no association between either mediator and adolescents' emotional symptoms in the other countries.

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The sensitivity analysis which used equivalized household consumption expenditure produced comparable results to the main analyses that used raw household consumption expenditure (Table S12 and Figure S1, available online). Results were also comparable to the main analyses after including adolescents with no living parents who were previously excluded (Table S13; Figure S2, available online). In our post-hoc analyses, the NIE was of slightly larger magnitude in several analyses when we no longer adjusted for intermediate confounders, consistent with the methods used in past studies (Table S14 and S15, available online). This was most apparent in Peru for analyses where household consumption expenditure was the exposure.

DISCUSSION

We aimed to investigate whether adolescents' relationships with their parents and peers mediated the association between their economic circumstances and future emotional symptoms in Ethiopia, India, Peru and Vietnam. We found no statistical evidence of mediation through adolescents' positive relations for any measure of economic circumstances or social relationships.

The lack of evidence for mediation through adolescents' positive relations with their parents contrasts with other longitudinal studies in high-income countries that have investigated similar variables. The null finding might be due to the lack of association between adolescents' positive relations with their parents and emotional symptoms in three of the four countries studied. In the countries studied, childrearing roles and responsibilities are commonly shared between parents, grandparents, older siblings and other family members.[37] The potential negative impact of relationship difficulties with parents on adolescents' mental health might be buffered by strong social ties with extended family members. In high-income countries in Europe and North America, nearly all caregiving for children and adolescents is carried out by parents within a nuclear family

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and the extended family and local community commonly only have a small role in childrearing.[38] Consequently, in high-income countries, adolescent-parent relationships might be more important for adolescents' mental health due to the lack of stronger ties with extended family members that might protect against the negative effects of economic adversity and relationship difficulties with parents.

To the best of our knowledge, this study was the first to investigate whether adolescents' peer relationships mediated the association between their economic circumstances and their emotional symptoms using longitudinal data. There was no evidence of mediation in any of the four countries. Having more positive relations with peers was associated with fewer emotional symptoms in Peru only. We had expected that positive relations with peers would be associated with emotional symptoms in all countries given consistent evidence that peer victimization, peer support and loneliness are all associated with poorer mental health, whilst friendships and social support are associated with better mental health in adolescents, including in the countries in this study.[11,12] The lack of mediation through peer-related factors in our study contrasts with cross-sectional research conducted in China and the Republic of Korea.[13,39,40] However, findings from previous studies might be upwardly biased and over-estimate the extent to which peer-related factors act as a mediator, given the severe limitations of estimating mediation in cross-sectional data.[41]

The null findings for both mediators might reflect methodological differences compared to past research. In this study, adolescents' positive relations with parents was measured at age 19 (the first time the Young Lives Older Cohort's social relations were assessed using a psychometric scale). Adolescents typically have more autonomy and independence from their family at this age

compared to in early adolescence. Positive and sensitive parenting is particularly important for emotional development in the early years, whereas adolescents' positive relations with parents in late adolescence may be less important for older adolescents' mental health. For instance, experiencing maltreatment in childhood (0 to 10) compared to adolescence (11 to 18 years) is associated with higher depressive symptoms in adulthood, suggesting that childhood is a more sensitive period for ill mental health effects of negative parenting.[42] Notably, we only found evidence in Peru that positive parent relations at age 19 was associated with fewer emotional symptoms at age 22. The lack of evidence for a mediating role for adolescents' positive relations with parents might be driven by the older age of the samples studied and the potential reduced importance of parenting-related factors on mental health in this age group.

Furthermore, the items within the measure to assess adolescents' positive relations with peers primarily assessed the quantity of adolescents' friendships.[28] Studies in the US have found that friendship quality is more strongly associated with adolescents' emotional symptoms compared to friendship quantity, which the measure in this study primarily assessed.[43,44] The measure also did not feature factors such as peer victimization, loneliness and social support that are associated with adolescents' mental health, including in the countries studied.[11,12,45] 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 emotional symptoms in the countries studied.

Our findings suggest that there might be more important mechanisms through which adolescents' economic circumstances affect their mental health in the countries studied. For instance, a recent review has proposed numerous possible behavioral, biological, environmental, material, social and

psychological mechanisms.[46] These potential mechanisms remain under-researched in the countries studied and other low- and middle-income countries and warrant further investigation in these settings.

We could not statistically compare findings from the mediation analyses across countries. However, cross-country differences in the extent that (a) economic circumstances were associated with adolescents' relations with their parents and peers, and (b) adolescents' relations with their parents and peers were associated with emotional symptoms, further underline the likelihood that mechanisms are likely to differ across countries. We did not formally investigate the Family Stress Model, however a cross-country study has highlighted its potential lack of universality across settings, and therefore there needs to be further consideration of factors outside adolescents' family or household that might be important in the development of economic inequalities in mental health.[8] Strategies to improve adolescents' economic circumstances, such as cash transfer programs, have been shown to improve mental health outcomes in low- and middle-income countries.[47] It is unclear from our study whether interventions that focus on improving adolescents' social relationships delivered alongside these would additionally benefit the mental health of adolescents living in poorer economic circumstances. Our study has several limitations that should be considered when interpreting its findings. First, owing to data availability, we used measures to assess the mediators, adolescents' relationships with their parents and peers, which were general assessments of relationships which might be less influential for adolescents' mental health than more adverse measures of relationship quality. Second, the scales we used to assess adolescents' positive relations with their parents and peers were developed in Australia, a context that is societally and culturally different from the countries in this study.[28] The scales might not feature

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items that are relevant in the countries studied and therefore may not accurately measure adolescents' positive relations with parents or peers in these contexts. Owing to the potential lack of validity of the Self-Description Questionnaire in the study samples, the mediators (adolescents' positive relations with their parents and peer) might have high measurement error. Owing to regression dilution bias, the associations between the mediators and outcome might be biased towards the null, in turn underestimating the indirect effects.[48]

Third, one of the exposures, subjective wealth, was measured with a single categorical item which we binarized to easily interpretable outputs from the mediation analyses. However, this would have reduced the statistical power and possibly lead an underestimation of the associations between subjective wealth and both mediators and emotional symptoms,[48] potentially biasing estimates within this study when subjective wealth was the exposure. There were cross-country differences in how adolescents' rated their subjective wealth (rich subjective wealth was high in Vietnam, and lower in Ethiopia and India). These differences might represent true cross-country differences in economic circumstances, or stem from differences in contextual factors such as country-level inequality, wealth and social mobility that shape adolescents' perception of their social standing.[49,50] Accordingly, the meaning of "high subjective wealth" is likely to vary across countries, limiting cross-country comparability of the results.

Fourth, we may have lacked sufficient power to detect mediation effects in any country. In Peru (n=675), we estimated that approximately 23% of the association between household consumption expenditure and emotional symptoms might be through pathways involving adolescents' positive relations with their parents and peers. Despite this, there was no statistical evidence of mediation.

In comparison, a different study of over 13,000 adolescents which used the same statistical approach as this study (counterfactual mediation using *gformula* and all continuous variables) estimated a similar proportion mediated (26%) to that we report in Peru, but found statistical evidence of mediation.[51] Therefore it is possible that some of the null findings within this study could be partially due to the small sample sizes and reduced statistical power to detect mediation. Finally, our measure of household consumption expenditure excluded purchases of food, as a proportion of households' food was sourced from their own production or in kind, but the value of this could not be ascertained. Household consumption expenditure measures with inaccurate assessments of own-produced food, can overstate differences in economic circumstances between households.[27] However, by excluding food consumption expenditure from our measure we might have underestimated economic circumstances in the wealthier households who are less to likely to produce their own food and also spend a larger amount of money on food, therefore understating differences in adolescents' economic circumstances. This measurement error might have biased the associations between objective economic circumstances and (a) adolescents' positive relations with their parents and peers, and (b) their emotional symptoms. As a result the indirect effects in this study might be over- or under-estimated. To note, we used data from 2008 to 2016. Our findings might not generalize to other time periods or generations, given societal changes, economic growth, the COVID-19 pandemic, and in the case of Ethiopia, a civil war, that have occurred in these countries since.

A strength of our study is the use of longitudinal data. We measured the exposures, mediators and outcome at separate time-points, reducing the potential impact of reverse causation on the findings.

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We adjusted for baseline confounders and additionally for intermediate confounders that might bias the association between mediators and the outcome, unlike previous studies in this area.

To conclude, we found little evidence that either adolescents' relationships with their parents or peers might be a mechanism through which economic circumstances impact emotional symptoms in any of four countries; Ethiopia, India, Peru and Vietnam. In these countries, there might other mechanisms that are more important in linking adolescents' economic circumstances to their mental health. Alternatively, the lack of evidence of mediation might be a result of the measures used, the age of our sample, the small sample size in each country, or reflect the robustness of our methods including the adjustment of intermediate confounders and analysis of longitudinal data. Further research in similar settings that overcomes our limitations, including through the use of more culturally-suitable measures, would be valuable in identifying whether the lack of evidence for mediation in our study is (a) driven by issues with our study design, or (b) that existing research and theory from high-income countries, regarding the importance of parent- and peer-level factors in the development of economic inequalities in adolescents' mental health, might not be as relevant in different contexts and settings.

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Table 1. Descriptive Statistics of Key Variables for Adolescents in the Main Analysis (Imputed Samples)

	Ethiopia (n=931)	India (n=960)	Peru (n=675)	Vietnam (n=963)
T1				
Gender				
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)
Household composition				
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)
Subjective wealth				
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 on non-food items[a] (Median [IQR])	4,163 (2,640 to 7,237)	36,311 (24,444 to 56,515)	4,321 (2,461 to 8,826)	21,022,308 (12,473,190 to 33,897,295)
Annual household consumption expenditure on non-food items[b] (Median [IQR])	353 (224 to 614)	750 (505 to 1167)	1,435 (818 to 2,932)	1,232 (730 to 1,986)
T2				
Adolescents' positive relations with peers (Self-Description Questionnaire I)[c]	23.8 (0.18)	24.8 (0.16)	22.8 (0.19)	22.3 (0.11)
Adolescents' positive relations with parents (Self-Description Questionnaire II)[c]	26.3 (0.15)	27.3 (0.20)	24.0 (0.19)	25.4 (0.16)
T3				
Emotional symptoms (SDQ-E)[d]	6.54 (0.14)	6.45 (0.19)	3.98 (0.13)	6.42 (0.10)

Note: Mean (standard error) unless specified. Ethiopia = ETB; India = INR; Peru = PEN; Vietnam = VND.

[a]Local currency units.

[b]US dollars, based on the official exchange rate in the International Financial Statistics database.

[c]Range: 8 to 32.

[d]Range for Ethiopia, India and Vietnam: 0 to 15. Range for Peru: 0 to 10.

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Figure 1. Conceptual Model Linking Adolescents' Objective and Subjective Economic Circumstances to Their Future Emotional Symptoms

Figure 2. Total Causal Effect and the Natural Indirect Effect of the Association Between Household Consumption Expenditure and Emotional 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 the 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.

Figure 3. Total Causal Effect and the Natural Indirect Effect of the Association Between Subjective Wealth and Emotional 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 the 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.

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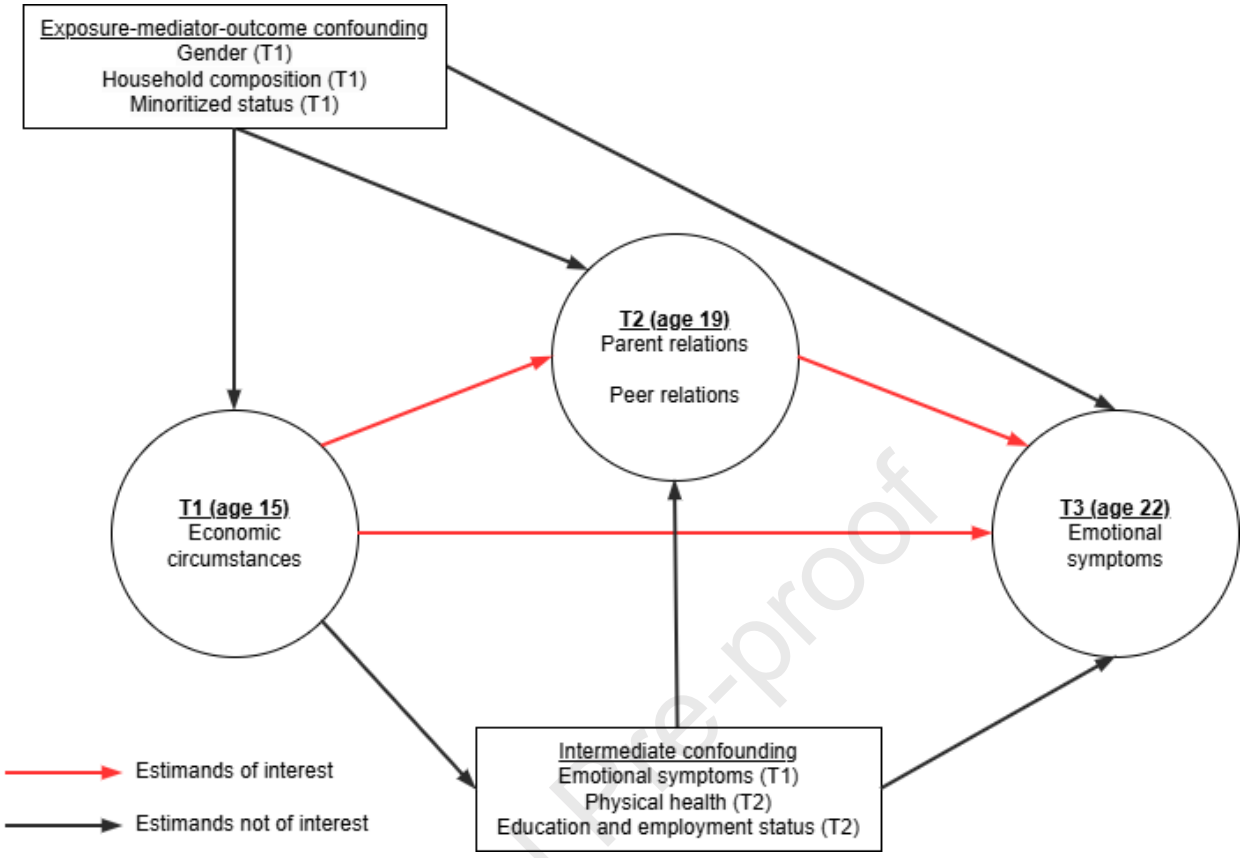

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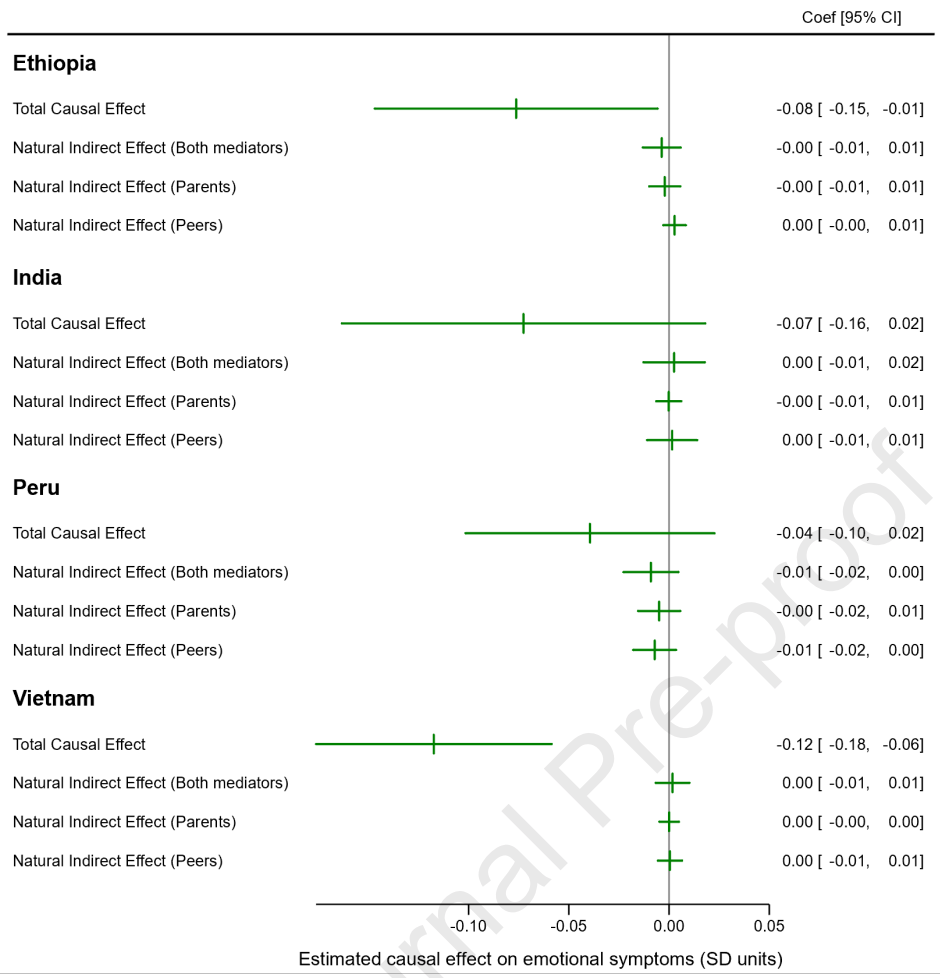

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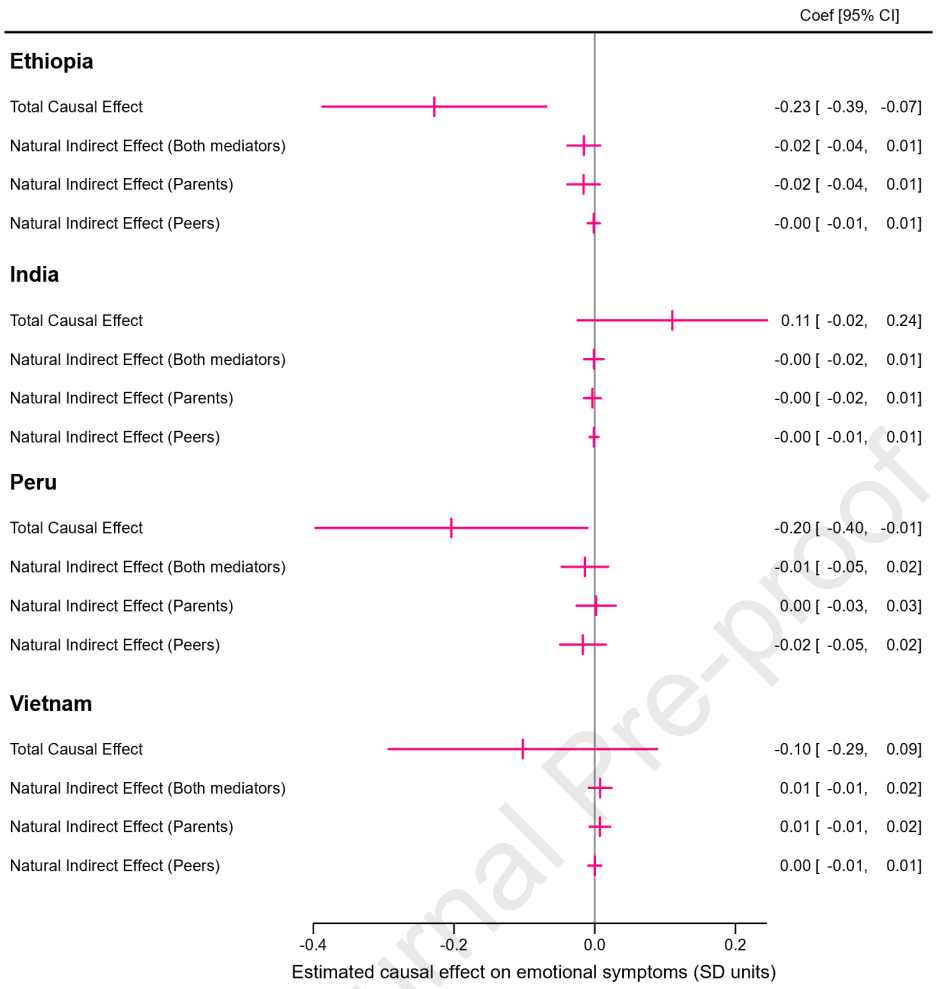

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Figure 1. Conceptual model linking adolescents' objective and subjective economic circumstances to their future emotional symptoms.

Figure 2. Total Causal Effect and the Natural Indirect Effect of the association between household consumption expenditure and emotional 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 the 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.

Figure 3. Total Causal Effect and the Natural Indirect Effect of the association between subjective wealth and emotional 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 the 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.

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