The mental health of adolescents in England: How does it vary during their time at school?

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The wellbeing of young people has become an important education policy issue, with suggestions that mental health problems amongst young people have increased in recent years. Experiences at school are thought to be a key factor contributing to mental ill-health amongst adolescents. Yet surprisingly, little is known about how mental health outcomes vary across school year groups, independent of the effects of age. This article contributes new evidence on this issue, drawing upon large-scale health data from England. We find substantial growth in mental health problems as young people progress through secondary school. Yet this seems to be driven by the effects of age, rather than due to movement into more senior school year groups. We consequently conclude that evidence of a direct link between school year group and young people's mental health remains relatively weak.

Keywords: mental health; wellbeing; schooling

Introduction

Mental health and wellbeing have become key policy issues (Parkin, 2016, 2020). There has been particular concern as to how mental ill-health is affecting young people (Conservatives, 2019), given the rising prevalence of such problems across Western societies (Twenge *et al.*, 2019). Mental ill-health during childhood can lead to long-term physical and psychological problems in later life (Clayborne *et al.*, 2019), as well as affecting achievement at school and labour market outcomes (Fergusson & Woodward, 2002). This has led to increased awareness of such problems across the education community (Education Policy Institute, 2020). It has even been suggested that there may be a reciprocal relationship between the wellbeing of teachers and young people (Spilt *et al.*, 2011), with the mental health of one group impacting the other (Glazzard & Rose, 2019).

Many factors may affect the wellbeing of adolescents. It is a time of significant biological change, influencing young people's emotions, attitudes and behaviours (Spenrath *et al.*, 2011). There are also environmental influences, including the home environment, peer influences and exposure to social media (Rapheal, 2015; Keles

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et al., 2020; Long *et al.*, 2020), which may act as risk or protective factors for young people's mental health. These are likely to interact with another environmental influence—young people's experience at school. Indeed, experiences at school may act as a background and precipitating factor for a range of mental health concerns. On the one hand, adolescents in England are often pushed (by schools, teachers, parents and peers) to work hard and maximise what they are able to achieve. This can lead to young people feeling stressed and under pressure, particularly at key points such as the approach of high-stakes exams (Roome & Soan, 2019). On the other hand, social and peer pressures are likely to change as adolescents progress through school, which in turn may also affect their wellbeing (Moore *et al.*, 2018). The impact of such factors may vary across countries, with transitions between schools and school year groups occurring at different ages, and may be managed in different ways.

It is therefore perhaps surprising that relatively little large-scale, longitudinal research has been conducted into how the mental health of adolescents in England changes during their time at school. There is a particular dearth of evidence attempting to isolate the impact of school year group from the potential confounding effect of age. A recent study by Wright *et al.* (2020) investigated the mental health of 6328 Year 8s, 9s and 11s from 21 schools in northern England. Using cross-sectional data, they found that Year 11s were at particular risk of mental health difficulties (in comparison to Year 8s and 9s)—hypothesising that this could be due to upcoming examinations, the associated academic pressures and being faced with having to make important decisions after leaving school. In contrast, work by Public Health England (2015) noted how several studies point to 'a "u-shaped" curve in mental wellbeing during adolescence with the lowest levels around the ages of 14 to 15 years' (corresponding to Year 10 in the English schooling system). Interestingly, they suggest that this dip in mental wellbeing is likely due to social and environmental factors, rather than physical and hormonal changes. Chanfraeu *et al.* (2013) note how the proportion of young people with low levels of subjective wellbeing in England almost doubles during secondary school. They argue that this is the result of young people's changing social context, and not biological change. Research has also noted how the primary-to-secondary school transition can be a particularly challenging time—known as the 'middle school malaise' in the United States (American Psychological Association, 2020). For instance, in mixed-methods research involving a wellbeing survey (*n* = 1110) and qualitative case studies, McLellan and Galton (2015) noted that during the first year of secondary school (Year 7), 'while students' perceptions of their well-being outside school remain more or less constant, their well-being in the school context decline[s] considerably over the year'. Outside of England, Nielsen *et al.* (2017) found selected mental health problems (most notably conduct problems and emotional symptoms) to increase with age in Denmark, but with mixed results for Australia.

A range of studies have specifically considered the link between wellbeing and the approach of the high-stakes GCSE exams in England, with particular emphasis on Year 11s. Qualitative research by Putwain (2009) found stress amongst Year 11s to be linked to educational context, including practices pursued by teachers and schools. Similarly, using 'a large-scale questionnaire survey, focus groups and interviews', Denscombe (2000) found how Year 11 GCSE examinations 'constitute a new and distinct source of stress in the already stressful lives of young people'. Small-scale

research by Owen-Yeates (2005) focused specifically on stress amongst Year 11s in England. They found that academic pressures were the main source of stress amongst this group, with important differences between genders. In qualitative research with recently finished Year 11s, Roome and Soan (2019) found GCSE exams to be a key cause of stress. Related literature from Ireland—using a mix of quantitative surveys and qualitative interviews focused on the build-up to high-stakes examinations—has noted how 'certain aspects of the schooling process impact on stress levels' (Banks & Smyth, 2015). Finally, an international systematic review by Wuthrich *et al.* (2020) has investigated academic stress during the final years of secondary education, noting how 'examinations seem to be particularly relevant to increased levels of stress reported by students'. They concluded that 'in general studies have shown that stress is heightened in the senior years compared to lower years and increases in the lead up to the major exam period', but also cautioned that 'more research using longitudinal designs and carefully timed assessment of distress in examination and non-examination periods across grade levels is needed'.

Over the last couple of years, GCSE examinations have been cancelled due to the COVID-19 pandemic, with young people having to contend with home schooling and lockdowns instead. There is a growing body of evidence demonstrating how this may have impacted their mental health (e.g. Singh *et al.*, 2020; Ford *et al.*, 2021). Although the analysis presented in this article will refer to young people's mental health in pre-COVID times, the insights it provides are still likely to be relevant as we (hopefully) move into a post-pandemic world. In particular, with schools resuming in-person teaching, old stressors—such as examinations—may return. Although young people's school experiences may not be the same as in the pre-pandemic world, with certain aspects being less stressful than during the pandemic, it is nevertheless important that we develop as detailed a picture as possible of the link between schooling and young people's mental health.

To this end, we have identified four main gaps in the literature on how young people's mental health is associated with their experiences at school. First, the few existing large-scale studies on this issue are based on subjective responses to questionnaires (e.g. Putwain & Daly, 2014; Pitchforth *et al.*, 2019). While these studies use standardised instruments, there remain issues with missing data, measurement error and measurement invariance (both across groups and over time). Second, many existing studies are cross-sectional, surveying individuals at one specific point during their school career (e.g. Wright *et al.*, 2020). There has been little attempt to track the mental health of a whole cohort of young people longitudinally, providing insights into how such psychological problems change as they move up school year groups. Third, Year 11 in England is often thought to be particularly stressful (Wright *et al.*, 2020), as young people are faced with a large number of important examinations (GCSEs). Yet we know relatively little about the extent to which there is indeed a spike in serious mental health problems during Year 11, and how this compares to other school years. Finally, a particularly difficult empirical challenge is separating out the effects of school year group from the effects of age. For instance, if young people are more likely to suffer mental ill-health at a particular age (e.g. due to biological factors), this could lead one to overstate the effect that a specific school year (e.g. Year 11) has upon such problems.

This article attempts to take the first steps towards resolving such issues. Longitudinal health data—including all the contacts made with primary and secondary healthcare services—are used to monitor the prevalence of mental health problems for three cohorts of young people. With detailed information about the timing of diagnoses and treatment of mental health problems, we provide new evidence on whether differences in mental health outcomes across school year groups might be driven by differences in age, rather than school year group per se.

Data

Data are drawn from the Clinical Practice Research Datalink (CPRD), extracted in July 2020. Herrett *et al.* (2015) note how these data are gathered monthly from a self-selecting sample of 674 General Practitioner (GP) practices in England. The CPRD includes all contacts made with primary (e.g. GP) and secondary (e.g. hospital) healthcare providers. Patients registered at participating practices are broadly representative of the national population (see Denaxas *et al.*, 2012; Herrett *et al.*, 2015; Denaxas *et al.*, 2019 for further details). Information is gathered from the point of GP practice registration until movement to a non-participating GP practice elsewhere. A record is made for each contact with a healthcare provider, including exact date (e.g. date of appointment) and outcome (e.g. diagnoses made, referrals, prescriptions).

School year group

For individuals younger than 16, the CPRD includes birth month and year. For those older than 16 at data extraction (July 2020), only birth year is available (birth is month masked). This information (birth month and year) can nevertheless be used to accurately identify school year group. Specifically, 1 September acts as a cut-off birthday, determining with (almost) certainty young people's school year group, given that delayed school entry, grade advancement and grade repetition in England are extremely rare. This can be illustrated using data from the Programme for International Student Assessment (PISA), where 98.5% of 15-year-olds in England belong to the school year group one would expect, given their birth month and year.[1]

We hence define the following cohorts of interest, relating to separate school year groups:

- *Cohort A*. Born 1 January 2004 to 31 August 2004. Only those born in July or August will have birth month available (those born January–June will be 16 years old and have their birth month masked). In July 2020 this cohort will have been in Year 11 and would have completed their GCSEs in May/June (were it not for the COVID pandemic, see below). This group will be identified through their birth year (2004) and their birth month being either July, August or not available (as they were born between January and June 2004, and will thus have turned age 16 by this point). There are 22,312 adolescents in cohort A with complete data during secondary school (i.e. CPRD registered September 2015–July 2020).
- *Cohort B*. Born 1 September 2004 to 31 August 2005. This group were age 15 (Year 10) in July 2020. This cohort is directly identified through birth month and

year. There are 27,198 adolescents in cohort B with complete data during secondary school (i.e. CPRD registered September 2016–July 2020).

- *Cohort C*. Born 1 September 2005 to 31 August 2006. This group were age 14 (Year 9) in July 2020. They will have been in Year 9 in July 2020. This cohort is directly identified through birth month and year. There are 31,983 children in cohort C with complete data during secondary school (i.e. CPRD registered September 2017–July 2020).

We only include individuals born January to August 2004 in cohort A, excluding those born September to December 2003 (who belong to the same school year group). This is due to it not being possible to identify school year group for those born in 2003 (due to birth month being masked). Additionally, in Appendix B we present some further analyses for another cohort (cohort D) which includes young people born in 2003.

Outcome measure

Our primary interest is occurrences of mental health problems as adolescents progress through school. Mental health problems have been operationalised as including anxiety, depression, reaction to stress, eating disorders, other affective mood disorders, obsessive–compulsive disorder (OCD) and self-harm. Note that behavioural problems (such as conduct disorders) have not been included within our definition of mental health problems. This is to ensure that the focus of our outcome measure is anxiety/depression (and closely related conditions), rather than also encompassing more general behavioural issues. Within the CPRD, each contact with a healthcare provider is converted into a 'Read Code' (a coded thesaurus of clinical terms). This captures detailed outcomes from medical consultations. We use these Read Codes to derive occurrences of the mental health problems listed above, drawing upon standard classifications used by medical researchers (https://www.caliberresearch.org/portal/codelists).[2] See Appendix A for the Read Codes used. An individual is classed as suffering from a mental health problem at any given time point if they had contact with a care provider resulting in one of the outcomes listed above.

There are pros and cons of this measure. On the one hand, it is objective data, and captures the most serious end of the mental ill-health spectrum. It will include longitudinal data about vulnerable groups who are amongst the most likely to not respond to surveys (Ekholm *et al.*, 2010), and the number of observations is large, meaning statistical power to detect effects is maximised. Yet it is unlikely to capture less serious (but possibly still quite severe) mental health problems. It could also be affected by selection, excluding those young people with mental ill-health who have not sought medical treatment. This would not be the case using other data sources and measures (e.g. a nationally representative survey that includes a standardised scale such as the General Health Questionnaire). There is a sizeable literature on inequalities in who seeks mental health support, including by age, ethnicity and comorbidities, along with social (e.g. stigma) and structural (e.g. availability of professional support) factors (see Radez *et al.*, 2021 for a systematic review). Relatedly, the data records when contact was made with healthcare providers, not when such problems

developed. Young people with a positive diagnosis may thus have been suffering from mental health issues for an (unknown) period of time before they had contact with medical providers.

The COVID-19 pandemic

The CPRD data used runs from birth to July 2020. The final months (March–July 2020) correspond to when the COVID-19 pandemic hit England, including the first national lockdown. This impacted health services in unprecedented ways, including the ability of young people to seek mental health support. A key implication is that the March–July 2020 data are difficult to interpret. For cohort A this would have been when they sat GCSE examinations (which, as announced in March 2020, were cancelled). In most parts of our analysis we hence restrict focus to pre-March 2020 (pre-COVID).

Methodology

Descriptive analysis

Descriptive statistics will first be presented, illustrating the prevalence of mental health problems since young people started school, based upon the following statistic:[3]

$$\frac{\sum C_t}{\sum P_t} \times 1000 \tag{1}$$

where
$\sum C_t$ = total number of adolescents who had contact with a health care provider in school month t resulting in one of the mental health outcomes of interest.
$\sum P_t$ = total number of adolescents registered at a CPRD practice in school month t. t = time = number of months of completed schooling. Secondary school starts at month 85 corresponding to September 2015 for cohort A, September 2016 for cohort B and September 2017 for cohort C.

Results can be interpreted as the number of cases per 1000 population per month. This part of the analysis pools data across all cohorts and does not impose any minimum registration/data availability criteria, using all available cases for each school month.

One issue is that any increase in prevalence of mental health problems could be driven by the effects of age, rather than school year group per se. A comparison shall therefore be made between young people of similar age who fall across different (adjacent) school year groups. Three-month windows are used where possible for consistency with existing literature (e.g. Buckles & Hungerman, 2013) and to maintain sufficient sample size.

Specifically, we will compare:

- Summer-born (July–August) adolescents in cohort A to autumn-born (September–November) adolescents in cohort B;
- Summer-born (June–August) adolescents in cohort B to autumn-born (September–November) adolescents in cohort C.

One important caveat here is the potential confounding effect of relative age. Summer-born adolescents will be young relative to their school year group peers, while autumn-born adolescents will be (relatively) old. Such relative age effects may influence child development (Crawford *et al.*, 2014), including mental health (Goodman *et al.*, 2003). Indeed, previous research (Root *et al.*, 2019) has argued that young people who are relatively young for their school year (i.e. summer-born) are at slightly greater risk of depression than those who are relatively old (i.e. autumn-born). Our estimates may hence provide an upper-bound on the link between school year group and mental health problems (as the estimates will, in part, also include the effects of relative age). In other words, a prudent interpretation is that we may slightly *overestimate* the effects of being in a more senior school year group.

Logistic regressions

We then formalise estimates using logistic regression. Using comparisons across Year 11, Year 10 and Year 9 as an example, we begin by restricting the CPRD to those consistently registered at a CPRD GP practice between September 2019 and February 2020. A binary variable is coded as one if the child experienced any mental health event between September 2019 and February 2020, and zero otherwise. Our model is then specified as:

$$logit(O_i) = \beta.Cohort_i + \gamma.G + \delta.M + \theta.Prior \tag{2}$$

where
O_i = whether the child experienced a mental health problem between September 2019 and February 2020.
$Cohort_i$ = school cohort dummy variables (cohort A = reference group); for the September 2019–February 2020 period, these capture differences between Year 11s (cohort A), Year 10s (cohort B) and Year 9s (cohort C).
G = gender.
M = a continuous, linear variable running from 1 (September) to 12 (August) capturing birth month.
Prior = a binary indicator of whether the child experienced a mental health problem before the outcome period (i.e. prior to September 2019).

Results from both a complete case and a multiple imputation by chained equations (MICE) analysis will be presented. The β parameter captures differences in mental health outcomes amongst adolescents in different school year groups. Yet, as noted above, this will encompass both the effect of school year group and the effect of age. We therefore estimate an additional set of logistic regressions, comparing those of similar age within different year groups (e.g. summer-born adolescents from cohort A to autumn-born adolescents from cohort B). These are specified as:

$$logit(O_i) = \beta.Group_i + \gamma.G + \theta.Prior \tag{3}$$

where
Group = a dummy variable comparing summer-born adolescents in cohort A to

autumn-born adolescents in cohort B (or, in a separate model, summer-born adolescents in cohort B to autumn-born adolescents in cohort C).

All other controls are specified as for Equation (2). A set of *ex-post* power calculations for this analysis are presented in Appendix G. These suggest that, in this part of our analysis, we have sufficient sample size to detect an odds ratio of between approximately 1.3 and 1.4.

The logistic regression modelling process outlined above is then repeated to make analogous comparisons across other school year groups at an earlier time point. For instance, we also investigate differences in mental health outcomes between cohorts during the 2018/2019 academic year, when cohort A were in Year 10, cohort B in Year 9 and cohort C in Year 8.

Growth in mental health outcomes within cohort

Finally, our attention turns to how the rate of change in mental health problems compares across school year groups. To investigate this issue, we first restrict the sample to those with complete CPRD records from when they started secondary school (September 2015 for cohort A, September 2016 for cohort B and September 2017 for cohort C). For each cohort, we then calculate the number of cases per 1000 young people for each school quarter. These quarters are defined as September–November, December–February, March–May and June–August, starting at September 2015 (quarter $q = 1$) and ending February 2020 (quarter $q = 18$). These estimates will illustrate trajectories in mental health problems through secondary school by cohort. This is followed by estimation of a logistic regression model:

$$Mental_{iq} = \beta.Cohort_i + \gamma.Post_Q + \delta.Cohort_i \times Post_Q \qquad (4)$$

where:
$Mental_{iq}$ = whether child i had at least one contact with healthcare services regarding a mental health problem in calendar quarter q.
$Cohort_i$ = a set of dummy variables capturing school cohort.
$Post_Q$ = a dummy variable indicating whether quarter q falls before (0) or after (1) September 2019.

The parameter of interest is δ, the interaction between school cohort and whether the quarter falls after September 2019. This reveals whether there was a particularly steep increase in mental health problems between September 2019 and February 2020 for cohort A (as they progressed through Year 11) in comparison to cohort B (as they progressed through Year 10) and cohort C (as they progressed through Year 9). As previously, the same process will be conducted using different dates to investigate patterns across different year groups.

Results

Descriptive analysis

Figure 1 illustrates variation in the case rate per 1000 young people per month (vertical axis) by total number of months young people have spent at school (horizontal
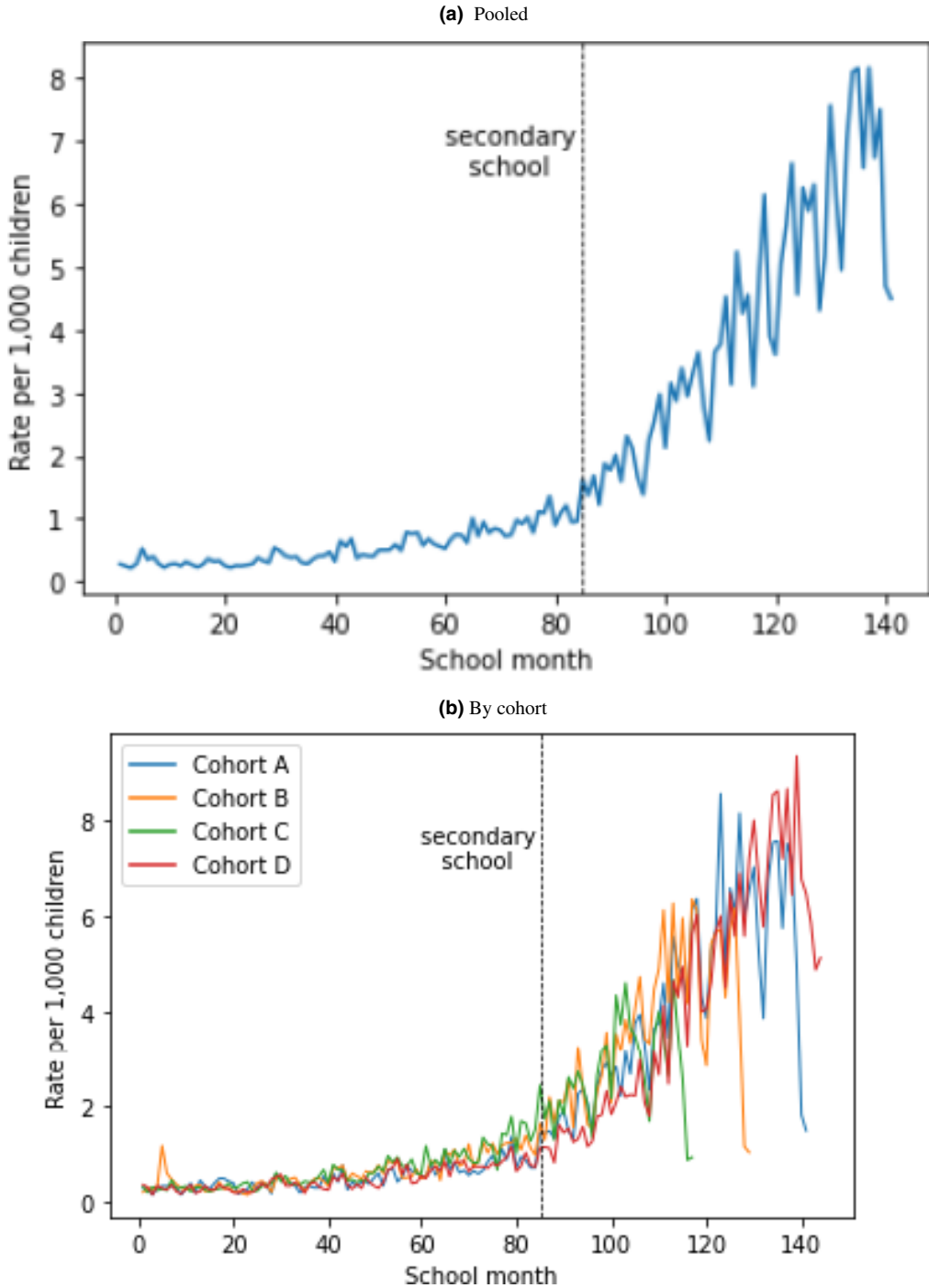
(a) Pooled

(b) By cohort

Figure 1.   Mental health problems amongst young people by their time at school: (a) pooled; (b) by cohort. Figures refer to the rate of mental health problems per 1000 by number of months spent at school. See Appendix B for further details and definition of cohort D. Dashed vertical line denotes the start of secondary school [Colour figure can be viewed at wileyonlinelibrary.com]

axis). The prevalence in mental health problems remains low throughout primary school (case rate of less than 1 per 1000 per month) and any increase with time at school is gentle. However, there is a big upturn in mental health problems from the start of secondary education, increasing from around 1 per 1000 per month at the start of Year 7 up to around 6 per 1000 per month by Year 11. We consequently focus on mental health problems during secondary school for the rest of the article. Another noteworthy feature is the large drop in case rates towards the right-hand side of Figure 1. This is almost certainly due to the COVID-19 pandemic and the first national lockdown.[4] As noted in the Methodology section, this motivates our choice to focus on the pre-COVID (i.e. pre-March 2020) period.

Figure 2 continues by illustrating changes in mental health outcomes during secondary school stratified by gender and socio-economic status (measured by the index of multiple deprivation of home postcode). At the point of secondary school entry, the mental health case rate is around the same level for both genders (approximately 1 per 1000 per month). For boys, there is little evidence of much increase until the latter stages of secondary education, reaching around 3 per 1000 per month by Year 11. The situation is different for girls. From the start of Year 8 onwards, there is clear evidence of an upward trajectory in mental health problems, with the number of cases increasing sharply—and becoming ever more divergent from boys—through to the end of Year 11. Indeed, by the end of secondary school, the mental health case rate for girls is more than double that for boys. Two factors could be driving this: (1) girls are more likely to suffer mental health problems during secondary school than boys; (2) boys may be less likely to seek help for mental health problems and/or have them diagnosed/treated than girls. Unfortunately, with the data available, it is not possible to separate these explanations.

The analyses presented thus far have not accounted for differences in age. Table 1 hence compares summer-born adolescents in cohort A to autumn-born adolescents in cohort B, and summer-born adolescents in cohort B to autumn-born adolescents in cohort C. The shading of cells highlights the figures to compare (see table notes for further details).

There is little evidence that mental health problems are more prevalent amongst Year 11s than similarly aged Year 10s. The case rate is around 5.9 per 1000 each month for cohort A (when they were in Year 11), compared to 5.3 per 1000 for cohort B (when they were in Year 10). This potentially suggests that any increase in mental health problems during Year 11 could be driven by age, rather than being due to school year per se. A similar finding emerges with respect to comparisons between each of the other school year groups as well.

Logistic regressions

Table 2 uses data from all young people, regardless of birth month, and presents estimates from our logistic regression models. The figures reported are adjusted for all other factors reported in the table.

Starting with the comparison between Year 11 and Year 10, the estimated odds ratio from the complete case analysis is close to one (1.02) and not statistically significant at conventional thresholds. Interestingly, the odds ratio from the multiple

(a) Gender

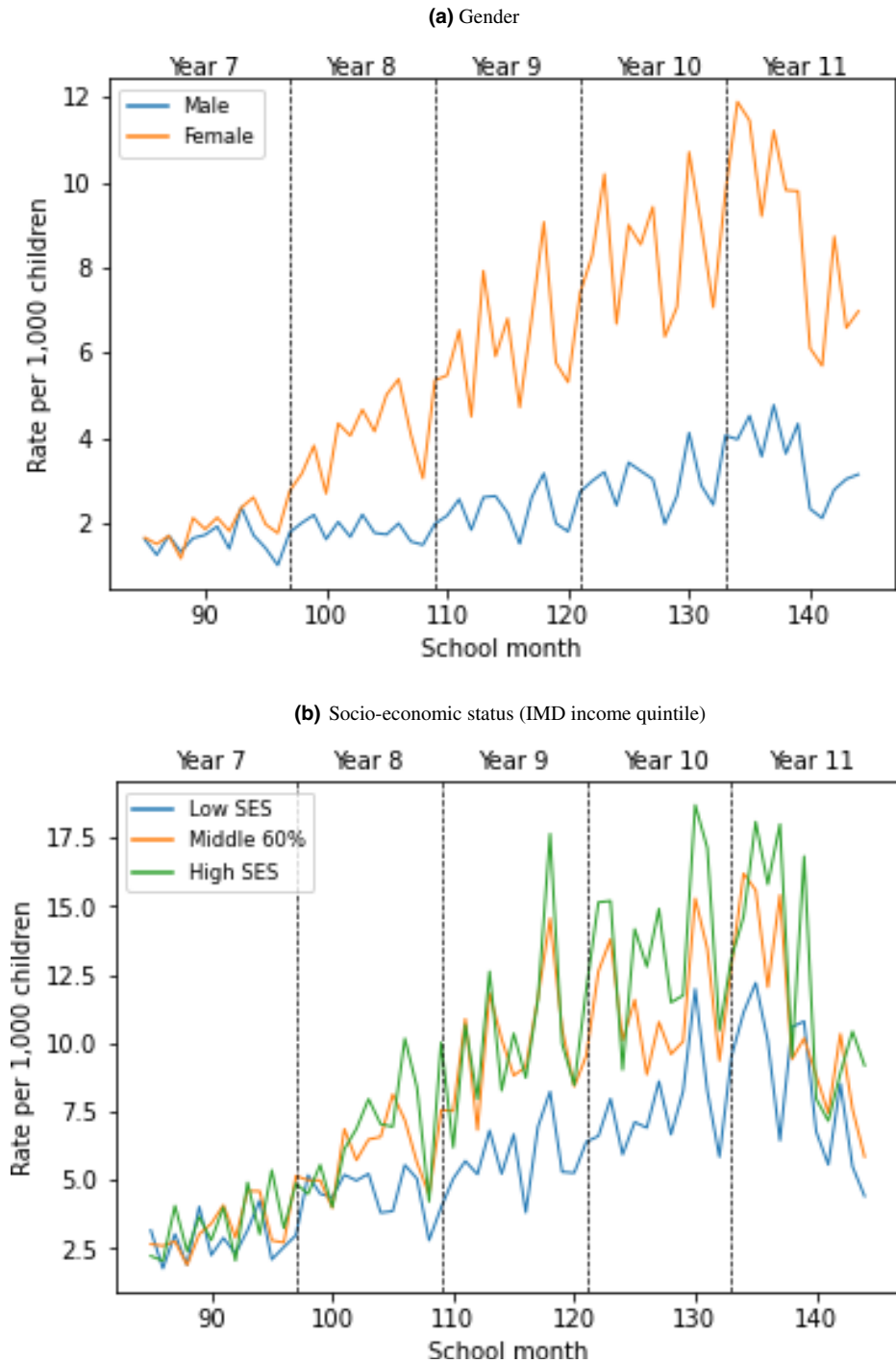**(b)** Socio-economic status (IMD income quintile)

Figure 2. Mental health problems of young people by time at secondary school. Differences by gender and socio-economic status: (a) gender; (b) socio-economic status (IMD income quintile). Figures refer to the rate of mental health problems per 1000 per month by number of months spent at school. Horizontal axis starts at 85, denoting the start of secondary school. Dashed vertical lines denote the start of a new school year group [Colour figure can be viewed at wileyonlinelibrary.com]

Table 1.   Rates of mental health issues per 1000 per month by school year

| School year | Cohort A | Cohort B | | Cohort C | |
	Summer	Autumn	Summer	Autumn	Summer
6	0.89	1.30	1.11	1.32	1.23
7	1.80	2.43	1.88	2.44	1.79
8	3.32	4.30	2.84	3.70	2.89
9	5.97	6.84	4.43	4.04	3.03
10	7.34	5.34	5.44		
11	5.86				

Note: Results by cohort and season of birth. Orange shading compares Year 11 vs Year 10. Blue shading compares Year 10 vs Year 9, purple shading Year 9 vs Year 8, green shading Year 8 vs Year 7 and grey shading Year 7 vs Year 6. Darker shading refers to the comparison between cohort A and cohort B; lighter shading refers to the comparison between cohort B and cohort C. Figures refer to the average rate per 1000 per month. Estimates use all data available each month, with the sample not restricted to those within the database for any set period. See Appendix C for sample sizes for each cell.

imputation analysis is lower (0.78), suggesting that the complete case results may be biased due to the missing month of birth data for cohort A. On the other hand, there is consistent evidence from across both the complete case and multiple imputation analyses that Year 9s are less likely to experience mental health problems than Year 11s (odds ratio = 0.72 from the complete case analysis and 0.53 from multiple imputation). A similar result emerges in panel (b), with mental health problems consistently found to be higher amongst Year 10s than Year 9s and Year 8s, and in panel (c) for the comparisons between Year 9, Year 8 and Year 7. Together, Table 2 confirms the inferences drawn previously from Figure 1—on the whole, mental health problems are more prevalent amongst those in more senior school year groups.

Table 3 presents analogous results from the logistic regression models that restrict the sample to summer and autumn-born adolescents across adjacent year groups. These findings reaffirm that there is no evidence that mental health outcomes are worse amongst Year 11s than similarly aged Year 10s. The estimated odds ratio is close to one (1.06) and does not approach statistical significance at conventional thresholds. A comparable finding holds for most other school year groups; on most occasions, the prevalence of mental health problems does not differ substantially between adolescents within adjacent school years. Year 9 is a possible exception, where adolescents are found to have lower odds of being referred, diagnosed or treated for a mental health problem than similarly aged adolescents in Year 8 (odds ratio ~ 0.85), although even this result is not statistically significant at conventional levels. Consequently, our overall interpretation of Table 3 is that school year group is unlikely to be a major risk factor for mental health problems per se.[5]

Growth in mental health outcomes within cohort

All the analyses thus far have considered differences in mental health outcomes across school year groups. We now investigate whether there are differences in the growth

Table 2.   Differences in mental health outcomes across year groups: logistic regressions

Variable	Complete case				Multiple imputation			
	OR	*p*	Lower CI	Upper CI	OR	*p*	Lower CI	Upper CI
(a) Year 11 (cohort A) vs Years 10 and 9 (cohorts B and C); 2019/20 academic year								
Year group (ref: Year 11)								
Year 10	1.02	0.89	0.80	1.30	0.78	0.00	0.68	0.88
Year 9	0.72	0.01	0.56	0.92	0.53	0.00	0.46	0.62
Gender (ref: Boys)								
Girls	2.46	0.00	2.19	2.77	2.37	0.00	2.16	2.60
Birth month	0.99	0.22	0.97	1.01	0.99	0.19	0.97	1.01
Previous mental health problem (Ref: No)								
Yes	2.36	0.00	2.23	2.50	2.22	0.00	2.13	2.32
Socio-economic status								
Quintile 2	—	—	—	—	1.14	0.22	0.92	1.41
Quintile 3	—	—	—	—	1.41	0.00	1.13	1.75
Quintile 4	—	—	—	—	0.97	0.81	0.76	1.24
Quintile 5	—	—	—	—	1.08	0.51	0.86	1.37
Observations	67,272				92,172			
(b) Year 10 (cohort A) vs Years 9 and 8 (cohorts B and C); 2018/19 academic year								
Year group (ref: Year 10)								
Year 9	0.78	0.01	0.65	0.93	0.69	0.00	0.61	0.78
Year 8	0.58	0.00	0.48	0.70	0.51	0.00	0.45	0.59
Gender (ref: Boys)								
Girls	2.39	0.00	2.16	2.63	2.42	0.00	2.23	2.62
Birth month	0.98	0.01	0.97	1.00	0.98	0.04	0.96	1.00
Previous mental health problem (Ref: No)								
Yes	2.56	0.00	2.40	2.74	2.43	0.00	2.31	2.56
Socio-economic status								
Quintile 2	—	—	—	—	1.18	0.06	0.99	1.40
Quintile 3	—	—	—	—	1.32	0.00	1.10	1.57
Quintile 4	—	—	—	—	1.29	0.01	1.08	1.55
Quintile 5	—	—	—	—	1.48	0.00	1.25	1.76
Observations	68,999				93,090			
(c) Year 9 (cohort A) vs Years 8 and 7 (cohorts B and C); 2017/18 academic year								
Year group (ref: Year 9)								
Year 8	0.72	0.00	0.59	0.87	0.69	0.00	0.60	0.80
Year 7	0.54	0.00	0.44	0.65	0.51	0.00	0.44	0.60
Gender (ref: Boys)								
Girls	1.88	0.00	1.69	2.11	2.05	0.00	1.87	2.25
Birth month	0.97	0.00	0.96	0.99	0.98	0.08	0.96	1.01

Table 2.   (Continued)

Variable	Complete case				Multiple imputation			
	OR	*p*	Lower CI	Upper CI	OR	*p*	Lower CI	Upper CI
Previous mental health problem (Ref: No)								
Yes	2.49	0.00	2.30	2.70	2.40	0.00	2.24	2.56
Socio-economic status								
Quintile 2	—	—	—	—	1.24	0.03	1.03	1.49
Quintile 3	—	—	—	—	1.33	0.01	1.09	1.63
Quintile 4	—	—	—	—	1.22	0.08	0.98	1.51
Quintile 5	—	—	—	—	1.40	0.00	1.14	1.71
Observations	72,853				95,757			

Note: Outcome = probability of suffering a mental health problem between September 2019 and February 2020 (panel a), between September 2018 and August 2019 (panel b) and between September 2017 and August 2018 (panel c). Complete case sample will only include July/August born for cohort A. The *p* column refers to the *p*-values. Figures refer to parameter estimates from logistic regression models and are thus adjusted/conditional upon all other variables reported in the table.

rate of mental health problems *within* school year groups. Figure 3 presents results when including all young people within each cohort, and thus does not take into account differences in biological age.

Focusing initially on outcomes post-September 2019, we find the rate of growth in mental health problems is very similar for cohort A (who were in Year 11) and cohort B (who were in Year 10). Specifically, the odds ratio for the interaction between cohort and time period is close to one (0.92) and not statistically significant. In contrast, the post-September 2019 growth rate for cohort C (who were in Year 9) is notably lower (odds ratio = 0.67). Increases in mental health problems are hence sharper amongst Year 10s and 11s than those in Year 9. The results in panel (c), focusing on September 2018–August 2019 as the outcome period, lead to a similar conclusion. In particular, the growth in mental health problems for those in Year 10 at this time (cohort A) is greater than for those in Year 9 (cohort B; odds ratio = 0.84) who, in turn, experience a greater increase than those who were in Year 8 (cohort C).

Figure 4 presents analogous results for young people in summer-born cohort A and their (similarly aged) autumn-born peers in cohort B. From panel (a) one can see that the lines for the two cohorts are generally close together and run parallel to one other. For the post-September 2019 period, the estimated odds ratio is 0.98 (see Figure 4, panel b). In other words, after abstracting from the effects of age, the growth in mental health outcomes is almost identical across Years 10 and 11. The same holds true for the Year 9/Year 10 comparison, with the odds ratio for the interaction term standing at 0.99 (see Figure 4, panel c). Thus, consistent with our earlier findings, there seems to be little independent association between school year group and growth in mental health problems.

Figure 5 replicates this analysis for the comparison between (summer-born) cohort B and (autumn-born) cohort C. On this occasion, there is some divergence in the

Table 3.   Differences in mental health outcomes between young people of similar age within different school year groups: logistic regression estimates

Comparison	Odds ratio	p	Lower CI	Upper CI	N
(a) No SES control					
Summer-born Year 11 vs autumn-born Year 10					
Cohort A vs B (Sep 19–Feb 20)	1.06	0.69	0.80	1.40	9056
Summer-born Year 10 vs autumn-born Year 9					
Cohort A vs B (Sep 18–Aug 19)	1.02	0.90	0.81	1.28	9285
Cohort B vs C (Sep 19–Feb 20)	0.73	0.00	0.59	0.89	17,657
Summer-born Year 9 vs autumn-born Year 8					
Cohort A vs B (Sep 17–Aug 18)	0.84	0.18	0.65	1.08	9961
Cohort B vs C (Sep 18–Aug 19)	0.85	0.08	0.71	1.02	17,834
Summer-born Year 8 vs autumn-born Year 7					
Cohort A vs B (Sep 16–Aug 17)	0.98	0.90	0.73	1.32	10,980
Cohort B vs C (Sep 17–Aug 18)	1.01	0.96	0.81	1.25	18,458
(b) With SES control					
Summer-born Year 11 vs autumn-born Year 10					
Cohort A vs B (Sep 19–Feb 20)	1.06	0.66	0.80	1.41	9056
Summer-born Year 10 vs autumn-born Year 9					
Cohort A vs B (Sep 18–Aug 19)	1.02	0.87	0.81	1.28	9285
Cohort B vs C (Sep 19–Feb 20)	0.72	0.00	0.59	0.89	17,657
Summer-born Year 9 vs autumn-born Year 8					
Cohort A vs B (Sep 17–Aug 18)	0.84	0.19	0.65	1.09	9961
Cohort B vs C (Sep 18–Aug 19)	0.85	0.07	0.71	1.01	17,834
Summer-born Year 8 vs autumn-born Year 7					
Cohort A vs B (Sep 16–Aug 17)	0.99	0.94	0.74	1.32	10,980
Cohort B vs C (Sep 17–Aug 18)	1.01	0.96	0.81	1.25	18,458

Note: Results from model that includes controls for gender and prior experience of a mental health problem. Odds ratios below one indicate that young people in the lower school year group are less likely to experience a mental health problem than a young person in the higher year group (e.g. the value of 0.85 indicates that young people in Year 8 were less likely to experience a mental health problem than those in Year 9 during the September 2018–August 2019 academic year). Sample restricted to summer and autumn-born adolescents in the relevant cohorts. The *p* column refers to *p*-values.

trend lines plotted in panel (a); they start close together in the pre-September 2018 period, but then move apart. The difference between these cohorts starts to emerge when cohort B moves into Year 9 and cohort C moves into Year 8. The gap is then maintained, but does not appreciably increase, post-September 2019, as the two cohorts move up into Year 10 and Year 9, respectively. The results in Figure 5, panels (b) and (c), help to reiterate these results. Most notably, the odds ratio is below one, suggesting that young people in the younger cohort (cohort C) have a lower

(a) Graph
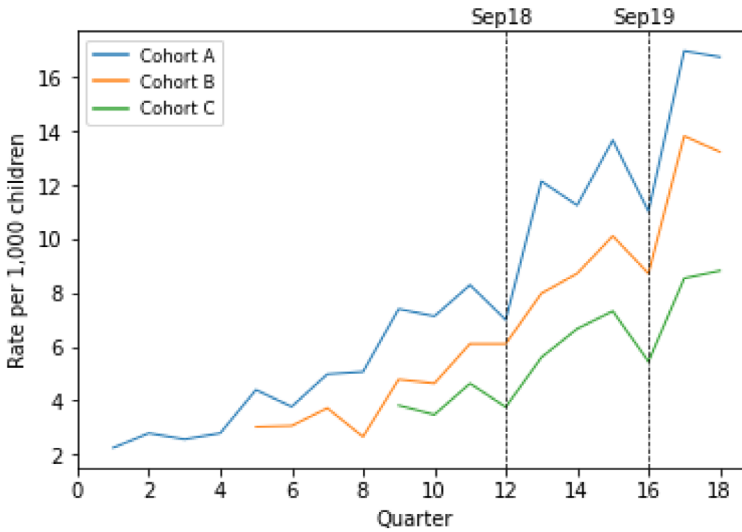
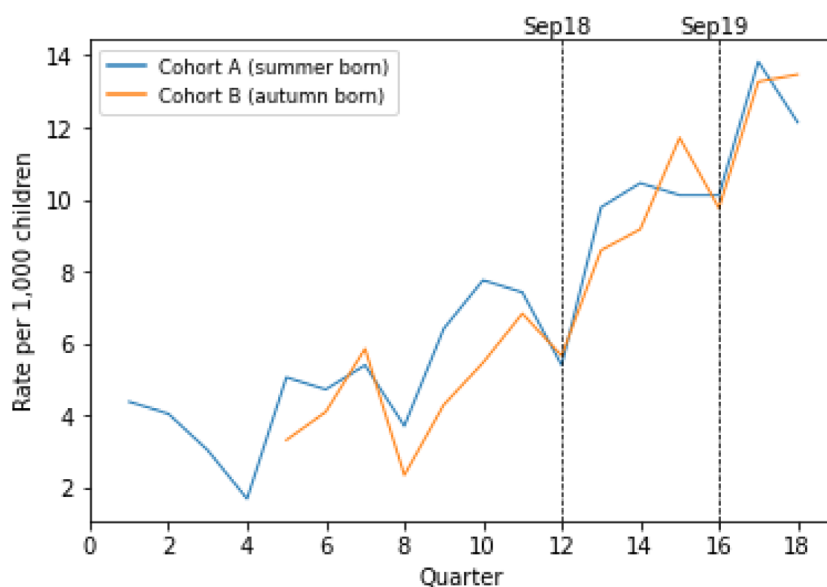**(b)** Pre/post September 2019 (Year 11 vs Year 10 vs Year 9)

Variable	OR	Lower CI	Upper CI	P-value
Cohort (reference: Cohort A)				
Cohort B	0.87	0.82	0.93	0.00
Cohort C	0.76	0.71	0.82	0.00
Time-period (ref: Pre Sep 2019)				
Post Sep 2019	2.56	2.36	2.78	0.00
Cohort*time-period interaction				
Cohort B * Post Sep 2019 interaction	0.92	0.81	1.03	0.16
Cohort C * Post Sep 2019 interaction	0.67	0.59	0.76	0.00

(c) Pre/post September 2018 (Year 10 vs Year 9 vs Year 8)

Variable	OR	Lower CI	Upper CI	P-value
Cohort (reference: Cohort A)				
Cohort B	0.87	0.80	0.95	0.00
Cohort C	0.80	0.73	0.89	0.00
Time-period (ref: Pre Sep 2018)				
Sep 2018-Aug 2019	2.49	2.30	2.70	0.00
Cohort*time-period interaction				
Cohort B * Sep2018-Aug2019 interaction	0.84	0.75	0.95	0.00
Cohort C * Sep2018-Aug2019 interaction	0.64	0.56	0.74	0.00

Figure 3.   Growth in the rate of mental health problems by cohort: (a) graph; (b) pre/post-September 2019 (Year 11 vs Year 10 vs Year 9); (c) pre/post-September 2018 (Year 10 vs Year 9 vs Year 8). The interaction captures differences in the growth rate of mental health problems between cohort A (reference) compared to cohorts B and C. In panel (b) this captures differences in growth rates in Year 11s, Year 10s and Year 9s between September 2019 and February 2020. In panel (c) this captures differences in growth rates between Year 10s, Year 9s and Year 8s between September 2018 and August 2019. Values less than 1 for the interaction term indicate that the growth in mental health problems is lower than for cohort A. $N = 1,102,218$ quarterly observations from 81,493 adolescents [Colour figure can be viewed at wileyonlinelibrary.com]

(a) Graph

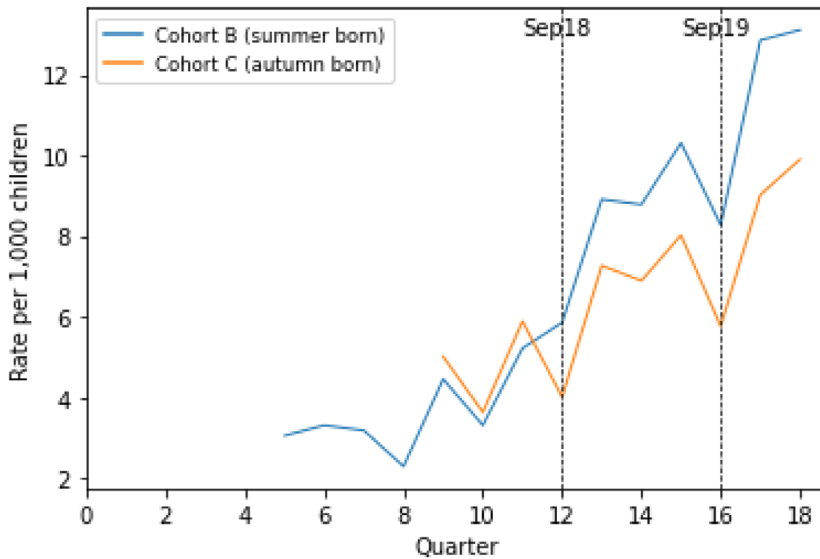
(b) Pre/post September 2019 (Year 11 vs Year 10)

Variable	OR	Lower CI	Upper CI	P-value
Cohort (reference: Cohort A)				
Cohort B	1.03	0.89	1.20	0.67
Time-period (ref: Pre Sep 2019)				
Post Sep 2019	2.10	1.63	2.70	0.00
Cohort*time-period interaction				
Cohort B * Post Sep 2019 interaction	1.00	0.72	1.37	0.98

(c) Pre/post September 2018 (Year 10 vs Year 9)

Variable	OR	Lower CI	Upper CI	P-value
Cohort (reference: Cohort A)				
Cohort B	0.96	0.78	1.18	0.71
Time-period (ref: Pre Sep 2018)				
Sep 2018-Aug 2019	2.07	1.64	2.61	0.00
Cohort*time-period interaction				
Cohort B * Sep2018-Aug2019 interaction	1.01	0.74	1.37	0.96

Figure 4.   Growth in mental health problems. Summer-born cohort A vs autumn-born cohort B: (a) graph; (b) pre/post-September 2019 (Year 11 vs Year 10); (c) pre/post-September 2018 (Year 10 vs Year 9). The interaction captures differences in the growth rate of mental health problems between cohort A (reference) compared to cohort B. In panel (b) this captures differences in growth rates between Year 11s and Year 9s between September 2019 and February 2020. In panel (c) this captures differences in growth rates between Year 10s and Year 9s between September 2018 and August 2019. Values less than 1 for the interaction term indicate that the growth in mental health problems for cohort B is lower than for cohort A. $N = 125,088$ (panel B) and 108,912 (panel C) quarterly observations from 8088 adolescents [Colour figure can be viewed at wileyonlinelibrary.com]

(a) Graph

(b) Pre/post September 2019 (Year 10 vs Year 9)

Variable	OR	Lower CI	Upper CI	P-value
Year group (reference: Cohort B)				
Cohort C	1.04	0.91	1.19	0.55
Time-period (ref: Pre Sep 2019)				
Post Sep 2019	2.34	1.99	2.76	0.00
Cohort*time-period interaction				
Cohort C * Post Sep 2019 interaction	0.70	0.54	0.89	0.01

(c) Pre/post September 2018 (Year 9 vs Year 8)

Variable	OR	Lower CI	Upper CI	P-value
Year group (reference: Cohort B)				
Cohort C	1.21	0.99	1.49	0.07
Time-period (ref: Pre Sep 2018)				
Sep 2018-Aug 2019	2.38	2.00	2.82	0.00
Cohort*time-period interaction				
Cohort C * Sep2018-Aug2019 interaction	0.64	0.48	0.83	0.00

Figure 5.   Growth in mental health problems. Summer-born cohort B vs autumn-born cohort C: (a) graph; (b) pre/post-September 2019 (Year 10 vs Year 9); (c) pre/post-September 2018 (Year 9 vs Year 8). The interaction captures differences in the growth rate of mental health problems between cohort B (reference) compared to cohort C. In panel (b) this captures differences in growth rates between Year 10s and Year 9s between September 2019 and February 2020. In panel (c) this captures differences in growth rates between Year 9s and Year 8s between September 2018 and August 2019. Values less than 1 for the interaction term indicate that the growth in mental health problems for cohort C is lower than for cohort B. $N = 189{,}774$ (panel b) and 158,104 (panel c) quarterly observations from 15,835 adolescents [Colour figure can be viewed at wileyonlinelibrary.com]

growth rate in mental health problems, and that this first occurs when they enter Year 9. Moreover, the odds ratio is of similar magnitude in panels (b) and (c), suggesting —as panel (a) illustrates—that the difference between cohorts B and C that first emerges when the latter is in Year 9 is maintained, but not extended. This provides a tentative suggestion that Year 9 may be linked to an increase in mental health problems. Further evidence is needed, however, to support this finding and to better understand the potential reasons why.

Discussion

This study has used large-scale health data from England to provide one of the most detailed investigations on the link between mental ill-health and school year group to date. We find that mental health problems—as measured by contact with health care providers—are rare throughout primary school, but then increase rapidly during secondary education. This increase in mental health problems during secondary education is particularly sharp for certain subgroups, most notably girls. Yet, against expectations, there is little to suggest that Year 11 is atypical compared to earlier points during young people's time at school. Indeed, on the whole, we find little evidence that any specific school year group is independently associated with diagnosis and treatment of mental health problems. Rather, the increase in the prevalence of mental health problems during secondary education seems to be largely due to age, not school year group per se.

These findings are consistent with evidence from the existing literature in some instances, but not in others. Our finding of a growing gender gap in mental health during adolescence is in line with much previous research (Silva *et al.*, 2020). Although we are unable to provide new empirical evidence as to why the change is particularly pronounced for girls, our findings suggest that this is likely to be primarily due to age, rather than different academic and peer pressures associated with being in a more senior school year group. Possible alternative explanations include issues related to body image (Stice & Bearman, 2001), pubertal change (Koenig & Gladstone, 1998), hormones (Naninck *et al.*, 2011) and cognitive vulnerabilities (Calvete & Cardenoso, 2005). On the other hand, our findings conflict with the conclusions of Wright *et al.* (2020), who found worse mental health problems amongst Year 11s than in Year 9s and 8s. There are several potential explanations for this divergence in research findings, including the use of different outcome measures, timing of data collection, research designs and the extent that differences in absolute age have been accounted for.

Our findings should also be interpreted considering this study's limitations. First, academic year group has been indirectly established from information on birth month and year. Although this is likely to only lead to a small amount of classification error, one cannot completely rule out this having some impact on the results. Second, the CPRD captures diagnoses/treatment of mental health issues. Yet there will be a lag (of indeterminate length) between the onset of mental health problems and young people seeking medical help. This may mean that mental health problems emerge at earlier points in young people's lives than our

estimates capture. Likewise, our outcome measures will miss young people suffering with mental ill-health but not seeking treatment; a problem known to differ between demographic groups (Zimmerman, 2005). Third, the COVID-19 pandemic has meant that our cohort of interest did not sit their GCSE examinations, with our investigations of mental health problems during Year 11 limited to the September–February period. We hence cannot comment on whether there is a spike in mental health problems amongst young people very close to the time they usually take their exams (March–June of Year 11). Indeed, more generally, our analysis refers to a pre-pandemic world. Although many of the old stressors associated with education and schooling are likely to return as the country creeps back to normality, this could lead to more or less severe mental health outcomes for a cohort of young people who have struggled through a pandemic.

Fourth, some potential moderators, or potential confounders, of the link between school year group and mental ill-health (such as academic achievement, social relationships, bullying, responsibilities at home, ethnicity) are either not observed in the CPRD or are limited in sample size. Some of these stressors may change over time, both within and outside of school, and may contribute to variation in young people's mental health outcomes as they age and progress through secondary education. This means that we are unable to explore the potential moderating or mediating effect that these factors may have upon our results. Fifth, most of our analysis has focused on young people who have remained registered at the same GP practice for a certain period of time (e.g. throughout secondary school). Sixth, our comparison of summer-born adolescents in one school cohort to autumn-born adolescents in an adjacent cohort will potentially be confounded by relative age effects (Goodman *et al.*, 2003; Root *et al.*, 2019). Our estimates may therefore provide an upper bound on the link between school year group and the prevalence of mental health problems, as our estimates in part also capture the effects of relative age. Finally, as an observational study, our estimates may not capture cause and effect.

Despite these limitations, some important evidence has emerged from this article. There is much discussion within the media (e.g. Weale, 2018) and amongst policy-makers about how academic pressure on young people increases as they progress through secondary school, which in turn contributes to the growth in mental health problems. Our findings to some extent challenge this view. Rather than seniority of school year group (and the increased academic pressure that this brings) being a risk factor per se, the increasing prevalence of mental ill-health during the teenage years seems to be largely due to the confounding effect of age. This in turn suggests that a stronger evidence base surrounding the role of schooling (including high-stakes examinations) to the growth in mental health problems during adolescence is needed.

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Conflict of Interest

The author declares no conflict of interest.

Ethical Statement

This research was conducted under BERA ethical guidelines and approved by the UCL Institute of Education Ethics committee (reference REC1313).

Data Availability Statement

This study was carried out as part of the CALIBER resource (https://www.ucl.ac.uk/health-informatics/caliber and https://www.caliberresearch.org/). CALIBER, led from the UCL Institute of Health Informatics, is a research resource providing validated electronic health record phenotyping algorithms and tools for national structured data sources. This study is based in part on data from the Clinical Practice Research Datalink obtained under licence from the UK Medicines and Healthcare Products Regulatory Agency. The data are provided by patients and collected by the NHS as part of their care and support. The interpretation and conclusions contained in this study are those of the author alone. The study was approved by the MHRA (UK) Independent Scientific Advisory Committee 20_133R3, under Section 251 (NHS Social Care Act 2006).

NOTES

[1] Author's calculations using PISA 2012 for England.
[2] I used previously validated CALIBER electronic health record outcomes available at the online portal https://www.caliberresearch.org/portal. This is a research resource created by UCL Institute of Health Informatics providing validated electronic health record phenotyping algorithms and tools for national structured data sources.
[3] A study protocol is available from https://www.cprd.com/protocol-list. Appendix E discusses instances where there are some minor differences between the protocol and the final analysis.
[4] This also explains why a sharp downturn is observed for cohorts A, B and C, but not cohort D, who left school (i.e. hit month 120 in the chart) in July 2019, before the COVID-19 pandemic hit the UK.
[5] Given the results presented in Figure 2, with girls experiencing a much sharper increase in mental health problems during secondary school than boys—in Appendix D we replicate the analysis presented in Table 3 for girls only. This produces similar results to those presented in Table 3, with the same substantive conclusions drawn. There is hence no evidence that this finding differs by gender.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Appendix A. CPRD Read Code list.

Appendix B. Analysis for cohort D.

Appendix C. Sample sizes for cross-reference with Table 1.

Appendix D. Differences in mental health outcomes between young people of similar age within different school year groups: results for girls.

Appendix E. Minor variations from study protocol.

Appendix F. Additional analysis using the CPRD Aurum database.

Appendix G. *Ex-post* power calculations.