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# Cross-cohort change in parent-reported emotional problem trajectories across childhood and adolescence in the UK



Jessica M Armitage, Alex S F Kwong, Foteini Tseliou, Ruth Sellers, Rachel Blakey, Rebecca Anthony, Frances Rice, Anita Thapar, Stephan Collishaw



## Summary

**Background** Over the past three decades, the prevalence of adolescent emotional problems (ie, anxiety and depression) has risen. Although the onset and developmental course of emotional symptoms shows high variability, no study has directly tested secular differences across development. Our aim was to investigate whether and how developmental trajectories of emotional problems have changed across generations.

**Methods** We used data from two UK prospective cohorts assessed 10 years apart: the Avon Longitudinal Study of Parents and Children (ALSPAC) including individuals born in 1991–92, and the Millennium Cohort Study (MCS) with individuals born in 2000–02. Our outcome was emotional problems, assessed using the parent-rated emotional subscale of the Strengths and Difficulties Questionnaire (SDQ-E) at approximate ages 4, 7, 8, 10, 11, 13, and 17 years in ALSPAC and ages 3, 5, 7, 11, 14, and 17 years in MCS. Participants were included if the SDQ-E was completed at least once in childhood and at least once in adolescence. Trajectories were generated using multilevel growth curve models using the repeated assessments of the SDQ-E in children aged 3–17 years.

**Findings** Data were available for 19 418 participants (7012 from ALSPAC and 12 406 from the MCS), of whom 9678 (49.8%) were female and 9740 (50.2%) were male, and 17 572 (90.5%) had White mothers. Individuals born between 2000 and 2002 had higher emotional problem scores from around 9 years (intercept statistic  $\beta$  1.75, 95% CI 1.71–1.79) than did individuals born in 1991–92 (1.55, 1.51–1.59). The later cohort had an earlier onset of problems than the earlier cohort, and sustained higher average trajectories from around 11 years, with female adolescents showing the steepest trajectories of emotional problems. Differences between cohorts peaked overall at age 14 years.

**Interpretation** Our comparison of two cohorts of young people provides evidence that compared with a cohort assessed 10 years prior, emotional problems emerge earlier in development in the more recent cohort, and these are especially pronounced for females during mid-adolescence. Such findings have implications for public health planning and service provision.

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## Introduction

The prevalence of emotional disorders and symptoms (ie, depression and anxiety) rose among young people in the first two decades of the 21st century,<sup>1–5</sup> with 9% of those aged 11–16 years meeting criteria for any depressive or anxiety disorder over the past month in 2017 in the UK, compared with around 5% in 2004.<sup>1</sup> The reasons for this rise are unknown.<sup>4</sup> Emotional problems often first manifest in late childhood (ie, age 10 years)<sup>6</sup> and then accelerate across mid-to-late adolescence (from 14 to 16.5 years) into adult life.<sup>7</sup> However, enormous heterogeneity exists in the development of emotional problems, including the age at first onset and subsequent clinical course.

Differences in the timing and nature of the developmental increase in symptoms have been noted between sexes, with females more likely to experience earlier peaks than males, followed by higher levels of symptoms,<sup>7</sup> although much more work has been done

with depression than with anxiety.<sup>8,9</sup> No study, to our knowledge, has directly tested secular changes in the development, rather than prevalence, of emotional problems across successive cohorts.

A developmental approach to investigating secular change in emotional problems could help to clarify whether there have been generational changes in age at onset and subsequent acceleration of emotional symptoms across adolescence. Understanding secular changes in development could also help to identify specific periods of vulnerability in which preventive and public health interventions might be most warranted, and it could inform the planning of services. This understanding is especially important as more recently born children with emotional problems have shown greater risk of problematic social, academic, and mental health outcomes in adolescence than children born in the past.<sup>10</sup>

The aim of the current study was to draw on existing longitudinal data from two UK population cohorts

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### Research in context

#### Evidence before this study

We searched PubMed for publications published between Jan 1, 1980, and Jan 1, 2023, with no language restriction, using the search terms “secular trend” OR “time trend” OR “temporal trend” OR “national trend” OR “cross-cohort” OR “cross cohort” OR “cohort comparison”, combined with additional search terms (“mental health” OR “emotional disorder” OR “emotional problems” OR “emotional symptoms” OR “psychosomatic” OR “SDQ” OR “depression” OR “depressed” OR “depressive” OR “major depressive disorder” OR “MDD” OR “anxiety”) AND (“longitudinal” OR “developmental” OR “trajectory” OR “trajectories” OR “child” OR “childhood” OR “adolescence” OR “adolescent” OR “young adult”). We also examined reviews, systematic reviews, and child mental health surveys published in the past three decades. Emotional problems such as depression and anxiety are common in adolescence and are associated with poor adult outcomes. Epidemiological evidence suggests that there has been an increase in the prevalence of emotional disorders and symptoms across high-income countries during the past three decades. These studies are suggestive of differences in rates of increase for children and adolescents, and for males and females, but we found no cross-cohort longitudinal studies directly testing secular changes in the development of emotional problems.

#### Added value of this study

Our study is the first, to our knowledge, to draw on repeated longitudinal population cohort data to assess whether

developmental trajectories of parent-rated emotional problems have changed over time. We found cohort differences in the timing and severity of emotional problems, with children born in 2000–02 experiencing steeper, earlier, and more prolonged developmental increases in emotional difficulties than children born 10 years earlier. Cross-cohort differences first appeared in late childhood, and then increased and were maintained across adolescence. Parent reports of female adolescents in the later-born cohort showed especially high rates of difficulties.

#### Implications of all the available evidence

Understanding the reasons for the increase in young people’s emotional problems is a priority for informing more effective child-centred public health policy, and for planning appropriate provision of mental health support and services for children and young people. Our findings provide evidence of a worsening of problem that is more pronounced for adolescents than for children. Although effects were more marked for females, they are also evident for males. Preventive and public health interventions are required to avoid further secular increases, and they should prioritise female adolescents. Investigating how, when, and why youth mental health problems are increasing is fundamental to improving the outlook for children and young people.

born 10 years apart (1990s and 2000s) to investigate whether and how developmental trajectories of emotional problems have changed over time. Specifically, we compared differences in age of onset, severity, and symptom course of parent-rated emotional symptoms across these two cohorts. Given previous evidence that secular change in emotional problems has been more marked for females,<sup>4</sup> we also tested whether cross-cohort differences in developmental trajectories differed between males and females.

### Methods

#### Study design and participants

This study used two longitudinal cohorts from the UK: the Avon Longitudinal Study of Parents and Children (ALSPAC) and the Millennium Cohort Study (MCS). These cohorts were assessed approximately 10 years apart, with each collecting data on emotional problems using the same parent-rated measure across development (ages 3–17 years). Sex was defined in both cohorts according to parental reports when the child was aged 8–9 months.

ALSPAC is a birth cohort that recruited pregnant women residing in Avon, UK, with expected delivery dates between April 1, 1991, and Dec 31, 1992.<sup>11</sup> The number of pregnancies enrolled was 14 541, with 13 988 children alive at age 1 year.<sup>12</sup> The total sample size for analyses using any data collected after age 7 years is

15 447 pregnancies following further follow-up.<sup>13</sup> Full details of the ALSPAC study are in the appendix (pp 5–8).

The sample population for the MCS comprised 19 517 children who were born between Sept 1, 2000, and Jan 11, 2002, in either England, Scotland, Wales, or Northern Ireland.<sup>14</sup> During recruitment, efforts were made to ensure adequate representation through oversampling disadvantaged and ethnic minority populations.<sup>15</sup> To account for this selection process and increase the generalisability of the estimates to the target population, sample design weights were used in the present analyses. These data were combined with inverse probability weighting that accounts for cohort-specific predictors of non-response.

The criterion for inclusion in the present study was that participants must have measurement data available for at least one occasion in childhood, defined as age 3–10 years, and at least once in adolescence, defined as age 11–17 years.

Ethics approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees. Informed consent for the use of data collected via questionnaires and clinics was obtained from participants following the recommendations of the ALSPAC Ethics and Law Committee at the time. The data collection for the MCS is approved by the UK National Health Service Research

See Online for appendix

For more on the **Avon Longitudinal Study of Parents and Children** see <http://www.bristol.ac.uk/alspac/>

For more on the **Millennium Cohort Study** see <https://cls.ucl.ac.uk/cls-studies/millennium-cohort-study>



Ethics Committee. Written consent was obtained from all parents in the MCS at each survey (for MCS1, South West MREC [MREC/01/6/19]; for MCS2 and MCS3, London MREC [MREC/03/2/022, 05/MRE02/46]; for MCS4, Yorkshire MREC [07/MRE03/32]; for MCS5, Yorkshire and The Humber-Leeds East [11/YH/0203]; for MCS6, London MREC [13/LO/1786]; for MCS7, North East-York [REC ref 17/NE/0341]). We adhered to the guidelines for strengthening the reporting of observational studies in epidemiology (STROBE) in the reporting in this Article.

### Measures

The present study focused on emotional problems as captured by the Strengths and Difficulties Questionnaire,<sup>16</sup> which was administered and completed by the main carer in both cohorts, who was usually a parental respondent. In ALSPAC, the SDQ emotional symptoms subscale (SDQ-E) was completed at seven timepoints, including approximate ages 4, 7, 8, 10, 11, 13, and 17 years. In the MCS, the SDQ was administered across six timepoints: ages 3, 5, 7, 11, 14, and 17 years.

SDQ is a 25-item scale that comprises five sections (emotional, conduct, hyperactivity, peer problems, and prosocial), each made up of five items. We focused on the SDQ-E, which includes the following items: “Often unhappy, down-hearted, or tearful”; “Complains of headache or stomach ache”; “Many worries, often seems worried”; “Nervous or clingy in new situations, easily loses confidence”; and “Many fears, easily scared”. All items were rated as 0 (not true), 1 (somewhat true), or 2 (certainly true). In line with SDQ recommendations, the total SDQ-E score was generated using mean imputation for those with at least three SDQ-E items. Subscale scores ranged from 0 to 10. Internal consistency was acceptable and increased with age (appendix p 9).

### Choice of primary measure

The SDQ has been shown to be a useful tool for cross-cohort comparisons, with studies showing partial measurement invariance across cohorts for a harmonised measure of mental health based on a subset of SDQ emotional and behavioural items,<sup>17</sup> and the SDQ-E has been validated against diagnoses of depressive and anxiety disorders in childhood and adolescence.<sup>18</sup> The SDQ is free, is time-efficient, has been used in multiple epidemiological surveys and in clinical practice, and is widely available in different languages, facilitating global cross-cohort comparisons.

### Statistical analyses

Trajectories of SDQ-E scores were first investigated separately in each cohort using multilevel growth curve models (repeated measurements at level one and individuals at level two). Multilevel growth curve models fit average population trajectories with intercept and slope terms. Every individual included in the model has their own intercept and slope term, which is allowed to

deviate from the population average, ensuring that each individual has a unique trajectory. The intercept is interpreted as the magnitude of mean scores, and the overall slope as the rate of change in mean scores. We investigated the total SDQ-E with age modelled as either a linear, quadratic, cubic, or quartic polynomial term, as previously reported.<sup>7</sup> Age was grand-mean centred for each cohort (means of age 9 years in MCS and age 9.5 years in ALSPAC) to improve interpretation and estimation.<sup>7</sup> We also added a post-hoc sensitivity analysis with age variable beginning at age 4 years (appendix p 16). The model of best fit was determined using likelihood ratio tests and information criteria,<sup>19</sup> which showed the quartic model to be the best fit for the ALSPAC and MCS in unadjusted models (appendix pp 10–13), and it was therefore chosen for the main analyses.

Following the creation of cohort-specific trajectories, multilevel models were repeated with cohort included as a dummy variable and entered as an interaction term with the fixed-effects age quartic polynomial term. This allowed tests of whether population-averaged trajectories of emotional problems differ between individuals born in 1991–92 (ALSPAC) and 2000–02 (MCS). As per the cohort-specific models, the age term was allowed to vary randomly across individuals to capture each individual's trajectory. We compared the age of peak velocity across cohorts to determine any differences in the period in which symptoms change most rapidly. The age of peak velocity was estimated by calculating the first derivative of the trajectory and finding the point of inflection. The delta method in Stata was also used to compare total SDQ-E scores from the trajectory models across critical age points. A full description of analyses with example code is in the appendix (pp 39–42).

We also investigated sex differences. Cross-cohort trajectory analyses were repeated after adding a three-way interaction term with sex ( $\text{sex} \times \text{cohort} \times \text{age}$ ), to provide insight into whether age-specific differences across cohorts are consistent for males and females. Given evidence of increasing social inequalities and links with youth mental health,<sup>20</sup> we did further analyses to test family income as a moderator of cohort differences in emotional problem trajectories. Family income was assessed in both cohorts at age 11 years using household income including social benefits. These variables were split into five quintiles in each cohort, and analyses compared families below or above the bottom quintile (bottom 20% vs rest), as previously reported.<sup>20</sup> A three-way interaction term ( $\text{income} \times \text{cohort} \times \text{age}$ ) was used to quantify the extent to which cohort differences in emotional problem trajectories varied by family income.

Sensitivity checks used a more stringent inclusion criterion whereby individuals were included if they had complete data on four or more occasions, including two in childhood, and two in adolescence. Missing data were handled in all models using full information maximum likelihood estimation. This approach assumes

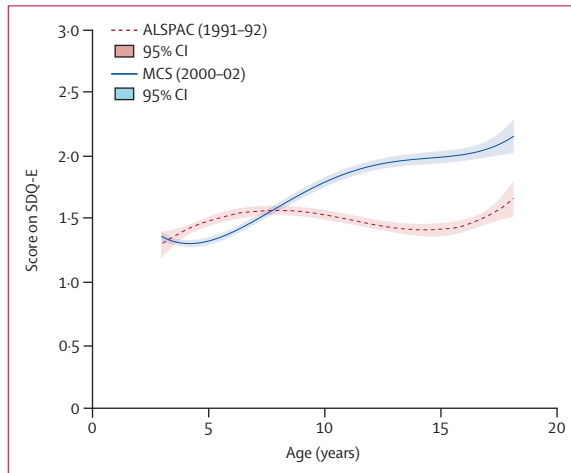
For the Strengths and Difficulties Questionnaire see [www.sdqinfo.org](http://www.sdqinfo.org)

	Whole sample		Analysis sample*			Analysis sample (weighted)	Analysis sample (entropy balanced)
	N	Mean SDQ-E score (SD)	N	Mean SDQ-E score (SD)	Individuals above SDQ-E clinical threshold (%) <sup>†</sup>	Mean SDQ-E score (SD)	Mean SDQ-E score (SD)
<b>ALSPAC</b>							
Age 4 years	9371	1.45 (1.52)	7131	1.43 (1.49)	301 (4.2%)	1.42 (1.49)	..
Age 7 years	8312	1.51 (1.67)	6898	1.51 (1.66)	442 (6.4%)	1.50 (1.65)	..
Age 8 years	7688	1.69 (1.83)	6737	1.67 (1.82)	592 (8.8%)	1.64 (1.79)	..
Age 10 years	7956	1.52 (1.77)	7122	1.51 (1.75)	503 (7.1%)	1.47 (1.72)	..
Age 11 years	7247	1.47 (1.73)	7085	1.46 (1.72)	494 (6.9%)	1.44 (1.72)	..
Age 13 years	6970	1.44 (1.72)	6817	1.43 (1.71)	447 (6.6%)	1.42 (1.71)	..
Age 17 years	5590	1.50 (1.86)	5489	1.49 (1.85)	441 (8.0%)	1.48 (1.84)	..
<b>MCS</b>							
Age 3 years	14 147	1.39 (1.52)	11 396	1.37 (1.51)	246 (2.2%)	1.31 (1.44)	1.60 (1.78)
Age 5 years	14 708	1.40 (1.60)	12 417	1.39 (1.61)	307 (2.5%)	1.34 (1.56)	1.50 (1.71)
Age 7 years	12 637	1.53 (1.77)	11 332	1.53 (1.76)	429 (3.8%)	1.49 (1.73)	1.54 (1.76)
Age 11 years	12 789	1.87 (2.00)	12 484	1.87 (1.99)	780 (6.2%)	1.84 (1.99)	1.62 (1.82)
Age 14 years	10 156	2.04 (2.14)	9962	2.03 (2.14)	788 (7.9%)	1.97 (2.12)	1.87 (1.94)
Age 17 years	7764	2.06 (2.26)	7621	2.06 (2.26)	724 (9.5%)	2.02 (2.26)	1.77 (1.97)

ALSPAC=Avon Longitudinal Study of Parents and Children. MCS=Millennium Cohort Study. SDQ-E=SDQ emotional symptoms subscale. \*Participants with SDQ-E problem scores at least once in childhood (age 3–10 years) and at least once in adolescence (age 11–17 years). <sup>†</sup>Clinical threshold defined according to SDQ scores of 5 or above (considered high according to new four band categorisation).

**Table 1: Frequency and mean item responses for whole sample and subsamples**

For more on four band categorisation see [www.sdqinfo.org](http://www.sdqinfo.org)



**Figure 1: Average population trajectories of emotional problems in the ALSPAC and MCS cohorts by age**  
 ALSPAC=Avon Longitudinal Study of Parents and Children. MCS=Millennium Cohort Study. SDQ-E=Strengths and Difficulties Questionnaire emotional symptoms subscale.

data are missing at random and enabled individuals with partially complete data to be included. Since missing at random is unlikely to hold for all cases, analyses were supplemented with inverse probability weighting. Complete cases were weighted by the inverse probability of their being a complete case using variables available for the full cohort assessed in pregnancy or infancy that were associated with missingness (see appendix pp 3–4). Note that inverse probability weighting makes samples

more representative of the baseline population but cannot account for unmeasured factors that systematically influence missingness. For MCS, sampling weights at age 17 years were also used to correct for the stratified cluster sample design.<sup>15</sup> This sampling weight was interacted with the non-response weight, and an additional control variable was used to adjust for sample stratification.

We used several approaches to test the robustness of findings to sociodemographic differences between the two cohorts (appendix p 31). First, we used entropy balancing to account for demographic differences between the cohorts.<sup>21</sup> Entropy balancing is a multivariate, reweighting method to ensure that two samples are balanced on prespecified variables. As previously reported,<sup>5</sup> prespecified variables included sociodemographic factors: sex, age, ethnicity, maternal education, and maternal age. We generated an entropy balancing weight value for all participants in MCS and used this when replicating trajectory models. As the two cohorts have different ethnic compositions (98% White mothers in ALSPAC vs 84% in MCS), sensitivity analyses also explored trajectories after limiting the sample to those with White mothers. In addition, as ALSPAC includes individuals from one region of England and MCS includes individuals from England, Wales, Scotland, and Northern Ireland, we tested whether any differences between ALSPAC and MCS replicated across each of the four nations included in the MCS cohort. Finally, we adjusted models for the mother’s mental health as changes in maternal mental

health could affect comparison of ratings of child emotional problems.<sup>22</sup>

All analyses were done in Stata (version 17), and trajectories were created through the user-written `runmlwin` command<sup>23</sup> within the standalone multilevel modelling package MLwiN (version 2.35).

### Role of the funding source

The funders of the study had no role in the study design, data collection, data analysis, data interpretation, or writing of the report.

### Results

Of the 10 102 participants in ALSPAC with baseline measures, 7012 (69.4%) completed the SDQ-E at least once in childhood and at least once in adolescence. Of these individuals, 3510 (50.1%) were female, 3502 (49.9%) were male, and 6896 (98.4%) had White mothers. In the MCS, data were available for 17782 participants at baseline, of whom 12 406 (69.8%) completed the SDQ-E at least once in childhood and at least once in adolescence. Of these individuals, 6226 (50.2%) were female, 6180 (49.8%) were male, and 10 685 (86.1%) had White mothers. At age 13 years, 447 (6.6%) of 6817 adolescents in ALSPAC had clinically relevant emotional symptoms according to the SDQ, compared with 788 (7.9%) of 9962 in the MCS at the closest comparable age of 14 years (table 1).

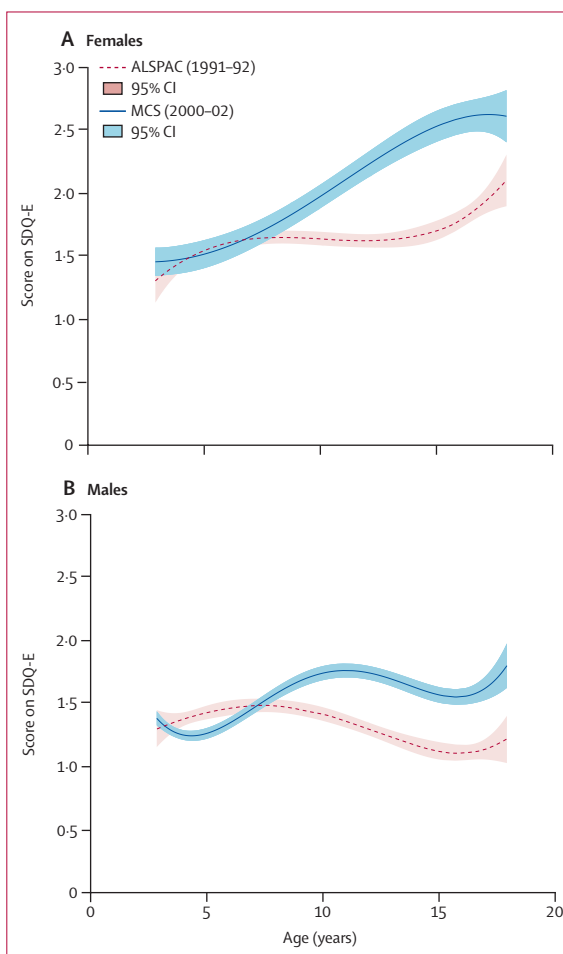
The two cohorts showed some similarities and some differences in emotional problem trajectories (appendix pp 7–8). Both showed a gradual increase in parent-rated emotional problems across development, but individuals born in 2000–02 had higher emotional problem scores from mid-childhood (age 9 years) onwards (as shown by the higher intercept statistic:  $\beta$  1.75, 95% CI 1.71–1.79) compared with individuals born in 1991–92 (1.55, 1.51–1.59; appendix p 14). The later cohort from 2000–02 had a steeper and earlier rise in emotional problems, with symptom scores increasing most rapidly from around age 8 years and reaching high levels in early adolescence (figure 1). By contrast, the earlier cohort from 1991–92 had relatively stable levels of emotional problems until late adolescence. This is reflected in different trajectory slope estimates for the two cohorts (appendix pp 14–16)). There was little difference between the two cohorts for emotional problems in childhood at age 8 years but substantial and increasing differences from age 11 onwards (table 2).

We calculated the age of peak decreasing velocity, which refers here to the age at which symptom increase in emotional problems is decreasing at the fastest rate. This occurred at age 14.5 years in the later cohort (MCS) and at age 11.5 years in the earlier cohort (ALSPAC). At these timepoints, average SDQ-E scores were 1.99 (95% CI 1.94–2.04) in the MCS, and 1.49 (1.45–1.53) in ALSPAC. This finding suggests that emotional problem scores for those born more recently are not only higher

	ALSPAC		MCS		Difference		
	SDQ-E estimate (95% CI)	SE	SDQ-E estimate (95% CI)	SE	SDQ-E estimate (95% CI)	SE	p value
Age 5 years	1.50 (1.46 to 1.54)	0.02	1.34 (1.31 to 1.37)	0.02	-0.16 (-0.11 to -0.21)	0.03	<0.0001
Age 8 years	1.57 (1.53 to 1.61)	0.02	1.61 (1.58 to 1.65)	0.02	0.04 (-0.01 to 0.09)	0.03	0.11
Age 11 years	1.50 (1.46 to 1.54)	0.02	1.87 (1.83 to 1.91)	0.02	0.37 (0.32 to 0.43)	0.03	<0.0001
Age 14 years	1.42 (1.37 to 1.46)	0.02	1.98 (1.93 to 2.03)	0.02	0.56 (0.49 to 0.63)	0.04	<0.0001
Age 17 years	1.51 (1.45 to 1.56)	0.03	2.05 (1.99 to 2.11)	0.03	0.55 (0.46 to 0.63)	0.04	<0.0001

Results are based on the quartic polynomial model (n=19 418). ALSPAC=Avon Longitudinal Study of Parents and Children. MCS=Millennium Cohort Study. SDQ-E=Strengths and Difficulties Questionnaire emotional symptoms subscale.

**Table 2: Cross-cohort comparison of average SDQ-E scores from trajectories for individuals born in 1991–92 (ALSPAC) and 2000–02 (MCS)**



For more on MLwiN see [www.cmm.bristol.ac.uk/MLwiN/index.shtml](http://www.cmm.bristol.ac.uk/MLwiN/index.shtml)

**Figure 2: Cross-cohort comparison of average population trajectories in the ALSPAC and MCS cohorts by age for females (A) and males (B)**  
ALSPAC=Avon Longitudinal Study of Parents and Children. MCS=Millennium Cohort Study. SDQ-E=Strengths and Difficulties Questionnaire emotional symptoms subscale.

than in the earlier cohort, but also maintained for a longer period during childhood and adolescence.

In terms of cross-cohort differences in sex-specific trajectories of emotional problems (appendix p 17), parent-ratings of emotional problems in females increased in both cohorts across development, but this increase occurred earlier and more rapidly for those born in the later cohort (figure 2A). Cohort differences in estimated emotional problem scores for females were small before age 8 years but increased in adolescence, with the largest differences between cohorts at age 14 years (table 3). Parent-reported emotional problems for males showed different trajectories in the two cohorts, with those born in the 1991–92 cohort showing stable and then declining rates of emotional problems from childhood into adolescence (figure 2B). By contrast, males born in 2000–02 showed a rise in problems across childhood and then sustained higher levels of difficulties compared with the earlier cohort. Males born in 2000–02 had higher estimated emotional problem scores from age 8 years onwards but lower problem scores at age 5 years (table 3). Full regression coefficients are in the appendix (p 18). The cubic models showed highly similar trajectory patterns for parent-rated female emotional problems but suggested that cohort differences for males are reduced in late adolescence (appendix p 19, 34).

Analyses using the more stringent inclusion criterion, whereby individuals were included if they had complete data on four or more occasions, including two in childhood and two in adolescence (n=6417 for ALSPAC and n=9751 for MCS), produced similar results (appendix pp 20–21). Trajectory models stratified by income (bottom quintile [19% for ALSPAC and 26% for MCS] vs rest) showed a main effect of income, meaning that those from lower income households had higher emotional problem scores than those from higher income families (appendix p 22, 35). However, cross-cohort differences in emotional problem trajectories were replicated for socially disadvantaged and more advantaged families. There was no cohort×income interaction, or cohort×age×income interaction (appendix p 23), meaning that cross-cohort emotional problem trajectories across development did not vary by family income.

Sensitivity analyses addressed whether cross-cohort differences might reflect sociodemographic or methodological differences in the sampling of the two cohorts. Emotional problem trajectories that included an entropy balanced weight showed similar results to the main analysis, with higher rates of emotional problems emerging at around age 10 years (appendix pp 24–25, 36).

Emotional problem trajectories were also similar when the samples were restricted to those with White mothers (appendix p 37) with overlapping confidence intervals to the full samples (appendix pp 26–27), and they remained similar when comparing trajectories between England and the three devolved nations of the UK within MCS (appendix p 38). The only observed difference was that parent-rated emotional problem scores were lower in Scotland than England when children were aged 5–11 years (appendix p 28). All four national samples in MCS showed higher problem scores compared with ALSPAC (appendix p 36). A table comparing key estimates across all sensitivity analyses is in the appendix (pp 29–30).

## Discussion

This study investigated whether the development of parent-reported child and adolescent emotional problems has changed over time by comparing two population cohorts born in 1991–92 and in 2000–02. Cross-cohort comparisons suggest that children born in the early 2000s had steeper and earlier increases in parent-rated emotional problems, which were sustained across development. These differences occurred in late childhood and then increased and were maintained across adolescence. Parent reports for females in both cohorts showed increasing emotional problems during adolescence, but those born in the 2000–02 cohort had particularly high emotional problem scores. The problems began earlier and lasted for longer than for the earlier cohort of females. For males, higher parent-rated emotional problem scores were also noted in the

	ALSPAC		MCS		Difference		p value
	SDQ-E estimate (95% CI)	SE	SDQ-E estimate (95% CI)	SE	SDQ-E estimate	SE	
<b>Females</b>							
Age 5 years	1.55 (1.50 to 1.61)	0.03	1.52 (1.41 to 1.64)	0.06	-0.03 (-0.14 to 0.09)	0.06	0.66
Age 8 years	1.65 (1.60 to 1.70)	0.03	1.76 (1.67 to 1.86)	0.05	0.11 (0.02 to 0.19)	0.04	0.013
Age 11 years	1.63 (1.58 to 1.68)	0.03	2.10 (2.00 to 2.20)	0.05	0.47 (0.38 to 0.55)	0.04	<0.0001
Age 14 years	1.65 (1.58 to 1.72)	0.04	2.44 (2.32 to 2.56)	0.06	0.79 (0.66 to 0.92)	0.07	<0.0001
Age 17 years	1.88 (1.80 to 1.96)	0.04	2.63 (2.50 to 2.76)	0.07	0.75 (0.61 to 0.89)	0.07	<0.0001
<b>Males</b>							
Age 5 years	1.45 (1.39 to 1.50)	0.03	1.28 (1.24 to 1.33)	0.02	-0.17 (-0.10 to -0.24)	0.04	<0.0001
Age 8 years	1.49 (1.44 to 1.55)	0.03	1.59 (1.54 to 1.64)	0.03	0.10 (0.03 to 0.17)	0.04	0.007
Age 11 years	1.38 (1.32 to 1.43)	0.03	1.78 (1.72 to 1.83)	0.03	0.40 (0.32 to 0.48)	0.04	<0.0001
Age 14 years	1.19 (1.12 to 1.25)	0.03	1.65 (1.59 to 1.71)	0.03	0.47 (0.38 to 0.55)	0.04	<0.0001
Age 17 years	1.13 (1.06 to 1.20)	0.03	1.60 (1.52 to 1.68)	0.04	0.47 (0.37 to 0.57)	0.05	<0.0001

Results are based on the quartic polynomial model (n=19 418). ALSPAC=Avon Longitudinal Study of Parents and Children. MCS=Millennium Cohort Study. SDQ-E=Strengths and Difficulties Questionnaire emotional symptoms subscale.

**Table 3: Cross-cohort comparison of average SDQ-E scores from female and male trajectories for individuals born in 1991–92 (ALSPAC) and 2000–02 (MCS)**

2000–02 cohort from mid-childhood onwards, with an earlier and more sustained developmental increase in emotional problems than males in the 1991–92 cohort.

Our findings extend previous secular investigations using repeat cross-sectional data focused on specific age groups. Collectively, such studies have suggested that secular increases in emotional problems might be more evident for adolescents than for children.<sup>24</sup> This study provides novel evidence that the developmental course of parent-rated emotional problems has changed between generations, and that cohort differences in emotional problems vary across development, being greatest for adolescents and more marked for females.<sup>4,24</sup>

In addition to the overall increase in emotional difficulties across development in both cohorts, our findings identified developmental periods in which parent-rated emotional problems plateaued or declined. The timing of this change differed across the cohorts. For females, there was some suggestion of stabilisation of emotional problems, but this occurred much later in the 2000–02 cohort and only after a period of sustained increase in emotional problems. For males, both cohorts showed a period of stable or declining rates of emotional problems, but this occurred later in the 2000–02 cohort, and again after a steeper rise. This finding suggests that both females and males born more recently experienced a longer period of heightened emotional problems than did those born previously. The finding that female adolescents were most affected by secular increases in emotional problems is consistent with existing literature.<sup>2–4,24</sup> The current study suggests that this increase probably reflects a combination of an earlier onset of problems and a prolonged period of increasing emotional problems across adolescence among girls in more recent cohorts.

Various explanations have been suggested for the worsening of youth emotional symptoms, including changes in young people's lifestyles, body image, use of digital technology, family life, school life and academic pressure, social relationships, and broader cultural and social factors, such as increasing societal inequalities,<sup>4,5,24–27</sup> but to date there is scarce evidence linking changes in purported explanatory factors and secular change in emotional problems.<sup>26</sup> A priority for future research is to better understand how young people's lives have changed and whether these factors explain the secular changes in emotional problems. There have been numerous interconnected changes in children's physical maturation, their social and educational environments, their use of digital tools for learning and socialisation, society's expectations of young people, and how young people perceive themselves. Little is currently known about how secular changes in biological, psychological, social, and cultural factors shape changes in young people's development. Mental health trends (and explanations of them) might also differ in important ways for females and males, or

for children growing up in advantaged or disadvantaged circumstances.<sup>20,22,24</sup>

It was beyond the scope of this study to test specific explanations for cross-cohort differences in trajectories of emotional problems. In our secondary analyses examining whether differences varied based on income, we showed steeper average trajectories of emotional problems for those from lower-income households in both cohorts. However, there was no evidence that this was especially the case for individuals born in a particular generation. Our results align with previous cross-cohort research that has shown no evidence of differential trends in emotional problems for young people from socially advantaged and disadvantaged households.<sup>20</sup> Others have also shown increases in emotional problems over time despite changing socioeconomic conditions.<sup>17</sup> Our findings suggest that increases in adolescent emotional problems occur despite differences in socioeconomic factors.

It is important to note that patterns of cross-cohort change, developmental trajectories, and sex or gender differences will vary for different mental health domains. For example, boys show higher rates of behavioural problems than girls, especially during childhood.<sup>1</sup> It was beyond the scope of this study to compare cross-cohort change in developmental trajectories for other mental health domains (eg, conduct problems or neurodevelopmental problems), but previous research suggests a pronounced increase in youth emotional problems in recent decades.<sup>14</sup>

This study has several limitations. Potentially important differences between the two cohorts should be considered. The MCS is a national UK cohort and more representative of the ethnic diversity of the UK than ALSPAC, which was recruited from one region in England. At the time of recruitment, mothers of children in the Avon region were more likely than those in Britain as a whole to live in owner-occupied accommodation and to have a car, and were less likely to be non-White.<sup>12</sup> Both cohorts experienced sample attrition, but missing data were more common in ALSPAC than in MCS. There was evidence for selective attrition in both cohorts and there were cohort-specific patterns of non-response that might act as a confounder. Inverse probability weighting accounted in part for cohort-specific patterns on non-response by making samples more representative of the baseline population. However, we cannot rule out biases arising from unmeasured factors that systematically influence missingness. Given that disadvantaged families typically drop out more from longitudinal research, it is plausible that findings provide a conservative estimate of levels of emotional problems. To test the potential effect of cohort differences, we did several sensitivity analyses including entropy balanced weights and restricting analyses to more closely comparable sample in terms of family income and parts of the UK in the MCS. It was not possible to determine



whether changes in emotional problems reflect a gradual ongoing increase or a particular period of non-linear change.

Another limitation is the use of parental reports of emotional problems. To model trajectories across childhood and adolescence, we needed to use the same rater, but parents might not be the best informant of emotional problems, particularly for older adolescents, as they might be less aware of internalising symptoms. Our estimates of emotional problems could therefore be conservative. Patterns of parent-reported emotional problems in the two cohorts were similar during childhood, suggesting no general difference in the propensity of parents to report difficulties in their children. Nevertheless, parental ratings of child difficulties are affected by parents' own mental health, and evidence shows an increase in adult mental health problems.<sup>28</sup> These increases could have affected our findings in two ways: by affecting reporting of emotional problems, or by affecting young people's mental health. Parent depression and anxiety are robust risk factors for offspring emotional problems,<sup>29</sup> and past research suggests that increasing parental mental health problems have contributed to long-term increases in self-reported youth mental health problems.<sup>22</sup> Indeed, maternal mental health was associated with higher SDQ-E in both cohorts, but adjusting for maternal mental health in a sensitivity check had a minimal effect on our trajectory results. Further research with comparable measures of parental mental health and multi-informant measures of youth mental health are needed to test the effect of cross-cohort change in parental mental health. There could also be other cohort differences in parental reporting, due to greater parental sensitivity or more open parent-child communication about mental health. Although difficult to test directly, evidence speaks against a general shift in parental reporting<sup>4</sup> and suggests that parental rating thresholds have not changed to identify less serious difficulties, and therefore more difficulties overall, in more recent cohorts. Evidence shows that the functional effects and outcomes of parent-reported child mental health difficulties have become more pronounced for more recent cohorts.<sup>10</sup>

Other limitations include possible differences in primary carer responding and in the specific ages at which the SDQ-E was completed. Most parent responders in ALSPAC were mothers; however, it was less clear across timepoints who the primary respondent was in the MCS. There were also slight differences in the age of SDQ assessments across cohorts. The trajectory models estimate predicted SDQ scores across the whole period covered by these assessments, but the scores measured at specific points can vary slightly due to differences in age at that assessment. In addition, specific emotional problems can show differences in developmental patterns of cross-cohort change. It was not possible to assess cohort differences in developmental trajectories

for specific forms of emotional problems, such as depression and anxiety, which could differ, with a typically later onset for depression relative to anxiety. We were also unable to test emotional problems in young adulthood—an important developmental risk period for emotional disorders such as depression and anxiety and one which has seen increasing rates of emotional disorders in more recently born cohorts.<sup>1</sup> Future research should extend cross-cohort research on trajectories of emotional problems into young adulthood, to examine developmental trajectories using self-reported symptoms, and to examine how trajectories have been affected through the COVID-19 pandemic.

Evidence of generational increases in youth emotional problems at the population level highlights the importance of a public health approach to mental health, which aims to improve the conditions in which young people grow up.<sup>30</sup> The long-lasting social, health, and economic consequences of youth mental health problems are well documented, as are the major gaps between young people's need for mental health support and care and that which is available currently.<sup>30</sup> Tackling entrenched and growing societal inequalities is one priority.<sup>30</sup> Inequalities in emotional problems were evident in both cohorts throughout childhood and adolescence. Improved understanding of drivers of secular change in youth emotional problems (and how these vary developmentally) is needed to inform preventive public health interventions.

Our findings show cohort differences in the developmental trajectories of parent-rated emotional problems. Children born in 2000–02 showed steeper, earlier, and more prolonged developmental increases in emotional difficulties than did children born 10 years earlier. Female adolescents in the later cohort showed especially high rates of difficulties. Understanding the reasons for the increase in young people's emotional problems is necessary to inform more effective child-centred public health policy, and for planning appropriate provision of mental health support and services for children and young people.

#### Contributors

JMA and SC conceptualised the study and JMA wrote the original draft. JMA performed all statistical analyses, and ASFK and SC provided supervision. All authors contributed to the interpretation of data and reviewed and edited the manuscript. All authors had access to all the data. JMA, ASFK, and SC accessed and verified the underlying data. JMA and SC had the final responsibility to submit for publication.

#### Declaration of interests

We declare no competing interests.

#### Data sharing

The University of Bristol owns the ALSPAC resource. Data can be made available on request to the ALSPAC Executive. Full instructions for applying for data access can be found at <http://www.bristol.ac.uk/alspac/researchers/access/>. The ALSPAC study website contains details of all the data that are available (<http://www.bristol.ac.uk/alspac/researchers/our-data/>). The University of London Centre for Longitudinal Studies owns the copyright for data in the MCS. These data are held by the UK Data Service and can be located by registering and submitting a data request at

<http://ukdataservice.ac.uk/>. Additional terms and conditions are outlined at <https://www.ukdataservice.ac.uk/get-data/how-to-access/conditions>.

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