The association between academic pressure and adolescent depressive symptoms and self-harm: a longitudinal, prospective study in England

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Summary

Background Academic pressure could increase the risk of adolescent depression and self-harm. However, there are few longitudinal studies of this association, and those that exist have limitations. We aimed to investigate associations between perceived levels of academic pressure and subsequent depressive symptoms and self-harm from adolescence to early adulthood. Our hypothesis was that higher levels of academic pressure would be associated with higher levels of depressive symptoms and self-harm.

Methods In this longitudinal study, we used data from the Avon Longitudinal Study of Parents and Children (Avon, UK) that includes adolescents born in 1991–92. Our primary exposure of interest was academic pressure measured at age 15 years, using items from a school experiences questionnaire (total scores 0–9). Outcomes were depressive symptoms assessed with the Short Mood and Feelings Questionnaire at five timepoints between age 16 years and 22 years (total scores 0–26), and a self-harm questionnaire at four timepoints between age 16 years and 24 years. Analyses were linear (depressive symptoms) and logistic (self-harm in the previous year) multilevel models in samples with multiply imputed data, before and after adjustments.

Findings We included 4714 adolescents (2725 [57·8%] female, 1989 [42·2%] male). In fully adjusted models, a 1-point increase in academic pressure at age 15 years was associated with a 0·43 (95% CI 0·36–0·51) point increase in depressive symptoms. This association was largest when depressive symptoms were assessed at age 16 years (0·53, 0·42–0·64), but remained at age 22 years (0·35, 0·23–0·47). For self-harm, in fully adjusted models, each 1-point increase in academic pressure was associated with an 8% higher odds of self-harm (adjusted odds ratio 1·08, 1·01–1·16), with no differences over time.

Interpretation Our findings support the hypothesis that academic pressure is a potential modifiable risk factor for adolescent depressive symptoms, and possibly self-harm. Interventions to reduce academic pressure could be developed and evaluated.

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Introduction

Depression and self-harm are common mental health challenges that often begin during adolescence. Over the past 20–30 years, rates of adolescent depression and self-harm have risen in many countries, including the UK,[1,2] with prevalence higher among girls than boys.[1] Identifying modifiable risk factors for these mental health challenges is required to inform public health interventions aimed at preventing these issues.

Developing preventive interventions that can be delivered in schools is a priority. Most school-based interventions involve psychological approaches aimed at students. These approaches have generally been ineffective at reducing depressive symptoms, although findings are inconsistent.[3,4] An alternative approach is to modify the school environment—whole-school interventions focus on school climate, culture, and values, not just individual students. Whole-school approaches can

reduce adolescent depressive symptoms;[5] however, a better understanding of the types of intervention targets to include is needed.

Academic pressure has increased in the UK, to a larger extent among girls than boys, and during a similar time period to increases in adolescent mental health challenges.[6] Academic pressure can broadly be described as adolescents' perceptions of, and responses to, the external demands of their schoolwork and the responsibility, expectations, and importance of educational performance.[7,8] Pressure might be motivating for students, particularly at low levels; however, in surveys and previous patient and public involvement and engagement (PPIE),[9,10] adolescents cited academic pressure as a major source of stress and one of the biggest adverse influences on their mental health. Together with adolescents, we co-produced a definition of academic pressure based on their experiences,

Research in context

Evidence before this study

Rates of adolescent depression and self-harm have been rising in many countries, including the UK. Globally, academic pressure has been cited as a major source of stress for adolescents and one of the top adverse influences on their mental health. We searched MEDLINE, PsycInfo, and Google Scholar for articles published in English between database inception and Oct 7, 2025, describing the association between academic pressure and depression or self-harm in adolescents. We used the following search terms: "academic pressure*" OR "academic stress*" OR "school pressure*" OR "school stress*" OR "exam stress*" OR "test anxiety*" AND "adolescen*" OR "student*" AND "depression" OR "self-harm". A systematic review published in 2023 found evidence of associations between higher academic pressure or academic stress and increased risk of adolescent depression, anxiety, self-harm, and suicide. However, the quality of studies was rated as low. Most studies were cross-sectional and could not exclude reverse causation. We found five longitudinal studies with depressive symptoms as the outcome and no longitudinal studies of self-harm. The longitudinal studies of depressive symptoms had small samples or did not adjust for potentially important confounders, including pre-existing mental health challenges and school grades. No studies had follow-up periods into adulthood. Findings were also inconsistent, with one study finding evidence of an association in boys only and another study finding no difference in depressive symptoms at exam times compared with other term-times.

Added value of this study

In a large, longitudinal cohort in England, we observed that higher levels of academic pressure at age 15 years were associated with higher depressive symptoms at five follow-up timepoints between ages 16 years and 22 years, the association being strongest for depressive symptoms measured at age 16 years, but remained up to age 22 years. Associations between academic pressure and depressive symptoms could therefore persist from secondary school to early adulthood. We found evidence, albeit statistically weaker than for depressive symptoms, that higher levels of academic pressure at age 15 years were associated with self-harm at four follow-up timepoints between ages 16 years and 24 years. These findings indicate that academic pressure may be a pathway to the observed rise in mental health challenges in young people that warrants further investigation.

Implications of all the available evidence

Whole-school interventions to reduce academic pressure might improve adolescent mental health and could be developed and evaluated. Exam stress can be reduced by interventions that enhance social and emotional learning and relaxation skills. There is also evidence that reducing the number of high-stakes tests reduces academic stress. Interventions that promote mastery-approach goals might also reduce academic pressure. Long-term academic pressure could be modified through changes in policy. Families and carers could also reduce academic pressure and encourage physical activity, socialising, and sleep. Clinicians should also be aware of, and assess for, academic pressure, and consider strategies to address it.

theoretical assumptions, and existing studies. Consistent with theory and research, adolescents stated that important definitional components of academic pressure were fear of failure, concerns about the future, high workload and exams, parental and teacher expectations, and competition with peers for grades.

Several theories about the causes of depression support the hypothesis that academic pressure increases the risk of adolescent mental health challenges. The Educational Stressors Hypothesis—developed in the UK in the early 2000s—proposed that academic pressure had increased, contributing to rising rates of adolescent mental health challenges.[11] Since the 1990s, educational attainment has become more important for assessing school performance and is increasingly crucial for adolescents' future prospects.[11] According to the Educational Stressors Hypothesis, academic pressure can be conceptualised as external demands from school, home, and society. These demands increase the risk of subjective stress responses when demands are perceived as excessive or threatening, or students feel unable to cope. There is evidence that stress is a potential determinant of depression and other mental health challenges.[11] Other theories of causes of depression are also relevant; for example, competency-based theories of depression suggest that young people internalise feedback about their academic performance, which can affect self-perceptions.[12] Consistent with cognitive theories, this might lead to negative self-concepts and perfectionism, increasing risk of depression.[13]

A systematic review[14] found evidence of association between higher levels of academic pressure or academic stress (with these terms often used interchangeably) and adolescent depression, anxiety, self-harm, and suicide. However, the quality of studies was low, and most studies were cross-sectional. To our knowledge, there have been only four longitudinal studies of perceived academic pressure,[15,16] academic stress,[17] or test anxiety[18] and subsequent adolescent depressive symptoms. However, the studies had small samples (less than 767 participants)[15,16,19] or did not adjust for potentially important confounders, including pre-existing mental health challenges or school grades.[15–18] Findings were also inconsistent, with one study reporting evidence of an association in boys but not in girls.[16] Another longitudinal study used proximity to exam date as a measure of academic pressure or stress. There were no differences in adolescent depression, anxiety, or self-esteem at exam

times compared with other term-times.[19] However, this study was small and perceived academic pressure might be more important for adolescent mental health than proximity to exam date. There are also no studies with follow-up from adolescence to adulthood.

To our knowledge, there are no longitudinal studies of academic pressure and self-harm. Several studies report that rates of self-harm,[20] suicide attempt,[21,22] suicide,[23–26] and use of mental health services[27,28] are lower during months of school closure. However, these studies cannot exclude factors such as bullying or referrals by teachers to such services. These studies also used hospital admissions as the outcome and therefore could have been susceptible to selection bias.

We aimed to investigate longitudinal associations between perceived levels of academic pressure and subsequent depressive symptoms and self-harm from adolescence to early adulthood in a large birth cohort in England. Our hypothesis was that higher levels of academic pressure would be associated with higher levels of depressive symptoms and self-harm.

Methods

Study design and participants

In this longitudinal study, we used data from the Avon Longitudinal Study of Parents and Children (ALSPAC; appendix pp 7–8).[29] Pregnant women in Avon, UK, with expected delivery dates between April 1, 1991, and Dec 31, 1992, were invited to take part. The children included in this study were followed up to age 24 years. The initial number of pregnancies enrolled was 14 541 (199 multiple pregnancies), with 13 988 children alive at 1 year of age. From the multiple pregnancies, we selected the first born child. Ethics approval was obtained from ALSPAC Ethics and Law Committee and the Local Research Ethics Committees. Further details of the sample are reported in the appendix (p 4). We pre-registered our statistical analysis plan and changes are reported in the appendix (p 5).

This manuscript was informed by previous PPIE work with the Advice Leading to Public Health Advancement (ALPHA) group at DECIPHer research centre, Cardiff University, Cardiff, UK. ALPHA consists of approximately 20 young people aged 14–25 years, trained to advise on public health research. We conducted a 1·5-hour workshop with 20 young people (16 girls and four boys; other demographics are not reported for anonymity) to co-produce a definition of academic pressure.

Measures

Questions about school-related experiences were included in questionnaires completed by children and adolescents at several ages. We selected items from the questionnaires that were consistent with the definition of academic pressure that we co-produced with adolescents (appendix p 6). We used this approach because, to our knowledge, there are no standardised measures of academic pressure

available for longitudinal analyses in UK cohorts. We found items consistent with our definition of academic pressure at age 11, 14, and 15 years, when participants would have been attending school in 2002–03, 2005–06, and 2006–07. Items were different at each timepoint. We selected the items from the questionnaire used at age 15 years as our primary exposure as these were most consistent with the co-produced adolescents' definitions of academic pressure. Academic pressure is also likely to be highest at age 15 years, closest to high-pressured national exams in the UK (General Certificates of Secondary Education [GCSEs]). The questionnaire used at age 15 years included three items: "I worry a lot about getting my school work done", "I feel under a lot of pressure from home to do well at school", and "how important is it to you that you get 5 GCSEs at level A*–C (or equivalent) this summer"? Response options ranged from 1 (definitely agree) to 4 (definitely disagree) for the first two items, and from 1 (very important) to 4 (not at all important) for the third item. We analysed items at age 11 years and 14 years as secondary exposures (appendix p 6).

Response options were coded so that higher scores represented higher levels of academic pressure. We ran principal components analyses—a method of estimating common variance that reduces observed variables to a smaller set of composite variables. If there was evidence that items had the same underlying component, we used the sum of items to increase precision and power.

We selected potential confounders based on existing literature and theoretical assumptions, measured at the same time as the primary exposure or before the exposure: child's sex (reported by the mother when the study child was born), mother's and partner's education (1=Certificate of Secondary Education; 2=vocational; 3=O level; 4=A level; 5=Degree), mother's and partner's social class (0=manual work; 1=non-manual work), and maternal depressive symptoms (Edinburgh Postnatal Depression Scale[30]). We also included the conduct and hyperactivity subscales of the Strengths and Difficulties Questionnaire at age 11 years,[31] whether the child had been bullied (binary variable when children were aged 10 years), and autistic social traits (Social and Communication Disorders Checklist at age 7 years and 14 years).[32] School grades were attained through linkage to compulsory UK educational assessments from the National Pupil Database. In our main analyses, we adjusted for grades obtained from national Standardised Assessment Tests (SATs) at Key Stage 3 when children were aged 13–14 years. In analyses of exposures at age 11 years and 14 years, we adjusted for SAT grades at Key Stage 2 (age 10–11 years). At each age, tests included English, mathematics, and science assessments. We adjusted for a total points score in deciles (for data protection). We also adjusted for baseline depressive symptoms (measured at age 13 years for the main analyses with exposures at age 15 years, age 10 years for

exposures at age 11 years, and age 13 years for exposures at age 14 years). For analyses of self-harm, baseline self-harm data were not available; therefore, we adjusted for depressive symptoms.

Outcomes

Depressive symptoms were measured in participants aged 10–22 years, using adolescent reports on the 13-item Short Mood and Feelings Questionnaire (SMFQ; figure), which shows high sensitivity and specificity for clinical diagnoses.[33,34] For our main analyses at age 15 years, we used five subsequent SMFQ outcomes (age 16·5, 17·5, 18·5, 21·5, and 22·5 years). Repeated outcome measures allowed us to investigate whether associations persisted from adolescence to early adulthood, and varied according to age. We used continuous scores (0–26; higher scores indicating more severe symptoms). For exposures at age 11 years and 14 years, we used subsequent SMFQ measurements (figure).

Questions about self-harm (regardless of suicidal intent) in the past year were completed by adolescents at age 16·5, 17·5, 21, and 24 years (figure). At age 16·5, 21, and 24 years participants responded yes or no to whether they had harmed themselves on purpose in any way. At age 17·5, participants were asked how often they had self-harmed in the past year (1=never; 2=only once; 3=two to five times; 4=six to ten times; 5=more than ten times). We used these repeated measures as our outcome, creating a binary variable at age 17 years (never compared with other options).

Statistical analysis

Data were analysed using StataNow MP (version 19.5). We described characteristics of the sample using means (with SD) for continuous variables and frequencies (with percentages) for categorical variables, overall, and according to academic pressure exposure status (classified using tertiles, for descriptive purposes only).

We used linear multilevel models with growth curves for depressive symptoms and logistic multilevel models for self-harm. Individuals were clustered within timepoints, with a random intercept at the level of the individual. First, we ran a model with exposure, age, and quadratic age then incrementally added confounders—these models contained no interactions. We investigated whether associations varied according to age at which outcomes were assessed using an interaction between exposure and age, in fully adjusted models. If we found evidence that associations varied by age (based on the p value for the interaction term), we reported age-specific estimates. Age-specific estimates were derived from the model with the interaction, using the lincom command. We used the same method for secondary analyses of exposures at age 11 years and 14 years. For the main analyses of the age 15 years exposure only, we used the same methods to investigate whether associations differed by sex and, as post-hoc analyses, social class and baseline depressive symptoms. We tested interactions in fully adjusted models using composite exposures (not individual items) to increase statistical power and reduce multiple testing.

Due to large amounts of missing data, we included participants in main analyses if they had complete exposure data, and used multiple imputation with chained equations to replace missing data in confounders and outcomes. We assumed missingness was dependent on observed data (missing at random) and imputed 25 datasets. To predict missing data, we used all variables selected for analyses and auxiliary variables. We ran analyses across imputed datasets using the mi estimate command.[35]

We conducted four sensitivity analyses. First, we investigated individual items comprising the academic pressure composite scores analysed with the same methods used for the main analyses. Second, we used the cutoff score on the SMFQ as the outcome, which approximates clinical diagnoses (<12 and ≥12), analysed with multilevel logistic regression models.[28] Third, re-ran analyses of each exposure variable using participants with complete data on exposure, confounders, and outcomes. Lastly, we analysed self-harm with suicidal intent (never or yes) as an outcome (see appendix p 25 for methods), available at age 16·5, 21, and 24 years (figure). The measure of self-harm with suicidal intent referred to frequency over the lifetime, which is susceptible to recall bias and the direction of associations cannot be determined. We used a binary outcome of self-harm with suicidal intent from the last timepoint (ie, age 24 years), analysed with logistic regression models.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, writing of the report, or the decision to submit it for publication.

Figure: **Measurement of depressive symptoms and self-harm in the Avon Longitudinal Study of Parents and Children**

Measures of self-harm in the past year (blue) included self-harm regardless of suicidal intent. Measures of self-harm with suicidal intent (green) included those who had self-harmed whether, on any occasion, self-harm involved suicidal intent. Our main analyses used the measures of self-harm regardless of suicidal intent to increase statistical power. Questions about self-harm with suicidal intent referred to frequency over the lifetime, which is susceptible to recall bias and the direction of associations cannot be determined. We therefore analysed self-harm with suicidal intent as a sensitivity analysis only.

Results

We included 4714 adolescents (2725 [57·8%] female, 1989 [42·2%] male) with complete data on the exposure of academic pressure. ALSPAC participants were predominantly White, therefore data on ethnicity are not
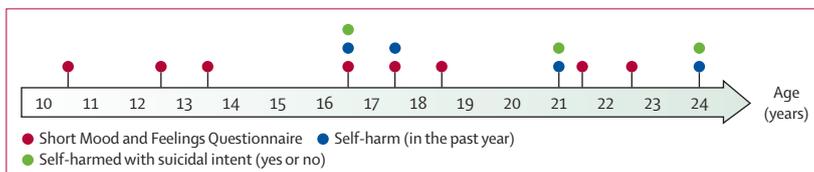
reported due to low numbers. At age 15 years, composite academic pressure scores ranged from 0 to 9 (mean 5·98 [SD 1·64]), with females (6·05 [1·64]) scoring higher than males (5·90 [1·64]). Characteristics of the overall study sample and according to levels of academic pressure are reported in table 1. The group with the highest level of academic pressure at age 15 years had a higher proportion of females (548 [63·4%] vs 973 [55·7%] in the group with the lowest level of academic pressure), a higher proportion of adolescents from higher socioeconomic backgrounds, and had higher Key Stage 3 grades and baseline depressive scores (table 1). The amount of missing data and differences between the full ALSPAC sample and those with complete exposure data are shown in the appendix (pp 7–8, 10–11).

Principal components analyses supported composite exposures. The Pearson's correlation coefficient between the academic pressure composite and depressive symptoms at age 16 was 0·20. Results for the age 15 years academic pressure exposure and depressive symptoms are shown in table 2. For each 1-point increase in academic pressure scores, depressive symptoms were 0·56 (95% CI 0·47–0·64) points higher in unadjusted models and 0·43 (0·36–0·51) points higher in fully adjusted models. We observed similar patterns for individual items except importance of GCSEs, for which there was no evidence of an association after adjustments (table 2). The magnitude of associations between academic pressure and depressive symptoms varied according to age ($p_{interaction}$=0·020). The association was largest at age 16 years, but remained up to age 22 years (table 3).

Results for the age 15 years academic pressure exposure and self-harm are shown in table 4. Each 1-point increase in academic pressure scores was associated with 16% higher odds of self-harm (odds ratio [OR] 1·16, 95% CI 1·08–1·25) in unadjusted models and 8% higher odds of self-harm (1·08, 1·01–1·16) in fully adjusted models. We observed similar patterns for individual items except importance of GCSEs, for which the odds of self-harm were lower per 1-point increase (unadjusted 0·59, 0·46–0·76; fully adjusted 0·67, 0·52–0·86). There was no evidence that the magnitude of associations with self-harm varied according to age ($p_{interaction}$=0·42). For self-harm with suicidal intent, we observed a similar pattern of associations with exposures measured at age 15 years (appendix pp 26–28).

There was no evidence that associations varied by sex (depressive symptoms: $p_{interaction}$=0·37; self-harm: $p_{interaction}$=0·93), social class (depressive symptoms: $p_{interaction}$=0·83; self-harm: $p_{interaction}$=0·58) or baseline depressive symptoms (depressive symptoms: $p_{interaction}$=0·62; self-harm: $p_{interaction}$=0·13). In sensitivity analyses of depressive symptoms using complete cases (appendix pp 12–13), associations were observed up to age 18 years but were no longer evident at age 21 years and 22 years (compared with the main findings with imputed missing data for which associations persisted to

	Sample analysed (n=4714)	Low academic pressure tertile* (n=1746)	Middle academic pressure tertile* (n=2103)	High academic pressure tertile* (n=865)
Child's sex				
Female	2725 (57·8%)	973 (55·7%)	1204 (57·3%)	548 (63·4%)
Male	1989 (42·2%)	773 (44·3%)	899 (42·7%)	317 (36·6%)
Mother's education				
Certificate of secondary education	547 (11·9%)	257 (15·3%)	205 (10·0%)	85 (10·0%)
Vocational qualification	342 (7·5%)	147 (8·7%)	140 (6·8%)	55 (6·5%)
Ordinary level (O level)	1541 (33·6%)	594 (35·3%)	688 (33·5%)	259 (30·6%)
Advanced level (A level)	1280 (27·9%)	426 (25·3%)	606 (29·5%)	248 (29·3%)
Degree	874 (19·1%)	259 (15·4%)	415 (20·2%)	200 (23·6%)
Father's education				
Certificate of secondary education	557 (14·6%)	253 (18·2%)	218 (12·6%)	86 (12·2%)
Vocational qualification	249 (6·5%)	113 (8·2%)	94 (5·4%)	42 (6·0%)
Ordinary level (O level)	839 (21·1%)	300 (21·6%)	407 (23·5%)	132 (18·7%)
Advanced level (A level)	1158 (30·3%)	398 (28·7%)	534 (30·1%)	226 (32·1%)
Degree	1019 (26·7%)	323 (23·3%)	477 (27·6%)	219 (31·1%)
Mother's social class				
Manual	563 (14·0%)	254 (17·6%)	228 (12·4%)	81 (10·7%)
Non-manual	3469 (86·0%)	1187 (82·4%)	1609 (87·6%)	673 (89·3%)
Father's social class				
Manual	1484 (34·9%)	622 (40·0%)	637 (33·4%)	225 (28·4%)
Non-manual	2771 (65·1%)	933 (60·0%)	1271 (66·6%)	567 (71·6%)
Child is a victim of bullying				
No	3042 (79·5%)	1092 (78·6%)	1428 (82·2%)	522 (74·5%)
Yes	785 (20·5%)	297 (21·4%)	309 (17·8%)	179 (25·5%)
Key Stage 3 school grade tertiles				
1 (lowest)	927 (27·0%)	457 (34·9%)	346 (22·9%)	124 (20·2%)
2	1052 (30·6%)	386 (29·5%)	479 (31·7%)	187 (30·4%)
3 (highest)	1456 (42·4%)	465 (35·6%)	687 (45·4%)	304 (49·4%)
Maternal depressive symptoms†	6·31 (4·54)	6·22 (4·51)	6·22 (4·50)	6·71 (4·72)
Social and Communication Disorders score at age 7 years‡	2·48 (3·23)	2·55 (3·45)	2·38 (3·07)	2·57 (3·16)
Hyperactivity at age 6 years§	3·10 (2·25)	3·14 (2·25)	3·00 (2·22)	3·24 (2·28)
Conduct problems at age 11 years¶	1·04 (1·28)	1·01 (1·27)	1·00 (1·24)	1·17 (1·40)
Depressive symptoms at age 13 years‖	4·84 (4·44)	4·15 (4·20)	4·86 (4·33)	6·16 (4·87)

Data are n (%) or mean (SD). Due to missing data, the number of participants in each category might not sum up to the number of participants with complete data on the exposure. *Academic pressure score ranges from 0–9 (low=0–5; middle=6–7; high=8–9). †Total possible score 0–30. ‡Total possible score 0–24. §Total possible score 0–10. ¶Total possible score 0–10. ‖Total possible score 0–26.

Table 1: Characteristics of sample analysed with complete data on the exposure (at age 15 years) overall and according to level of academic pressure

age 22 years, possibly due to increased statistical power in the multiply imputed sample). In analyses using the cutoff score on the SMFQ, results were unaltered (appendix pp 29–31).

For exposures measured at age 11 years and 14 years, there were some differences compared with main analyses of exposure measured at age 15 years (appendix pp 15–19). When the exposure was assessed at age 14 years, associations with depressive symptoms were no longer

	Model 1*	Model 2†	Model 3‡	Model 4§	Model 5¶
Composite score (adolescent-reported)	0·56 (0·47 to 0·64; p<0·0001)	0·54 (0·45 to 0·62; p<0·0001)	0·56 (0·48 to 0·64; p<0·0001)	0·56 (0·48 to 0·64; p<0·0001)	0·43 (0·36 to 0·51; p<0·0001)
Individual items					
I worry a lot about getting my school work done	1·08 (0·94 to 1·23; p<0·0001)	1·00 (0·85 to 1·14; p<0·0001)	0·98 (0·83 to 1·12; p<0·0001)	0·95 (0·81 to 1·09; p<0·0001)	0·72 (0·59 to 0·85; p<0·0001)
Importance of GCSEs	–0·46 (–0·77 to –0·15; p=0·0036)	–0·53 (–0·83 to –0·22; p=0·0074)	–0·43 (–0·74 to –0·13; p=0·0056)	–0·16 (–0·47 to –0·16; p=0·33)	0·043 (–0·26 to 0·53; p=0·78)
I feel under a lot of pressure from home to do well at school	0·62 (0·49 to 0·76; p<0·0001)	0·68 (0·54 to 0·81; p<0·0001)	0·72 (0·58 to 0·85; p<0·0001)	0·68 (0·55 to 0·81; p<0·0001)	0·50 (0·37 to 0·63; p<0·0001)

Data are coefficient (95% CI; p value). ADHD=attention-deficit hyperactivity disorder. GCSE=General Certificate of Secondary Education. *Model 1: exposure, age, and age². †Model 2: model 1 and sex. ‡Model 3: model 2, mother's and father's education and social class, and maternal depression. §Model 4: model 3, conduct problems, whether bullied, ADHD symptoms, autistic social traits, and Key Stage 3 grades. ¶Model 5: model 4 and baseline depressive symptoms. Models did not include an interaction between exposure and age.

Table 2: Multilevel linear regression models for the increase in depressive symptoms according to a 1-point increase in the academic pressure composite and individual items at age 15 years (n=4714; sample with multiply imputed confounders and outcomes)

	Age 16 years	Age 17 years	Age 18 years	Age 21 years	Age 22 years
Composite score (adolescent-reported)	0·53 (0·42–0·64)	0·41 (0·31–0·52)	0·42 (0·29–0·55)	0·45 (0·33–0·57)	0·35 (0·23–0·47)

Data are coefficient (95% CI). Age-specific estimates are adjusted for the same set of confounders as model 5 in table 2. p values are not presented because p values for stratum-specific estimates can be unreliable. Time-specific estimates are not presented for individual items.

Table 3: Linear regression models for the increase in depressive symptoms according to a 1-point increase in the academic pressure composite at each timepoint during follow-up (n=4714; sample with multiply imputed confounders and outcomes)

	Model 1*	Model 2†	Model 3‡	Model 4§	Model 5¶
Composite score (adolescent-reported)	1·16 (1·08–1·25; p<0·0001)	1·15 (1·06–1·23; p<0·0001)	1·16 (1·07–1·24; p<0·0001)	1·14 (1·06–1·23; p<0·0001)	1·08 (1·01–1·16; p=0·035)
Individual items					
I worry a lot about getting my school work done	1·41 (1·25–1·60; p<0·0001)	1·32 (1·17–1·50; p<0·0001)	1·31 (1·16–1·48; p<0·0001)	1·29 (1·14–1·45; p<0·0001)	1·16 (1·02–1·30; p=0·015)
Importance of GCSEs	0·59 (0·46–0·76; p<0·0001)	0·56 (0·43–0·72; p<0·0001)	0·58 (0·45–0·75; p<0·0001)	0·61 (0·47–0·79; p<0·0001)	0·67 (0·52–0·86; p=0·0016)
I feel under a lot of pressure from home to do well at school	1·25 (1·11–1·42; p<0·0001)	1·29 (1·14–1·46; p<0·0001)	1·31 (1·16–1·49; p<0·0001)	1·27 (1·12–1·44; p<0·0001)	1·18 (1·04–1·34; p=0·010)

Data are odds ratio (95% CI; p value). ADHD=attention-deficit hyperactivity disorder. GCSE=General Certificate of Secondary Education. *Model 1: exposure, age, and age². †Model 2: model 1 and sex. ‡Model 3: model 2, mother's and father's education and social class, and maternal depression. §Model 4: model 3, conduct problems, whether bullied, ADHD symptoms, autistic social traits, and Key Stage 3 grades. ¶Model 5: model 4 and baseline depressive symptoms. Models did not include an interaction between exposure and age.

Table 4: Multilevel logistic regression models for self-harm according to a 1-point increase in the academic pressure composite and individual items at age 15 years (n=4714; sample with multiply imputed confounders and outcomes)

observed at age 21 years and 22 years, but were present up to age 18 years (appendix p 19). For self-harm, there was weak evidence of an association with the adolescent academic pressure composite at age 11 years (appendix p 17), but no evidence at age 14 years (appendix p 18).

Discussion
We found strong evidence that adolescents who reported higher levels of academic pressure at age 15 years had higher depressive symptoms between age 16 years and 22 years. This association was largest when depressive symptoms were measured at age 16 years, but persisted to age 22 years. We also found evidence, albeit weaker than for depressive symptoms, that higher academic pressure at age 15 years was associated with self-harm between ages 16 years and 24 years. This association did not vary by timepoint. Our findings therefore suggest that associations between academic pressure and depressive symptoms and self-harm could persist into early adulthood. For academic pressure at age 11 years and 14 years, results for depressive symptoms were generally consistent with main findings at age 15 years. Replication with different measures of the exposure at multiple timepoints strengthens validity. However, for the exposure at age 14 years, there was no evidence of an association with self-harm, indicating that the association between academic pressure and self-harm was less consistent than the association with depression.

We extend on previous studies by using a large longitudinal sample, repeated outcome measures, follow-up to early adulthood, and adjustment for a range of confounders. Our study has several limitations. There is no standard measure of academic pressure available for longitudinal studies in UK cohorts. We therefore measured academic pressure using items from a school experiences questionnaire, combined into continuous scores (at age 11, 14, and 15 years). Selection of items was informed by theory and PPIE. However, our primary exposure measure at age 15 years contained only three items and was not validated. The measures also combined internal and external components of pressure (ie, pressure from home and school, as well as adolescents' worries). Items also differed across timepoints and we did not examine measurement invariance. These factors limit comparisons across ages but do not affect associations within timepoints, which remain valid. Items also did not include all components of academic pressure (eg, pressure from teachers). Not all individual items were positively associated with depression and self-harm (eg, importance of GCSEs), which could be relevant when interpreting findings and informing interventions. Academic pressure is also likely influenced by policy and society, as well as individuals, families, and schools. It was not possible, in our study, to investigate school-level variation in academic pressure.

In our primary investigation, adolescents were aged 15 years in 2006–07. We therefore investigated the period after academic pressure was hypothesised to have increased (ie, after educational, policy, and social changes during the 1990s).[11] However, we were unable to

investigate subsequent changes to educational policy (eg, GCSE reform) or the effects of the COVID-19 pandemic. Studies using more recent data are important given evidence that academic pressure has continued to rise.[6]

There is overlap between academic pressure and symptoms of depression and anxiety, particularly for items that referred to worries. It is possible that our measure was detecting some of the perceptual biases resulting from depression and anxiety, which could have made associations appear stronger than they actually are. However, correlations between academic pressure and depressive symptoms were small, indicating measures did not substantially overlap, and we adjusted for baseline measures of depressive symptoms.

Our measure of self-harm included suicidal and non-suicidal self-harm, and associations might differ for these behaviours. However, findings for suicide attempt were consistent with our main findings for self-harm. Self-harm was assessed with self-reports of the past year, which would have eliminated observer bias but might introduce recall bias. Depressive symptoms were also assessed with self-reports, not clinical diagnoses. However, the SMFQ has high discriminant validity for depression meeting diagnostic criteria. Common method bias might also have occurred but should have been reduced by the longitudinal design.

Our study was observational, therefore we cannot exclude the possibility of residual confounding. Factors such as perfectionism, personality, family mental health challenges, self-esteem, or vulnerability to stress might increase academic pressure and youth mental health challenges. Although vulnerability to stress might be a factor, reducing pressure within the school environment could still reduce mental health challenges. As with most longitudinal studies, attrition is a limitation and might have introduced selection bias. However, we used multiple imputation to replace missing data in confounders and outcomes, which did not substantially alter our findings. As there was also a large amount of missing data in the exposure, our imputed sample differed from the sample initially recruited. However, in ALSPAC data, there is evidence that within-cohort associations remain valid even when missing data are systematic.[36] We used variables associated with missing data to strengthen the missing data at random assumption. However, we cannot rule out the possibility that data were missing not at random, which could lead to biases not addressed by multiple imputation. We did not correct for multiple comparisons because these tests can be conservative, increasing the probability of type II errors and reducing statistical power.[37] However, we prespecified primary exposure and outcomes, with a priori hypotheses, and interpreted the strength of statistical evidence. Data from ALSPAC are not representative of the general population; participants were predominantly White with high levels of education. Finally, effect sizes were small. However, small effect sizes can be of clinical and public health importance when exposures

and outcomes are common, and the population of interest is large. Depression and self-harm are multifactorial, and prevention is likely to involve the reduction of multiple risk factors with relatively small effect sizes.

The association between academic pressure and mental health is likely to involve biopsychosocial mechanisms. Academic pressure might lead to stress, social isolation, perfectionism, reduced self-esteem and self-worth, physical inactivity, and sleep problems. At the level of the school environment, academic pressure could lead to reduced school connectedness and a more negative school climate, and affect achievement goals.

Our findings suggest that higher levels of academic pressure during secondary school increase the risk of adolescent depressive symptoms and self-harm, and that this association could persist to early adulthood. Whole-school interventions to reduce academic pressure might improve adolescent mental health and could be developed and evaluated. These interventions could include components that reduce or delay assessments and tests and enhance social and emotional learning and relaxation skills. Interventions that promote mastery-approach goals (the motivation to develop competence and task or subject understanding, and to learn as much as possible) might also reduce academic pressure.[38] Long-term academic pressure could be modified through changes in policy. Families and carers could reduce academic pressure and encourage physical activity, socialising, and sleep. Clinicians should also be aware of, and assess for, academic pressure, and consider strategies to address it.

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