Title: Investigating the impact of the COVID-19 pandemic on the psychological wellbeing and cognitive function of older adolescents

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Adolescent wellbeing and cognitive function during the pandemic

Abstract

Background The COVID-19 pandemic coincides with growing concern regarding the mental health of young people. Older adolescents have faced a particular set of pandemic-related challenges and demonstrate heightened vulnerability to affective disorders (particularly anxiety). Anxiety symptoms are associated with a range of cognitive difficulties. As such, older adolescents may be susceptible to pandemic-related declines in both wellbeing and cognitive function.

Methods At three timepoints, independent samples of young people aged 16-18 years (N = 607, 242, 618 respectively) completed an online survey. Data collection coincided with periods of lockdown (timepoints 1 and 3) and young people returning to school (timepoint 2). The survey assessed subjective impacts of the pandemic on overall wellbeing, anxiety and cognitive function.

Results Findings demonstrated the detrimental impact of the COVID-19 pandemic on older adolescents' psychological wellbeing. Crucially, heightened anxiety was associated with self-identified cognitive difficulties, and this pattern of association was sustained in subsequent independent samples. Furthermore, the nature and extent of these difficulties were predictive of particular pandemic-related concerns in this age group.

Conclusions Older adolescents' experiences of the pandemic are characterised by a clear pattern of association between anxiety and self-identified cognitive difficulties, which was sustained over time. Implications are discussed with reference to both future research and intervention.

Abbreviations: Exploratory Factor Analysis (EFA); Confirmatory Factor Analysis (CFA)

Keywords: anxiety, cognitive function, wellbeing, older adolescent, adolescence, pandemic

Adolescent wellbeing and cognitive function during the pandemic

The COVID-19 pandemic has resulted in significant and sustained disruption to the education, social interaction and daily routines of young people across the globe. While the SARS-CoV-2 virus poses limited risk to adolescents' physical health (Bhopal, Bagaria, & Bhopal, 2020), there is considerable concern regarding the impact of the pandemic on young peoples' mental health and wellbeing (Crawley et al., 2020; Orben et al., 2020). Social distancing measures, while important for a range of reasons, introduce significant "social risk factors" for poor mental health in young people (Dewa et al., 2021, p.667), risks which were highlighted early on in the pandemic (Holmes et al., 2020). Mental health difficulties typically emerge in adolescence (Merikangas et al., 2010) and psychosocial experiences are fundamental in shaping young peoples' risk (and resilience) to these difficulties (e.g., Paus, Keshavan, & Giedd, 2008; Rapee et al., 2019).

The pandemic coincides with rising rates of prevalence of affective disorders among adolescents (e.g., Collishaw, 2015) with anxiety the most common of these difficulties (Polanczyk, Salum, Sugaya, Caye, & Rohde, 2015). While anxiety and worry are typical (and adaptive) responses to environmental stressors (Eysenck & Calvo, 1992), persistent elevated levels of anxiety are associated with significant impairment in functioning (Baxter et al., 2014). In the cognitive domain, anxiety-related difficulties are well-established (see Moran, 2016 for a review). Difficulties with concentration and greater distractibility are common in anxious individuals (Airaksinen et al., 2005), and anxiety-related detriments in cognitive function have been reported across a range of domains including reading comprehension (Calvo, Ramos, & Estevez, 1992), problem-solving ability (Ashcraft & Kirk, 2001), and performance on standardised assessments of intelligence (see Eysenck, Derakshan, Santos, & Calvo, 2007 for a review). These cognitive difficulties may well underpin the increased likelihood of academic underachievement in anxious young people (e.g, Kessler, Saunders, & Stang, 1995.; Van Ameringen, Mancini, & Farvolden, 2003). The pandemic has been marked by prolonged educational disruption and sustained uncertainty regarding both its course and the

Adolescent wellbeing and cognitive function during the pandemic

measures required to contain it. Investigating the extent to which these challenges are associated with detrimental impacts on older adolescents' wellbeing and cognitive function will inform our understanding of anxiety-related cognitive difficulties in this age group, as well as supporting targeted intervention for vulnerable young people.

While several studies have sought to understand the impact of COVID-19 infection on individuals' cognitive functioning (e.g., Becker et al., 2021; Daroische, Hemminghyth, Eilertsen, Breivte, & Chwischczuk, 2021), to the authors' knowledge only one previous study has investigated the implications of social distancing measures for cognitive functioning (Ingram, Hand, & Maciejewski, 2021). This study provides initial support for an association between social distancing measures (in this case, enforced social isolation during a period of lockdown) and reduced cognitive performance in an adult sample (aged 18-72 years). Although prior research on the relationship between social isolation and cognitive function has typically focused on older adults (Evans et al., 2019), studies with younger participants have demonstrated that even perceived social exclusion can impair cognitive function (Baumeister, DeWall, Ciarocco & Twenge, 2005) and self-regulation (Twenge, Baumeister, Tice, & Stucke, 2001). While there is therefore initial support for an association between social isolation and cognitive impairment during the pandemic (Ingram et al., 2021), this has yet to be examined in an adolescent cohort. Cognitive difficulties are associated with both social isolation and anxiety, yet the particular impacts of the pandemic on young people's cognitive functioning have yet to be examined.

Older adolescents have faced a particular set of challenges during the pandemic and prolonged educational disruption, cancellation of examinations, and uncertainty regarding jobs and university places may have been particularly anxiety-provoking. There is growing recognition of the vulnerability of older adolescents to mental health difficulties. For example, in the United Kingdom (UK), rising rates of prevalence of emotional difficulties (most

Adolescent wellbeing and cognitive function during the pandemic

commonly, anxiety) have been reported in young people (particularly girls) aged 17-19 years (Sadler et al., 2018). Previous work supports disproportionate negative effects of the pandemic on the wellbeing of older adolescents/young adults, as well as girls and individuals with pre-existing mental health difficulties (e.g., Fancourt, Steptoe, & Bu, 2020; Pierce et al., 2020; Racine et al., 2020; Smirni, Lavanco, & Smirni, 2020). Understanding the nature and extent of the impact of the pandemic on older adolescents, both in terms of their psychological wellbeing and cognitive function, is a priority given acknowledged vulnerability within this age group.

The current study therefore investigated the impact of the COVID-19 pandemic on older adolescents' psychological wellbeing and cognitive function during periods of school closure (during lockdown) and on returning to school (post-lockdown). The aims were: to determine the particular impact of the pandemic on subjective wellbeing and anxiety in older adolescents and crucially, to move beyond previous work to assess the extent to which any detrimental wellbeing impacts were associated with self-identified cognitive difficulties (relating to attention, planning and memory) in this age group.

Adolescent wellbeing and cognitive function during the pandemic

Method

Participants

Participants aged 16-18 years were recruited through email contact with secondary schools and sixth form colleges across the UK¹. Participating settings shared a study flyer with eligible students, which included a weblink with detailed study information. The study was open to all young people, and not limited to those who had experienced detrimental effects of the pandemic. Informed consent was obtained from all participants prior to survey completion. Full ethical approval for the study was provided by the School of Psychological Science's Human Research Ethics Committee at the University of Bristol (ref: 104404). Participants who consented were entered into a prize draw for an e-voucher of £100.

Data were collected at three timepoints from independent samples of young people. The first survey was conducted in June and July 2020 when UK secondary schools and colleges were closed as part of national lockdown measures (timepoint 1). The second survey took place in September 2020 when students returned to school after the summer break (timepoint 2); and the third survey was conducted in February and March 2021 during another period of school closures (timepoint 3). A detailed description of relevant social distancing measures in place during this 12-month period is provided in the online supplement (S1.1).

Measures

The study utilised a cross-sectional survey design. Survey items covered several aspects of young peoples' functioning including overall wellbeing, anxiety and worries, cognitive function, and school engagement (S1.2). The survey was divided into subsets of items, each associated with one of the above domains. All items were rated on a 4-point Likert scale (never, some of the time, most of the time, always), unless otherwise specified. Demographic data including

¹ Schools and colleges in England, Wales and Scotland were approached, but the majority of participants were from England.

Adolescent wellbeing and cognitive function during the pandemic

age, gender, year group (Year 11, 12 or 13 corresponding to the final three years of formal schooling), country of domicile and current school attendance were also captured. Survey items remained consistent across timepoints, except where specified. Subtle changes to the wording of some items were made to account for the changing context across timepoints (i.e., learning from home or returning to school).

Wellbeing

The first survey subsection focused on young peoples' overall wellbeing and included items relating to mood and broader aspects of wellbeing (social interaction, sleep and exercise). Participants were asked to rate their overall level of wellbeing on a visual analogue scale from 0 to 10. They were then asked to report any changes in their wellbeing on account of the pandemic (reporting either an increase, decrease or no change in wellbeing). Participants reporting decreased wellbeing were asked to identify the main contributor to this change from a prespecified list, but could specify their own contributors where applicable. The series of items which followed required participants to rate different aspects of their mood (e.g., "I feel lonely", "I feel positive about my future"). Participants were also asked to report on the quality of their sleep, social interaction and physical activity (providing a rating in each case of "too much", "too little" or the "right amount" for them).

Anxiety and worries

Participants were first asked to rate how anxious they had been feeling over the past week using a visual analogue scale from 0 to 10, and to report any changes in anxiety on account of the pandemic (reporting either an increase, decrease or no change in anxiety). Follow-up questions sought to identify contributors to anxiety and domains of functioning most affected. In both cases, participants selected and then ranked items from a prespecified list, but could add their own items where applicable. Participants were then presented with a list of possible concerns (e.g., concerns about the future, job prospects, schoolwork) and asked to select those that were applicable. At timepoint 1, participants responded yes or no to identify the

Adolescent wellbeing and cognitive function during the pandemic

presence or absence of these concerns. At timepoints 2 and 3, participants were asked to respond to each concern using a 4-point Likert scale (never, some of the time, most of the time, always).

Participants also completed the trait scale of the State-Trait Inventory of Cognitive and Somatic Anxiety (STICSA; Ree, MacLeod, French & Locke, 2000), which assesses an individual's predisposition towards anxiety. The 21-item STICSA measure produces a total trait anxiety score and subscale scores for cognitive and somatic dimensions of anxiety. The scale demonstrated good reliability, as measured by Cronbach's alpha in all three samples ($\alpha = .92$; $\alpha = .92$; $\alpha = .91$ respectively). Surveys 2 and 3 also included the 7-item Pandemic Anxiety Scale (McElroy et al., 2020), a newly developed measure of pandemic-related worry that assesses anxieties relating to COVID-19 infection (e.g., "I am worried that I will catch COVID-19") and consequences of the pandemic (e.g., "I am worried about missing school"). The scale demonstrated acceptable reliability in both samples ($\alpha = .69$; $\alpha = .67$).

Cognitive function

The penultimate subset of survey items asked participants to rate their level of functioning across a range of cognitive domains including attention, planning and memory (e.g., "My mind wanders when I should be concentrating", "I am able to prioritise my to do list"). No link was made in this section to anxiety or wellbeing.

School engagement

The final survey items focused on school engagement and combined mood-related and cognitive aspects of young peoples' learning during the pandemic. Participants rated how the pandemic had affected their ability to complete coursework, and their feelings about their learning, as well as reporting any difficulties with distance learning or access to online materials. At timepoint 1, participants were additionally asked to report how regularly they had contact with their teachers.

Results

Final samples for each study were as follows: 607 participants (392 girls, $M = 17.55$ years) at timepoint 1; 242 participants (172 girls, $M = 17.15$ years) at timepoint 2; and 618 participants (465 girls, $M = 17.24$ years) at timepoint 3. Sample characteristics and all preliminary screening measures are reported in full (see S1.3). For brevity, given the scope of the study, results relating to the main study aims are reported below, and contextual information and supplementary analyses are included in the online supplement.

Preliminary analyses

Mean wellbeing and anxiety scores for girls and boys are presented in Table 1. Preliminary analyses at timepoint 1 identified significant positive correlations between the state (VAS) and trait (STICSA) anxiety measures ($r = .634$, $p < .001$) and negative correlations between wellbeing and state and trait anxiety measures at timepoint 1 ($r = -.549$, $p < .001$; $r = -.550$, $p < .001$), which were consistent across timepoints (S1.4). Gender differences in wellbeing were consistent across timepoints with girls reporting significantly lower wellbeing and higher anxiety scores than boys (S1.5).

Adolescent wellbeing and cognitive function during the pandemic

Table 1. Wellbeing and anxiety scores by gender across timepoints.

	Study 1		Study 2		Study 3	
	M	SD	M	SD	M	SD
Trait anxiety (STICSA total)*						
Female	45.50	11.80	48.24	11.53	48.48	11.16
Male	38.20	10.01	36.37	10.42	39.80	11.09
State anxiety (VAS)						
Female	5.43	2.33	6.10	2.34	5.91	2.15
Male	4.17	2.30	4.55	2.85	5.15	2.40
Overall wellbeing (VAS)						
Female	5.32	1.85	5.37	1.94	4.75	1.92
Male	6.18	1.84	6.08	1.95	5.58	1.94

*A score of 43 on this trait scale denotes “probable cases of clinical anxiety” and a threshold score of 40 is applied for “possible cases of clinical anxiety” (Roberts, Hart, & Eastwood, 2016).

Self-reported wellbeing during the pandemic

Participants reported the impact of the pandemic on their overall wellbeing as either an increase, no change or decrease in wellbeing. At all three timepoints, the majority of young people reported a decrease in wellbeing (62%, 58%, 76% respectively). Reduced social contact, anxiety or worries, and uncertainty about the future were cited as predominant contributors to this decline and reports of low mood and negativity about the future were common across timepoints, as were feelings of loneliness and difficulty coping. Participants reported broader impacts of the pandemic on their wellbeing including reduced physical activity, sleep disturbances and limited social interaction (S2.1). Supplementary analyses (S2.2) examined gender differences in reporting of pandemic-related wellbeing impacts and group differences in overall wellbeing scores, both of which became more marked over time with girls more likely to report declines in wellbeing.

Adolescent wellbeing and cognitive function during the pandemic

Self-reported anxiety during the pandemic

Over the three timepoints, an increasing majority of respondents reported increased anxiety on account of the pandemic (58%, 63%, 71% respectively). Supplementary analyses (S3.1) demonstrated consistent differences in overall anxiety scores for individuals reporting different impacts of the pandemic and identified predictors of increased anxiety reporting (as compared to reporting of no change in anxiety). Participants were asked to attribute their anxiety (where present) to one main contributor and proportional ranked responses were examined to identify predominant contributors (S3.2). Uncertainty about the future was cited as a predominant contributor to anxiety at all three timepoints. Other key contributors to anxiety varied across timepoints. Along with future uncertainty, limited social contact was a predominant contributor to anxiety during periods of lockdown. However, as young people returned to school, the role of examination disruption and school concerns became more prominent (and remained so at timepoint 3).

Participants' identified the nature of their concerns relating to the pandemic at each timepoint (S3.3). The most commonly reported worry at all timepoints (for both boys and girls) was concern about the future. Overall, girls were more likely to express all concerns at timepoint 1 and reported higher frequency of concerns than boys at timepoints 2 and 3. Girls were more consistent than boys in their reporting of concerns and after uncertainty about the future, were most likely to worry about schoolwork and their psychological wellbeing (a concern that became more common for boys at timepoint 3). During periods of lockdown (timepoints 1 and 3), concerns regarding schoolwork were also common among boys, but on returning to school (timepoint 2), worries about the health of others and job prospects became more prominent.

Examining associations between anxiety and cognitive difficulties

While the preceding subsections have focused on reported wellbeing impacts of the pandemic for older adolescents, subsequent analyses sought to identify pandemic-related impacts on cognitive functioning. In addition to contributors to anxiety during the pandemic (reported

Adolescent wellbeing and cognitive function during the pandemic

above), participants were asked to identify areas of their functioning most affected by anxiety. As before, proportional ranked responses were examined to identify the predominant effects of anxiety (S4.1). At timepoints 1 and 2, respondents most commonly reported effects of anxiety on their mood, motivation, and focus and concentration. At timepoint 3, overall wellbeing was most commonly affected, along with motivation, mood, and focus and concentration.

In order to elucidate these associations between anxiety and self-identified cognitive difficulties relating to motivation and focus and concentration, survey items (from timepoint 1 including items from the wellbeing, anxiety, and cognitive function subsets²) were entered into an exploratory factor analysis (EFA). Any respondent who omitted more than 2 of the 22 survey items included in the EFA were dropped from subsequent analyses, which reduced the sample to 606 respondents³. The use of EFA in this instance was supported by a KMO value above 0.9 and highly significant Bartlett's test ($p < .001$). Visual inspection of the scree plot (following an initial EFA without rotation) suggested a three factor solution, which was confirmed with a subsequent parallel analysis (Patil, Singh, Mishra, & Donovan, 2017). The final EFA, estimated using Principal Axis Factoring and Direct Oblimin rotation, produced three factors (with eigenvalues > 1), which explained a total of 47% of the variance in responses. 21 of the 22 items had sufficiently high loadings ($> .4$) to be included in the model (see Table 2). Item loadings supported characterisation of factors 1 and 3 as cognitive factors describing skills relating to prioritisation and planning, and focus and concentration respectively, while factor 2 describes participant mood. Factor scores were computed for each respondent using the regression method and these were used in subsequent correlation and regression analyses.

² Schoolwork-related items were excluded on account of high levels of missing data (Year 13 respondents had no schoolwork set at timepoint 1). Furthermore, an initial factor analysis with no rotation identified three items with multiple low-order correlations ($r < +/- .30$). These items (relating to sleep, socialising and exercise) were excluded from the EFA (Yong & Pearce, 2013).

³ Any remaining missing values were imputed using mean substitution for that subscale to allow all cases to be assigned factor scores and included in subsequent regression analyses.

Adolescent wellbeing and cognitive function during the pandemic

Table 2. Factor loadings after rotation (EFA, timepoint 1).

	Factor 1	Factor 2	Factor 3
1) Prioritisation and planning			
I am able to structure my day	0.794		
I feel motivated	0.685		
I feel good about my daily routine	0.653		
I am able to prioritise my to do list	0.641		
I am able to get things done	0.626		
I am lacking motivation	-0.545		
I am able to focus when I need to	0.483		
I can complete important tasks within the time allowed	0.437		
2) Mood			
I have been feeling worried or anxious		0.780	
I am coping well		-0.722	
I feel overwhelmed		0.652	
I feel calm		-0.612	
I have to distract myself from negative thoughts		0.600	
I feel lonely		0.444	
I feel upbeat		-0.442	
I feel positive about my future		-0.412	
3) Focus and concentration			
I struggle to focus on one task at a time			0.769
My mind wanders when I should be concentrating			0.608
I struggle to work on one task at a time			0.598
I feel overwhelmed by the amount I have to do in a day			0.442
I struggle to remember important things			0.418
Eigenvalues	7.96	1.94	1.43
% of variance	35.49	6.83	4.41

Adolescent wellbeing and cognitive function during the pandemic

Though distinguishable, these three factors were significantly correlated such that increased difficulties with mood (factor 2) were associated with reduced ability to plan and prioritise (factor 1; $r = -.572$, $n = 606$, $p > .001$) and greater difficulty with focus and concentration (factor 3; $r = .520$, $n = 606$, $p > .001$)⁴. A multiple regression analysis established the association between these mood and cognitive difficulties, and trait anxiety scores. Together these factors explained 56% of the variance in trait anxiety scores ($F(3, 602) = 262.171$, $p < .001$, $R^2 = .564$). Factors 2 and 3 contributed statistically significantly to the model, $p < .001$, while Factor 1 did not ($p = .503$).

A subsequent series of logistic regression analyses examined the extent to which these mood and cognitive difficulties predicted the nature of respondents' reported concerns at timepoint 1 (see Figure 1, full model statistics reported in S4.2). Mood difficulties were predictive of all but one of the worries young people reported, but the strength of their predictive value varied across concerns. For example, mood difficulties were most predictive of concerns about respondents' psychological wellbeing and the future. Difficulties with focus and concentration and mood were predictive of worries about schoolwork, although the former was the stronger predictor of this concern. Planning and prioritisation was not a significant predictor of any concerns at this timepoint.

⁴ Positive scores on factor 1 represent an increased ability to prioritise and plan, whereas positive scores on factor 3 represent increased difficulty with focus and concentration.

Adolescent wellbeing and cognitive function during the pandemic

Figure 1. Logistic regression results demonstrating likelihood of worries as predicted by EFA factor scores (timepoint 1).

Clarifying associations between anxiety and cognitive difficulties

Subsequent confirmatory factor analyses (CFAs) sought to clarify the extent to which the initial EFA factor structure was representative of subsequent participants' reporting of anxiety and cognitive difficulties at timepoints 2 and 3. The normality of item distributions was assessed in each case, and no issues were identified with regard to either skew or kurtosis (Kline, 2005). CFAs using maximum likelihood estimation were computed in AMOS (Version 27.0; Arbuckle, 2021) using the EFA factor structure and survey data from timepoints 2 and 3. Any respondent who omitted more than 2 of the 21 survey items included in this analysis were excluded⁵ reducing the samples to 241 respondents and 617 respondents respectively. Multivariate

⁵ Any remaining missing values (of which there were few) were imputed using mean substitution for that subscale.

Adolescent wellbeing and cognitive function during the pandemic

outliers⁶ were removed prior to analysis and this produced a final sample of 234 respondents for timepoint 2 and 609 participants for timepoint 3. Table 3 reports the model fit indices from these analyses. Data from both timepoints cross-validated the 3-factor structure identified in the EFA, with favourable fit (Brown, 2006; Kline, 2005), and strong factor loadings (Figure 2), which were significant ($p < .001$) for all indicator variables.

Table 3. Model Fit Indices (CFA, timepoints 2 and 3).

CFA Model	X^2 (df)	p	CMIN/DF	TLI	CFI	RMSEA (90% CI)	SRMR
Timepoint 2 (N = 234)							
3-factor model	397.93 (185)	**	2.15	.90	.91	.070 [.061, .080]	.0567
Timepoint 3 (N = 609)							
3-factor model	692.00 (186)	**	3.72	.91	.92	.067 [.062, .072]	.0569
Abbreviations: CMIN/DF, chi-square fit statistics/degree of freedom; TLI, Tucker-Lewis index; CFI, comparative fit index; RMSEA, root mean square of approximation; SRMR, standardized root mean square residual.							

⁶ Mahalanobis Distance scores (computed for the 21 survey items included in the CFA) were used to identify multivariate outliers, and these cases were removed from subsequent analyses.

Adolescent wellbeing and cognitive function during the pandemic

Figure 2. Confirmatory Factor Analysis Path Diagram (timepoint 3)

As before, regression scores were computed to enable subsequent regression analyses. Using data from timepoint 3, a follow-up multiple regression analysis demonstrated that together, the three (CFA) factors explained 59% of the variance in trait anxiety ($F(3, 605) = 284.204, p < .001, R^2 = .585$) and all three factors added statistically significantly to the model, $p < .001$. At timepoint 2, the three-factor structure resulted in significant

Adolescent wellbeing and cognitive function during the pandemic

multicollinearity between factors 1 and 3 (the cognitive factors), an issue which affected the accuracy of subsequent regression analyses for timepoint 2⁷.

A subsequent series of ordinal regression analyses (S4.4) were conducted to examine the extent to which mood and cognitive difficulties predicted the nature and extent of respondents' concerns at timepoint 3. Two models (relating to worries about psychological wellbeing, and schoolwork) failed to meet all necessary assumptions for ordinal regression and results for these models should therefore be interpreted with caution. As at timepoint 1, increased mood difficulties (factor 2) predicted all concerns, but with varying predictive strength. The ability to plan and prioritise (factor 1) predicted the likelihood of concerns regarding the health of others, difficulties with focus and concentration (factor 3) predicted concerns regarding jobs and both factor 1 and 3 predicted worries about schoolwork (although in all cases, mood difficulties were the stronger predictor).

⁷ S4.3 includes model fit indices for a 2-factor solution for timepoint 2, which reduced multicollinearity issues, along with subsequent regression analyses.

Discussion

In addition to demonstrating a sustained negative impact of the pandemic on older adolescents' overall wellbeing, the findings of this study support a clear association between anxiety and self-identified cognitive difficulties in characterising older adolescents' experiences of the pandemic. In relation to the first of these main findings, the majority of older adolescents reported pandemic-related declines in their overall wellbeing at all three timepoints, suggesting that detrimental effects of the pandemic were not confined to periods of lockdown. These declines in wellbeing were consistently attributed to reduced social contact, anxiety/worries and uncertainty about the future. Limited social interaction (Magson et al., 2020), reported at all three timepoints, will have compromised access to peer support (Laible, 2007), and this may have exacerbated the effects of uncertainty and worry on young peoples' wellbeing.

An increasing majority of older adolescents reported increases in pandemic-related anxiety across the three timepoints, in line with previous work demonstrating disproportionate effects of the pandemic on the mental health and wellbeing of older adolescents and young adults (e.g., Fancourt et al., 2020; Smirni et al., 2020). Young people consistently attributed their anxiety to feelings of uncertainty about the future. Other key contributors to anxiety varied over time, likely reflecting shifts in the nature of restrictions: concerns regarding limited social interaction and disruption to routines were present during periods of lockdown, but were replaced by worries about returning to school and examination arrangements when schools reopened. Rising rates of prevalence of emotional difficulties in older adolescents pre-date the pandemic (Sadler et al., 2018). However, incidence of affective symptoms in this age group has continued to increase in recent months (NHS Digital, 2020) as has demand for specialist intervention with both referrals and waiting times at a record high within the UK (NHS Digital,

Adolescent wellbeing and cognitive function during the pandemic

2021). Our data suggest a disproportionate effect of the pandemic on the wellbeing of girls. Girls were more likely to report pandemic-related increases in anxiety, and had consistently higher state anxiety scores and lower overall wellbeing scores than boys. Although these findings likely reflect a pre-existing bias in girls' susceptibility to emotional difficulties, girls' reports of detrimental effects on their wellbeing were consistent across study measures and timepoints. Furthermore, these findings align with other COVID-19-impact studies, which demonstrate particular detrimental effects of the pandemic on the wellbeing of young women (e.g., Racine et al., 2021). Anxiety symptoms that emerge in adolescence tend to be more severe and enduring (Essau, Lewinsohn, Olaya & Seeley, 2014). As such, it is important that the extent of the challenges faced by this age group are recognised, and targeted intervention put in place to identify and support those most affected.

This study is novel in its identification of self-identified cognitive difficulties as part of the broader impact of the pandemic on older adolescents' psychological functioning. Increasing mood difficulties (reflecting both anxiety and low mood) were associated with difficulties with focus and concentration and reduced ability to plan and prioritise. This pattern of association emerged early on in the pandemic and was sustained over subsequent timepoints, including when young people returned to school and social distancing measures and pressures associated with distance learning eased. This suggests that cognitive difficulties in this age group may be reflective of sustained overall impacts of the pandemic, as opposed to being linked to particular social distancing protocols (e.g., lockdowns; Ingram et al., 2021). A key aim for future work will be to ascertain the extent to which any pandemic-related cognitive difficulties are sustained as social distancing measures ease, and if transient, whether these difficulties may return during subsequent periods of stress relating to either the pandemic or other life events. This study demonstrated patterns of association between the nature and extent of mood and cognitive difficulties, and the content of participants' worries. While mood difficulties were a consistent predictor (though variable in predictive strength) of a range of

Adolescent wellbeing and cognitive function during the pandemic

pandemic-related worries, increasing cognitive difficulties (particularly those relating to focus and concentration) were linked with particular concerns, for example those regarding schoolwork. A key question, that cannot be answered with these data, is the extent to which subjective reports of cognitive difficulties were accompanied by objective, measurable declines in cognitive performance (Soto et al., 2020). To our knowledge, no study has examined the extent to which mental health impacts of the pandemic are associated with declines in young peoples' cognitive function, but the findings of Ingram and colleagues (2021) support a relationship between enforced social isolation and declines in cognitive functioning in adults. The current findings identify a role for cognitive difficulties in shaping young peoples' experiences of the pandemic, and suggest that along with gender-specific vulnerability, cognitive difficulties may form part of a profile of individual risk (or resilience) to stress in this age group.

These findings are limited in certain respects. The lack of baseline data prevents us from establishing whether reports of increased anxiety reflect a "true increase" from pre-pandemic levels, but nonetheless, our findings demonstrate clear, sustained patterns of subjective declines in wellbeing and self-identified cognitive difficulties over the course of the pandemic. Although tempting to attribute these findings to longitudinal increases in symptoms, our data do not allow for this interpretation. Rather, independent samples of young people reported these declines at three separate timepoints. While our samples are not necessarily representative, care was taken to approach schools and colleges across the UK in order to capture the variety of experiences of older adolescents. We did not collect sociodemographic data as part of our survey and therefore cannot draw any conclusions regarding particular effects of the pandemic for those in different socioeconomic groups. High levels of trait anxiety (Roberts et al., 2016) within our study samples suggest there could be recruitment bias such that those individuals more prone to anxiety were more likely to respond to our surveys. However, given the acknowledged vulnerability of older adolescents (particularly girls) to

Adolescent wellbeing and cognitive function during the pandemic

emotional difficulties (most commonly, anxiety), these sample characteristics may simply be reflective of a predominantly female sample of older adolescents in the UK. In spite of these limitations, this study is novel in its particular focus on pandemic-related cognitive difficulties in this age group and has important implications for both our theoretical understanding of adolescent anxiety and for clinical and educational intervention.

Adolescent wellbeing and cognitive function during the pandemic

Conclusion

While it is impossible to alleviate the uncertainties presented by a global pandemic, the role of uncertainty in shaping young peoples' experiences of the COVID-19 pandemic and their negative feelings about the future is striking. Older adolescents have acknowledged vulnerability to emotional difficulties and have faced a particular set of pandemic-related challenges. The findings of this study demonstrate sustained detrimental impacts of the pandemic on the wellbeing of these young people and support a clear pattern of association between anxiety and self-identified cognitive difficulties in this age group. Further work is required to identify how best to enable young people at a crucial stage in their education (and broader development) to cope with sustained uncertainty - uncertainty that reflects significant societal challenges, not limited to COVID-19. While this study focused on the context of a pandemic, findings will inform ongoing work to determine the broader impacts of stress, both acute (e.g., during examination periods) and chronic (e.g., climate anxiety) on young peoples' psychological functioning, and to shape assessment and intervention for those most vulnerable to anxiety.

Key Practitioner Message

- There is growing concern regarding the detrimental impact of the COVID-19 pandemic on young peoples' mental health and wellbeing.
- Older adolescents are vulnerable to the onset of emotional difficulties and have faced a particular set of pandemic-related challenges.
- This study demonstrates the detrimental impact of the pandemic on older adolescents' psychological wellbeing and crucially, supports a clear pattern of association between anxiety and self-identified cognitive difficulties in this age group (a novel finding).
- These findings have implications for both our theoretical understanding of adolescent anxiety and assessment and intervention approaches for vulnerable young people.

Adolescent wellbeing and cognitive function during the pandemic

Supporting information

Additional supporting information can be found in the online supplement:

- S1.** Contextual information relevant to the study
- S2.** Impacts of the pandemic on overall wellbeing
- S3.** Impacts of the pandemic on anxiety
- S4.** Self-identified cognitive difficulties associated with anxiety

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Data availability statement: Supplementary analyses and contextual information in support of this submission are provided in the online supplement. All relevant data will be made available on publication via the University of Bristol Research Data Repository (data.bris.ac.uk/data).

Adolescent wellbeing and cognitive function during the pandemic

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