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# Socioeconomic position and adverse childhood experiences as risk factors for health-related behaviour change and employment adversity during the COVID-19 pandemic: insights from a prospective cohort study in the UK

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## Abstract

**Background:** Non-pharmaceutical interventions to reduce the spread of COVID-19 may have disproportionately affected already disadvantaged populations.

**Methods:** We analysed data from 2710 young adult participants of the Avon Longitudinal Study of Parents and Children. We assessed the associations of socioeconomic position (SEP) and Adverse Childhood Experiences (ACEs, e.g. abuse, neglect, measures of family dysfunction) with changes to health-related behaviours (meals, snacks, exercise, sleep, alcohol and smoking/vaping), and to financial and employment status during the first UK lockdown between March–June 2020.

**Results:** Experiencing 4+ ACEs was associated with reporting decreased sleep quantity during lockdown (OR 1.53, 95% CI: 1.07–2.18) and increased smoking and/or vaping (OR 1.85, 95% CI: 0.99–3.43); no other associations were seen between ACEs or SEP and health-related behaviour changes. Adverse financial and employment changes were more likely for people with low SEP and for people who had experienced multiple ACEs; e.g. a history of 4+ ACEs was associated with being furloughed or on other leave during lockdown (OR 1.92, 95% CI: 1.35–2.74).

**Conclusions:** In this sample of young adults, there was little evidence that lockdown worsened inequalities in health-related behaviours. However, adverse financial and employment consequences of lockdown were more likely to be experienced by people who have already experienced socioeconomic deprivation or childhood adversity, thereby widening social inequalities and demonstrating the need for support into adulthood for those with a history of ACEs.

**Keywords:** Adverse childhood experiences, Socioeconomic position, COVID-19, Health-related behaviour, Employment

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## Background

Measures taken to reduce the spread of COVID-19 in the United Kingdom (UK), including a national ‘lockdown’ implemented on 23rd March 2020 [1], have had profound



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effects on everyday life. Under this lockdown, all non-essential shops and other premises were closed and people were only permitted to leave their home to shop for basic necessities, to exercise once a day, for medical needs or for work if absolutely necessary. Concerns that lockdown measures could worsen existing socioeconomic and health inequalities by disproportionately affecting disadvantaged populations were expressed early on in the pandemic [2–5]. Since then, evidence suggests these concerns were well founded [6]. Determining who is more likely to have suffered adverse effects will be critical in guiding comprehensive and targeted support for those most in need.

Several studies have highlighted consequences of lockdown on physical and mental health in the UK [7–15]. During lockdown, health behaviours such as diet, alcohol consumption, smoking, sleep and physical activity were subject to rapid change, with both increases and decreases observed. Many health behaviours have complex relationships with health, such as sleep quantity, where too little or too much sleep can reflect worse mental and physical health [16]. Similarly, an increase in meals may be associated with obesity, but a decrease in meals may reflect hunger due to financial difficulties, and could lead to under-nutrition. Since the lockdown is likely to have differentially affected people's lifestyle, there will be variation in whether lockdown has improved or worsened their overall health. Analysis of five British cohort studies suggested lockdown widened socioeconomic inequalities in sleep but did not affect inequalities in other health behaviours [7]. Another study found that, relative to pre-pandemic levels, participants consumed less fruit and vegetables, did less exercise and increased alcohol over a 3 month period from April 2020 [17]. In the same study, worsening health behaviours were associated with being younger and female. A study of smartphone-tracked physical activity highlighted a general decline in physical activity from pre-lockdown to during lockdown, with a greater decline in young adults compare to those aged over 65 but no effect of socioeconomic group on level of decline [18].

Financial and employment changes were also prevalent during lockdown, due in part to the effective shutdown of a number of sectors, including hospitality and travel [19, 20]. Initial UK evidence suggested younger people were more affected by loss of employment and income during lockdown [21]. There was a clear social gradient for loss of income and employment, and difficulties accessing food and medicines, with individuals of lower socioeconomic position (SEP) more negatively affected [22, 23].

Impact on individuals of the UK lockdown may also differ by other factors, including a history of adverse childhood experiences (ACEs), that is, stressful events

in childhood such as abuse, neglect, and family dysfunction. Exposure to ACEs has been shown to be associated with worse health and health-related behaviours across adolescence and adulthood [24–27], as well as with poor adulthood socioeconomic outcomes [28]. Therefore, individuals with a history of ACEs may be less resilient to the damaging effects of periods of adversity such as lockdown. Evidence from 12 longitudinal studies in the UK has shown that those who were experiencing psychological distress pre-pandemic were more likely to experience economic disruptions during the pandemic [29]. Whether ACEs in particular predict increased hardship during lockdown remains to be determined [30].

Using data from the Avon Longitudinal Study of Parents and Children (ALSPAC), a UK prospective cohort study, collected during the COVID-19 pandemic [31], we investigated associations of SEP and ACEs with health and financial consequences of the first UK lockdown (March–June 2020). We aimed to elucidate whether young adults with low SEP or previous exposure childhood adversity were differently affected by lockdown measures, in ways which could exacerbate existing health and social inequalities experienced by this population. We hypothesized that those with lower SEP and more exposure to ACEs would experience more detrimental change in their health-related behaviours, such as increased smoking, increased alcohol use and decreased exercise. For some health-related behaviours, both increases and decreases could be adverse – for example increased meal/snack frequency could be a risk factor for increasing weight, but decreased meal/snack frequency could be a result of economic hardship and be a risk factor for underweight. We also hypothesized that those with lower SEP and greater exposure to ACEs would be more likely to lose their job or be furloughed during lockdown, and face greater financial adversity than others.

## Methods

### Study population

The study used data from the Avon Longitudinal Study of Parents and Children (ALSPAC), an ongoing birth cohort study that recruited 14,541 pregnant women in Avon, UK with expected delivery dates between 1st April 1991 and 31st December 1992 [32–34]. Mothers, children, and mother's partners have been followed up using clinics, questionnaires, and linkage to routine data. Additional eligible cases were recruited to the study when the oldest participants were approximately 7 years old. Including these, the offspring cohort consists of 14,901 participants that were alive at 1 year of age. The website contains details of available data through a fully searchable data

dictionary: <http://www.bristol.ac.uk/alspac/researchers/our-data/>.

This study is based on 2710 offspring participants who responded between 26th May and 5th July 2020 to a questionnaire rapidly deployed early on during the COVID-19 pandemic [31]. The questionnaire was developed and deployed using REDCap (Research Electronic Data CAPture tools), a secure web application for online data collection hosted at the University of Bristol [35].

### ACEs

ACE measures were derived from questions relating to multiple forms of ACEs reported by participants and their mothers at multiple timepoints from birth to 23 years of age via questionnaires. Full details are described elsewhere [36]. Briefly, dichotomous indicators of exposure between 0 and 16 years were created for the ten ACEs included in the World Health Organization ACE international questionnaire [37]. The ten ACEs we considered were:

1. ever sexually abused or forced to perform sexual acts or touch someone in a sexual way (sexual abuse)
2. adult in family was ever physically cruel towards or hurt the child (physical abuse)
3. parent was ever emotionally cruel towards the child or often said hurtful/insulting things to the child (emotional abuse)
4. child always felt excluded, misunderstood, or never important to family, parents never asked or never listened when child talked about their free time (emotional neglect)
5. parent was a daily cannabis or any hard drug user or had an alcohol problem (parental substance abuse)
6. parent was ever diagnosed with schizophrenia or hospitalized for a psychiatric problem or, during the first 18 years of the child's life, parent had an eating disorder (bulimia or anorexia), used medication for depression or anxiety, attempted suicide, or scored above previously established cut-offs for depression (Edinburgh Postnatal Depression Scale (EPDS) > 12–13) (parental mental illness or suicide)
7. parents were ever affected by physically cruel behaviour by partner or ever violent towards each other, including hitting, choking, strangling, beating, and shoving (violence between parents)
8. parents separated or divorced (parental separation)
9. child was a victim of bullying on a weekly basis (bullying)

10. parent was convicted of a crime (parental criminal conviction)

Based on the sum of the dichotomous ACE constructs, each participant was given an ACE score (0–10 ACEs), which was categorized as 0, 1, 2–3, or 4+ ACEs for comparability with previous studies.

### SEP

Socioeconomic position was indicated by occupational social class at age 23 (~4 years prior to the start of the pandemic), using the 3-class National Statistics Socioeconomic classification (NS-SEC) [38]:

1. Higher managerial, administrative, and professional occupations (NS-SEC group 1)
2. Intermediate occupations (NS-SEC group 2)
3. Routine and manual occupations (NS-SEC group 3)
4. Never worked and long-term unemployed (LTU)

This was derived from participant self-reports of occupation, business/industry and job responsibilities from a postal questionnaire administered at mean age 23 years. Responses were coded into eight NS-SEC classes, which were then collapsed into the above four classes (Supplementary Table 1). Participants were instructed to skip certain questions if they were “not engaged in any form of work”, so participants who skipped these questions only were assigned to the fourth class. Participants who indicated they were full-time students were excluded from analysis of SEP (Supplementary Fig. 1).

### Outcomes

The term lockdown refers to the stay-at-home order made by the UK government on Monday 23rd March 2020. An online questionnaire deployed between 26th May and 5th July 2020 asked participants (mean age 27.8 years) to report their perceived change in several health-related behaviours compared to pre-lockdown. The question asked whether each of the following activities had decreased a lot, decreased a little, stayed the same, increased a little or increased a lot since lockdown: number of home-cooked meals eaten, number of meals eaten in a day, number of snacks eaten in a day, amount of physical activity/exercise, amount of sleep, alcohol and smoking/vaping. We combined the responses to give three levels: “decreased”, “stayed the same” and “increased”.

Participants could select “not applicable” if they didn't do the activity before lockdown and weren't doing it at the time of questionnaire completion. For the first five variables (number of home-cooked meals, number of meals, number of snacks, amount of physical activity, amount of sleep), the number of participants selecting

“not applicable” was negligible ( $n=6, 4, 8, 2, 4$ , respectively) so these responses were coded as missing. For alcohol and smoking, “not applicable” was coded as a fourth category, representing non-drinkers and non-smokers/vapers.

In the same questionnaire, participants reported their employment situation before lockdown. We categorized responses into working and not working pre-lockdown and combined these with employment status at questionnaire completion to derive change in employment status during lockdown. This had five categories: employed with no change, employed with reduced hours, employed and on furlough or paid or unpaid leave, no longer working, and not working pre-lockdown.

Participants also reported how their financial situation compared to before the COVID-19 pandemic. Possible responses were: “much worse off”, “a little worse off”, “about the same”, “a little better off”, or “much better off”; we grouped the first two into ‘worse off’ and the last two into ‘better off’. Participants reported whether they or their partner had made any new claims for benefits since the pandemic, or had used rent or mortgage or other debt deferral since the pandemic.

#### Missing data

ACE measures were derived from >500 questions answered between birth and 23 years of age, and no participant had data on all these questions. We therefore used multivariate multiple imputation to estimate missing values, that were assumed to be missing at random. This avoids exclusion of participants whilst reducing selection bias. Participants were only excluded from analyses if they responded to <10% of ACE questions (Supplementary Fig. 1). For participants who responded to  $\geq 50\%$  of questions for an ACE, these questions were used to create a binary indicator of presence/absence of that ACE. For participants who responded to < 50% of questions for an ACE, presence/absence of the ACE was set to missing and was imputed. The ACE score was derived after imputing presence/absence of individual ACEs. Given known sex differences in ACE prevalence, missing data for males and females were imputed separately, and the datasets re-combined before analysis. The imputation model included all outcomes, exposures and covariates included in analysis, and 24 auxiliary variables likely to predict missingness or ACE exposure (details in Additional File 2). Some participants had missing SEP data, so we included in the imputation model 8-class NS-SEC [38], from which the 4-group version described above was derived. Since only participants who completed the COVID-19 questionnaire were included in analysis, most of the analytic sample had complete outcome data. For those that had not responded to certain sections or

questions, these were imputed in the same model. Using the mice package [39] in R version 4.0.2, we created 50 imputed datasets for both males and females, with 10 iterations per dataset. Imputed values were combined using Rubin’s rules [40] and trace plots used to check convergence of estimates.

#### Statistical analyses

All analysis was conducted in R version 4.0.2. To explore how participants in our analysis differed from the full cohort, we compared the distribution of maternal education between included participants and those excluded due to missing data. We used multinomial logistic regression to examine associations of ACE score, individual ACEs, and SEP with health behaviour and employment outcomes during lockdown. We assessed unadjusted associations, and associations adjusted for covariates. These included participant’s ethnicity, age in years at questionnaire completion, and home ownership. We also adjusted for their mother’s marital status, parity, and age at the participant’s birth, and educational qualifications of the mother and their partner. We tested for an interaction between each exposure and sex on the outcome.

## Results

#### Participant characteristics

For associations of ACEs with outcomes, 2707 participants were included in analyses (70.6% female). For associations of SEP with outcomes, 2557 participants were included in analyses (71.0% female) (Supplementary Fig. 1). Almost all participants were white (95.2 and 95.8% in ACE and SEP subsamples, respectively; Table 1, Supplementary Table 2). In the non-imputed dataset, 58.9% of participants had obtained GSCE grades A\*-C by age 18 and 36.3% had monthly take-home pay of more than £1500 at age 25 (Supplementary Table 3). Between 0 and 16 years, 81.4% of participants were exposed to at least one ACE, and 20.1% to 4 or more ACEs (Table 1). Prevalence of individual ACEs ranged from 6% for sexual abuse to 43.7% for parental mental illness or suicide (Table 1). Of participants included in the SEP analyses, 44% were employed in higher managerial, administrative, and professional occupations, and 9.2% were long-term unemployed at age 23 (Supplementary Table 2). Participants included in our regression analysis had more highly educated mothers than participants that were excluded due to missing data before multiple imputation (Supplementary Table 4).

Changes to health-related behaviours during lockdown varied in direction (Table 1; Supplementary Table 2). For example, 40.2% of participants reported a decrease in exercise quantity and 40.6% an increase, while 23.3%

**Table 1** Characteristics of the participants included in ACE analyses using data from multi-variate imputation. *N* = 2707

Variable	n (%)				
<b>Sex</b>	<b>Female</b>		<b>Male</b>		
	1912 (70.6)		795 (29.4)		
<b>Age (years)</b>	<b>27</b>	<b>28</b>		<b>29</b>	
	886 (32.7)	1556 (57.5)		265 (9.8)	
<b>Ethnicity</b>	<b>White</b>		<b>Non-white</b>		
	2576 (95.2)		131 (4.8)		
<b>ACE score</b>	<b>0</b>	<b>1</b>	<b>2–3</b>	<b>4+</b>	
	504 (18.6)	679 (25.1)	980 (36.2)	544 (20.1)	
<b>ACEs</b>					
Physical abuse	622 (23.0)				
Sexual abuse	163 (6.0)				
Emotional abuse	659 (24.3)				
Emotional neglect	529 (19.5)				
Bullying	646 (23.9)				
Violence between parents	604 (22.3)				
Parental substance abuse	330 (12.2)				
Parental mental illness or suicide	1183 (43.7)				
Parental criminal conviction	280 (10.3)				
Parental separation	780 (28.8)				
<b>Health-related behaviours</b>	<b>Decreased</b>	<b>Stayed the same</b>		<b>Increased</b>	
Number of homecooked meals	104 (3.8)	909 (33.6)		1694 (62.6)	
Number of meals	280 (10.3)	1942 (71.7)		485 (17.9)	
Number of snacks	358 (13.2)	1023 (37.8)		1326 (49.0)	
Exercise quantity	1087 (40.2)	520 (19.2)		1100 (40.6)	
Sleep quantity	630 (23.3)	1141 (42.1)		936 (34.6)	
	<b>Decreased</b>	<b>Stayed the same</b>	<b>Increased</b>	<b>Non-drinker/non-smoker</b>	
Alcohol quantity	462 (17.1)	828 (30.6)	1047 (38.7)	370 (13.7)	
Smoking/vaping quantity	103 (3.8)	287 (10.6)	299 (11.0)	2018 (74.5)	
<b>Financial/employment variables</b>					
Change in employment status	<b>Employed no change</b>	<b>Employed reduced hours</b>	<b>Furlough/paid leave/unpaid leave</b>	<b>Stopped working during pandemic</b>	<b>Not working pre-pandemic</b>
	1587 (58.6)	261 (9.6)	496 (18.3)	165 (6.1)	198 (7.3)
Financial situation since pandemic	<b>Worse off</b>		<b>Stayed the same</b>		<b>Better off</b>
	685 (25.3)		1012 (37.4)		1010 (37.3)
Claimed benefits since pandemic	336 (12.4)				
Mortgage/rent deferral since pandemic	181 (6.7)				

reported a decrease in sleep quantity and 34.6% an increase.

A large proportion of participants (58.6%) reported no change in employment during lockdown, 9.6% were working reduced hours, 18.3% were on furlough or unpaid leave and 6.1% had stopped working during lockdown (Table 1). 25.3% of participants reported feeling financially worse off compared to pre-lockdown, whereas 37.3% felt financially better off (Table 1).

There was no evidence for interactions between each exposure and sex on any of the outcomes.

Estimates of all associations are shown in Tables 2, 3, 4 and 5. Given the large number of estimates presented, here we will specifically describe in the text the associations with the lowest and highest OR estimates, taking into account the strength of statistical evidence (based on 95% CIs).

### Associations of SEP and ACEs with health-related behaviours during lockdown

SEP was associated with changes in health-related behaviours in either direction (increase or decrease), but not for all outcomes (Table 2; Supplementary Table 5). Where there were associations, there were often trends across the categories of SEP. For example, the odds of increasing number of home-cooked meals increased from LTU to NS-SEC group 2 (LTU OR 0.7, 95% CI: 0.50,0.99; NS-SEC group 1 OR 0.74, 95% CI: 0.58, 0.94; NS-SEC group 2 OR 0.95, 95% CI: 0.74, 1.21). Participants who were in NS-SEC group 3 or LTU at age 23 had higher odds

of both decreased and increased number of meals, and higher odds of decreased sleep quantity, compared with participants in NS-SEC group 1 (Table 2; Supplementary Table 5). LTU participants were less likely to have either increased or decreased their physical activity compared to NS-SEC 1 participants. However, odds ratios were imprecisely estimated, and confidence intervals spanned the null. For other health-related behaviours, there was little evidence of socioeconomic differences.

In the unadjusted model, exposure to 4+ ACEs was associated with reporting decreased sleep quantity during lockdown (odds ratio (OR) 1.53, 95% CI: 1.07–2.18) which

**Table 2** Association between social class and changes in health-related behaviour during the March–July 2020 lockdown (unadjusted). *N* = 2557

		NS-SEC social class at age 23 years			
		Higher managerial, administrative and professional occupations	Intermediate occupations	Routine and manual occupations	Never worked and long-term unemployed
		<i>N</i> = 1126	<i>N</i> = 616	<i>N</i> = 579	<i>N</i> = 236
<b>Number of home-cooked meals</b>					
Decreased	ref		0.79 (0.43–1.45)	0.64 (0.33–1.26)	0.63 (0.24–1.66)
Stayed the same	ref		ref	ref	ref
Increased	ref		0.95 (0.74–1.21)	0.74 (0.58–0.94)	0.7 (0.50–0.99)
<b>Number of meals</b>					
Decreased	ref		1.04 (0.70–1.55)	1.42 (0.97–2.08)	1.29 (0.73–2.28)
Stayed the same	ref		ref	ref	ref
Increased	ref		0.94 (0.70–1.27)	1.23 (0.91–1.66)	1.38 (0.91–2.10)
<b>Number of snacks</b>					
Decreased	ref		1.21 (0.85–1.71)	1.07 (0.73–1.57)	0.85 (0.46–1.57)
Stayed the same	ref		ref	ref	ref
Increased	ref		1.05 (0.82–1.33)	1.09 (0.86–1.39)	1.05 (0.74–1.50)
<b>Exercise quantity</b>					
Decreased	ref		1.10 (0.79–1.51)	1.03 (0.75–1.41)	0.84 (0.54–1.32)
Stayed the same	ref		ref	ref	ref
Increased	ref		1.11 (0.82–1.51)	0.98 (0.73–1.33)	0.78 (0.51–1.19)
<b>Sleep quantity</b>					
Decreased	ref		1.17 (0.87–1.56)	1.31 (0.97–1.75)	1.49 (0.99–2.25)
Stayed the same	ref		ref	ref	ref
Increased	ref		1.11 (0.86–1.42)	0.93 (0.71–1.20)	1.02 (0.69–1.50)
<b>Alcohol quantity</b>					
Decreased	ref		1.07 (0.77–1.49)	0.96 (0.67–1.39)	1.03 (0.62–1.71)
Stayed the same	ref		ref	ref	ref
Increased	ref		1.09 (0.84–1.43)	1.03 (0.78–1.36)	0.75 (0.49–1.15)
Non-drinker	ref		1.14 (0.79–1.66)	1.51 (1.04–2.20)	1.66 (0.99–2.78)
<b>Smoking/vaping quantity</b>					
Decreased	ref		1.37 (0.68–2.76)	1.01 (0.49–2.06)	1.60 (0.69–3.70)
Stayed the same	ref		ref	ref	ref
Increased	ref		1.01 (0.60–1.70)	0.88 (0.55–1.42)	1.01 (0.54–1.91)
Non-smoker	ref		0.87 (0.58–1.30)	0.54 (0.37–0.78)	0.45 (0.28–0.74)

**Table 3** Association between Adverse Childhood Experiences score and changes in health-related behaviour during the March–July 2020 lockdown (unadjusted). *N* = 2707

	Number of Adverse Childhood Experiences between 0-16 years			
	0 <i>N</i> = 504	1 <i>N</i> = 679	2–3 <i>N</i> = 980	4 or more <i>N</i> = 544
<b>Number of home-cooked meals</b>				
Decreased	ref	1.12 (0.54–2.32)	1.23 (0.63–2.41)	1.38 (0.65–2.92)
Stayed the same	ref	ref	ref	ref
Increased	ref	0.98 (0.74–1.29)	1.09 (0.84–1.42)	0.81 (0.61–1.07)
<b>Number of meals</b>				
Decreased	ref	1.22 (0.73–2.05)	1.73 (1.11–2.69)	2.34 (1.43–3.82)
Stayed the same	ref	ref	ref	ref
Increased	ref	1.42 (0.98–2.05)	1.55 (1.10–2.18)	2.18 (1.49–3.18)
<b>Number of snacks</b>				
Decreased	ref	1.07 (0.72–1.60)	1.14 (0.78–1.65)	1.25 (0.82–1.89)
Stayed the same	ref	ref	ref	ref
Increased	ref	1.06 (0.80–1.40)	1.17 (0.91–1.50)	1.24 (0.92–1.67)
<b>Exercise quantity</b>				
Decreased	ref	1.00 (0.70–1.43)	0.95 (0.69–1.33)	1.08 (0.74–1.57)
Stayed the same	ref	ref	ref	ref
Increased	ref	0.95 (0.66–1.36)	0.93 (0.68–1.28)	0.98 (0.66–1.44)
<b>Sleep quantity</b>				
Decreased	ref	1.00 (0.70–1.42)	1.13 (0.82–1.56)	1.53 (1.07–2.18)
Stayed the same	ref	ref	ref	ref
Increased	ref	0.94 (0.70–1.27)	1.00 (0.76–1.32)	0.97 (0.71–1.34)
<b>Alcohol quantity</b>				
Decreased	ref	0.98 (0.66–1.43)	0.88 (0.61–1.25)	1.33 (0.88–2.00)
Stayed the same	ref	ref	ref	ref
Increased	ref	0.96 (0.70–1.32)	1.05 (0.79–1.41)	1.25 (0.88–1.77)
Non-drinker	ref	0.85 (0.55–1.30)	1.01 (0.68–1.49)	1.92 (1.24–2.96)
<b>Smoking/vaping quantity</b>				
Decreased	ref	1.08 (0.47–2.51)	0.99 (0.48–2.07)	0.92 (0.41–2.09)
Stayed the same	ref	ref	ref	ref
Increased	ref	1.35 (0.68–2.65)	1.21 (0.68–2.16)	1.85 (0.99–3.43)
Non-smoker	ref	0.97 (0.61–1.56)	0.63 (0.42–0.94)	0.54 (0.34–0.85)

attenuated slightly after adjustment for confounders (OR 1.39, 95% CI: 0.94–2.06) (Table 3; Supplementary Table 6). Confounders adjusted for were ethnicity, age in years at questionnaire completion, home ownership, mother's marital status, parity, and age at the participant's birth, and educational qualifications of the mother and their partner. Experience of ACEs was related to change in both directions to number of meals per day, and the magnitude of the odds for change in either direction increased with number of ACEs. For example, people who had experienced 4+ ACEs were more than twice as likely to decrease

(OR 2.34, 95% CI: 1.43–3.82) or increase (OR 2.18, 95% CI: 1.49–3.18) the number of meals compared with people reporting no ACEs. Experiencing 4+ ACEs was also associated with higher odds of increasing smoking and/or vaping (OR 1.85, 95% CI: 0.99–3.43). For other health behaviours, there was little evidence of associations with the ACE score.

For individual ACEs, there was some evidence of associations with health behaviour changes (Supplementary Tables 7 & 8). Decreased sleep quantity during lockdown was associated with emotional abuse (OR 1.44,

**Table 4** Association between social class and changes in financial situation during the March–July 2020 lockdown (unadjusted).  $N = 2557$ 

	NS-SEC social class at age 23 years			
	Higher managerial, administrative and professional occupations $N = 1126$	Intermediate occupations $N = 616$	Routine and manual occupations $N = 579$	Never worked and long-term unemployed $N = 236$
<b>Change in employment</b>				
Employed with the same or more hours	ref	ref	ref	ref
Reduced hours	ref	0.89 (0.59–1.36)	1.51 (1.01–2.24)	1.65 (0.95–2.87)
Furlough/paid or unpaid leave	ref	1.41 (1.04–1.92)	2.53 (1.86–3.43)	2.20 (1.40–3.47)
Stopped working during pandemic	ref	1.00 (0.59–1.67)	2.54 (1.58–4.08)	2.57 (1.35–4.87)
Not working pre-pandemic	ref	1.28 (0.77–2.13)	2.34 (1.45–3.79)	5.40 (3.20–9.12)
<b>Financial situation</b>				
Worse off	ref	0.97 (0.73–1.29)	1.39 (1.05–1.84)	1.36 (0.89–2.06)
No change	ref	ref	ref	ref
Better off	ref	0.95 (0.74–1.22)	0.73 (0.56–0.97)	0.73 (0.49–1.10)
<b>Claimed benefits since pandemic</b>	ref	0.96 (0.66–1.40)	1.39 (0.97–1.98)	1.96 (1.22–3.16)
<b>Used rent/mortgage deferral since pandemic</b>	ref	1.33 (0.88–2.03)	1.21 (0.77–1.90)	0.77 (0.33–1.81)

**Table 5** Association between Adverse Childhood Experiences score and changes in financial situation during the March–July 2020 lockdown (unadjusted).  $N = 2707$ 

	Number of Adverse Childhood Experiences between 0–16 years			
	0 $N = 504$	1 $N = 679$	2–3 $N = 980$	4 or more $N = 544$
<b>Change in employment</b>				
Employed with the same or more hours	ref	ref	ref	ref
Reduced hours	ref	0.82 (0.53–1.29)	1.03 (0.69–1.55)	0.99 (0.62–1.57)
Furlough/paid or unpaid leave	ref	1.01 (0.70–1.46)	1.45 (1.03–2.03)	1.92 (1.35–2.74)
Stopped working during pandemic	ref	1.03 (0.58–1.80)	1.31 (0.78–2.21)	1.39 (0.73–2.65)
Not working pre-pandemic	ref	1.11 (0.65–1.91)	1.31 (0.78–2.19)	2.11 (1.22–3.66)
<b>Financial situation</b>				
Worse off	ref	0.97 (0.68–1.38)	1.26 (0.92–1.71)	1.42 (1.00–2.02)
No change	ref	ref	ref	ref
Better off	ref	0.86 (0.65–1.14)	0.87 (0.66–1.14)	0.83 (0.60–1.15)
<b>Claimed benefits since pandemic</b>	ref	1.36 (0.90–2.06)	1.14 (0.77–1.68)	1.36 (0.87–2.12)
<b>Used rent/mortgage deferral since pandemic</b>	ref	0.74 (0.42–1.30)	1.17 (0.72–1.91)	1.31 (0.74–2.32)

95% CI: 1.09–1.90; unadjusted), physical abuse (OR 1.38, 95% CI: 1.07–1.78; unadjusted) and violence between parents (OR 1.38, 95% CI: 1.04–1.84; unadjusted). Participants with a history of violence between parents were twice as likely to increase smoking/vaping quantity during lockdown. For other individual ACEs, there was little evidence of associations with changes in health-related behaviours.

#### Associations of SEP and ACEs with employment and financial situation during lockdown

People who were in NS-SEC group 3 or LTU at age 23 were more likely than those in NS-SEC group 1 at that age to experience the most adverse financial and employment outcomes (Table 4; Supplementary Table 9). For example, they were almost 3 times more likely to stop working during lockdown (OR 2.83, 95%

CI: 1.45–5.50 for NS-SEC 3, OR 2.68, 95% CI: 1.63–4.42 for LTU). Both groups were also more than twice as likely to be on furlough or other leave, and about 50% more likely to have reduced employment hours. Being in NS-SEC group 3 was associated with an increased likelihood of being financially worse off during the pandemic compared to NS-SEC group 1 (OR 1.39, 95% CI: 1.05–1.84).

Some financial outcomes exhibited trends from low to high ACE score. For example, in the unadjusted model, an ACE score of 2–3 and 4+ was associated with being furloughed or on paid or unpaid leave during lockdown (OR 1.45, 95% CI: 1.03–2.03 and OR 1.92, 95% CI: 1.35–2.74, respectively) (Table 5; Supplementary Table 10). Experiencing 4+ ACEs was also associated with a higher chance of stopping working during lockdown, but the confidence interval for this estimate was wide (OR = 1.39, 95% CI 0.73–2.65). Experiencing 4+ ACEs was associated with feeling worse off financially during the pandemic, claiming new benefits, and using rent or mortgage deferral since the start of the pandemic. However, estimates were imprecise, reflecting low prevalence of these outcomes.

Some individual ACEs were associated with employment status change (Supplementary Tables 11 & 12). For example, those with a history of physical abuse were more than twice as likely to have stopped working during lockdown than other participants (OR 2.15, 95% CI: 1.41–3.27). This was robust to adjustment for confounders (OR 2.32, 95% CI: 1.49–3.6). Participants with a history of parental substance abuse were almost twice as likely to have stopped working during lockdown compared to those without (OR 1.87, 95% CI: 1.05–3.33). Participants with a history of emotional neglect or parental separation were around 50% more likely to be furloughed or on other leave during lockdown than those without. A history of physical abuse or parental substance abuse was associated with being worse off financially during the pandemic. For other individual ACEs, there was little evidence of associations with changes in employment status or financial situation during lockdown.

## Discussion

In a population-based longitudinal cohort study we identified changes in multiple health-related behaviours in both directions during lockdown, as well as changes to employment status and financial situation. The evidence of associations between SEP and health-related behaviour changes during lockdown was limited, but a higher overall ACE score and various individual ACEs were found to be associated with some behaviours e.g., decreased sleep and increased smoking. There was, however, clear evidence that adverse employment and

financial changes were more likely to be experienced by people with low SEP or a history of ACE exposure. In this cohort of young adults, people in routine or manual occupations or long-term unemployment 4 years prior to the pandemic were more likely to experience adverse changes to their employment status during lockdown compared to participants in higher managerial, administrative, or professional occupations at that time. Those with a higher ACE score were more likely to be put on furlough or other leave or stop working entirely during lockdown. In addition, we found some evidence that the group with the greatest ACE exposure were more likely to experience adverse financial outcomes during lockdown.

There is a growing body of evidence of the indirect effects of lockdown on health-related behaviours. A study analyzing five British cohorts of different ages investigated whether behaviour change during lockdown differed by SEP and, like the present study, found that adverse effects on sleep during lockdown were more frequent amongst socioeconomically disadvantaged groups [7]. The same study, which had a large combined sample size, found that lower SEP was associated with lower exercise quantity during lockdown, something that wasn't detected in our sample, or in a study that measured smart-phone tracked physical activity [18]. Analysis of a large UK cohort found that overall smoking declined during lockdown and that there was no interaction of smoking behaviour with education level [11]. There is evidence of socioeconomic disparities in drinking behaviours during lockdown [13, 14], which we did not detect in our sample.

In keeping with our findings, adverse effects on employment seem to be more common for younger people and those in lower paid occupations [6, 21, 22]. One study exploring adversities during the first 3 weeks of lockdown by SEP found that people of low SEP were more likely to lose work, experience a cut in household income and be unable to pay bills during lockdown than people of higher SEP [22]. Similarly, a Welsh study found that unemployment and furlough during lockdown disproportionately affected those experiencing financial difficulties and living in deprived communities [23].

To our knowledge, ours is the first study to assess ACEs as a risk factor for adverse employment and financial changes during lockdown. There is evidence that childhood maltreatment is associated with poor adulthood socioeconomic outcomes, but the mechanisms underlying this relationship are largely unclear, with mental health and adolescent cognition potentially playing a role [28]. Further study into the causal pathway from ACEs

to adulthood adversity is warranted so that interventions can better support those with a history of ACEs.

### Strengths and limitations

A key strength of this study is the detailed data on a range of ACEs (captured at multiple time points throughout childhood and adolescence) combined with data collected during the COVID-19 pandemic, which gave us the unique opportunity to examine the effect of the pandemic on people who have experienced childhood adversity. This study has limitations. The sample size and thus statistical power was restricted as the questionnaire was online only - invites were only sent to those participants for whom the study had a valid email address, impacting participants who prefer to complete questionnaires on paper. Our results therefore require replication in larger sample sizes, however this is a challenge given lack of cohorts with data on both ACEs and the pandemic. We have not corrected for multiple testing due to the correlated nature of our exposures and outcomes, meaning that the large number of statistical tests carried out are not independent. We acknowledge that type I error may be present. Some of the associations found have large confidence intervals. For these findings, had multiple testing corrected  $p$  values been presented (i.e., if the  $\alpha$  level for individual tests had been adjusted downward), many would not pass the arbitrary threshold for 'statistical significance'. We do not consider these estimates to be definitive evidence against the null hypothesis of no association; replication in larger samples is recommended. Self-reported measures were used, so associations may have been biased by measurement error and reporting biases. During the pandemic, the ALSPAC cohort administered questionnaires that asked participants about changes in behaviour/socioeconomic circumstances. The questions used capture subjective changes in behaviour/circumstances since the start of lockdown, and not absolute levels of those behaviours/circumstances. This precludes analysis of how trajectories of absolute levels of a given behaviour/circumstances changed during the pandemic. Furthermore, the changes within each category of the 'change variable' are likely to be heterogeneous. ALSPAC participants are more socioeconomically advantaged and less ethnically diverse than the national average, and mothers of participants included in this study had higher educational attainment compared to the rest of the ALSPAC cohort. Results therefore may not be generalizable to the UK population. Although ALSPAC participants are in the age group most likely to be affected by lockdown in terms of employment [21], their similar ages meant we could not study the effect of age on the

outcomes. Finally, our SEP measure was solely based on participants' occupations, but individual's income, education, or residential area may also determine negative impacts of lockdown.

### Conclusions

The results of this study support findings from routine data that the financial and employment situation of adults with lower occupational social class are more likely to have been adversely affected by the COVID-19 non-pharmaceutical interventions [41]. Our results also suggest that exposure to multiple ACEs was associated with decreased sleep quantity and increased smoking/vaping, but we found little evidence that SEP or ACEs influenced changes in other health-related behaviours during the pandemic in this study of young adults, providing some reassurance that, at least in the short-term, the non-pharmaceutical interventions used against COVID-19 have not led to increased inequalities in health-related behaviours in this age group.

However, importantly, our findings highlight the economic adversity experienced by adults who have been exposed to ACEs. Despite the long-reaching consequences of ACEs persisting into adulthood, there are few interventions and services targeted at this group (with most services for adults targeting adult risk factors rather than previous childhood risk factors), and they are largely hidden from view in routine data. Our findings demonstrate the need for continued support of people who experience ACEs into adulthood and demonstrate that this need may have increased during the COVID-19 pandemic.

### Abbreviations

SEP: Socioeconomic position; ACE: Adverse childhood experience; ALSPAC: Avon Longitudinal Study of Parents and Children; NS-SEC: National Statistics Socio-economic classification; LTU: Long term unemployed.

### Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-022-14184-8>.

**Additional file 1: Supplementary Fig. 1.** Flow chart of inclusion and exclusion of participants. **Supplementary Table 1.** Recoding of 8-class NS-SEC variables to 4 classes as defined by UK Office for National Statistics. **Supplementary Table 2.** Participant characteristics. Characteristics of the participants included in SEP analyses using data from multi-variate multiple imputation.  $N = 2557$ . **Supplementary Table 3.** Characteristics of participants that responded to COVID questionnaire 2, before imputation.  $N = 2710$ . **Supplementary Table 4.** Maternal education for excluded participants and participants included in analyses. **Supplementary Table 5.** Association between social class and changes in health-related behaviour during the March–July 2020 lockdown (adjusted for ethnicity, age at time of questionnaire, home ownership, maternal and partner education, parity, maternal age and maternal marital status).  $N = 2557$ . **Supplementary Table 6.** Association between Adverse Childhood Experiences score and changes in health-related behaviour during the March–July 2020

lockdown (adjusted for ethnicity, age at time of questionnaire, home ownership, maternal and partner education, parity, maternal age and maternal marital status).  $N = 2707$ . **Supplementary Table 7.** Association between individual Adverse Childhood Experiences and changes in health-related behaviour during the March–July 2020 lockdown (unadjusted).  $N = 2707$ . **Supplementary Table 8.** Association between individual Adverse Childhood Experiences and changes in health-related behaviour during the March–July 2020 lockdown (adjusted for ethnicity, age at time of questionnaire, home ownership, maternal and partner education, parity, maternal age and maternal marital status).  $N = 2707$ . **Supplementary Table 9.** Association between social class and changes in financial situation during the March–July 2020 lockdown (adjusted for ethnicity, age at time of questionnaire, home ownership, maternal and partner education, parity, maternal age and maternal marital status).  $N = 2557$ . **Supplementary Table 10.** Association between Adverse Childhood Experiences score and changes in financial situation during the March–July 2020 lockdown (adjusted for ethnicity, age at time of questionnaire, home ownership, maternal and partner education, parity, maternal age and maternal marital status).  $N = 2707$ . **Supplementary Table 11.** Association between individual Adverse Childhood Experiences and changes in financial situation during the March–July 2020 lockdown (unadjusted).  $N = 2707$ . **Supplementary Table 12.** Association between individual Adverse Childhood Experiences and changes in financial situation during the March–July 2020 lockdown (adjusted for ethnicity, age at time of questionnaire, home ownership, maternal and partner education, parity, maternal age and maternal marital status).  $N = 2707$ .

**Additional file 2.** Additional demographic variables. Dichotomous ACE indicators. Auxiliary variables for multiple imputation.

### Acknowledgements

We are extremely grateful to all the families who took part in this study, the midwives for their help in recruiting them, and the whole ALSPAC team, which includes interviewers, computer and laboratory technicians, clerical workers, research scientists, volunteers, managers, receptionists and nurses.

### Authors' contributions

LDH and A Hughes conceived the idea for the study. MLS and A Herbert conducted the analysis. MLS drafted the manuscript. MLS, LDH, A Hughes, A Herbert and KN contributed to the study design, interpretation of the findings and critically revised the manuscript. All authors approved the final version of the paper.

### Funding

This work was supported by the Wellcome Trust through a PhD studentship to MLS [218495/Z/19/Z]. For the purpose of Open Access, the author has applied a CC BY public copyright licence to any Author Accepted Manuscript version arising from this submission.

The UK Medical Research Council and Wellcome (Grant ref.: 217065/Z/19/Z) and the University of Bristol provide core support for ALSPAC. This publication is the work of the authors and MLS and LDH will serve as guarantors for the contents of this paper. A comprehensive list of grants funding is available on the ALSPAC website (<http://www.bristol.ac.uk/alspac/external/documents/grant-acknowledgements.pdf>). This research was specifically funded by Wellcome Trust and MRC UoB Faculty Research Director's Discretionary Fund (Grant ref.: 102215/2/13/2).

### Availability of data and materials

The ALSPAC study website contains details of all the data that is available (upon application) through a fully searchable data dictionary and variable search tool (<http://www.bristol.ac.uk/alspac/researchers/our-data/>).

### Declarations

#### Ethics approval and consent to participate

Ethical approval for this study was obtained from the ALSPAC Law and Ethics Committee and the Local Research Ethics Committees. Study participants who complete questionnaires consent to the use of their data by approved researchers. Up until age 18 an overarching parental consent was used to

indicate parents were happy for their child (the study participant) to take part in ALSPAC. Consent for data collection and use was implied via the written completion and return of questionnaires. Study participants have the right to withdraw their consent for specific elements of the study, or from the study as a whole, at any time.

Authors received administrative permission to access and use the data for this study by the ALSPAC Executive Committee.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.

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Received: 8 July 2021 Accepted: 14 September 2022

Published online: 24 September 2022

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