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Impact of Parental Mental Health and Poverty on the Health of the Next Generation: A Multi-Trajectory Analysis Using the UK Millennium Cohort Study

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ABSTRACT

Purpose: Exposure to parental mental ill-health and poverty in childhood impact health across the lifecycle. Both maternal and paternal mental health may be important influences, but few studies have unpicked the complex interrelationships between these exposures and family poverty for later health.

Methods: We used longitudinal data on 10,500 children from the nationally representative UK millennium cohort study. Trajectories of poverty, maternal mental health, and secondary caregiver mental health were constructed from child age of 9 months through to 14 years. We assessed the associations of these trajectories with mental health outcomes at the age of 17 years. Population-attributable fractions were calculated to quantify the contribution of caregivers' mental health problems and poverty to adverse outcomes at the country level.

Results: We identified five distinct trajectories. Compared with children with low poverty and good parental mental health, those who experienced poverty and poor primary or secondary caregiver mental health (53%) had worse outcomes. Children exposed to both persistent poverty and poor caregiver mental health were at markedly increased risk of socioemotional behavioural problems (aOR 4.2; 95% CI 2.7–6.7), mental health problems (aOR 2.5; CI 1.6–3.9), and cognitive disability (aOR 1.7; CI 1.1–2.5). We estimate that 40% of socioemotional behavioural problems at the age of 17 were attributable to persistent parental caregivers' mental health problems and poverty.

IMPLICATIONS AND CONTRIBUTION

Child poverty and poor caregiver mental health problems act synergistically across childhood developmental stages, with large negative impacts on the health of the next generation. Policies and interventions to reduce child poverty and parental mental health problems could result in a substantial reduction in poor health across the life course of the UK population.

Conflicts of interest: The authors have no conflicts of interest to declare.

Ethics approval and consent to participate: Ethical approval for each wave of the MCS was granted by NHS Multicenter Research Ethics Committees. No further ethical approval was required for this secondary analysis of MCS data.

Data Sharing: All data used in this study are publicly available.

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Discussion: More than half of children growing up in the UK are persistently exposed to either one or both of poor caregiver mental health and family poverty. The combination of these exposures is strongly associated with adverse health outcomes in the next generation.

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Parental mental illness and family poverty are growing public health problems affecting children and young people globally [1]. In the UK, there are concerns about the deterioration in adult mental health [2], particularly in adults aged < 25. Child poverty is also rising [3,4]. It is estimated that one in three children in the UK lives in poverty [3], and over 50% are exposed to parental mental health problems by the age of 16 years [5]. Both parental mental health problems and poverty are undoubtedly important childhood risk factors for lifelong health, as they have been linked to multiple adverse outcomes, including cognitive, emotional, behavioural, and health problems [6–8].

Recent research has shown that the combined effect of parental mental health problems and poverty may dramatically increase the risk of adverse health outcomes in children at the age of 14 [4,8]. A recent cohort study showed that UK children who experienced continuous exposure to maternal mental illness and poverty were at increased risk of adverse behavioural and health outcomes [4]. Those exposed to persistent maternal mental illness and poverty throughout childhood and early adolescence had a 6 to 4 times higher risk of developing socioemotional problems at the age of 14 compared to those in low poverty and adversity [4].

However, research on the impact of caregivers' mental health to date has mostly focused on maternal health, perhaps because mothers are most often the primary caregiver in families [9,10]. There is now a small body of evidence suggesting that the mental health of caregivers other than mothers may influence the risk of behavioural and developmental disturbances in children [11]. In a recent review [9], Stein et al. found paternal mental health to be linked to children's socioemotional and behavioural development. Although both maternal and paternal (caregivers) mental health may influence child development and health outcomes, few studies have unpicked the complex interrelationships between these exposures and family poverty from childhood to adolescence. Adolescence is a crucial period of development noted to be marked by persistent inequalities in exposure to social adversity, and inequalities in physical and mental health tend to increase during this period [4]. Existing studies have also not investigated the combined effect of both paternal and maternal (caregivers) mental health over multiple years of childhood, including early adolescence [12], although there is now some evidence that children's behavioural and emotional well-being is directly or indirectly connected to their relationship with their caregivers [9].

With the role of paternal mental health conditions being increasingly recognized in shaping children's development and health [9,13], it is important to assess the timing of exposure, accumulation, and interactive effect of maternal and paternal mental health conditions together with other structural risk factors [14] in order to develop effective public health interventions. Indeed, modifiable socioeconomic risk factors, including poverty and material deprivation, are key areas to target for both short- and long-term interventions since they are

important risk factors in the accumulation of family adversity [4,15].

In this current study, we build on our previous work on the clustering of family adversity and poverty [4], to further unpick the complex interrelationships between parental mental health and family poverty across childhood developmental stages. To inform policy, we aimed to identify and assess the life course mental health and poverty trajectories of parental caregivers and their impacts on the health of the next generation at the point of transition to adulthood. We also quantified the contributions of exposure to caregivers' mental health problems and poverty trajectories to adolescent mental and behavioural health outcomes at the country level. In our view, quantifying the burden of long-term patterns of modifiable risk factors will be an important step in identifying priority areas for prevention efforts in the UK.

Methods

Study design and population

We examined data from the millennium cohort study (MCS), a large national longitudinal study of children born in the UK between September 2000 and January 2002, and followed up through seven survey waves. The initial sample included all children born during these timeframes and eligible to receive child benefit [16]. We used data from the birth survey, when the children were around 9 months old, with subsequent follow-ups at 3, 5, 7, 11, and 14 years of age and the most recent wave (child age 17), which was conducted in 2018–2019. The MCS oversampled children from areas with a high proportion of ethnic minority groups and disadvantaged families using a stratified cluster sampling procedure. Unlike many longitudinal studies, the MCS interviewed fathers or mother's partners in the household (where applicable) with questions about demographics, family routines, socioeconomic status, and health. In each wave, interviews were carried out by trained interviewers, with information provided by the primary caregiver, usually the mother (about 99% at wave 1, 96% by wave 7), the caregiver's resident partner (i.e., father and step-parents/partner), and as the child grows older, from the cohort member (waves six and 7). The most common response from a non-natural parent was a male step-parent/partner (about < 1% at wave 1, 8% by wave 7). Hence, unless otherwise specified, references to primary caregiver refer to maternal influences (mainly the mother) and secondary caregiver refer to the paternal influences of the resident partner of the primary caregiver (usually the father otherwise step-parents/partner), respectively. Our definition of "parental" included both primary caregiver and secondary caregiver. The numbers of responding families at waves 1, 2, 3, 4, 5, six and seven were 18,552, 15,590, 15,246, 13,857, 13,287, 11,726 and 10,625, respectively. We included only singletons (i.e., not twins or other multiple

pregnancies) in our analyses to ensure independence of observations and to prevent clustering by family. According to the MCS technical report of responses, attrition at the age of 17 was predicted by single-parent families, lower-income occupation, lower educational-level, and Black ethnicity [16]. Attrition weights were used to handle nonrandom attrition [16]. The data collection of MCS is approved by the UK National Health Service Research Ethics Committee, and written consent was obtained from all participating parents at each survey; MCS1: South West MREC (MREC/01/6/19); MCS2 and MCS3: London MREC (MREC/03/2/022, 05/MRE02/46); MCS4: Yorkshire MREC (07/MRE03/32); MCS5: Yorkshire and The Humber-Leeds East (11/YH/0203); MCS6: London MREC(13/LO/1786). No additional ethical approval was needed for this secondary data analysis.

Measure

Components of exposure trajectories: poor primary caregiver mental health, poor secondary caregiver mental health, and poverty. The main exposures were trajectories of primary caregiver mental health, secondary caregiver mental health, and poverty at different times of follow-up. A binary score was constructed at each wave for all exposures included in the trajectories throughout childhood to midadolescence [4] (for full details, see Box 1). We then created categories for these exposures based on modelled trajectories from 9 months to 14 years of age (details below).

Outcomes. The main outcomes of interest were parent- and child-reported socioemotional behavioural problems, cognitive disability, and mental health problems when the children were 17 years old. Children socioemotional behavioural problems were measured using the strengths and difficulties questionnaire (SDQ). The SDQ scores in the MCS at the age of 17 were obtained from both primary and secondary caregivers and cohort members, which consist of a 25-item questionnaire with five scales (hyperactivity, emotional symptoms, conduct disorders, peer problems, and prosocial behaviour), with each consisting of five items on a 3-point scale ordinal response scale with the following answer options: 0 (not true), 1 (somewhat true), and 2 (certainly true). We used the total difficulties score (excluding prosocial behaviour items, score range 0–40) to classify children in two groups, and applied a validated cut-off of 0–16 'normal to borderline behaviour problems', and 17–40 'socioemotional behavioural problems' for parent-reported socioemotional behavioural problems. For child-reported SDQ, a validated cut-off of 0–19 indicates 'normal to borderline behaviour problems' and 20–40 indicates 'socioemotional behavioural problems'. The reliability and internal consistency for this measure was high for both parent-reported SDQ (Cronbach's $\alpha = 0.83$) and child-reported SDQ (Cronbach's $\alpha = 0.77$). Cognitive disability was assessed through the number analogies' measure. The number analogies are a short version of the quantitative reasoning battery, which assessed children's reasoning ability with numbers. The test has 10 different number activities and five possible answers for each cognitive test. We applied a widely used validated cut-off score of -1.25 standard deviation (SD) below the normed mean score [17] to define children as having cognitive disabilities. Adolescent mental health was measured using the Kessler 6 (K6) scale. The K6 assesses mental health symptoms by asking respondents how frequently they

Box 1. Description of measurements assessed for trajectory exposures

- **Poor primary & secondary caregiver mental health (Child aged 9 months)** – Rutter Malaise Inventory scale was used to assess primary and secondary caregiver mental ill health in the last 30 days. A shortened 9-item self-completed version of the Rutter Malaise Inventory measuring depression, anxiety and psychosomatic illness was used. The 9-item short form included items 'feel tired most of the time', 'feel miserable or depressed', 'worried about things', 'often get into violent rage', 'suddenly become scared for no good reason', 'easily upset or irritated', 'constantly keyed up or jittery', 'every little thing gets on nerves and wears you out', and 'heart race like mad'. Scores from these items were summed, and we used a validated cut off for mental ill health ['yes (scores ≥ 4)/no'] [4].
- **Poor primary & secondary caregiver mental health (Child aged 3 to 14 years)** – K6 scale was used to assess primary and secondary caregiver mental ill health in the last 30 days asking the responders how often they felt depressed, hopeless, restless or fidgety, worthless, or that everything was an effort. Respondents answered on a five-point scale from 1 (all the time) to 5 (none of the time). We reversed and rescaled all items from 0 to four for analysis purposes, so that high scores indicate high levels of psychological distress. We used a validated cutoff widely used in previous studies ['yes (scores ≥ 6)/no'] [4].
- **Poverty (Child aged 9 months to 14 years)** – relative income poverty, defined as household equivalised income of less than 60% of national median household income equivalised* according to the Organisation for Economic Co-operation and Development household equivalence scale. Household income was reported by the main respondent (usually the primary caregiver) at each wave.

* "Equivalised" means that the Organisation for Economic Co-operation and Development household equivalence scales were applied to net income figures, which takes into account the number and age of adults and dependents in the household, giving a more accurate representation of a household's available resources relevant to its size and composition. This equivalised income measure is commonly used in studies of poverty in the UK, including using MCS [4].

experienced six key symptoms (depression, hopelessness, restlessness or fidgetiness, worthlessness, or difficulty making an effort) in the past 30 days. Total scores range from 0 to 24, with higher scores indicating more severe symptoms. We applied the severe cut-off of ≥ 13 , usually considered indicative of clinical level of psychological distress or serious mental illness [18]. Internal consistency and reliability was Cronbach's $\alpha = 0.86$.

Covariates. We considered child's sex, maternal education (degree plus, diploma, A-levels, GCSE A-C, GCSE D-G, or none), maternal ethnicity (White, mixed, Indian, Pakistani and Bangladeshi, Black or Black British, or other ethnic groups) when the child was aged 9 months as potential confounding factors

associated with the exposures and outcomes [4,19], on the basis of directed acyclic graph (Appendix, pp 1).

Statistical analysis. The analysis was carried out in three steps. The first step consisted of identifying distinct subgroups of children who shared similar underlying trajectories of poverty and parental mental health trajectories from 9 months to 14 years of age. For this purpose, we used a group-based multitrajectory modelling (GBTM) approach [20,21] and followed a three-stage model selection process. First, we used the TRAJ procedure in Stata (version 14.2) [20] to fit between 1 and six trajectory clusters using logistic regressions with cubic trajectory functions of age (see [Supplementary Material](#) for more details on the model specification). Second, to guide the choice for the optimal number of trajectories, we used fit indices from the Bayesian information criterion (BIC) as recommended by Nagin and Odgers [20]. The chosen number of trajectories was determined by the change in the rate of decrease of the BIC, where BIC values closest to zero were used to determine the best fit model (Appendix, pp 5). Full-information maximum likelihood was used to account for missing data on primary caregivers' exposures [20,21], while secondary caregivers with full information on all exposures were used for analysis. Third, the adequacy of the final model was assessed using average posterior probabilities of assignment (AvePP > 0.70) and odds of correct classification based on the posterior probabilities of group membership (odds of correct classification > 5.0) (Appendix, pp 5), calculated for each trajectory group. Individuals were assigned to the group having the highest posterior probability (i.e., using the maximum probability assignment rule). Further, we qualitatively judged that the best-fit five trajectory groups divided the individuals optimally and had sufficient sample sizes in each identified group (i.e., 5% minimum membership requirement) [21].

The second step of the analyses consisted of conducting logistic regressions, using odds ratio (ORs) and 95% confidence intervals (CIs) to assess the associations between predicted parental caregivers' mental health and poverty trajectories and socioemotional behavioural problems, cognitive disability, and adolescent mental health problems. We tested two regression models as follows: an unadjusted model (model 1) to assess the relationship between predicted trajectory groups and each outcome of interest and an adjusted model that controlled for confounders (model 2). Both models included longitudinal weights that accounts for attrition and response bias.

Third, we applied population-attributable fraction (PAF) [22] to estimate the proportion of adolescent mental and behavioural problems that could be prevented if exposure to poverty and caregivers mental health problems during childhood developmental stages were eliminated or reduced to the levels of children who experience low adversity (see [Supplementary Material](#) for more details on the model specification).

All statistical analyses were undertaken using STATA 14.2. The written user command *traj* [23] was used to estimate GBTM and *punaf* [24] was used to calculate PAF, CIs for PAF, and scenario means and their ratio. *Punaf* uses the method for estimating PAFs recommended by Greenland and Drescher for cohort studies [25].

To test the robustness of our results, we repeated the main analysis using multiple imputation by chained equation ($n = 20$) with results pooled using Rubin's rules [26] to address missingness in the predictor and outcome variables. Second, we

repeated the analysis using the multiple pseudo-class draw method [27] (20 draws) to account for uncertainty that may arise in group membership. We also included interaction terms to examine whether the relationship between the identified trajectory groups and outcomes varied by child's sex.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

Study population characteristics

Of the 14,443 families who were eligible at the age of 17 (wave 7), 10,500 responded and were analyzed (Figure 1). 6564 (63%) of this sample were families in which the secondary caregiver information was analyzed.

Figure 2 shows the weighted estimated cross-sectional child-level prevalence of primary and secondary caregiver mental health and poverty. The prevalence of poor caregivers mental health increased with age of the child for both primary caregiver (13.6%, 95% CI 12.9%–14.3% at the age of 9 months vs. 32.1%, 30.7%–33.5% at the age of 14 years) and secondary caregiver (9.0%, 8.8%–9.9% at the age of 9 months vs. 22.8%, 21.5%–24.2% at the age of 14 years). The prevalence of household poverty increased from (30.3%, 28.3%–32.2% at the age of 9 months vs. 34.6%, 32.2%–37.1% at the age of 14 years).

Exposure trajectories

We identified five distinct trajectory groups based on life course patterns of poverty and primary and secondary caregiver's mental health (Figure 3). 4912 (46.8%) children belonged to the low poverty and good parental (primary and secondary caregiver) mental health group during the entire childhood. The persistent poor primary caregiver's mental health trajectory group (1187 children, 11.3%) was characterized by a high probability of exposure to poor primary caregiver mental health over time. The persistent poor secondary caregiver's mental health trajectory group (961 children, 9.2%) was characterized by a high probability of exposure to poor secondary caregiver's mental health. The persistent poverty group comprising 2289 children (21.8%) was characterized by a high probability of childhood exposure to poverty. The persistent poverty and poor parental (primary and secondary caregiver) mental health group (1151 children, 10.9%) was characterized by children who were more likely to experience co-occurrence of persistent poverty and poor primary caregiver and secondary caregiver's mental health throughout childhood.

Table 1 shows the characteristics of the cohort participants by the five estimated trajectory groups (see imputed estimates in Appendix, pp 6). All the baseline characteristics and adolescent mental and behavioural health outcomes differed among the different trajectory groups. A clear education gradient was observed, where, for instance, 6.0% of children in the low poverty and good parental mental health group had mothers with no educational qualifications compared to 43.5% of children in the

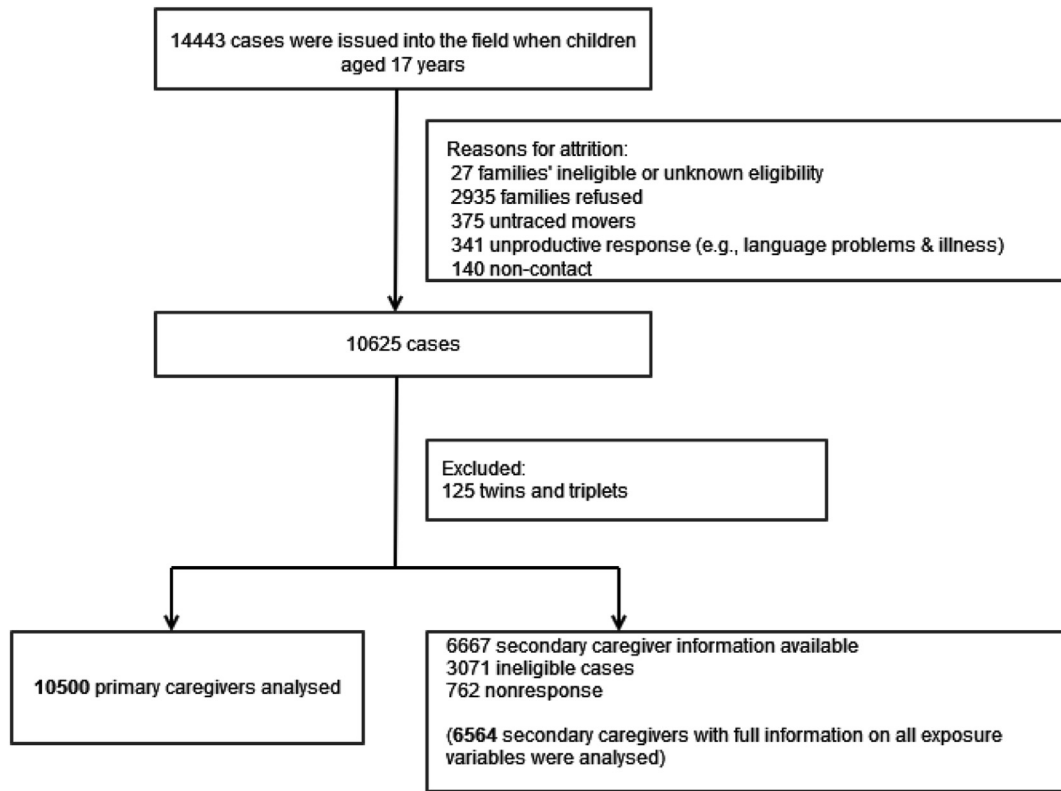


Figure 1. Study flow diagram showing inclusion and exclusion of cohort participant.

persistent poverty and poor parental mental health. Children in the persistent poverty and poor parental mental health group were more likely to be of nonWhite ethnicity than those in low poverty and good parental mental health. Approximately 23% of children in the persistent poverty and poor parental mental health group had Pakistani or Bangladeshi mothers compared to about 1% in the low poverty and good parental mental health. As expected, the prevalence of socioemotional behavioural problems, cognitive disability, and poor adolescent mental

health was higher in the persistent poverty and poor parental mental health group and lower in the low poverty and good parental mental health.

Associations between exposure trajectories and adolescent mental health outcomes

Table 2 and Figure 4 shows the associations of predicted trajectory groups and adolescent mental and behavioural health

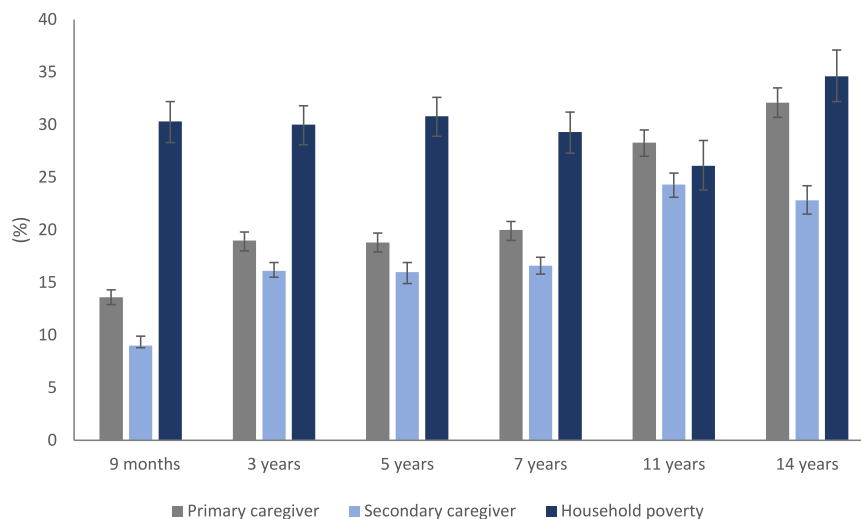


Figure 2. Estimated child-level prevalence for poor parental mental health (primary and secondary caregiver) and household poverty in the UK millennium cohort study (MCS), and weighted sample.

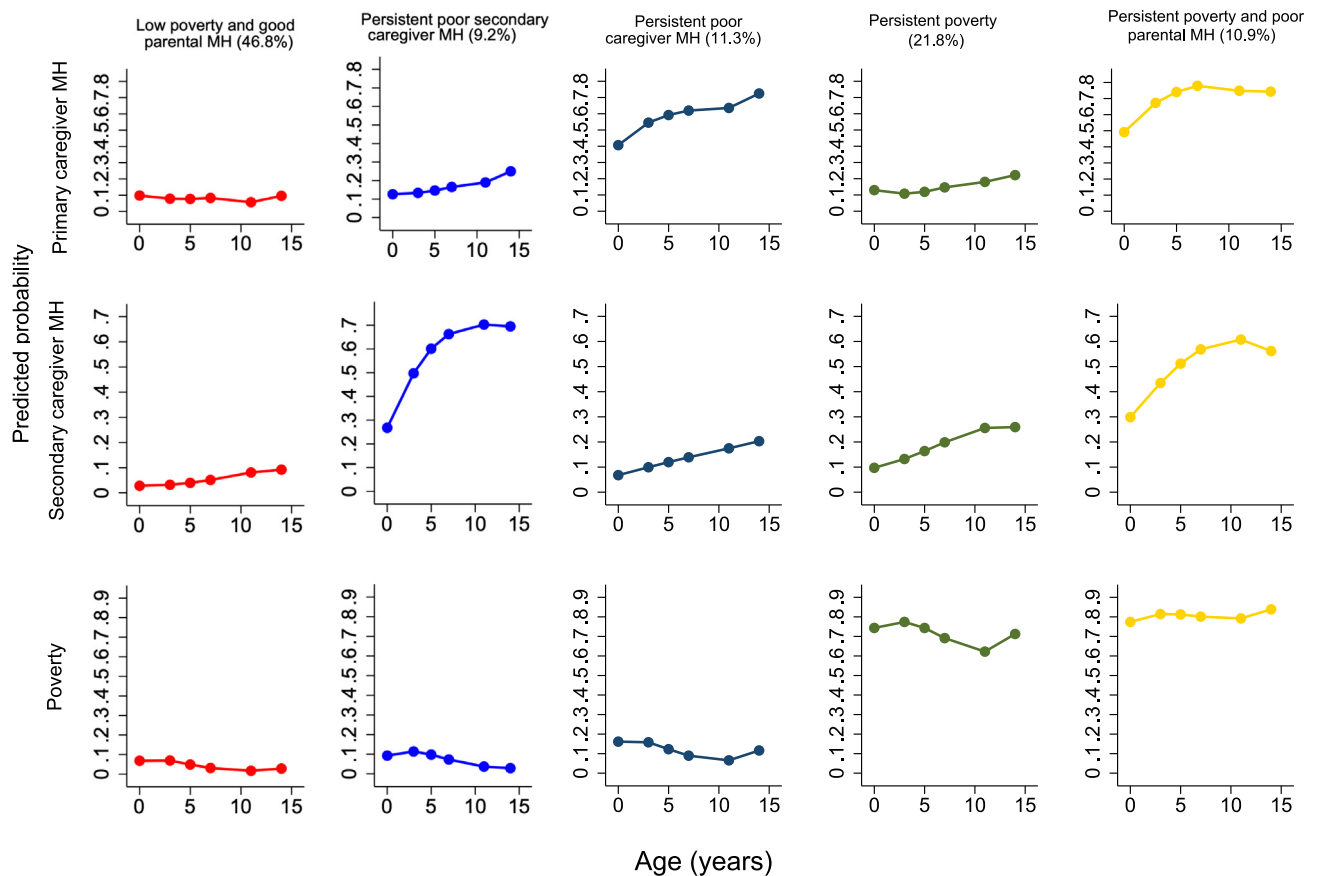


Figure 3. Estimated trajectory of caregivers' mental health and poverty in the UK MCS.

outcomes at the age of 17 years. Both the crude model (model 1) and adjusted model (model 2) showed that all children in the persistent poverty, primary and secondary caregiver (parental) mental health groups have worse mental and behavioural health outcomes at the age of 17 years. For example, the adjusted model (model 2) showed that when compared with children exposed to low poverty and good parental mental health, those who experienced the combination of poverty and poor primary caregiver and secondary caregiver mental health had 4.2 times the odds (95% CI: 2.7–6.7) of having maternal reported socioemotional behavioural problems at the age of 17. For socioemotional behavioural problems—child reported, the adjusted ORs was 2.2 (95% CI: 1.5–3.3), for mental health problems the aOR was 2.5 (CI: 1.6–3.9) and for cognitive disability the aOR was 1.7 (CI: 1.1–2.5). For adolescent mental health at the age of 17, the impact of exposure to persistent poor primary caregiver mental health was similar to that of persistent secondary caregiver mental health (Table 2 and Figure 4). We observed a slight attenuation in most of the associations in the adjusted model (model 2) when compared to the crude model (model 1) after adjusting for sex, maternal education, and ethnicity. A sensitivity analysis using imputed data ($n = 20$) (Appendix, pp 7) and the multiple pseudo-class draw method [27] showed similar results as the main analysis (Appendix, p 8). Furthermore, we observed that associations were of similar magnitude when comparing the analyses by primary caregiver and secondary caregiver separately (Appendix, pp 9–12). We

also repeated our analyses using information from stable resident two caregiver families across all waves ($N = 5538$) to assess any difference between families with or without a secondary caregiver. The results were very similar (Appendix, pp 13–14).

Population attributable fraction (PAF)

Figure 5 shows the burden of adolescent mental and behavioural health outcomes attributable to each trajectory group. The PAF was calculated by comparing two scenarios: a hypothetical scenario in which all children were in the low poverty and good parental mental health trajectory, and the real world in which there are children in the low poverty and good parental mental health and other trajectories.

Overall, the identified exposure trajectories contributed substantially to the burden of adolescent mental and behavioural health outcomes at the age of 17 years. For example, about 40% of the cases of socioemotional behavioural problem at the age of 17 in this UK cohort (adjusted PAF 40.0%, 95% CI: 22.7%–50.1%) were attributable to exposure to poverty and parental mental health problems. In other words, if all children in the UK had the exposure trajectory of low poverty and good caregiver mental health, we would see a reduction of socioemotional behavioural problems of 40%, assuming causality. Breaking down the contribution of the specific adversity trajectories further, the persistent poverty trajectory and persistent poverty plus poor

Table 1

Baseline characteristics and adolescent mental and behavioural health outcomes by the five estimated trajectory groups, observed data, and weighted sample

Characteristics	Predicted parental mental health and poverty trajectories				
	Low poverty and good parental mental health (n = 4912)	Persistent poor secondary caregiver mental health (n = 961)	Persistent poor primary caregiver mental health (n = 1187)	Persistent poverty (n = 2289)	Persistent poverty and poor parental mental health (n = 1151)
Female	2424 (49.4%)	444 (46.2%)	569 (48.0%)	1115 (48.7%)	509 (44.2%)
Missing	113 (2.3%)	23 (2.4%)	34 (2.9%)	124 (5.4%)	74 (6.4%)
Maternal education					
Degree plus	1461 (29.7%)	248 (25.8%)	233 (19.6%)	50 (2.2%)	22 (1.9%)
Diploma	606 (12.3%)	124 (12.9%)	114 (9.6%)	72 (3.2%)	20 (1.7%)
A-levels	605 (12.3%)	122 (12.7%)	130 (10.9%)	120 (5.2%)	42 (3.7%)
GCSE A–C	1544 (31.4%)	300 (31.2%)	425 (35.8%)	699 (30.5%)	307 (26.7%)
GCSE D–G	289 (5.9%)	57 (5.9%)	116 (9.7%)	320 (13.9%)	177 (15.4%)
None	293 (6.0%)	84 (8.7%)	134 (11.3%)	895 (39.1%)	501 (43.5%)
Missing	114 (2.3%)	26 (2.7%)	35 (3.0%)	133 (5.8%)	82 (7.1%)
Maternal ethnicity					
White	4445 (90.5%)	820 (85.5%)	1001 (84.3%)	1432 (62.6%)	680 (59.1%)
Mixed	27 (0.6%)	7 (0.7%)	11 (0.9%)	45 (2.0%)	21 (1.8%)
Indian	115 (2.3%)	42 (4.4%)	46 (3.9%)	53 (2.3%)	31 (2.7%)
Pakistani and Bangladeshi	54 (1.1%)	15 (1.6%)	29 (2.4%)	430 (18.8%)	260 (22.5%)
Black or Black British	95 (1.9%)	20 (2.1%)	33 (2.7%)	151 (6.6%)	51 (4.4%)
Other ethnic groups	54 (1.1%)	32 (3.3%)	30 (2.5%)	48 (2.1%)	32 (2.8%)
Missing	122 (2.5%)	25 (2.6%)	37 (3.1%)	130 (5.7%)	76 (6.6%)
Socioemotional behavioural problems (maternal reported)	223 (4.5%)	73 (7.6%)	145 (12.2%)	277 (12.1%)	225 (19.5%)
Missing	454 (9.2%)	88 (9.2%)	137 (11.5%)	411 (17.9%)	224 (19.4%)
Socioemotional behavioural problems (child reported)	312 (6.4%)	74 (7.7%)	114 (9.6%)	217 (9.5%)	146 (12.7%)
Missing	313 (6.4%)	67 (6.9%)	86 (7.3%)	262 (11.5%)	131 (11.3%)
Cognitive disability	301 (6.1%)	68 (7.1%)	91 (7.7%)	263 (11.5%)	179 (15.6%)
Missing	399 (8.1%)	87 (9.1%)	116 (9.8%)	361 (15.8%)	195 (16.9%)
Poor adolescent mental health	609 (12.4%)	165 (17.1%)	196 (16.5%)	356 (15.6%)	214 (18.6%)
Missing	307 (6.3%)	64 (6.7%)	81 (6.8%)	268 (11.7%)	132 (11.5%)

parental mental health trajectory contributed the highest PAF across all adolescent mental and behavioural health outcomes. For example, the PAF was 16.7% (95% CI: 7.7%–24.8%) for the persistent poverty trajectory and 16.0% (95% CI: 9.7%–21.8%) for the persistent poverty and poor parental mental health trajectory for socioemotional behavioural problems (Figure 5).

Discussion

In a large contemporary, population-based cohort from the UK, we found evidence that both primary caregiver (typically the child's mother) and secondary caregiver (usually the child's father, step-parents/partner) health co-occur with family poverty in one in 10 children, with more than half of UK children being exposed to some degree of poverty and parental (caregivers) mental health problems, alone or in combination. These exposures, in isolation or in combination, were strongly associated with adverse mental and behavioural health outcomes. Our study, importantly, demonstrates a similar impact of mental health problems in either caregiver on adolescent mental health outcomes and some evidence of clustering and accumulation whereby mental health problems in both caregivers and family poverty combine to have large negative impacts on the mental health of the next generation.

Over 10% of children experienced persistent poverty and persistent poor mental health in both caregivers up to the age of 14 years, which was associated with over 4 times the odds of adolescent socioemotional behavioural problems and more than a 2-fold increased risk of mental health problems at the age of

17 years. The estimated attributable fraction for adolescent mental health problems attributable to having experienced persistent mental health problems in both caregivers and household poverty ranged from 22% to 40%. Mental health problems in either caregiver have a broadly similar impact, leading to a roughly 50% increase in the odds of adolescent mental health problems, the same as the impact of persistent poverty.

Our study is unique in that, to our knowledge, it is the first to explore the life course mental health and poverty trajectories of both parental caregivers and their impacts on the health of the next generation at the point of transition to adulthood. Furthermore, no study in the UK has calculated PAFs to estimate the proportion of adolescent mental health problems associated with trajectories of family-related adversities. Although one of the most important risk factors for adolescent health is parental mental illness [4,28], there are few studies on the relationship between paternal mental health and adolescent physical and mental health [10,29,30]. Few studies exist in the UK [12], but the longitudinal experience of children yet to be captured across childhood and adolescence. In this current study, we used the life course concept of trajectories [31], which implies a long-term approach, taking into account critical and sensitive periods across the developmental stages to unpick the complex interrelationships that exist among multiple family-related risk factors.

We identified five distinct life course trajectories of poverty and primary and secondary caregiver mental health, spanning from the age of 9 months to 14 years, and found that children in

Table 2

Associations of predicted poverty and parental caregivers' mental health trajectories and adolescent mental and behavioural health outcomes at the age of 17 years in the UK MCS

OR	Model ^a	Low poverty and good parental mental health	Persistent poor secondary caregiver mental health	Persistent poor primary caregiver mental health	Persistent poverty	Persistent poverty and poor parental mental health
Socioemotional behavioural problems (SDQ \geq 17) maternal reported	1	Ref.	1.33 (0.91–1.93)	2.38 (1.67–3.39)	3.28 (2.20–4.88)	5.68 (3.85–8.38)
Socioemotional behavioural problems (SDQ \geq 20) child reported	1	Ref.	1.29 (0.88–1.89)	2.06 (1.39–3.06)	2.39 (1.58–3.61)	4.23 (2.67–6.71)
Cognitive disability	1	Ref.	1.29 (0.90–1.86)	1.77 (0.99–3.14)	2.71 (1.74–4.22)	2.75 (1.96–3.88)
Poor adolescent mental health	1	Ref.	1.32 (0.89–1.95)	1.64 (0.92–2.94)	1.75 (1.09–2.82)	1.69 (1.14–2.52)
	2	Ref.	1.56 (1.09–2.23)	1.82 (1.28–2.58)	1.83 (1.30–2.59)	2.24 (1.51–3.32)
	2	Ref.	1.32 (0.89–1.95)	1.64 (0.92–2.94)	1.75 (1.09–2.82)	1.69 (1.14–2.52)
	2	Ref.	1.50 (1.17–1.93)	1.45 (1.12–1.87)	1.40 (1.03–1.89)	2.29 (1.43–3.66)
	2	Ref.	1.62 (1.24–2.11)	1.46 (1.11–1.92)	1.58 (1.16–2.16)	2.52 (1.62–3.93)

SDQ = strength and difficulties questionnaire.

^a Model 1 - crude model; Model 2 – adjusted for child's sex, maternal education, and maternal ethnicity.

the adversity trajectory groups have worse mental and behavioural health outcomes at the age of 17 years. It is worth noting that approximately 9% of children in the UK experienced persistent poor secondary parental caregiver (usually paternal) mental health. We observed that secondary caregiver mental health problems are associated with an increased risk of adolescent mental health and behavioural problems [9], similar in magnitude to that due to primary caregiver mental health problems [10].

This evidence supports the intuitive hypothesis that children's and adolescents' well-being depends to a large extent on the family environment [32]. The potential mechanisms through which paternal mental health problems increase the risk of adolescent mental health problems are still unclear but may include environmental mechanisms such as family violence, genetics [9,10], and parent (father) child attachment relationships and engagement (direct interaction with the child) [10,33]. Indeed, many secondary caregivers now play a more active role in child care activities than they did in the past [34], and their involvement during the early and late childhood periods may

affect the extent to which children and adolescents are affected by secondary caregivers health (physical or mental) [33].

Another important finding in our study is the co-occurrence of primary caregiver and secondary caregiver mental health and family poverty and the synergistic impact of these exposures on adolescent mental health and behavioural problems. Over 50% of children were in trajectories with persistently high exposure to poverty and/or poor primary caregiver and secondary caregiver mental health, and all these exposures were independently associated with an increased risk of adolescent mental health problems. Those exposed to a combination of persistent family poverty and poor primary and secondary caregivers' mental health (10.9%) had over four times the odds of socioemotional behavioural problems at the age of 17 compared with children in low adversity group. The pathways through which poverty affects parental mental illness are increasingly becoming clearer [9,10,35,36]. The social conditions of poverty, including family stress, low quality of housing, and home environment, are known mechanisms that may increase the risk of parental mental health problems [35], and conversely, families

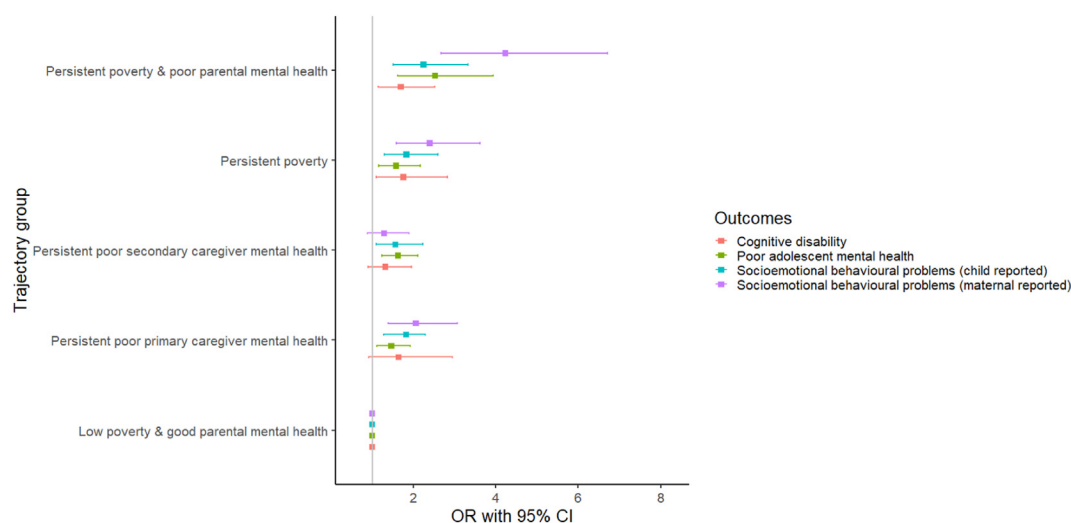


Figure 4. Associations of predicted poverty and parental caregivers' mental health trajectories and adolescent mental and behavioural health outcomes at age 17 years in the UK MCS. Models adjusted for child's sex, maternal education, and maternal ethnicity.

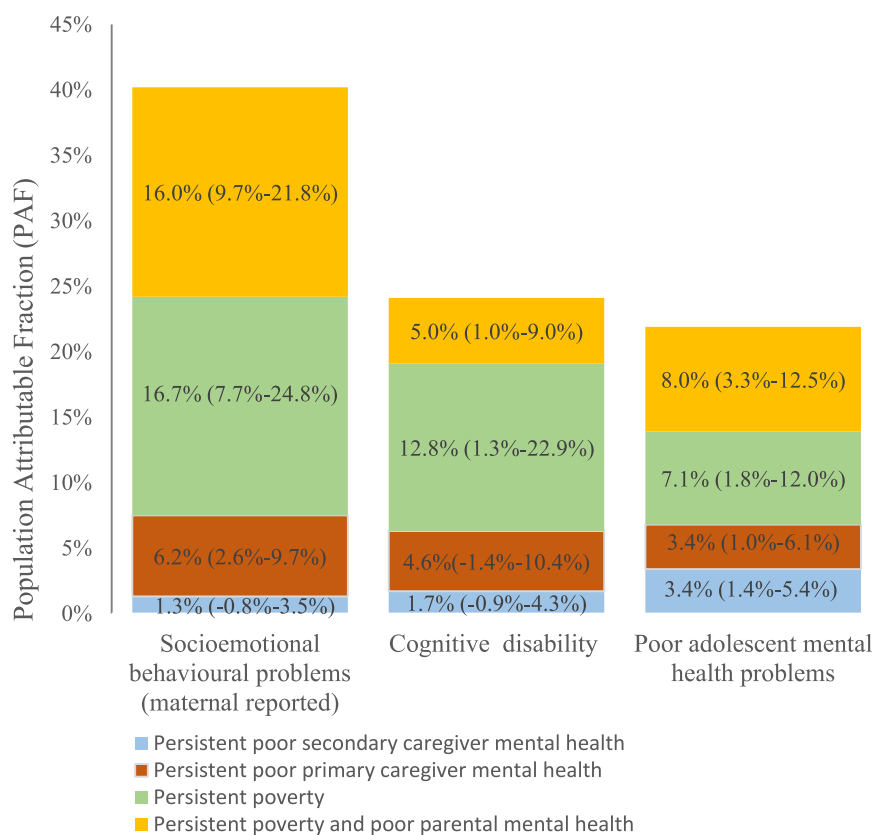


Figure 5. Population-attributable fractions of trajectory groups. Compared to the low poverty and parental mental health trajectory, the overall proportion of socioemotional behavioural problems, cognitive disability, and poor adolescent mental health-attributable to persistent poverty and parental mental health trajectories was 40.0% (95% CI 22.7%–50.1%), 24.1% (95% CI 8.2%–36.2%), 21.9% (95% CI 13.0%–28.4%) respectively.

living with mental health issues are more likely to drift into or remain in poverty [7,35]. Our findings, based on a population-based longitudinal study, add to the current body of evidence by showing that the coexistence of parental caregiver mental health problems is strongly connected to poverty, and their persistence over time is also associated with adverse adolescent health and behavioural outcomes.

Our study further contributes to the sparse longitudinal evidence by quantifying the contribution of caregivers' mental health problems and poverty to adverse outcomes at the country level, which provides information regarding the potential public health impact of family adversity and poverty on adolescent mental and behavioural health outcomes. We found that both parental mental health and household poverty contributed substantially to the burden of adolescent mental and behavioural health outcomes at the age of 17 years. However, poverty accounted for a large proportion of the burden of adverse adolescent developmental outcomes, consistent with prior studies [37]. This reinforces findings from previous studies, demonstrating that poverty is an important modifiable structural risk factor in the clustering and accumulation of adverse childhood experiences [4,15].

This study has several other strengths. First, we used secondary data from a large, contemporary, nationally representative UK birth cohort and believe our results are likely to be generalizable to high-income countries where poverty and parental mental health problems are highly prevalent. The

conclusions in this study are strengthened by the robust tests showing similar effects across different models. Our study was unique in that we further assessed the impact of secondary caregiver mental health along with primary caregivers' mental health. We observed similar effects when using different measures of adolescent mental health (i.e., SDQ maternal-reported vs. SDQ child-reported). Second, we used rigorous and robust modelling techniques to predict multiple risks over time [20,21] and further assessed the public health impact of these risk in the population using PAFs [22]. The PAF estimates provided a useful way to express the potential burden of adolescent mental and behavioural health outcomes associated with parental mental health problems and poverty in the UK, taking into account both the prevalence of poverty and parental mental health problems and the relative risk of the outcomes associated with both exposures (i.e., poverty and mental health).

Despite these strengths, some important limitations deserve discussion. First, the classification of individuals into distinct trajectories may not be perfect [38], and we acknowledge that the current labels may not fully capture the complexity of the population. Second, although the GBTM technique is useful for identifying distinct developmental trajectories [20,21], the shapes of the polynomial curves lack flexibility [21]. Nonetheless, the variability in the shapes of the curves may not have any impact on our estimates, as GBTM models have a high ability to classify individuals into groups based on the highest probability [21]. Moreover, the focus of this study was particularly on the

trajectory groups themselves and the associations with later outcomes rather than the exact shape of the polynomial curves. Third, there are also some limitations related to the use of PAFs. PAFs rest on the assumption that relationships between exposure and outcome are similar to the true causal effect. Fourth, although our exposure and outcome indicators were assessed using validated measures and cut-offs, they could be subjected to reporting bias as they were based on self-reports. Meanwhile, we believe that any potential bias or measurement error may be low, as we found high reliability and internal consistency for some of the measures (e.g., parent and child version of the SDQ), and the results were similar despite the associations being attenuated in some cases. For adolescent mental health, although clinical diagnoses were not measured in the MCS, this study applied clinical level cut-offs of the K6 scale (≥ 13 –24) to assess adolescent mental health status. Furthermore, the response bias and random error for self-reported income have been shown to be quite low in previous studies [39]. Fifth, the sample for secondary caregivers' mental health in the MCS was modest in size compared to maternal mental health, but this study was able to explore long-term secondary caregivers' mental health problems, which were associated with socioemotional and behavioural problems in adolescents, consistent with prior reviews [9]. Lastly, although we have shown that the relationship between poor caregiver mental health and family poverty largely persisted across the childhood and early adolescent developmental stages to impact negatively on adolescent mental and behavioural health outcomes, data about possible unmeasured confounding factors such as genetics were not analyzed due to data constraints.

Nonetheless, this study provides a novel methodological framework and lifecourse research into child poverty and household caregivers' mental health problems that simultaneously incorporate secondary caregivers' mental health problems over time. The existing literature on parental mental illness tends to focus on maternal mental illness and largely ignores paternal mental health as a contributing factor to children's and adolescents health problems. We add this to the literature by further quantifying the total burden of adolescent developmental problems attributable to both primary and secondary caregiver mental health problems. Indeed, we found that persistent secondary caregiver mental health alone contributes about 3.4% of the burden of adolescent mental health problems, while the coexistence of persistent primary and secondary caregivers' mental health and poverty contributes about 21.9% of the burden of adolescent mental health problems, 24.1% of the burden of cognitive disability and 40.0% of the burden of socioemotional behavioural problems at the age of 17 years.

Both poverty and mental health problems are of particular concern to the UK government [36]. It is even more concerning that these issues are contributing substantially to the burden of adolescents' health and development, which are likely to have adverse implications for social policies and associated social and economic cost [36]. Currently, one in six children and young people in the UK have mental health problems [40], while one in three children is in poverty [6]. Even before the COVID-19 pandemic, rising levels of poverty and mental health problems among the UK population were urgent problem [36]. Therefore, it is now critical that the UK government's postpandemic recovery agenda ensure that the next generation is protected from family-related adversities that co-occur with poverty. We have argued elsewhere that policy interventions to address the coexistence of

poverty and mental health issues are likely to be complex and multilevel [4]. Nonetheless, child poverty is an easily modifiable risk factor if there is political will, and recent studies in the UK and the US suggest that policy interventions to reduce or end child poverty are among the most cost-effective solutions [3].

Improving socioeconomic conditions is likely to be necessary to reduce both family-related adversities and their impact on child health and poor health outcomes across the lifecourse in the UK [8]. From a policy perspective, our analysis suggests that this approach could lead to a large reduction in the burden of societal mental health problems with huge cost-savings across all sectors of government. For instance, the lifetime costs of childhood mental health conditions are estimated to amount to around US \$300,000 (equivalent to £260,000) in lost family income [41]. In 2020, there were an estimated 371,935 17-year-olds living in the UK [42]. According to a recent report by the health foundation, 1 in six adolescents was living with a mental health condition in the UK [43], equivalent to around 62,000 17-year-olds. If 40% of these potential cases (equivalent to around 25,000 cases) can be avoided by reducing poverty and parental mental health problems to the levels seen in about half of adolescents in the UK, then the potential lifetime improvement in earnings across these adolescents is equivalent to around £6.5bn. This increased productivity will generate significant returns to the exchequer in increased tax revenues and contribute to the levelling-up agenda.

In summary, our study highlights the close interconnection and synergistic interaction between child poverty and caregivers' mental health problems and their subsequent large negative impacts on health and behaviour outcomes in later life. Meanwhile, in the UK, there are few policy efforts designed to address both poverty and mental health issues *simultaneously and synergistically* [36]. Although multiple reports and new studies have outlined policies to address parental mental health problems and poverty in the UK (e.g., reversing changes to social welfare benefits that have led to rising child poverty, providing support to children and families through children's centres and improving access to mental health services for families) [4,44], our longitudinal analysis re-enforces the need for holistic policies informed by the concept of syndemics [14]. Policies that act synergistically to address the clustering of childhood adversities, particularly child poverty and parental mental health problems, rather than focusing on single issues could dramatically improve developmental outcomes among adolescents in the UK.

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Supplementary Data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jadohealth.2023.07.029>.

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