



## King's Research Portal

DOI:

[10.1080/00224499.2021.1959509](https://doi.org/10.1080/00224499.2021.1959509)

*Document Version*

Peer reviewed version

[Link to publication record in King's Research Portal](#)

*Citation for published version (APA):*

Xu, Y., Norton, S., & Rahman, Q. (2022). Adolescent Sexual Behavior Patterns, Mental Health, and Early Life Adversities in a British Birth Cohort. *JOURNAL OF SEX RESEARCH*, 59(1).  
<https://doi.org/10.1080/00224499.2021.1959509>

### **Citing this paper**

Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

### **General rights**

Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Research Portal

### **Take down policy**

If you believe that this document breaches copyright please contact [librarypure@kcl.ac.uk](mailto:librarypure@kcl.ac.uk) providing details, and we will remove access to the work immediately and investigate your claim.

**Adolescent Sexual Behavior Patterns, Mental Health, and Early Life Adversities in a  
British Birth Cohort**

Yin Xu<sup>a\*</sup>, Sam Norton<sup>b</sup>, and Qazi Rahman<sup>b</sup>

<sup>a</sup>Clinical Epidemiology and Biostatistics, School of Medical Sciences, Örebro University,  
Örebro, Sweden

<sup>b</sup>Department of Psychology, Institute of Psychiatry Psychology & Neuroscience, King's  
College London, London, UK.

**Correspondence Author:** Yin Xu (Orcid ID: 0000-0003-3718-4715), Clinical Epidemiology  
and Biostatistics, School of Medical Sciences, Campus USÖ, Örebro University, SE-703 62  
Örebro, Sweden; E-mail: yin.xu@oru.se

**Keywords:** sexual behavior; adolescence; mental health; early life adversity; MCS

**Acknowledgements:** The authors are extremely grateful to all the families who took part in  
the Millennium Cohort Study. We are also grateful to the Centre for Longitudinal Studies,  
Institute of Education for the use of the data and to the UK Data Archive and Economic and  
Social Data Service for making them available.

**Funding:** This research received no specific grant from any funding agency, commercial or  
not-for-profit sectors.

## **Adolescent Sexual Behavior Patterns, Mental Health, and Early Life Adversities in a British Birth Cohort**

### **Abstract**

This study tested adolescent sexual behavior patterns at age 14, their association with mental health at age 17 (psychological well-being, substance use, and self-harm attempts), and the influence of early life adversities upon this association. A British birth cohort (5,593 boys and 5,724 girls from the Millennium Cohort Study) was used. Latent class analysis suggested five subgroups of adolescent sexual behaviors: a “no sexual behavior” (50.74%), a “kisser” (39.92%), a “touching under clothes” (4.71%), a “genital touching” (2.64%), and an “all sexual activities” class (1.99%). Adolescents from the “kisser”, “touching under clothes”, “genital touching”, and “all sexual activities” classes reported significantly more substance use and self-harm attempt compared to adolescents from the “no sexual behavior” group. The associations became weaker after controlling early life adversities (reducing around 4.38% to 37.35% for boys, and 9.29% to 52.56% for girls), and reduced to a smaller degree after further controlling mental health variables at 14. The associations between sexual behaviors and psychological well-being became non-significant after controlling early life adversities. Adolescents who have engaged in low-intensity sexual activities at early age may have poorer reported mental health; a pattern that is stronger for girls; and early life adversity may partially explain this association.

*Keywords:* sexual behavior; adolescence; mental health; early life adversity; MCS

## Introduction

Early sexual debut may be a risk factor for subsequent poorer mental health (Ramrakha et al., 2000). However, prior studies have focused mostly on early sexual intercourse and ignored the diversity of sexual activities that adolescents may engage in. Different sexual behavior patterns may be associated with different health outcomes. Studying adolescents who have engaged in a range of sexual activities at early age (outside of simply sexual intercourse) could help identify adolescents with greater risk of negative health outcomes. This information could then inform the development of interventions targeted towards these groups.

There are few studies on a range of early sexual activities and mental health but those that exist have produced mixed results (Espinosa-Hernández & Vasilenko, 2015; Hershenberg & Davila, 2010; Hipwell et al., 2011). In general, this body of work suggest that sexual activities were associated with poorer mental health, and these associations are worse for girls than boys (Meier, 2007), possibly due to more negative appraisals (Donald et al., 1995) and greater social stigma attached to having earlier sexual experiences among girls compared to boys (Kreager et al., 2016). Prior studies also have important methodological limitations. Most studies are cross-sectional, likely to suffer from recall bias, and have difficulty in determining whether early sexual behaviors precede or are followed by mental health outcomes (Espinosa-Hernández & Vasilenko, 2015). Others have included only one sex (Hipwell et al., 2011), have small sample sizes (Hershenberg & Davila, 2010), or have included a restricted range of sexual activities (Wesche et al., 2017). Studies which use latent class or latent profile analysis, include risky sexual behavior outcomes (e.g., condom use) as indicators of latent class membership of adolescent sexual behaviors. These bias the estimates of any association between sexual behaviors and health-related outcomes (Vasilenko et al., 2015). Some studies also use complete cases to deal with missing information, and a two-step

approach for latent class analysis (LCA) with distal outcomes (Hipwell et al., 2011). Finally, almost all prior research do not control for early life adversities as potential confounders associated with adolescent sexual behaviors and health related outcomes (Hershenberg & Davila, 2010).

Early life adversity, which encompasses a range of negative exposures from infancy through adolescence (e.g., abuse, neglect, parental separation, parental psychopathology, domestic violence, familial socioeconomic inequality), is a prominent risk for all classes of mental health disorders in adolescence (Hughes et al., 2017). Prolonged exposures to adverse early life adversities could cause depletion of somatic and psychological resources without sufficient recovery, dysfunction of hypothalamic–pituitary–adrenal axis, deficits in emotional regulation, or increased attention to negative stimuli which increases risks for mental health problems (Pechtel & Pizzagalli, 2011).

Several versions of life history theory also propose that early life adversity may be associated with early sexual activities because it constrains physiological and behavioral development, dysregulates stress response systems, or acts as a forecast for possible negative future conditions which results in youth engaging in earlier sexual behavior (Del Giudice et al., 2015). The biosocial model suggests that early life adversity may be associated with earlier physical maturation and pubertal timing (Ellis, 2004), which is associated with early sexual activities due to the increases in pubertal hormones and sensation-seeking or impulsivity (Halpern et al., 1997; Suleiman et al., 2017). For example, one study reported that increase in testosterone during puberty was associated with earlier sexual intercourse among girls (Halpern et al., 1997). Other types of early life adversity, such as childhood maltreatment, may be associated with greater impulsivity (Liu, 2019), which is in turn associated with early sexual debut (Khurana et al., 2012). Problem behavior theory also suggests that behaviors that depart from social or age-graded norms (e.g., early sexual debut)

may tend to cluster together due to the common biological factors, perceived environment (e.g., lack of parental control or parental absence), and personality (e.g., poor impulse control) (Madkour et al., 2010).

Meta-analyses have found that some markers of early life adversity are associated with increased risk of poorer mental health (Hughes et al., 2017) and, in a separate meta-analysis, with early sexual debut (Xu et al., 2018). Although prior research is limited to studying sexual intercourse rather than exploring the relationship to the diverse range of sexual behaviors, they do suggest that the relationship between adolescent sexual behaviors and mental health outcomes may become either weaker or even reduce to non-significance when adverse early life adversities are controlled for. Thus early life adversity may be a common cause confounder between sexual behavior patterns and mental health.

In the present study we investigate; (1) whether there are subgroups of adolescent sexual behaviors at age 14 years via a LCA; (2) whether these sexual behavior patterns are associated with mental health outcomes at age 17 years via probability-weighted regressions; and (3) whether these associations remain after controlling for early life adversity (measured prospectively) and mental health at age 14. These research objectives were tested in a large, well-characterized British prospective birth cohort, the Millennium Cohort Study (MCS). The first seven years postnatally are characterized by important processes such as greater cognitive development from 5 to 7 years, and the sensitivity of brain development to early life events (Danese & McEwen, 2012; Ellis, 2004). The sex differences in somatic physiology, aggression, and social behavior expand during the middle childhood (6 to 11 years; Del Giudice, 2014). Thus, several developmental stages may be important sensitive periods for the influences of early life adversity upon early sexual behaviors and mental health outcomes. Accordingly, we classified the early life conditions into two relevant developmental periods, including postnatal before 7 years of age and postnatal after 7 years

of age. Given the exploratory nature of the LCA, we do not have specific hypotheses regarding the predicted number of subgroups. However, based on the extant literature reviewed, we hypothesized that there would be associations between clusters of adolescent sexual behaviors at 14 and mental health outcomes at 17; that these would be stronger for girls than boys; and that these association would become either statistically weaker or non-significant when measures of early life adversity were controlled for.

## **Method**

### ***Participants***

Participants were part of the MCS, an ongoing longitudinal study of children born in the UK between September 2000 and January 2002, which has been described in detail elsewhere (Connelly & Platt, 2014). To ensure adequate representation of ethnic minority and children living in disadvantaged areas, a random sample was collected from the eligible population using a disproportionate stratified cluster sampling design. The initial sample recruited 18,827 children from 18,552 families, and 1,389 new families who had moved into the sampling wards after their initial registration were recruited on the second occasion. Seven waves of the MCS cohort have been carried out so far. Attrition is a problem common to all longitudinal studies. Among 19,941 families, the proportion of productive cases were 93.03%, 78.18%, 76.46%, 69.49%, 66.63%, 58.80%, and 53.28% for wave 1 to wave 7, respectively. The drop out was mainly due to refusal. This study was performed in accordance with the Helsinki Declaration of 1975, as revised in 2008, and informed parental consent was obtained at each wave. No ethical approval is needed since secondary data were used which are completely anonymous and unidentifiable when we access. The current study analyzed MCS data reported by parents and children across different waves. Adolescents who reported a valid response of at least one item of Adolescent Sexual Activities Index (ASAI) at 14 years old were included,  $N = 11,317$  (5,593 boys and 5,724 girls). The majority of the

adolescents in the sample were ethnically White (78.89%), and the median equivalized weekly family income (divided the family weekly income by number of household members according to their weights on the modified Organisation for Economic Co-operation and Development's equivalized income scale) was 394.75£ when adolescents were 17 years old.

### ***Measures***

#### ***Sexual Behavior***

At 14 years old, adolescents reported whether they had engaged in any of ten sexual activities with another young person from the ASAI in the last 12 months (Hansen et al., 1999). For the assessment of ASAI in MCS, those sexual activities were presented in order from low (e.g., kissing) to high (e.g., have oral sex) intensity and were categorized into four stages based on the intensity: holding hands, kissing, and cuddling together were in the first stage; letting others touch them under clothes and touching others under clothes in the second stage; touching others genitals and letting others touch their genitals in the third stage; and oral sex and sexual intercourse questions in the fourth stage. Adolescents who reported having not engaged in a particular sexual activity received a score of 0 on that activity and those who reported having engaged in the activity received a score of 1 on that activity. Adolescents did not progress to the next stage if they reported having not engaged in all sexual activities in one stage. ASAI is a validated self-report measure and has high internal consistency (Cronbach's  $\alpha = .93$ ) (Hansen et al., 1999).

#### ***Mental Health Outcome***

The mental health outcomes at 14 and 17 years old were chosen based on availability in the MCS and robust associations with early sexual behaviors reported by prior research.

***Mental well-being.*** When adolescents were 17 years old, the Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS) was used to measure their mental well-being in the past 2 weeks. The SWEMWBS is a validated self-report inventory with seven items (McKay



& Andretta, 2017). The SWEMWBS has acceptable reliability and validity (Cronbach's  $\alpha = .85$ ; Stewart-Brown et al., 2009). Each item was measured on a 5-point scale ranging from 1 = *none of the time* to 5 = *all of the time*. An example item is “I have been feeling useful”. The total score of the seven items was transformed into metric scores using the Rasch model and was used in the analysis, with a higher score indicating higher positive mental wellbeing (Stewart-Brown et al., 2009).

***Psychological distress.*** When adolescents were 17 years old, the Kessler Psychological Distress Scale (K6) was used to measure their psychological distress in the past 30 days. K6 is a validated self-report inventory with six items on a 5-point scale ranging from 1 = *all of the time* to 5 = *none of the time* (Kessler et al., 2002). K6 also has good reliability and validity (Cronbach's  $\alpha = .84$ ; Mewton et al., 2016). An example item is “During the last 30 days, about how often did you feel hopeless?” The total score of the six items was used in the analysis, with a higher score indicating greater psychological distress.

***Emotional and behavioral difficulties.*** When adolescents were 14 and 17 years old, the Strength and Difficulties Questionnaire (SDQ) was used to measure their psychological adjustment in the past six months (Goodman, 2001). The SDQ is a validated self-report inventory with 25 items divided into 5 subscales (emotional symptoms, conduct problems, hyperactivity, peer relationship problems, and prosocial behavior). The SDQ has acceptable reliability and validity (Cronbach's  $\alpha = .82$ ; Goodman, 2001). Each subscale consists of five items rated by the main carers (usually mothers) on a 3-point scale ranging from 0 = *not true* to 2 = *certainly true*. An example of item is “*Child's name* is restless, overactive, cannot stay still for long”. The total difficulties score (the sum of all subscales except the prosocial behavior subscale since it is independent of the difficulties measured by the other subscales) was used in the analysis, with a higher score indicating a greater emotional and behavioral difficulties. Total difficulties score was chosen over five separate subscales scores in our

sample since it has been validated in prior research (Achenbach et al., 2008). By contrast, subscale scores were suggested to be only justified when studying high-risk children (those with mental disorders or with higher scores on SDQ subscales) (Goodman et al., 2010).

**Self-esteem.** When adolescents were 14 and 17 years old, a shortened version of Rosenberg's Self-Esteem Scale was used to assess self-esteem (Rosenberg, 2015). Five items including self-satisfaction, having a number of good qualities, being able to do things similar to others, a person of value, and feeling good about oneself were used. Adolescents reported how much they agree with the above statements on a 4-point scale ranging from 1 = *strongly agree* to 4 = *strongly disagree*. Cronbach's alpha for the scale in our sample was .91. Exploratory factor analysis yielded one factor (eigenvalue = 3.71) accounting for 74.16% of the variance in our sample. The total score of the five items was used in the analysis, with a higher score indicating lower self-esteem.

**Reported self-harm attempts.** Adolescents reported whether they had hurt themselves on purpose in an attempt to end life in the last 12 months at 17 years old (*yes* or *no*).

**Substance use.** Adolescents reported the frequency of smoking, binge drinking (having five or more alcoholic drinks at a time), and drug use at 14 and 17 years old. Two items were used to assess the smoking behavior: frequency of smoking cigarettes on a 6-point scale ranging from 1 = *never* to 6 = *more than six cigarettes a week* and frequency of smoking electronic cigarettes on a 4-point scale ranging from 1 = *never* to 4 = *every day* at 14 years old or a 6-point scale ranging from 1 = *never* to 6 = *more than six times a week* at 17 years old. One item was used to assess the frequency of binge drinking in the last 12 months on a 5-point scale ranging from 1 = *never* to 5 = *10 or more times*. One item was used to assess the frequency of cannabis use in the last 12 months on a 5-point scale ranging from 0 = *never* to 4 = *more than ten times*.

**Early Life Adversities**

The early life adversities were chosen based on availability in the MCS and known associations with both early sexual behaviors and mental health outcomes reported by prior research. These included reported victimization experiences, domestic violence, parental psychosocial distress, parental absence, parental-child relationship quality, family socioeconomic position, and parental substance use. Details on the measurement of parental absence (a derived variable based on household members reports of relationships to adolescents and their sexes at each wave), parental psychosocial distress (K6) measured at each wave and reported by adolescents' parents, family socioeconomic position (a summary score incorporating parents' education and occupation, and household income at each wave), and parental-child relationship quality (Child Parent Relationship Scale) when adolescents were 3 years and reported by their parents have been described elsewhere (Xu et al., 2020).

***Victimization experiences.*** When adolescents were 14 years old, four binary items were used to assess the experience of victimization (verbal, sexual, and physical) in the past 12 months. Verbal abuse was measured via one item: "whether someone has insulted you, called you names, threatened or shouted at you in a public place, at school or anywhere else". Sexual harassment or assault was measured via one item: "whether someone has made an unwelcome sexual approach to you or assaulted you sexually". Reported sexual harassment or assault and verbal abuse was coded as present if they reported "yes". Physical abuse was measured via two items: "whether someone has been physically violent towards you, e.g. pushed, shoved, hit, slapped or punched you" and "whether someone has hit you with or used a weapon against you". Physical abuse was coded as present if they reported "yes" to either of the two items.

***Domestic violence.*** At each wave, adolescents' parents reported whether their partners had ever used force on them for any reason. We recoded this into two variables: domestic violence before 7 years of age and domestic violence since 7 years of age. To do this,

domestic violence before 7 was coded as present if either adolescents' mothers or fathers reported that their partners have used force on them when adolescents were 9 months, 3 years old, and 5 years old. We did similarly for domestic violence since 7 years of age.

***Parental substance use.*** When adolescents were 3 years old, the CAGE was used to measure parents' problem drinking (Mayfield et al., 1974). The CAGE is a validated self-report inventory with four items assessing whether respondents had ever experienced four alcohol-related symptoms in their lifetime on a binary scale: 1 = *yes* and 0 = *no* (Mayfield et al., 1974). The scale also has good reliability and validity (Dhalla & Kopec, 2007). Cronbach's alpha for the scale in our sample was .60. An example item is "Have you ever felt you should cut down on your drinking?". Mothers' and fathers' problem drinking was coded as present if they reported one or more alcohol-related symptoms. When adolescents were 3 and 5 years old, adolescents' parents reported their frequency of any illicit drug use (e.g., cannabis, cocaine or ecstasy) during the past years on a 3-point scale: 1 = *never*, 2 = *occasionally*, and 3 = *Regularly*. Mothers' and fathers' drug use was coded as present if they reported regular drug use at any time point and absent if they reported never or occasional drug use at all time points.

### ***Statistical Analysis***

#### ***Missing Data***

The ten sexual activities items had 0.40%-94.61% missing information, mainly due to the non-responses to high-intensity sexual activities (about 44 % and 90% of adolescents did not progress to the second and third stage of sexual activities, respectively). Research has found that most adolescents follow a progressive sexual trajectory from kissing and touching over the clothes to touching under the clothes and then having sexual intercourse (Shtarkshall et al., 2009). Thus, adolescents who did not progress to answer these sexual activities were recoded as not having engaged in that sexual activity. As a result, the ten sexual activities

items had 0.04%-0.51% missing information in the final analysis sample, mainly due to the non-responses to the first stage of sexual activities. The mental health outcomes had 19.66%-20.80% missing information. For LCA and multigroup confirmatory factor analysis (CFA), this missing data were handled via full information maximum likelihood estimation with robust standard errors (MLR) in Mplus 7.4.

The mental health factor scores, self-harm attempt, and early life adversity variables had 0.02% - 57.86% missing information (Supplemental Table 1 and 2). This was handled using multiple imputation stratified by sex using Stata 16.0, which could help to reduce biases due to selective attrition (Twisk & de Vente, 2002). For the imputation model, all variables in the analysis model were included, a chained equations algorithm model was used, a predictive mean matching approach with 10 nearest-neighbor donors was used for continuous variables, and 58 imputations (should be at least as large as the percentage of missing data) were created (White et al., 2011). Trace plots and other diagnostics provided no cause for concern regarding the imputed values. Sensitivity analysis found no substantial difference in estimates for mental health outcomes associated with latent class membership of sexual behaviors between univariate regression using complete-case and analysis using imputed data. Due to the relatively high proportion of missing data in the sample, no sensitivity analysis comparing multivariate regressions based complete-case and imputed data, controlling for all early life adversities, was conducted. But our sample size allows us to conduct complete-case analysis that includes some early life adversities. When early life adversities variables with missing less than 15%, including parental absence, victimization experiences, and parental-child relationship quality, were included in the multivariate regressions, sensitivity analyses found no substantial difference in estimates between multivariate regression using complete-case and analysis using imputed data.

*LCA*

We evaluated whether there are meaningful subgroups of adolescents who show the similar early sexual behavior pattern at 14 years old through LCA in Mplus 7.4, with ten binary items of ASAI as the manifest indicators of latent class memberships. We started with a single-class model and fitted successive models with an increasing number of latent classes (one at a time) until the results were no longer interpretable. The best-fitting model was determined by the interpretability of the model, sample size of each latent class, and model fit statistics. Smaller values of Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and adjusted BIC, and a significant  $p$  value for the Lo-Mendell-Rubin likelihood ratio test (LMR LR), adjusted LMR LR test, and bootstrapped likelihood ratio test (BLRT) indicate that the  $k$  class model fit the data better than the  $k-1$  class model (Asparouhov & Muthén, 2012). Models were estimated multiple times using 1000 random sets of starting values to ensure the model converged at its global maxima. Once the best-fitting model was determined, adolescents were assigned their most likely latent class membership representing their sexual behavior profile.

#### *Multigroup CFA*

Based on theory, correlation matrix (Supplemental Table 3), and exploratory factor analysis, factor loadings from two-factor CFA were used as item weightings to generate summary scores incorporating mental health outcomes at age 14 and 17, respectively: psychological well-being and substance use, with a higher score indicating more negative psychological well-being and more substance use (Figure 1). Self-harm attempt was not included in the CFA since it presents a different construct and the model fit statistics were not affected when self-harm attempt was excluded. Likert scales were treated as continuous and MLR was used to handle the missing data and potential multivariate normality violation in Mplus 7.4. MLR assuming continuous scaling was used because the latent mental health outcomes measured here are more likely to be continuous constructs, and simulation studies showed that MLR

performed well even with skewed responses when sample sizes were large (Sass et al., 2014). Sensitivity analysis indicated that there were no substantial differences in model fit statistics between analysis using MLR and analysis using robust weighted least squares which treats Likert scored items as ordered categorical variables (Supplemental Table 4). We also followed the guideline to test whether measurement invariance at age 17 is supported across different latent class membership of sexual behaviors (Putnick & Bornstein, 2016). Since likelihood ratio test is sensitive to large sample sizes, measurement invariance is considered to be supported when constraints lead to a change in the comparative fit index  $\leq 0.01$  among model comparison (Putnick & Bornstein, 2016).

*[Figure 1 near here]*

### *Regressions*

All regressions stratified by sex were performed in Stata 16.0. To test whether early life adversities could predict latent class membership of adolescent sexual behaviors, a multivariate probability-weighted ordered logistic regression was estimated with latent class membership regressed on all early life adversities. The maximum posterior probability of class membership for each observation was included as a sampling weight to account for measurement error from the determination of most likely latent class (Kamata et al., 2018). The *Brant* test was used to test the proportional odds assumption and the assumption was relaxed for variables where test was significant at the 5% level (use *gologit2* function).

A three-step hierarchical multivariate probability-weighted regression was used to test the association between latent class membership of sexual behaviors and mental health outcomes at age 17 (linear regression for psychological well-being and substance use, and logistic regression for self-harm attempt). First, a univariate regression was estimated

including only latent class membership as a predictor (Model 1). In the second step, all early life adversities were entered (Model 2). In the final step, mental health outcomes at age 14 were entered (Model 3). Substance use at age 17 was log-transformed (adding 0.40 to convert negative values to positive values before transform) since its distribution is skewed. In all models, the maximum posterior probability of class membership for each observation was included as a sampling weight to account for measurement error from the determination of most likely latent class (Kamata et al., 2018). There was no indication of multicollinearity problems based on the variance inflation factor (all <2.5 except family SEP before and since 7 with a maximum value of 5.69). For linear regressions, model residual checks were performed on each imputed dataset (White et al., 2011). Residuals were normally distributed based on QQ plot and homoscedasticity was not violated.

As a potential check against possible mischievous responding between adolescent who had not engaged in any sexual activities and those who had, we compared both groups on several screening items that could potentially capture such responding (Robinson-Cimpian, 2014). These include items on have computer of their own and have seen a dentist in the past 12 months. These items were selected because they are unrelated to sexual behavior development. We found no evidence of potential mischievous responding (Supplemental Table 6).

## **Results**

### ***LCA of Adolescent Sexual Behavior***

The lowest BIC was for the six class model, while the lowest AIC and ABIC were for the seven class model (Supplemental Table 7). The results of BLRT tests also suggested that the seven class model was optimal. However, we selected the five class model over six and seven class model as providing the most parsimonious explanation of the adolescent sexual behavior patterns because all classes were qualitatively distinct from one another based on



item-response probabilities, and thus more interpretable. For example, compared to the five class model, classes 4 and 5 from the six class model ( $n = 338$ ), and classes 4, 5, and 6 from the seven class model ( $n = 371$ ) were all marked by a high probability of having genital touching (see Table 1, Supplemental Table 8, and Supplemental Table 9 for the comparison among five, six, and seven class models). The distinction among those classes seems to be whether adolescents have engaged in touching others under clothes or genitals, versus adolescents have engaged in being touched under the clothes or their genitals. Sensitivity analyses found no significant differences in demographic characteristics (ethnicity, family income, and parental absence) and mental health outcomes at 17 between Class 4 and 5 from the six class model, and among classes 4, 5, and 6 from the seven class model, which further support that all classes from six and seven class model were not qualitatively distinct from one another and it is reasonable to choose five class model over six and seven class model. Sensitivity analyses also found no substantial differences in estimates for mental health outcomes associated with latent class membership of sexual behaviors between analysis using five class model and analysis using six or seven class model.

Basing on item-response probabilities (Table 1), the five class model were interpreted as: “no sexual behavior” (class 1), “kisser” (class 2); “touching under clothes” (class 3); “genital touching” (class 4); and “all sexual activities” (class 5). The “no sexual behavior” class contained 50.74% ( $n = 5,742$ ) of participants and was characterized by a high probability of having not engaged in any sexual activities. The “kisser” class contained 39.92% ( $n = 4,518$ ) of participants and was marked by a high probability of having engaged in kissing. The “touching under clothes” class contained 4.71% ( $n = 533$ ) of participants and was characterized by a high probability of having engaged in kissing and touching under clothes. The “genital touching” class contained 2.64% ( $n = 299$ ) of participants and was characterized by a high probability of having engaged in kissing, touching under clothes, and

genital touching. The “all sexual activities” class contained 1.99% ( $n = 225$ ) of participants who had a high probability of having engaged in all sexual activities. The relative small sample sizes of class 3, 4, and 5 may be due to the measurement of sexual activities at the early stage of adolescence.

*[Table 1 near here]*

### ***Early Life Adversity and Adolescent Sexual Behaviors***

Compared to boys from the “no sexual behavior” class, boys with reported verbal abuse experiences, physical abuse experiences, father’s problem drinking, and parental absence were more likely to engage in early sexual activities as captured by the remaining four latent classes among boys (odds ratio ranging from 1.21 to 2.65, all  $ps < .05$ ; Table 2). Compared to girls from the “no sexual behavior” class, girls with reported verbal abuse experiences, physical abuse experiences, sexual harassment or assault experiences, and parental absence were significantly more likely to have engaged in early sexual activities as captured by the remaining four latent classes (odds ratio ranging from 1.34 to 6.26, all  $ps < .01$ ; Table 3).

*[Table 2 and Table 3 near here]*

### ***Sexual Behavior Classes and Mental Health-Related Outcomes***

Two-factor CFA has acceptable model fit statistics (Supplemental Table 4). Scalar invariance for CFA at age 17 across latent class membership of sexual behaviors is supported (Supplemental Table 5). Compared to adolescents from the “no sexual behavior” class, boys and girls from the “kisser”, “touching under clothes”, “genital touching”, and “all sexual activities” classes reported significantly more substance use at age 17 in univariate

regressions (Table 4 and 5). These associations reduced to a smaller degree but remained statistically significant after controlling early life adversities (Model 2), and mental health outcomes at 14 (Model 3). Compared to adolescents from the “no sexual behavior” class, boys and girls from the “kisser”, “touching under clothes”, “genital touching”, and “all sexual activities” classes were also at greater risk of self-harm attempt at age 17 in univariate regressions (Table 4 and 5). These associations (except for boys from “genital touching” class) reduced to a smaller degree but remained statistically significant after controlling for early life adversities (Model 2). For boys, these associations remained statistically significant after further controlling mental health outcomes at 14. However, for girls, only the increased risk of self-harm attempt at age 17 among girls from “all sexual activities” compared with girls from the “no sexual behavior” class remained statistically significant after further controlling mental health outcomes at 14. Early life adversities could explain 6.33% and 34.28% of the increased risk of substance use and self-harm attempt associated with “all sexual activities” compared to boys from “no sexual behavior” class, respectively. For girls, the corresponding figures were 11.62% and 52.56%, respectively.

Compared to adolescents from the “no sexual behavior” class, boys and girls from the “touching under clothes”, “genital touching”, and “all sexual activities” classes also reported significantly negative psychological well-being at age 17 in univariate regressions, unstandardized regression coefficients from 0.80 to 2.29, all  $ps < .01$  (Table 4 and 5). These associations became statistically non-significant after controlling early life adversities. Compared to boys from the “no sexual behavior” class, boys from the “kisser” class reported significantly positive psychological well-being, Cohen’s  $d = -0.07$ , 95% confidence interval =  $[-0.12, -0.01]$ ,  $p < .05$ ) after controlling early life adversities. However, this association became statistically non-significant after further controlling for mental health outcomes at 14, Cohen’s  $d = -0.04$ , 95% confidence interval =  $[-0.10, 0.01]$ .

*[Table 4 and Table 5 near here]*

### **Discussion**

This study examined adolescent sexual behavior patterns, their association with mental health, and the influence of early life adversities upon this association in a British birth cohort. We found that there is a quantitatively meaningful diversity of early adolescent sexual behaviors. The five subgroups of adolescent sexual behaviors were similar to the pattern of subgroups revealed in a different prospective birth cohort study (where they did not test the association between sexual behavior and mental health outcomes; Xu et al., 2021). However, given the exploratory nature of LCA, there may be different results if sexual activities were measured at later ages. We expect that as adolescents become older they will transition from no sexual behavior towards greater engagement in high-intensity sexual activities resulting in different latent growth curve profiles (Xu et al., 2021). Future studies using later waves of sexual behavior are required to test this.

The findings are consistent with prior research that early life adversities may be associated with earlier onset of sexual activity (Xu et al., 2018). The strongest candidates appear to be recalled experiences of verbal and physical abuse and parental absence for both sexes. These associations likely have multifactorial causes. For example, the patterns could be due to dysregulation of stress response systems caused by experiencing early life adversity. Life history models suggest that it may also be adaptive for adolescents to allocate more resources to early sexual behaviors over body growth under adverse or resource scarce conditions early in life (Del Giudice et al., 2015). Alternatively, adolescents with parental absence may be more likely to lack parental monitoring or control which increases their risk of early sexual experimentation (Wight et al., 2006). Individual differences in sexual

behaviors and exposure to early life adversities may also be influenced by common genetic and/or environmental factors (Mendle et al., 2009).

Compared to adolescents who engaged in no sexual activities, those engaging in kissing, touching under clothes, genital touching, and all sexual activities were at greater risk for substance use and self-harm attempt. The risk of substance use and self-harm attempt increased in a dose-dependent manner across the subgroups in accordance with the intensity of the sexual activities. These patterns indicate that a greater range of sexual activities, rather than just sexual intercourse, should be considered in future studies on the impact of early sexual activity on health outcomes among adolescents. The poorer mental health associated with adolescents who have engaged in kissing only compared with adolescents without any sexual experiences is consistent with prior research (Kaltiala-Heino et al., 2003). Adolescents who have engaged in kissing may be likely to have earlier pubertal timing compared with adolescents without any sexual experiences (Lam et al., 2002). The incongruence between their physical maturity and cognitive and emotional resources, and the increased levels of adrenal and gonadal hormones at puberty among early maturing adolescents may increase their risk of poorer mental health (Ge & Natsuaki, 2009). Our results also suggest that the type of mental health outcome appears important. Indeed, the strength of the associations depended on type of mental health outcome; strongest for substance use and weakest for psychological well-being.

The present study also found sex differences in the pattern of results. Negative mental health outcomes were more common among girls who had engaged in any sexual activities compared to boys, which is consistent with prior studies (Meier, 2007). This was reflected in the larger effect sizes for the associations in the current study. This may be related to the 'sexual double standard' where girls and boys are evaluated differently regarding sexual behaviors (Kreager et al., 2016). Boys are socially expected to be sexual active and take

sexual initiative, whereas girls are expected to be sexually reactive and submissive (Kreager et al., 2016). Accordingly, girls may be more restricted in their sexual freedom, and there are more negative appraisals (Donald et al., 1995) and greater social stigma attached to having earlier sexual experiences among girls compared to boys (Kreager et al., 2016), which increase their risk of poorer mental health. Girls who engaged in early sexual activities are more likely to have earlier pubertal timing. The greater risk of peer victimization associated with more noticeable physical characteristics of puberty exhibited by early maturing girls (Petersen & Hyde, 2009), the increased levels of adrenal and gonadal hormones at puberty (Ge & Natsuaki, 2009), and the incongruence between their physical maturity and psychological resources among early maturing girls (Ge & Natsuaki, 2009), may interact with the greater social stigma attached to having earlier sexual experiences among girls, which increase their risk of poorer mental health. This finding has both developmental and prevention implications. In term of development, sexual debut is a milestone in adolescent development. Knowledge of the influence of early sexual activities on developmental trajectories may enhance our understanding of how multiple domains of adolescent development interact. From a prevention perspective, sexual education programs for adolescents may wish to encourage students to manage expectations (including delaying) early sexual activities.

Several mechanisms may help explain the link between early life adversities, early sexual behaviors and mental health outcomes reported here. Early life adversities may be one of the common causes associated with both early sexual behavior and mental health outcomes. Prolonged exposure to adverse early life conditions could trigger dysregulated stress responses which cascade into earlier sexual behavior and/or mental health problems (Pechtel & Pizzagalli, 2011). However, it should be noted that although the associations between early sexual behaviors and mental health outcomes were attenuated after controlling

for early life adversities, the associations were not reduced to zero. There are a number of potential explanations for these findings. It could be that a direct effect of sexual behavior on mental health where greater sexual behavior results in poorer mental health exists given the indications from the existing literature. Alternatively, it may be that early life adversity does explain all of the association but measurement error attenuated the reduction in the effect observed since the assessments of adversity had limitations and were not all encompassing. Or it could be that all of the association between sexual behavior and mental health is explained by third variables, including unmeasured confounders (e.g. genetic and/or environmental factors). Indeed, sexual behaviors and mental health outcomes have their own genetic and environmental contributions (Harden, 2014; McAdams et al., 2014). Exposure to early life adversities could also have prior causes in unmeasured genetic and/or environmental factors. Thus, there may be complex patterns of multivariate genetic and environmental associations between early adversity, sexual behavior and psychopathology. Future research using genetically sensitive longitudinal designs may help unpack these complex associations (e.g., cross-lagged twin approaches; Luo et al., 2010). Such studies will need to incorporate measures of the social context and psychosocial factors to improve our understanding of biopsychosocial causation.

The key strengths of the present study include the use of a prospective, well-characterized and representative longitudinal cohort with good statistical power. Mental health outcomes at age 17 were measured prospectively after sexual behavior at age 14, and early life adversities were also measured prospectively and often by independent ratings (e.g., caregiver). This reduces the risk of recall biases and the likelihood of reverse causation between early life factors and later sexual behavior and mental health scores. The range of early adversity factors studied closely match those reported in previous work as does the use of two theoretically relevant developmental stages. We found little evidence of differences in

mischievous responding between adolescents who had no sexual experience and those with sexual experience. Our LCA also incorporated the measurement error from the determination of most likely latent class memberships of adolescent sexual behavior. The use of the ASAI provided a relatively unambiguous and validated measure of a full range of sexual activities among adolescents. The measure reduces the use of excessive introspection or deliberation regarding sexual feelings when completing the measure, again improving accuracy of recall.

Nevertheless, several limitations are important to note. Adolescents who have engaged in oral sex but not sexual intercourse may be different from those who have engaged in both sexual activities. Some adolescents may have engaged in high-intensity sexual activities without having experienced low-intensity ones. However, we are unable to detect such patterns since adolescents did not progress to the next stage of the ASAI in MCS if they reported having not engaged in all sexual activities in one stage. The ASAI may still suffer from some recall bias given the very low rates of endorsement to sexual activities in the higher-intensity range. Of course that could simply be due to the young age that the ASAI was administered. Also, within the age range examined, our statistical approach incorporated measurement error and so misclassification of class membership based on ASAI responses is less likely. The MCS study sample also suffers from additional measurement issues. Different periods were used for each mental health measure (e.g., mental well-being in the past 2 weeks and psychological distress in the past 30 days), which may affect the prevalence of poor mental health measured here. Some of the early life adversity and mental health measures were based on restricted or single item responses (e.g., self-harm attempt), which is a key limitation. Some early life adversities, such as parental substance use, were measured only at one or two time points. Thus, we cannot be certain what the duration of such early life adversities was nor test the influence of early life adversities at different critical periods on adolescents' mental health outcomes. As mentioned, we were also unable to control for



unmeasured confounders that load simultaneously on early life adversities, early sexual behaviors, and mental health outcomes.

In sum, the present findings suggest that not only adolescent who have engaged in sexual intercourse but also adolescents who have engaged in low-intensity sexual activities at early age may be at risk of some poor mental health outcomes. Early life adversities may help explain some of this association. Future studies should test for possible causal mechanisms and unmeasured factors that may explain these associations such as genetic and environmental confounds.

### **Declaration of Conflicting Interests**

The authors declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

### **Data Availability statement**

The data that support the findings of this study are openly available in UK Data Service at <https://www.ukdataservice.ac.uk>.

### **References**

- Achenbach, T. M., Becker, A., Döpfner, M., Heiervang, E., Roessner, V., Steinhausen, H. C., & Rothenberger, A. (2008). Multicultural assessment of child and adolescent psychopathology with ASEBA and SDQ instruments: Research findings, applications, and future directions. *Journal of Child Psychology and Psychiatry*, *49*(3), 251–275.  
<https://doi.org/10.1111/j.1469-7610.2007.01867.x>
- Asparouhov, T., & Muthén, B. (2012). *Using Mplus tech11 and tech14 to test the number of latent classes* (Mplus Web Notes No. 14). Retrieved from <http://www.statmodel.com/examples/webnotes/webnote14.pdf>.
- Connelly, R., & Platt, L. (2014). Cohort profile: UK millennium Cohort study (MCS). *International Journal of Epidemiology*, *43*(6), 1719–1725.

<https://doi.org/10.1093/ije/dyu001>

Danese, A., & McEwen, B. S. (2012). Adverse childhood experiences, allostasis, allostatic load, and age-related disease. *Physiology & Behavior, 106*(1), 29–39.

<https://doi.org/10.1016/j.physbeh.2011.08.019>

Del Giudice, M. (2014). Middle childhood: An evolutionary-developmental synthesis. *Child Development Perspectives, 8*(4), 193–200. <https://doi.org/10.1111/cdep.12084>

Del Giudice, M., Gangestad, S. W., & Kaplan, H. S. (2015). Life history theory and evolutionary psychology. In Buss D.M. (Ed.), *The Handbook of Evolutionary Psychology* (2nd ed., pp. 88–114). Wiley.

Dhalla, S., & Kopec, J. A. (2007). The CAGE questionnaire for alcohol misuse: A review of reliability and validity studies. *Clinical & Investigative Medicine, 30*(1), 33–41.

<https://doi.org/10.25011/cim.v30i1.447>

Donald, M., Lucke, J., Dunne, M., & Raphael, B. (1995). Gender differences associated with young people's emotional reactions to sexual intercourse. *Journal of Youth and Adolescence, 24*(4), 453–464. <https://doi.org/10.1007/BF01537191>

Ellis, B. J. (2004). Timing of pubertal maturation in girls: An integrated life history approach. *Psychological Bulletin, 130*(6), 920–958. <https://doi.org/10.1037/0033-2909.130.6.920>

Espinosa-Hernández, G., & Vasilenko, S. A. (2015). Patterns of relationship and sexual behaviors in Mexican adolescents and associations with well-being: A latent class approach. *Journal of Adolescence, 44*, 280-290.

<https://doi.org/10.1016/j.adolescence.2015.08.011>

Ge, X., & Natsuaki, M. N. (2009). In search of explanations for early pubertal timing effects on developmental psychopathology. *Current Directions in Psychological Science, 18* (6), 327–331. <https://doi.org/10.1111/j.1467-8721.2009.01661.x>

Goodman, R. (2001). Psychometric properties of the strengths and difficulties

- questionnaire. *Journal of the American Academy of Child & Adolescent Psychiatry*, 40(11), 1337–1345. <https://doi.org/10.1097/00004583-200111000-00015>
- Goodman, A., Lamping, D. L., & Ploubidis, G. B. (2010). When to use broader internalising and externalising subscales instead of the hypothesised five subscales on the Strengths and Difficulties Questionnaire (SDQ): Data from British parents, teachers and children. *Journal of Abnormal Child Psychology*, 38(8), 1179–1191. <https://doi.org/10.1007/s10802-010-9434-x>
- Halpern, C. T., Udry, J. R., & Suchindran, C. (1997). Testosterone predicts initiation of coitus in adolescent females. *Psychosomatic Medicine*, 59(2), 161–171. <https://doi.org/10.1097/00006842-199703000-00008>
- Hansen, W. B., Paskett, E. D., & Carter, L. J. (1999). The Adolescent Sexual Activity Index (ASAI): A standardized strategy for measuring interpersonal heterosexual behaviors among youth. *Health Education Research*, 14(4), 485–490. <https://doi.org/10.1093/her/14.4.485>
- Harden, K. P. (2014). Genetic influences on adolescent sexual behavior: Why genes matter for environmentally oriented researchers. *Psychological Bulletin*, 140(2), 434–465. <https://doi.org/10.1037/a0033564>
- Hershenberg, R., & Davila, J. (2010). Depressive symptoms and sexual experiences among early adolescent girls: Interpersonal avoidance as moderator. *Journal of Youth and Adolescence*, 39(8), 967–976. <https://doi.org/10.1007/s10964-009-9446-4>
- Hipwell, A. E., Stepp, S. D., Keenan, K., Chung, T., & Loeber, R. (2011). Parsing the heterogeneity of adolescent girls' sexual behavior: Relationships to individual and interpersonal factors. *Journal of Adolescence*, 34(3), 589–592. <https://doi.org/10.1016/j.adolescence.2010.03.002>
- Hughes, K., Bellis, M. A., Hardcastle, K. A., Sethi, D., Butchart, A., Mikton, C., Jones, L., &

- Dunne, M. P. (2017). The effect of multiple adverse childhood experiences on health: A systematic review and meta-analysis. *The Lancet Public Health*, 2(8), e356–e366.  
[https://doi.org/10.1016/S2468-2667\(17\)30118-4](https://doi.org/10.1016/S2468-2667(17)30118-4)
- Kaltiala-Heino, R., Kosunen, E., & Rimpelä, M. (2003). Pubertal timing, sexual behaviour and self-reported depression in middle adolescence. *Journal of Adolescence*, 26(5), 531–545.  
[https://doi.org/10.1016/s0140-1971\(03\)00053-8](https://doi.org/10.1016/s0140-1971(03)00053-8)
- Kamata, A., Kara, Y., Patarapichayatham, C., & Lan, P. (2018). Evaluation of analysis approaches for latent class analysis with auxiliary linear growth model. *Frontiers in Psychology*, 9, 130. <https://doi.org/10.3389/fpsyg.2018.00130>
- Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S. L., Walters, E. E., & Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine*, 32(6), 959–976. <https://doi.org/10.1017/s0033291702006074>
- Khurana, A., Romer, D., Betancourt, L. M., Brodsky, N. L., Giannetta, J. M., & Hurt, H. (2012). Early adolescent sexual debut: The mediating role of working memory ability, sensation seeking, and impulsivity. *Developmental Psychology*, 48(5), 1416–1428.  
<https://doi.org/10.1037/a0027491>
- Kreager, D. A., Staff, J., Gauthier, R., Lefkowitz, E. S., & Feinberg, M. E. (2016). The double standard at sexual debut: Gender, sexual behavior and adolescent peer acceptance. *Sex Roles*, 75(7), 377–392. <https://doi.org/10.1007/s11199-016-0618-x>
- Lam, T. H., Shi, H. J., Ho, L. M., Stewart, S. M., & Fan, S. (2002). Timing of pubertal maturation and heterosexual behavior among Hong Kong Chinese adolescents. *Archives of Sexual Behavior*, 31(4), 359–366. <https://doi.org/10.1023/a:1016228427210>
- Liu, R. T. (2019). Childhood maltreatment and impulsivity: A meta-analysis and recommendations for future study. *Journal of Abnormal Child Psychology*, 47(2), 221–

243. <https://doi.org/10.1007/s10802-018-0445-3>

- Luo, Y. L., Haworth, C. M., & Plomin, R. (2010). A novel approach to genetic and environmental analysis of cross-lagged associations over time: The cross-lagged relationship between self-perceived abilities and school achievement is mediated by genes as well as the environment. *Twin Research and Human Genetics*, *13*(5), 426–436. <https://doi.org/10.1375/twin.13.5.426>
- Madkour, A. S., Farhat, T., Halpern, C. T., Godeau, E., & Gabhainn, S. N. (2010). Early adolescent sexual initiation as a problem behavior: A comparative study of five nations. *Journal of Adolescent Health*, *47*(4), 389–398. <https://doi.org/10.1016/j.jadohealth.2010.02.008>
- Mayfield, D., McLeod, G., & Hall, P. (1974). The CAGE questionnaire: Validation of a new alcoholism screening instrument. *American Journal of Psychiatry*, *131*(10), 1121–1123. <https://doi.org/10.1176/ajp.131.10.1121>
- McAdams, T. A., Neiderhiser, J. M., Rijdsdijk, F. V., Narusyte, J., Lichtenstein, P., & Eley, T. C. (2014). Accounting for genetic and environmental confounds in associations between parent and child characteristics: A systematic review of children-of-twins studies. *Psychological Bulletin*, *140*(4), 1138–1173. <https://doi.org/10.1037/a0036416>
- McKay, M. T., & Andretta, J. R. (2017). Evidence for the psychometric validity, internal consistency and measurement invariance of Warwick Edinburgh Mental Well-being Scale scores in Scottish and Irish adolescents. *Psychiatry Research*, *255*, 382–386. <https://doi.org/10.1016/j.psychres.2017.06.071>
- Meier, A. M. (2007). Adolescent first sex and subsequent mental health. *American Journal of Sociology*, *112*(6), 1811–1847. <https://doi.org/10.1086/512708>
- Mendle, J., Harden, K. P., Turkheimer, E., Van Hulle, C. A., D'Onofrio, B. M., Brooks-Gunn, J., Rodgers, J. L., Emery, R. E., & Lahey, B. B. (2009). Associations between father

absence and age of first sexual intercourse. *Child Development*, 80(5), 1463–1480.

<https://doi.org/10.1111/j.1467-8624.2009.01345.x>

Mewton, L., Kessler, R. C., Slade, T., Hobbs, M. J., Brownhill, L., Birrell, L., Tonks, Z., Teesson, M., Newton, N., Chapman, C., & Allsop, S. (2016). The psychometric properties of the Kessler Psychological Distress Scale (K6) in a general population sample of adolescents. *Psychological Assessment*, 28(10), 1232–1242.

<https://doi.org/10.1037/pas0000239>

Pechtel, P., & Pizzagalli, D. A. (2011). Effects of early life stress on cognitive and affective function: An integrated review of human literature. *Psychopharmacology*, 214(1), 55–70. <https://doi.org/10.1007/s00213-010-2009-2>

Petersen, J. L., & Hyde, J. S. (2009). A longitudinal investigation of peer sexual harassment victimization in adolescence. *Journal of Adolescence*, 32(5), 1173–1188.

<https://doi.org/10.1016/j.adolescence.2009.01.011>

Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review*, 41, 71–90. <https://doi.org/10.1016/j.dr.2016.06.004>

Ramrakha, S., Caspi, A., Dickson, N., Moffitt, T. E., & Paul, C. (2000). Psychiatric disorders and risky sexual behaviour in young adulthood: Cross sectional study in birth cohort. *BMJ*, 321(7256), 263–266. <https://doi.org/10.1136/bmj.321.7256.263>

Robinson-Cimpian, J. P. (2014). Inaccurate estimation of disparities due to mischievous responders: Several suggestions to assess conclusions. *Educational Researcher*, 43(4), 171–185. <https://doi.org/10.3102/0013189X14534297>

Rosenberg, M. (2015). *Society and the adolescent self-image*. Princeton university press.

Sass, D. A., Schmitt, T. A., & Marsh, H. W. (2014). Evaluating model fit with ordered categorical data within a measurement invariance framework: A comparison of

- estimators. *Structural Equation Modeling: A Multidisciplinary Journal*, 21(2), 167–180. <https://doi.org/10.1080/10705511.2014.882658>
- Shtarkshall, R. A., Carmel, S., Jaffe-Hirschfield, D., & Woloski-Wruble, A. (2009). Sexual milestones and factors associated with coitus initiation among Israeli high school students. *Archives of Sexual Behavior*, 38(4), 591–604. <https://doi.org/10.1007/s10508-008-9418-x>
- Stewart-Brown, S., Tennant, A., Tennant, R., Platt, S., Parkinson, J., & Weich, S. (2009). Internal construct validity of the Warwick-Edinburgh mental well-being scale (WEMWBS): A Rasch analysis using data from the Scottish health education population survey. *Health and Quality of Life Outcomes*, 7, 15. <https://doi.org/10.1186/1477-7525-7-15>
- Suleiman, A. B., Galván, A., Harden, K. P., & Dahl, R. E. (2017). Becoming a sexual being: The ‘elephant in the room’ of adolescent brain development. *Developmental Cognitive Neuroscience*, 25, 209-220. <https://doi.org/10.1016/j.dcn.2016.09.004>
- Twisk, J., & de Vente, W. (2002). Attrition in longitudinal studies: How to deal with missing data. *Journal of Clinical Epidemiology*, 55(4), 329–337. [https://doi.org/10.1016/s0895-4356\(01\)00476-0](https://doi.org/10.1016/s0895-4356(01)00476-0)
- Vasilenko, S. A., Kugler, K. C., Butera, N. M., & Lanza, S. T. (2015). Patterns of adolescent sexual behavior predicting young adult sexually transmitted infections: A latent class analysis approach. *Archives of Sexual Behavior*, 44(3), 705–715. <https://doi.org/10.1007/s10508-014-0258-6>
- Wesche, R., Lefkowitz, E. S., & Vasilenko, S. A. (2017). Latent classes of sexual behaviors: Prevalence, predictors, and consequences. *Sexuality Research and Social Policy*, 14(1), 100–111. <https://doi.org/10.1007/s13178-016-0228-y>
- White, I. R., Royston, P., & Wood, A. M. (2011). Multiple imputation using chained

equations: Issues and guidance for practice. *Statistics in Medicine*, 30(4), 377–399.

<https://doi.org/10.1002/sim.4067>

Wight, D., Williamson, L., & Henderson, M. (2006). Parental influences on young people's sexual behaviour: A longitudinal analysis. *Journal of Adolescence*, 29(4), 473–494.

<https://doi.org/10.1016/j.adolescence.2005.08.007>

Xu, Y., Norton, S., & Rahman, Q. (2018). Early life conditions, reproductive and sexuality-related life history outcomes among human males: A systematic review and meta-analysis. *Evolution and Human Behavior*, 39(1), 40–51.

<https://doi.org/10.1016/j.evolhumbehav.2017.08.005>

Xu, Y., Norton, S., & Rahman, Q. (2020). A longitudinal birth cohort study of early life conditions, psychosocial factors, and emerging adolescent sexual orientation. *Developmental Psychobiology*, 62(1), 5–20.

<https://doi.org/10.1002/dev.21894>

Xu, Y., Norton, S., & Rahman, Q. (2021). Adolescent sexual behavior patterns in a British birth cohort: A latent class analysis. *Archives of Sexual Behavior*, 50(1), 161–180.

<https://doi.org/10.1007/s10508-019-01578-w>



### Figure Captions

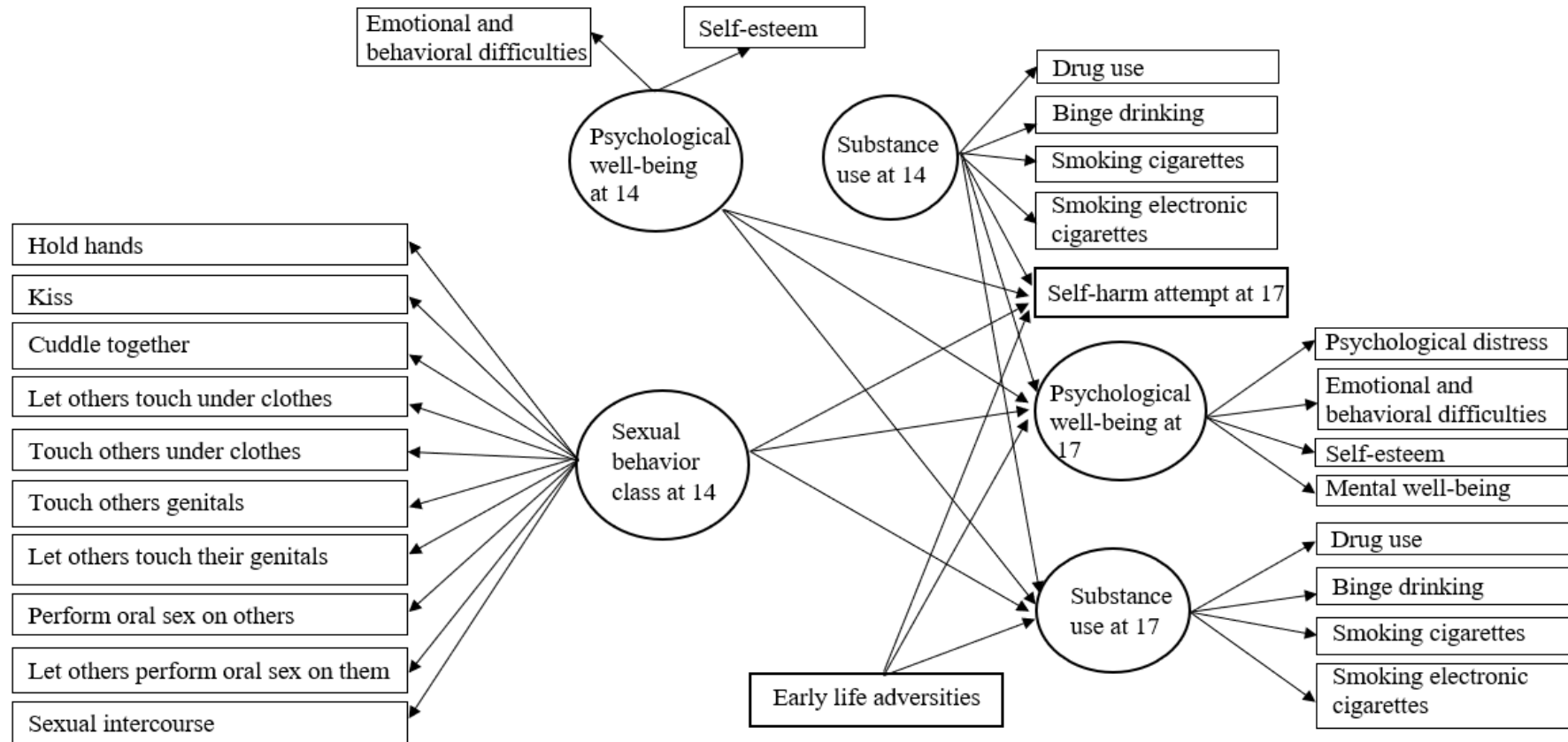


Figure 1. Model tested in this study.

Table 1. Item-response probabilities for the five classes model of adolescent sexual behavior at 14.

Sexual behaviors at 14 years, yes	Latent class membership of early sexual behaviors at 14 years				
	No sexual behavior ( <i>N</i> = 5,742 )	Kisser ( <i>N</i> = 4,518)	Touching under clothes ( <i>N</i> = 533)	Genital touching ( <i>N</i> = 299)	All sexual activities ( <i>N</i> = 225)
Hold hands	.20	.95	.96	.96	.98
Kiss	.03	.66	.93	.97	1.00
Cuddle together	.14	.89	.98	.98	1.00
Let others touch under clothes	.00	.01	.78	.97	.99
Touch others under clothes	.00	.00	.70	.85	.99
Touch others genitals	.00	.00	.08	.80	1.00
Let others touch their genitals	.00	.00	.09	.93	.99
Perform oral sex on others	.00	.00	.00	.09	.91
Let others perform oral sex on them	.00	.00	.00	.17	.90
Sexual intercourse	.00	.00	.00	.17	.62

Table 2. Multivariate ordered logistic regressions for latent class membership of sexual behavior at 14 years old among boys

Variable	Multivariate ordered logistic regression				
	OR	OR <sup>a</sup>	OR <sup>b</sup>	OR <sup>c</sup>	OR <sup>d</sup>
Maternal psychological distress before 7	0.98 (0.96, 1.01)				
Maternal psychological distress since 7	1.00 (0.97, 1.02)				
Paternal psychological distress before 7		0.99 (0.95, 1.02)	1.02 (0.97, 1.07)	1.03 (0.97, 1.09)	0.99 (0.91, 1.08)
Paternal psychological distress since 7	0.98 (0.95, 1.02)				
Family socioeconomic position before 7	0.96 (0.90, 1.03)				
Family socioeconomic position since 7	1.02 (0.95, 1.08)				
Parent-child relationship		1.01 (1.00, 1.02)	1.00 (0.98, 1.01)	0.99 (0.97, 1.01)	0.99 (0.96, 1.02)
Verbal abuse (Ref = no)	1.30***(1.15, 1.47)				
		1.56***	2.23***	2.29***	2.65***
Physical abuse (Ref = no)		(1.36, 1.79)	(1.84, 2.70)	(1.76, 2.97)	(1.77, 3.97)
Sexual harassment or assault (Ref = no)	1.56 (0.96, 2.54)				
Domestic violence before 7 (Ref = no)	1.09 (0.89, 1.33)				
Domestic violence since 7 (Ref = no)	1.20 (0.96, 1.49)				
Mother's problem drinking (Ref = no)		1.09 (0.89, 1.33)	1.33 (0.97, 1.82)	1.76**(1.20, 2.60)	1.22 (0.65, 2.27)
Father's problem drinking (Ref = no)	1.21*(1.03, 1.43)				
Mother's drug use (Ref = no)	1.23 (0.75, 2.02)				
Father's drug use (Ref = no)	1.06 (0.70, 1.61)				
Parental absence (Ref = parents presence)					
Either parent absence before 7	1.38**(1.12, 1.69)				

Either parent absence since 7                      1.37\*\*\*(1.18, 1.60)

---

*Note.* *Brant* test was applied to test the proportional odds assumption. If the proportional odds assumption is not violated, one odds ratio in the column OR was reported; if it is violated, *generalised ordered ordered logit model (gologit2)* was used and four odds ratios in the columns OR<sup>a</sup>, OR<sup>b</sup>, OR<sup>c</sup>, and OR<sup>d</sup> were reported. The five classes were interpreted as: “no sexual behavior” (class 1), “kisser” (class 2); “touching under clothes” (class 3); “genital touching” (class 4); and “all sexual activities” (class 5).

<sup>a</sup>Class 1 versus class 2, 3, 4, and 5.

<sup>b</sup>Class 1 and 2 versus class 3, 4, and 5.

<sup>c</sup>Class 1, 2, and 3 versus class 4 and 5.

<sup>d</sup>Class 1, 2, 3, and 4 versus class 5.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

Table 3. Multivariate ordered logistic regressions for latent class membership of sexual behavior at 14 years among girls

Variable	Multivariate ordered logistic regression				
	OR	OR <sup>a</sup>	OR <sup>b</sup>	OR <sup>c</sup>	OR <sup>d</sup>
Maternal psychological distress before 7		0.98 (0.96, 1.01)	0.96 (0.92, 1.00)	1.00 (0.95, 1.05)	0.99 (0.92, 1.06)
Maternal psychological distress since 7	1.02 (0.99, 1.04)				
Paternal psychological distress before 7	0.97 (0.93, 1.01)				
Paternal psychological distress since 7		1.00 (0.96, 1.04)	1.01 (0.95, 1.07)	1.00 (0.92, 1.09)	1.09 (0.98, 1.21)
Family socioeconomic position before 7	0.95 (0.89, 1.02)				
Family socioeconomic position since 7	1.04 (0.98, 1.11)				
Parent-child relationship	1.00 (0.99, 1.01)				
Verbal abuse (Ref = no)	2.25***(2.01, 2.53)				
Physical abuse (Ref = no)	1.68***(1.43, 1.98)				
Sexual harassment or assault (Ref = no)	6.26***(4.69, 8.36)				
Domestic violence before 7 (Ref = no)	1.21 (0.98, 1.50)				
Domestic violence since 7(Ref = no)	0.92 (0.70, 1.21)				
Mother's problem drinking (Ref = no)	0.96 (0.79, 1.18)				
Father's problem drinking (Ref = no)	1.15 (0.96, 1.38)				
Mother's drug use (Ref = no)	1.59 (0.77, 3.28)				
Father's drug use (Ref = no)	1.22 (0.80, 1.88)				
Parental absence (Ref = parents presence)					
Either parent absence before 7	1.34**(1.09, 1.65)				
Either parent absence since 7	1.62***(1.38, 1.90)				

*Note.* *Brant* test was applied to test the proportional odds assumption. If the proportional odds assumption is not violated, one odds ratio in the column OR was reported; if it is violated, *gologit2* was used and four odds ratios in the columns OR<sup>a</sup>, OR<sup>b</sup>, OR<sup>c</sup>, and OR<sup>d</sup> were reported. The five classes were interpreted as: “no sexual behavior” (class 1), “kisser” (class 2); “touching under clothes” (class 3); “genital touching” (class 4); and “all sexual activities” (class 5).

<sup>a</sup>Class 1 versus class 2, 3, 4, and 5.

<sup>b</sup>Class 1 and 2 versus class 3, 4, and 5.

<sup>c</sup>Class 1, 2, and 3 versus class 4 and 5.

<sup>d</sup>Class 1, 2, 3, and 4 versus class 5.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

Table 4. Univariate and multivariate regressions for mental health outcomes for boys

Mental health		Model 1	Model 2	Model 3
Psychological Well-being	Latent class membership of early sexual behaviors	-0.00	-0.24*	-0.15
	Class 2	(-0.23, 0.22) 0.80**	(-0.46, -0.02) 0.21	(-0.37, 0.07) 0.22
	Class 3	(0.30, 1.31) 0.97**	(-0.30, 0.72) 0.27	(-0.27, 0.72) 0.16
	Class 4	(0.30, 1.64) 1.37**	(-0.38, 0.92) 0.55	(-0.49, 0.80) 0.11
	Class 5	(0.51, 2.23)	(-0.29, 1.40)	(-0.77, 0.98)
	Substance use	Latent class membership of early sexual behaviors	1.37***	1.31***
	Class 2	(1.29, 1.45) 1.86***	(1.24, 1.39) 1.73***	(1.10, 1.25) 1.35***
	Class 3	(1.74, 1.97) 2.07***	(1.62, 1.85) 1.94***	(1.24, 1.47) 1.41***
	Class 4	(1.94, 2.21) 2.37***	(1.80, 2.07) 2.22***	(1.28, 1.55) 1.48***
	Class 5	(2.23, 2.51)	(2.08, 2.37)	(1.31, 1.64)
Self-harm attempt	Latent class membership of early sexual behaviors	1.97***	1.73**	1.77**
	Class 2	(1.41, 2.77) 3.12***	(1.21, 2.46) 2.32**	(1.24, 2.55) 2.23*
	Class 3	(1.79, 5.44) 3.24**	(1.28, 4.22) 2.03	(1.19, 4.18) 1.60
	Class 4	(1.57, 6.65) 6.68***	(0.92, 4.45) 4.39***	(0.68, 3.74) 2.86*
	Class 5	(3.24, 13.77)	(2.05, 9.38)	(1.20, 6.82)

*Note.* Substance use at 17 was log-transformed. For psychological well-being and substance use at 17, the mean differences and 95% confidence interval were reported here, with higher score indicating more negative psychological well-being and more substance use. For self-harm attempt at 17, the odds ratios and 95% confidence interval were reported here. The five classes were interpreted as: “no sexual behavior” (class 1), “kisser” (class 2); “touching under clothes” (class 3); “genital touching” (class 4); and “all sexual activities” (class 5). Boys from the “no sexual behavior” class were the reference groups. Model 1 is the univariate regression. Model 2 controlled for early life adversities. Model 3 is the same as Model 2 with mental health outcomes at 14 being further controlled for.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .



Table 5. Univariate and multivariate regressions for mental health outcomes for girls

Mental health		Model 1	Model 2	Model 3
Psychological Well-being	Latent class membership of early sexual behaviors	0.66***	0.01	-0.05
	Class 2	(0.41, 0.90)	(-0.23, 0.25)	(-0.27, 0.18)
		1.59***	0.56	0.33
	Class 3	(0.96, 2.22)	(-0.06, 1.19)	(-0.27, 0.94)
		1.08**	-0.16	-0.59
	Class 4	(0.27, 1.90)	(-0.96, 0.64)	(-1.38, 0.19)
	2.29***	0.64	0.10	
	Class 5	(1.29, 3.30)	(-0.38, 1.66)	(-0.89, 1.09)
Substance use	Latent class membership of early sexual behaviors	1.40***	1.27***	1.08***
	Class 2	(1.33, 1.47)	(1.20, 1.34)	(1.01, 1.15)
		1.95***	1.73***	1.22***
	Class 3	(1.84, 2.07)	(1.60, 1.85)	(1.09, 1.34)
		2.06***	1.78***	1.11***
	Class 4	(1.91, 2.21)	(1.62, 1.94)	(0.95, 1.28)
	2.41***	2.13***	1.21***	
	Class 5	(2.29, 2.53)	(1.99, 2.27)	(1.06, 1.36)
Self-harm attempt	Latent class membership of early sexual behaviors	1.98***	1.34*	1.24
	Class 2	(1.60, 2.44)	(1.06, 1.69)	(0.97, 1.59)
		3.09***	1.88**	1.51
	Class 3	(2.04, 4.67)	(1.19, 2.98)	(0.95, 2.41)
		4.38***	2.30**	1.66
	Class 4	(2.64, 7.28)	(1.26, 4.22)	(0.89, 3.07)
	8.20***	3.89***	2.49**	
	Class 5	(5.06, 13.29)	(2.24, 6.73)	(1.35, 4.62)

*Note.* Substance use at 17 was log-transformed. For psychological well-being and substance use at 17, the mean differences and 95% confidence interval were reported here, with higher

score indicating more negative psychological well-being and more substance use. For self-harm attempt at 17, the odds ratios and 95% confidence interval were reported here. The five classes were interpreted as: “no sexual behavior” (class 1), “kisser” (class 2); “touching under clothes” (class 3); “genital touching” (class 4); and “all sexual activities” (class 5). Girls from the “no sexual behavior” class were the reference groups. Model 1 is the univariate regression. Model 2 controlled for early life adversities. Model 3 is the same as Model 2 with mental health outcomes at 14 being further controlled for.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Supplemental Table 1.** Descriptive statistics for mental health outcomes and early life adversities stratified by latent class membership of early sexual behavior among boys

	Latent class membership of early sexual behaviors at 14 years					Missing ,%
	Class 1	Class 2	Class 3	Class 4	Class 5	
<b>Mental health outcomes at 17</b>						
Psychological well-being						21.47
<i>N</i>	2239	1713	232	132	76	
<i>M (SD)</i>	-0.72 (3.56)	-0.77 (3.62)	0.03 (3.76)	0.21 (3.83)	0.47 (3.55)	
Substance use						21.47
<i>N</i>	2239	1713	232	132	76	
<i>M (SD)</i>	0.03 (0.62)	0.52 (0.75)	0.86 (0.75)	1.12 (0.83)	1.50 (0.74)	
Self-harm attempt <i>N</i> (%)						22.44
No	2155 (97.29)	1607 (95.03)	209 (92.07)	119 (91.54)	64 (85.33)	
Yes	60 (2.71)	84 (4.97)	18 (7.93)	11 (8.46)	11 (14.67)	
<b>Mental health outcomes at 14</b>						
Psychological well-being						0.00
<i>N</i>	2771	2219	312	180	111	
<i>M (SD)</i>	-0.32 (1.51)	-0.24 (1.64)	0.24 (1.95)	0.87 (2.23)	1.86 (2.46)	
Substance use						0.00
<i>N</i>	2771	2219	312	180	111	
<i>M (SD)</i>	-0.17 (0.32)	-0.00 (0.58)	0.35 (0.95)	0.78 (1.27)	1.35 (1.47)	
<b>Early life adversities</b>						
Maternal psychological distress before adolescents were 7						24.76
<i>N</i>	1993	1752	236	142	85	
<i>M (SD)</i>	9.05 (3.09)	9.04 (3.26)	9.12 (3.07)	9.44 (3.50)	9.59 (3.54)	
Maternal psychological distress since adolescents were 7						25.60
<i>N</i>	1978	1734	227	140	82	
<i>M (SD)</i>	9.54 (3.25)	9.50 (3.32)	9.63 (3.30)	9.91 (3.53)	10.44 (4.07)	
Paternal psychological distress before adolescents were 7						47.68
<i>N</i>	1454	1179	159	76	58	

<i>M (SD)</i>	8.99 (2.79)	8.74 (2.65)	9.01 (2.87)	9.61 (3.80)	8.99 (2.40)	
Paternal psychological distress since adolescents were 7						57.45
<i>N</i>	1202	965	116	62	35	
<i>M (SD)</i>	9.32 (2.82)	9.32 (2.91)	9.34 (2.70)	9.26 (2.74)	9.67 (2.87)	
Family socioeconomic position before adolescents were 7						47.67
<i>N</i>	1417	1183	172	90	65	
<i>M (SD)</i>	6.66 (2.50)	6.48 (2.55)	6.52 (2.42)	6.42 (2.48)	6.61 (2.47)	
Family socioeconomic position since adolescents were 7						41.07
<i>N</i>	1624	1332	180	95	65	
<i>M (SD)</i>	6.38 (2.57)	6.31 (2.53)	6.47 (2.44)	6.29 (2.30)	6.33 (2.41)	
Parent-child relationship						14.77
<i>N</i>	2306	1945	263	158	95	
<i>M (SD)</i>	63.01 (6.34)	63.47 (6.22)	63.02 (6.19)	62.07 (7.18)	62.62 (6.32)	
Verbal abuse <i>N (%)</i>						0.20
No	1747 (63.21)	1200 (54.18)	138 (44.23)	80 (44.44)	40 (36.04)	
Yes	1017 (36.79)	1015 (45.82)	174 (55.77)	100 (55.56)	71 (63.96)	
Physical abuse <i>N (%)</i>						0.23
No	2126 (76.95)	1514 (68.35)	164 (52.56)	90 (50.28)	49 (44.14)	
Yes	637 (23.05)	701 (31.65)	148 (47.44)	89 (49.72)	62 (55.86)	
Sexual harassment or assault <i>N (%)</i>						0.30
No	2739 (99.17)	2187 (98.78)	302 (97.42)	172 (96.09)	108 (97.30)	
Yes	23 (0.83)	27 (1.22)	8 (2.58)	7 (3.91)	-	
Domestic violence before adolescents were 7						52.14
No	907 (69.56)	726 (67.10)	91 (59.87)	47 (55.95)	32 (58.18)	
Yes	397 (30.44)	356 (32.90)	61 (40.13)	37 (44.05)	23 (41.82)	
Domestic violence since adolescents were 7						42.50
No	1400 (88.50)	1113 (84.83)	135 (80.84)	78 (81.25)	51 (86.44)	
Yes	182 (11.50)	199 (15.17)	32 (19.16)	18 (18.75)	8 (13.56)	
Mother's problem drinking <i>N (%)</i>						41.64
No	1305 (86.03)	1177 (85.23)	154 (84.62)	79 (68.70)	56 (81.16)	

Yes	212 (13.97)	204 (14.77)	28 (15.38)	36 (31.30)	13 (18.84)	
Father's problem drinking <i>N</i> (%)						55.43
No	863 (69.99)	661 (65.51)	86 (66.15)	46 (63.01)	30 (62.50)	
Yes	370 (30.01)	348 (34.49)	44 (33.85)	27 (36.99)	18 (37.50)	
Mother's drug use <i>N</i> (%)						26.12
No	1950 (98.68)	1682 (98.13)	227 (98.70)	129 (97.73)	76 (95.00)	
Yes	26 (1.32)	32 (1.87)	-	-	-	
Father's drug use <i>N</i> (%)						48.69
No	1393 (97.21)	1118 (96.55)	141 (94.63)	70 (95.89)	53 (92.98)	
Yes	40 (2.79)	40 (3.45)	8 (5.37)	-	-	
Parental absence <i>N</i> (%)						0.00
Either parent absence before adolescents were 7	596 (21.51)	612 (27.58)	98 (31.41)	62 (34.44)	37 (33.33)	
Either parent absence since adolescents were 7	360 (12.99)	340 (15.32)	52 (16.67)	31 (17.22)	23 (20.72)	
Parents presence	1815 (65.50)	1267 (57.10)	162 (51.92)	87 (48.33)	51 (45.95)	

*Note.* The range for psychological well-being at 17, substance use at 17, psychological well-being at 14, substance use at 14, maternal/paternal psychological distress, family socioeconomic position before 7, family socioeconomic position since 7, and parent-child relationship is , -8.73-15.72, -0.40-2.72, -2.97-10.47, -0.31-5.07, 6-30, 0-11.63, 0-11.68, and 15-75, respectively. The five classes were interpreted as: "no sexual behavior" (class 1), "kisser" (class 2); "touching under clothes" (class 3); "genital touching" (class 4); and "all sexual activities" (class 5). "-" means 5 or less. Cell counts 5 or less are not presented to avoid any potential identification.

**Supplemental Table 2.** Descriptive statistics for mental health outcomes and early life adversities stratified by latent class membership of early sexual behavior among girls

	Latent class membership of early sexual behaviors at 14					Missing, %
	Class 1	Class 2	Class 3	Class 4	Class 5	
<b>Mental health outcomes at 17</b>						
Psychological well-being						17.71
<i>N</i>	2500	1860	182	90	78	
<i>M (SD)</i>	0.64 (4.06)	1.19 (4.21)	2.22 (4.11)	1.78 (3.88)	3.05 (4.79)	
Substance use						17.71
<i>N</i>	2500	1860	182	90	78	
<i>M (SD)</i>	-0.02 (0.53)	0.47 (0.71)	0.87 (0.70)	1.00 (0.74)	1.43 (0.64)	
Self-harm attempt <i>N</i> (%)						19.48
No	2283 (93.34)	1606 (88.34)	147 (82.12)	69 (77.53)	48 (62.34)	
Yes	163 (6.66)	212 (11.66)	32 (17.88)	20 (22.47)	29 (37.66)	
<b>Mental health outcomes at 14</b>						
Psychological well-being						0.00
<i>N</i>	2971	2299	221	119	114	
<i>M (SD)</i>	-0.24 (1.46)	0.36 (1.87)	1.23 (2.02)	1.97 (2.19)	3.43 (2.53)	
Substance use						0.00
<i>N</i>	2971	2299	221	119	114	
<i>M (SD)</i>	-0.18 (0.29)	0.07 (0.69)	0.59 (1.04)	0.95 (1.17)	1.91 (1.47)	
<b>Early life adversities</b>						
Maternal psychological distress before adolescents were 7						26.03
<i>N</i>	2096	1766	178	99	95	
<i>M (SD)</i>	8.93 (3.03)	9.12 (3.29)	8.60 (2.45)	9.19 (3.82)	9.63 (3.55)	
Maternal psychological distress since adolescents were 7						23.99
<i>N</i>	2200	1774	194	92	91	
<i>M (SD)</i>	9.46 (3.20)	9.77 (3.49)	9.59 (2.88)	10.24 (3.37)	10.56 (4.09)	
Paternal psychological distress before adolescents were 7						47.92
<i>N</i>	1587	1160	129	54	51	

<i>M (SD)</i>	8.85 (2.76)	8.85 (2.73)	8.99 (2.71)	8.01 (1.71)	8.64 (2.08)	
Paternal psychological distress since adolescents were 7						58.26
<i>N</i>	1317	907	100	37	28	
<i>M (SD)</i>	9.18 (2.90)	9.19 (2.85)	9.31 (2.43)	8.09 (1.74)	10.79 (3.90)	
Family socioeconomic position before adolescents were 7						48.92
<i>N</i>	1498	1168	138	57	63	
<i>M (SD)</i>	6.66 (2.60)	6.39 (2.54)	6.47 (2.59)	6.85 (2.50)	5.76 (2.38)	
Family socioeconomic position since adolescents were 7						41.63
<i>N</i>	1776	1302	137	64	62	
<i>M (SD)</i>	6.39 (2.65)	6.26 (2.55)	6.57 (2.47)	6.79 (2.59)	5.92 (2.48)	
Parent-child relationship						14.20
<i>N</i>	2494	2003	200	110	104	
<i>M (SD)</i>	63.87 (5.92)	63.73 (6.02)	63.97 (5.67)	64.09 (6.25)	64.00 (6.05)	
Verbal abuse <i>N (%)</i>						0.17
No	2025 (68.27)	1081 (47.08)	69 (31.51)	33 (27.73)	29 (25.44)	
Yes	941 (31.73)	1215 (52.92)	150 (68.49)	86 (72.27)	85 (74.56)	
Physical abuse <i>N (%)</i>						0.23
No	2700 (91.03)	1840 (80.24)	158 (72.15)	71 (59.66)	73 (64.04)	
Yes	266 (8.97)	453 (19.76)	61 (27.85)	48 (40.34)	41 (35.96)	
Sexual harassment or assault <i>N (%)</i>						0.21
No	2931 (98.79)	2188 (95.38)	173 (79.36)	92 (77.31)	84 (73.68)	
Yes	36 (1.21)	106 (4.62)	45 (20.64)	27 (22.69)	30 (26.32)	
Domestic violence before adolescents were 7						52.74
No	979 (70.84)	714 (65.09)	82 (65.60)	35 (68.63)	28 (56.00)	
Yes	403 (29.16)	383 (34.91)	43 (34.40)	16 (31.37)	22 (44.00)	
Domestic violence since adolescents were 7						43.54
No	1519 (87.50)	1083 (86.64)	118 (85.51)	47 (85.45)	41 (77.36)	
Yes	217 (12.50)	167 (13.36)	20 (14.49)	8 (14.55)	12 (22.64)	
Mother's problem drinking <i>N (%)</i>						42.54
No	1364 (85.57)	1204 (85.33)	113 (80.14)	58 (80.56)	61 (85.92)	

Yes	230 (14.43)	207 (14.67)	28 (19.86)	14 (19.44)	10 (14.08)	
Father's problem drinking <i>N</i> (%)						56.29
No	917 (69.84)	655 (65.76)	65 (68.42)	33 (70.21)	36 (70.59)	
Yes	396 (30.16)	341 (34.24)	30 (31.58)	14 (29.79)	15 (29.41)	
Mother's drug use <i>N</i> (%)						27.45
No	2046 (99.22)	1716 (99.08)	167 (97.09)	92 (95.83)	89 (97.80)	
Yes	16 (0.78)	16 (0.92)	5 (2.91)	-	-	
Father's drug use <i>N</i> (%)						48.67
No	1523 (97.32)	1101 (96.41)	114 (92.68)	51 (92.73)	51 (96.23)	
Yes	42 (2.68)	41 (3.59)	9 (7.32)	-	-	
Parental absence <i>N</i> (%)						0.00
Either parent absence before adolescents were 7	631 (21.24)	687 (29.88)	57 (25.79)	42 (35.29)	46 (40.35)	
Either parent absence since adolescents were 7	369 (12.42)	353 (15.35)	46 (20.81)	25 (21.01)	25 (21.93)	
Parents presence	1971 (66.34)	1259 (54.76)	118 (53.39)	52 (43.70)	43 (37.72)	

*Note.* The range for psychological well-being at 17, substance use at 17, psychological well-being at 14, substance use at 14, maternal/paternal psychological distress, family socioeconomic position before 7, family socioeconomic position since 7, and parent-child relationship is , -8.73-15.72, -0.40-2.72, -2.97-10.47, -0.31-5.07, 6-30, 0-11.63, 0-11.68, and 15-75, respectively. The five classes were interpreted as: “no sexual behavior” (class 1), “kisser” (class 2); “touching under clothes” (class 3); “genital touching” (class 4); and “all sexual activities” (class 5). “-” means 5 or less. Cell counts 5 or less are not presented to avoid any potential identification.



**Supplemental Table 3.** Correlations among mental health outcomes

	1	2	3	4	5	6	7	8	9
1. Psychological distress	-	-	-	-	-	-	-	-	-
2. Emotional and behavioral difficulties	.71***	-	.19***	-	.21***	.11***	.25***	.17***	-
3. Self-esteem	.55***	.48***	-	-	.15***	.16***	.22***	.14***	-
4. Mental well-being	-.62***	-.56***	-.52***	-	-	-	-	-	-
5. Drug use	.18***	.20***	.09***	-.11***	-	.70***	.85***	.72***	-
6. Binge drinking	.11***	.09***	.06***	-.05***	.60***	-	.68***	.63***	-
7. Smoking cigarettes	.20***	.24***	.14***	-.13***	.74***	.59***	-	.76***	-
8. Smoking electronic cigarettes	.13***	.19***	.08***	-.08**	.61***	.49***	.72***	-	-
9. Self-harm attempt	.52***	.46***	.35***	-.42***	.32***	.17***	.39***	.29***	-

Note. Correlations among continuous mental health outcomes (psychological distress, emotional and behavioral difficulties, self-esteem, and mental well-being) were calculated using maximum likelihood estimation with robust standard errors. Polychoric correlations between continuous and ordinal mental health outcome (drug use, binge drinking, smoking cigarettes, smoking electronic cigarettes, and self-harm attempt) are reported here. Polychoric correlations between ordinal mental health outcomes are also reported. Biserial correlations between self-harm attempt and continuous mental health outcomes are given here. Correlations among mental health outcomes at age 14 years are listed above the diagonal line, and the correlations among mental health outcomes at age 17 years are listed below the diagonal line. Psychological distress, mental well-being, and self-harm attempt was not measured at age 14 years.

\*\*\* $p < .001$

**Supplemental Table 4.** Model fit statistics between analysis using MLR and analysis using WLSMV

Age	Model	Model fit statistics					
		Estimator	CFI	TLI	SRMR	RMSEA, 90%CI	$\chi^2(df), p$
14 years	Two-factor exploratory factor analysis	WLSMV	0.998	0.994	-	0.028 (0.020, 0.036)	$\chi^2(4) = 39.34, p < .001$
		MLR	0.988	0.953	0.014	0.036 (0.028, 0.044)	$\chi^2(4) = 61.48, p < .001$
	Two-factor confirmatory factor analysis	WLSMV	0.996	0.992	-	0.031 (0.026, 0.037)	$\chi^2(8) = 95.04, p < .001$
		MLR	0.976	0.956	0.019	0.035 (0.029, 0.040)	$\chi^2(8) = 116.98, p < .001$
17 years	Two-factor exploratory factor analysis	WLSMV	0.988	0.975	-	0.054 (0.049, 0.059)	$\chi^2(13) = 360.42, p < .001$
		MLR	0.987	0.972	0.014	0.045 (0.040, 0.049)	$\chi^2(13) = 247.97, p < .001$
	Two-factor confirmatory factor analysis	WLSMV	0.988	0.982	-	0.045 (0.042, 0.050)	$\chi^2(19) = 376.18, p < .001$
		MLR	0.980	0.971	0.025	0.045 (0.041, 0.049)	$\chi^2(19) = 371.14, p < .001$

Note. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; CI = confidence interval; MLR = maximum likelihood estimation with robust standard errors; WLSMV = weighted least squares means and variance adjusted.

**Supplemental Table 5.** Model fit statistics for measurement invariance models

Model	Model fit indices					Model comparison
	CFI	TLI	RMSEA,90%CI	SRMR	$\chi^2(df), p$	
Configural invariance	0.980	0.971	0.045 (0.041, 0.049)	0.026	$\chi^2(95) = 441.70, p < .001$	Reference group
Metric invariance	0.979	0.975	0.041 (0.037, 0.045)	0.031	$\chi^2(119) = 487.40, p < .001$	$\chi^2(24) = 48.29, p = .002$ $\Delta\text{CFI} = .001; \Delta\text{RMSEA} = .004$
Scalar invariance	0.970	0.971	0.045 (0.041, 0.048)	0.038	$\chi^2(143) = 664.76, p < .001$	$\chi^2(48) = 223.06, p < .001$ $\Delta\text{CFI} = .010; \Delta\text{RMSEA} = .000$

Note. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; CI = confidence interval;  $\Delta\text{CFI}$  = change in comparative fit index; and  $\Delta\text{RMSEA}$  = change in root mean square error of approximation.

**Supplemental Table 6.** Descriptive statistics for screening items for mischievous responding stratified by sex

Sex	Screen items	Latent class membership of early sexual behaviors at 14 years				
		Class 1	Class 2	Class 3	Class 4	Class 5
Boys	Have seen a dentist in the past 12 months					
	No	348 (12.64)	192 (8.68)	33 (10.61)	29 (16.11)	16 (14.55)
	Yes	2406 (87.36)	2020 (91.32)	278 (89.39)	151 (83.89)	94 (85.45)
	Never go to the cinema					
	No	2555 (92.37)	2108 (95.26)	299 (95.83)	173 (96.11)	107 (97.27)
	Yes	211 (7.63)	105 (4.74)	13 (4.17)	7 (3.89)	-
	Have computer of their own					
	No	483 (17.43)	403 (18.16)	49 (15.71)	29 (16.11)	19 (17.12)
	Yes	2288 (82.57)	1816 (81.84)	263 (84.29)	151 (83.89)	92 (82.88)
	Never have at least two portions of vegetables per day					
	No	2508 (90.87)	2031 (91.94)	282 (91.26)	163 (91.06)	98 (88.29)
	Yes	252 (9.13)	178 (8.06)	27 (8.74)	16 (8.94)	13 (11.71)
Girls	Have seen a dentist in the past 12 months					
	No	269 (9.07)	202 (8.80)	19 (8.64)	10 (8.40)	12 (10.62)
	Yes	2696 (90.93)	2094 (91.20)	201 (91.36)	109 (91.60)	101 (89.38)
	Never go to the cinema					
	No	2816 (94.91)	2205 (95.99)	211 (95.48)	113 (94.96)	112 (98.25)
	Yes	151 (5.09)	92 (4.01)	10 (4.52)	6 (5.04)	-
	Have computer of their own					
	No	455 (15.32)	314 (13.66)	30 (13.57)	20 (16.81)	14 (12.28)
	Yes	2515 (84.68)	1985 (86.34)	191 (86.43)	99 (83.19)	100 (87.72)
	Never have at least two portions of vegetables per day					
	No	2776 (93.59)	2124 (92.51)	202 (91.82)	108 (90.76)	101 (88.60)
	Yes	190 (6.41)	172 (7.49)	18 (8.18)	11 (9.24)	13 (11.40)

Note. “-” means 5 or less. Cell counts 5 or less are not presented to avoid any potential identification.

**Supplemental Table 7.** Model fit statistics for latent class analysis of sexual behavior at 14 years with 1-8 classes

Number of Classes	AIC	BIC	ABIC	LMR LR test	ALMR LR test	BLRT	Entropy
1	73817.61	73890.95	73859.17				
2	56824.26	56978.28	56911.54	<.001	<.001	<.001	.98
3	49224.78	49459.47	49357.78	<.001	<.001	<.001	.87
4	47838.80	48154.17	48017.52	<.001	<.001	<.001	.88
5	47563.73	47959.77	47788.16	<.001	<.001	<.001	.89
6	47479.09	47955.80	47749.24	<.001	<.001	<.001	.91
7	47422.44	47979.83	47738.31	<.001	<.001	<.001	.92
8	47433.29	48071.35	47794.88	.310	.313	1.000	.94

*Note.* AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; ABIC = adjusted Bayesian Information Criterion; LMR LR test = Lo-Mendell-Rubin likelihood ratio test; ALMR LR test = adjusted Lo-Mendell-Rubin likelihood ratio test; BLRT = bootstrapped likelihood ratio test.

**Supplemental Table 8.** Item-response probabilities for the six classes model of adolescent sexual behavior at 14.

Sexual behaviors at 14 years, yes	Latent class membership of early sexual behaviors at 14 years					
	Class 1 ( <i>N</i> = 5,742 )	Class 2 ( <i>N</i> = 4,518)	Class 3 ( <i>N</i> = 494)	Class 4 ( <i>N</i> = 115)	Class 5 ( <i>N</i> = 223)	Class 6 ( <i>N</i> = 225)
Hold hands	.20	.95	.96	.92	.97	.98
Kiss	.03	.66	.93	.92	.98	1.00
Cuddle together	.14	.89	.98	.97	.98	1.00
Let others touch under clothes	.00	.01	.78	1.00	.95	.99
Touch others under clothes	.00	.00	.78	.38	1.00	.98
Touch other genitals	.00	.00	.08	.25	1.00	1.00
Let others touch their genitals	.00	.00	.05	1.00	.90	.99
Perform oral sex on others	.00	.00	.00	.05	.10	.89
Let others perform oral sex on them	.00	.00	.00	.21	.12	.91
Sexual intercourse	.00	.00	.00	.11	.17	.62

**Supplemental Table 9.** Item-response probabilities for the seven classes model of adolescent sexual behavior at 14.

Sexual behaviors at 14 years, yes	Latent class membership of early sexual behaviors at 14 years						
	Class 1 ( <i>N</i> = 5,742 )	Class 2 ( <i>N</i> = 4,526)	Class 3 ( <i>N</i> = 439)	Class 4 ( <i>N</i> = 66)	Class 5 ( <i>N</i> = 232)	Class 6 ( <i>N</i> = 73)	Class 7 ( <i>N</i> = 239)
Hold hands	.20	.95	.97	.88	.98	.89	.98
Kiss	.03	.66	.95	.85	1.00	.88	1.00
Cuddle together	.14	.89	.99	1.00	.98	.96	1.00
Let others touch under clothes	.00	.01	.84	.55	.99	1.00	.99
Touch others under clothes	.00	.00	.74	1.00	1.00	.00	.99
Touch other genitals	.00	.00	.00	1.00	.85	.26	1.00
Let others touch their genitals	.00	.00	.05	.22	.99	.96	.99
Perform oral sex on others	.00	.00	.00	.13	.00	.08	.91
Let others perform oral sex on them	.00	.00	.00	.03	.16	.18	.87
Sexual intercourse	.00	.00	.00	.06	.15	.12	.60