Title: Depression and self-harm from adolescence to young adulthood in sexual minorities compared to heterosexuals: a population-based cohort study

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Abstract

Background: There are few population-based cohort studies of the emergence, development, and persistence of mental health problems in sexual minorities compared to heterosexuals. We compared trajectories of depressive symptoms from 10 to 21 years of age in sexual minority and heterosexual adolescents, and examined self-harm at ages 16 and 21.

Methods: The study included 4828 adolescents from the ALSPAC birth cohort (Bristol, UK) who reported their sexual orientation at age 16. Depressive symptoms were assessed with the short Mood and Feelings Questionnaire (sMFQ) at seven time-points between ages 10 and 21. A self-harm questionnaire was completed at ages 16 and 21. Analyses were linear multilevel models with growth curves (depressive symptoms), logistic multilevel models (self-harm in the past year at ages 16 and 21) and multinomial regression (lifetime self-harm with and without suicidal intent at age 21).

Findings: In sexual minorities, depressive symptoms were higher at age 10 and increased to a larger extent compared to heterosexuals. In heterosexuals, depressive symptoms increased by 0.31 sMFQ points at each time-point (95% CI 0.27 to 0.34) and in sexual minorities by 0.49 sMFQ points (95% CI 0.40 to 0.59). Sexual minority adolescents were more likely to report self-harm in the past year at ages 16 and 21 (adjusted odds ratio 4.23, 95% CI 2.90 to 6.16), with no evidence that this estimate reduced with age (p=0.798). At 21, sexual minorities were 4.53 (95% CI 3.02 to 6.78) times more likely to report previous self-harm with suicidal intent.

Interpretation: Mental health disparities between heterosexuals and sexual minorities are present early in adolescence and increase throughout the school years, persisting to young

adulthood. Prevention of these mental health problems must be a priority, as well as early intervention.

Introduction

Sexual minorities (for example people identifying as lesbian, gay or bisexual, not exclusively heterosexual or not sure of their sexual orientation[1,2]) are more likely to experience depression, self-harm and suicide attempts than heterosexuals.[2,3] These associations have been reported in cross-sectional surveys across the world, in adults[2,3] and adolescents.[4,5] However, there is little longitudinal research on when increased risk for these mental health problems emerges and how it develops over time.

Depression and self-harm often begin in adolescence which can be defined as the period from 10 years of age to the early 20s.[6,7] Depressive symptoms start to increase at around 13 years of age and continue to rise until early adulthood.[6] Adolescence is stressful for many young people and involves identity formation and changes in sexuality, self-esteem and family and peer relationships.[8] These changes may be particularly difficult for sexual minority adolescents who could also be experiencing chronic minority stress.[9] There is evidence that sexual minority adolescents often experience multiple additional stressors, relative to heterosexuals.[9,10] Adolescent depressive symptoms might therefore increase to a larger extent in sexual minority than heterosexual youth.

Self-harm is often comorbid with depression but tends to decrease from adolescence to young adulthood.[11,12] However, due to experiences of chronic minority stress, self-harm might be more likely to persist from adolescence to young adulthood in sexual minority than heterosexual adolescents. Persistent or repetitive self-harm is particularly problematic as it indicates ongoing distress and is a marker of increased suicide risk.[13]

Few population-based cohort studies have compared depressive symptoms in sexual minority and heterosexual adolescents over time, and fewer still have investigated self-harm. Existing cohort studies mostly use short follow-up periods to mid-adolescence[14] and are either small so might lack statistical power [15,16] or retrospective which might introduce information bias.[17,18] As far as we are aware, only two large population-based samples have been used to compare depressive symptoms (but not self-harm) in sexual minority and heterosexual youth from adolescence to young adulthood. Both were from the USA and their findings are inconsistent.[19,20]

We compared depressive symptoms and self-harm in sexual minority and heterosexual young people from early adolescence to young adulthood in a large UK population-based birth cohort. We investigated whether the increase in depressive symptoms that occurs during adolescence was greater in sexual minority than heterosexual adolescents. We also investigated whether sexual minority adolescents were at increased risk of self-harm in both adolescence and young adulthood.

Methods

Participants

The Avon Longitudinal Study of Parents and Children (ALSPAC) is an ongoing population-based birth cohort examining a wide range of influences on health and development.[21,22] All pregnant women in the former county of Avon in Bristol (South West England, UK), with an estimated delivery date between April 01 1991 and December 31 1992 were invited. The core enrolled sample consisted of 14,541 women (85-90% of those eligible). Of 14,062 live births, 13,798 were singletons or first born twins alive at 1 year of age. Detailed information were collected at multiple time-points during pregnancy and the child's life, with postal questionnaires and in research clinics. Information on the data collected is available from www.bristol.ac.uk/alspac and a fully searchable data dictionary (www.bristol.ac.uk/alspac/researchers/data-access/data-dictionary). In this study we used data from core singleton offspring who answered a question about sexual orientation at age 16.

Ethical approval.

Ethical approval for the study was obtained from the ALSPAC Law and Ethics Committee and the Local NHS Research Ethics Committee. All participants provided written informed consent.

Measures.

Depressive symptoms: The short Mood and Feelings Questionnaire (sMFQ) is a 13-item self-report measure of the severity of DSM-IV depressive symptoms in the past two weeks.[23] The sMFQ was completed by adolescents at 10, 12, 13, 16, 17, 19 and 21 years of age. Possible

scores range from 0 to 26, higher scores indicating more severe depressive symptoms. The discriminatory ability of the sMFQ for ICD-10 depression is high in ALSPAC.[24]

At 18 years of age adolescents completed a self-administered computerized version of the Clinical Interview Schedule-Revised (CIS-R) which assesses depressive symptom severity in the last week and generates ICD-10 depression diagnoses.[25] The CIS-R is well validated in community samples.[25]

Self-harm: Self-harm was measured at ages 16 and 21 with a questionnaire adapted from the Child and Adolescent Self-harm in Europe (CASE) study.[26] Participants responded yes or no to the question 'have you ever hurt yourself on purpose in any way (for example, by taking an overdose of pills or by cutting yourself)?' For those who answered yes, a further question was asked about the last time they had self-harmed. Response options included 'in the last week,' 'more than a week ago, but in the last year,' and 'more than a year ago.' Our primary self-harm analyses focused on self-harm in the past year which is more clinically relevant and less prone to recall bias.[27,28] This allowed us to investigate whether sexual minority adolescents were at increased risk of self-harm at both time-points (ages 16 and 21). We created a binary variable for past-year self-harm at ages 16 and 21: never self-harmed or self-harmed more than a year ago (0) and self-harmed in the past year (1). In sensitivity analyses we excluded excluding those reporting self-harm more than a year ago.

As a secondary analysis we investigated self-harm with suicidal intent which was only assessed with a lifetime question. Participants who answered yes to having ever self-harmed were asked 'on any of the occasions when you have hurt yourself on purpose, have you ever seriously wanted to kill yourself?' Response options included 'yes' and 'no.' Participants

were also asked to give reasons for their self-harm. Consistent with prior studies,[12,27] anyone who either (a) gave the answer "I wanted to die" or (b) answered "yes" to: "On any of the occasions when you have hurt yourself on purpose, have you ever seriously wanted to kill yourself?" were classified as having self-harmed with suicidal intent. We derived a categorical measure of lifetime self-harm with suicidal intent using data from the latest time-point, age 21: 'never self-harmed (0),' 'have self-harmed, but never with suicidal intent (1)' and 'have self-harmed with suicidal intent (2).'

Sexual orientation: At a research clinic at 16 years of age, adolescents were asked to choose from a list indicating the 'description that best fits how you think about yourself.' Response options included 'not sure,' 'not attracted to either sex,' '100% heterosexual (straight),' 'mostly heterosexual, but also attracted to own sex,' 'bisexual (equally attracted to both sexes),' 'mostly homosexual, but also attracted to opposite sex' and '100% homosexual (gay).' There is strong evidence that these sexual minority groups, including those identifying as 'mainly heterosexual' or 'not sure', have increased risk of mental health problems compared to heterosexuals.[2,4] In line with existing literature, and due to small numbers in the gay and bisexual groups, all non-exclusively heterosexual categories were combined to form a 'sexual minority' group. Adolescents who responded 'not attracted to either sex' were excluded. Sensitivity analyses were conducted of the separate sexual minority groups to explore any potential differences. We used the following groups: mainly heterosexual, bisexual, lesbian/gay (100% and mostly combined due to small numbers) and not sure.

Covariates: We adjusted for participants' sex, their age when the exposure was measured, and maternal education and social class. Maternal education was measured using five categories and dichotomized (compulsory and non-compulsory education). Social class was measured

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using five categories from the 1991 classification of the UK Office of Population Censuses and Surveys, dichotomized into manual and non-manual.[29] We did not adjust for variables assumed to be on the causal pathway between sexual orientation and mental health problems such as bullying.

Statistical analyses

All analyses were conducted in STATA version 14.

The association between sexual orientation and depressive symptoms.

We used linear multilevel regression (STATA command 'xtmixed') to model depressive symptom trajectories. Multilevel models maximize available data and increase statistical power and precision. We included adolescents with at least three sMFQs.[30] Depressive symptoms at each of the seven time-points were a continuous repeated measures outcome, clustered within individuals. Time was a continuous exposure and the association between time and depressive symptoms calculates the trajectory. We also used a quadratic time variable, to investigate evidence of a curvilinear trajectory. The time variable was centred at the mean to reduce collinearity between time variables. Random effects were specified for intercept and slope. Random slopes are recommended as slopes within individuals may vary. We used an unstructured random-effects covariance matrix, allowing distinct variances and covariances between random-effects at the same level.

Model specifications are in Supplementary Table 3. Including the binary exposure tested whether intercept and slope differed between sexual minorities and heterosexuals. The extent to which growth in depressive symptoms differed between sexual minorities and

heterosexuals was tested with interactions between sexual orientation and time. We also calculated an interaction between sexual orientation and sex to test whether the association differed for females and males. Models were run before and after adjustment for covariates. Residual distributions of random effects at each level were inspected for normality. Sensitivity analyses were conducted separately for females and males and sexual minority groups.

The association between sexual orientation and past-year self-harm.

We calculated logistic multilevel models using the STATA command 'xtmelogit' for associations between sexual orientation and past-year self-harm. Past-year self-harm or not at ages 16 and 21 was a repeated measures binary outcome, clustered within individuals. We calculated an interaction between sexual orientation and time, to test whether estimates differed at ages 16 and 21. We also calculated an interaction between sexual orientation and sex. This model was run before and after adjustment for covariates. Residual distributions of random effects at each level were inspected for normality.

The association between sexual orientation and lifetime self-harm with suicidal intent.

We used multinomial logistic regression for associations between sexual orientation and lifetime self-harm (reported at age 21) with (category 2) or without (category 1) suicidal intent. 'No self-harm' (category 0) was the reference. Estimates from multinomial logistic regressions are 'multinomial relative risk ratios (RRR)' (the exponentiated coefficient on the log odds scale from the 'mlogit' command in STATA, which is the ratio of two relative risks). We also calculated an interaction between sexual orientation and sex. This model was run before and after adjustment for covariates. Sensitivity analyses of gender and sexual

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minority groups were not conducted for the categorical self-harm variables because numbers were too small and the loss of precision in multilevel models too high. Descriptive self-harm data by gender and sexual minority group are presented in the supplement.

Population Attributable Fraction

We estimated the proportion of cases of depression at age 18 and past year self-harm at ages 16 and 21 that might be attributable to sexual minority status if this relation were causal. We used the STATA command 'punaf' to calculate the population attributable risk and 95% confidence interval from adjusted logistic regression models.

Missing data

Multilevel models include everyone with outcome data at any time-point, weighting for missingness between time-points. For analyses of lifetime self-harm with suicidal intent we did not use multilevel models as the outcome was only at one time-point. We conducted a sensitivity analysis for this model, imputing missing covariate and outcome data (sexual orientation was not imputed). We assumed missingness was dependent on observed data (missing at random) and imputed 50 datasets using multiple imputation by chained equations (MICE). To predict missing data we used all variables in depression and self-harm analyses. Analyses were run across imputed data sets using the 'mi estimate' command.

Role of the funding source

The funding source had no role in study design, data collection, data analysis, interpretation or writing of the report. Gemma Lewis and Madeleine Irish had access to the raw data. The

corresponding author had full access to all data used in the study, and final responsibility for

the decision to submit for publication.

Results

Descriptive statistics

Data on sexual orientation were provided by 4843 adolescents who were a mean age of 15.53 (SD 0.30) and 53% female (87% of those who attended the research clinic). Of these, 87% (n=4203) identified as 'heterosexual,' 9% (n=416) as 'mostly heterosexual but also attracted to the same sex,' 2% (n=81) as bisexual, 0.6% (n=26) as 'mostly homosexual but also attracted to the opposite sex', 0.3% (n=15) as 'homosexual', 0.3% (n=15) as 'not attracted to either sex', and 2% (n=87) as 'not sure.' We defined 13% of adolescents (n=625) as sexual minority. Of these, data on covariates and at least three sMFQs were available for n=3885 (80%). Data on covariates and self-harm at either 16 or 21 years of age were available for n=3266 (68%).

Differences between analytic samples and the rest of ALSPAC are presented in Supplementary Tables 1 and 2. Characteristics of analytic samples according to sexual orientation are presented in Table 1.

The prevalence of past-year self-harm was 11% (n=321) at age 16 and 7% (n=154) at age 21. Of those who reported lifetime self-harm at 21 years of age (n=436), 126 (29%) were classified as having self-harmed with suicidal intent.

The association between sexual orientation and depressive symptoms.

Mean sMFQ scores are shown in Supplementary Table 4. There was evidence that depressive symptoms increased in the sample overall by 0.34 (95% CI 0.30 to 0.37) sMFQ points at each time-point. There was also evidence that this association was not linear (p<0.0001): sMFQ

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scores began to decrease from around age 18. After adjustments, there was evidence that mean depressive symptoms were 1.41 points higher (95% CI 1.15 to 1.67) in sexual minority then heterosexual adolescents. There was evidence of interaction between sexual orientation and time (p=0.0003). Depressive symptoms increased by 0.31 sMFQ points per time-point (95% CI 0.27 to 0.34) in heterosexuals and 0.49 (95% CI 0.40 to 0.59) in sexual minorities. There was also interaction between sexual orientation and time-squared (p<.0001). From age 18 depressive symptoms decreased by .11 (95% CI -.15 to -.06) sMFQ points in heterosexuals and from age 19 by -.19 (95% CI -.24 to -.15) in sexual minorities. The difference in sMFQ slopes for sexual minority and heterosexual adolescents is shown in Figure 1. The influence of covariates is reported in Supplementary Table 5. There was no evidence that the association between sexual orientation and depressive symptoms differed between females and males (p=0.208).

There was evidence that the odds of meeting diagnostic criteria for depression at age 18 were 2.02 times higher (95% CI 1.42 to 2.87) in sexual minorities than heterosexuals (after adjustments). The population attributable fraction from the adjusted model suggested that 11.2% (95% CI 4.2% to 16.8%) of the total depression risk at age 18 would be explained by sexual orientation if this association were causal.

The association between sexual orientation and past-year self-harm.

Associations are shown in Table 4. Sexual minority adolescents had 4.23 (95% CI 2.90 to 6.16) increased odds of self-harm in the past year after adjustments. There was no evidence that this estimate differed at ages 16 and 21 (p value 0.80). There was no evidence that the association between sexual orientation and past-year self-harm differed for females and males (p=0.190). The population attributable fraction from adjusted models was 14.8% (95% CI

9.6% to 19.8%) at age 16 and 18.1% (95% CI 10.4% to 25.1%) at age 21. In sensitivity analyses with self-harm more than a year ago removed, associations were similar (available on request).

The association between sexual orientation and lifetime self-harm with suicidal intent.

Associations are shown in Table 5. Compared to heterosexuals, sexual minorities were four times more likely to report self-harm with suicidal intent (adjusted RRR 4.51, 95% CI 2.99 to 6.80). There was no evidence that the association between sexual orientation and self-harm with (p=0.210) or without (p=0.689) suicidal intent differed for females and males. Results using the multiply imputed sample were very similar, Supplementary Table 13.

Sensitivity analyses of gender and sexual minority groups

Mean sMFQ scores at each time-point and depressive symptom trajectories according to sexual orientation are presented separately for females and males in Supplementary Table 6 and Supplementary Figures 1 and 2. There was no evidence that the association between sexual orientation and depressive symptoms differed between females and males. For the separate sexual miority groups, mean sMFQ scores are shown in Supplementary Table 7 and depressive symptom trajectories in Supplementary Table 8 and Suppmentary Figure 3. Mean sMFQ scores were higher in each sexual minority group compared to heterosexuals, with confidence intervals for the mean differences overlapping (Supplementary Table 8). Depressive symptom trajectories were also similar, Supplementary Figure 3.

Discussion

We found evidence that adolescents who identified as sexual minority at 16 years of age had more depressive symptoms than heterosexuals from early adolescence to young adulthood. We also found that the increase in depressive symptoms during mid-adolescence was larger in sexual minority than heterosexual adolescents. Depressive symptoms increased in both groups, but more so in sexual minority adolescents. There was also evidence that depressive symptoms started to decline from age 18, and more so in sexual minorities.

Compared to heterosexuals, sexual minority adolescents were four times more likely to have self-harmed in the past year at ages 16 and 21 and there was no evidence that the association between sexual orientation and self-harm reduced between ages 16 and 21. This suggests that sexual minority adolescents are more likely than heterosexuals to engage in self-harm that persists from adolescence to young adulthood. Sexual minority adolescents were also four times more likely to have self-harmed with suicidal intent by the age of 21.

Strengths and limitations

We used a large sample from an ongoing UK population-based cohort born in the early 1990s. Another strength was the multiple depressive symptom measures and follow-up from 10 to 21 years of age, a period when the incidence of depression is increasing.[6] The study covered a period of social change in the UK and other Western countries, when sexual minority identities were increasingly accepted at social, legal and political levels.

Attrition is a limitation of all birth cohorts and can introduce selection biases. Compared to the rest of ALSPAC, adolescents in our study were more likely to be female and were from more educated families. They had lower depression scores though there was no difference in

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self-harm. There was no evidence that sexual orientation was associated with attrition so we think it unlikely that missing data has biased our associations. Another limitation is that the sample was from one UK region and may not generalize to other populations.

Sexual orientation was measured with a single question about sexual attraction and identity. The question aimed to capture granularities in sexual orientation with options such as 'mostly' and 'not sure.' This nuanced assessment is preferable to blunter versions such as the UK's Office for National Statistics' harmonized format ('lesbian,' 'gay,' 'bisexual,' 'heterosexual,' 'other' and/or 'prefer not to say') and tends to identify greater numbers identifying as not entirely heterosexual.[31] On the other hand it may result in fewer individuals who identify as sexual minority than separate questions on attraction, behaviour and identity.[32] Differences in sexual orientation assessment will affect comparisons between studies.

We combined adolescents identifying as 'lesbian, gay, bisexual,' 'mainly heterosexual' and 'not sure' into a 'sexual minority' group.[2] This increased the statistical power and precision of our estimates as there were small numbers in the individual sexual minority groups. The added rationale from a clinical and public mental health perspective was evidence that all sexual minority groups are at increased risk of mental health problems compared to heterosexuals. The limitation of this approach is that different sexual minority groups have been found to have different mental health outcomes. Bisexuals are consistently found to have worse mental health outcomes than lesbians and gays.[2] The 'mainly heterosexual' group has also been found to have worse mental health than lesbians and gays though this is less consistent.[2,33] There is also recent evidence that the 'mainly heterosexual' group is increasing in UK females.[32] In sensitivity analyses we found similar depressive symptom trajectories for

the different sexual minority groups. However, our study may have been under-powered to detect differences. Gender differences may also have been masked by the single sexual minority group, for example there is evidence that bisexual women have poorer mental health than other sexual minorities.[2]

Our assessment of sexual orientation occurred after some of our depression measures. We included the earlier depression measures to capture the age at which depressive symptoms begin to emerge (around 12-13 years).[6] Measures of sexual orientation prior to this were unavailable. Retrospective analyses of the mental health of sexual minority youth are common due to the difficulties in assessing sexual orientation at younger ages. Of course, not all youth who report non-heterosexuality at age 16 will have been clearly aware of this at ages 10 through 16, particularly girls.[34] However there is evidence that a substantial proportion of young people who become non-heterosexual are aware of their sexual orientation or report feeling 'different' to their peers – even if they cannot articulate why - at very young ages (often below 10).[35] We considered it plausible to explore whether this underlying development affected mental health.

Sexual orientation is often fluid, particularly in adolescence and early adulthood, and our single assessment would not have captured changes which might lead to subsequent mental health problems.[19] It is also possible that there were changes in sexual orientation between ages 10 and 16. This could have led to some misclassification of the exposure and, possibly, an under-estimate of associations if changes in sexual identity worsen mental health problems. Some misclassification may also have occurred if sexual minority orientation was under-reported due to perceived stigma. However, if there were sexual minority adolescents in the heterosexual group or missing, this is likely to have attenuated associations rather than

introduced a spurious effect. There are few studies on the influence of changes in sexual identity on youth mental health and this is an important area for future research.

We collected data on whether self-harm had *ever* involved suicidal intent and lifetime data are more susceptible to recall bias. We also could not distinguish those who had attempted suicide but never self-harmed from those who had engaged in both behaviors. That said, our estimate of suicidal self-harm is broadly comparable with other population studies of young adults.[36] Finally, the prevalence of past-year self-harm in ALSPAC is higher than other population-based studies. This is discussed in detail elsewhere and is likely due to methodological differences in the sample, setting and questions used.[27,28]

Mechanisms

Suggestions that homosexuality is a mental abnormality accompanied by inevitable co-morbidity have been systematically ruled out.[37] Minority groups experience unique stressors caused by stigma, discrimination and prejudice.[9] Sexual minority adolescents are more likely to be bullied,[10] but there is evidence that bullying does not entirely account for poorer mental health.[38] Family discord and feelings of guilt, shame, fear, isolation and rejection are also reported and are associated with mental health problems.[39] We found that depressive symptoms began to decline from age 18 in the sample overall and more so in sexual minorities. This could be due to social and psychological changes such as increased independence or changes in peer groups that result from moving away perhaps.

Implications

Our evidence suggests that sexual minority adolescents in the UK consistently experience depression and self-harm throughout their school years, and that these mental health

problems persist to young adulthood. This is concerning as the cohort has lived through a period when non-heterosexual orientation has been met with increasing acceptance. One might expect less psychological distress in this cohort than earlier studies. It is possible that there has been more disclosure of non-heterosexual orientation by youth in recent times which has, paradoxically, exposed them to more discrimination and maintained or even strengthened associations.

Our evidence suggests that mental health disparities between sexual minorities and heterosexuals are present very early in adolescence. This indicates that prevention of these mental health problems must be a priority, as well as efforts at early intervention. There is already evidence that the school environment can be changed to reduce minority stress for gay and lesbian youth.[40] It is important, however, to avoid a simplistic focus on bullying. The lack of sexual minority role models and unquestioning acceptance of rigid concepts of gendered behavior should be addressed in schools as well as society at large. Many aspects of school education focus on heterosexual relationships which could make sexual minority or questioning young people feel isolated. Education could incorporate wider social issues and influences on young people's attitudes and behaviours, by challenging assumptions of heteronormativity rather than concentrating on isolated "gay and lesbian issues" in lessons that may have little impact on what happens outside the lesson.[41] The attitudes and behavior of families and friends are also likely to be key in improving sexual minority mental health. There is little evidence on the effectiveness of such initiatives on a public scale, and their impact on mental health. It is relevant for clinicians and those working in public mental health to be aware that any young person who identifies as not exclusively heterosexual may be at increased risk of persistent future mental problems, and may have experienced mental health problems earlier in development.

Our findings illustrate the potential importance of mental health problems prior to conscious self-identification and labelling of sexual minority orientation. Despite changes in public perceptions and attitudes, sexual minority youth remain at increased risk of long-term mental health problems that impact broadly on social, educational and health outcomes. Addressing this inequality should be a priority.

Research in context

Evidence before this study.

We searched PubMed for population-based cohort studies published in English before June 2018 using the search terms 'sexual minority' or 'sexual orientation' or 'LGB' AND 'depress$' or 'self-harm.' We then manually searched reference lists. We found that few population-based cohort studies had compared depressive symptoms in sexual minority and heterosexual adolescents over time, and fewer still had investigated self-harm. Existing cohort studies mostly used short follow-up periods to mid-adolescence and were either small or retrospective. We found that only two large population-based samples had been used to compare depressive symptoms (but not self-harm) in sexual minorities and heterosexuals from adolescence to young adulthood. Both were from the USA and their findings were inconsistent.

Added value of this study.

In this large contemporary population-based cohort, we show that depressive symptoms are higher in sexual minorities than heterosexuals as early as 10 years of age, develop faster during adolescence, and persist to young adulthood. Sexual minorities were also four times more likely to have self-harmed in the past year at ages 16 and 21, with no evidence that this estimate reduced with age. This is indicative of self-harm that persists from adolescence to young adulthood, a marker of increased suicide risk.

Implications of all the available evidence.

Our evidence suggests that sexual minority adolescents in the UK consistently experience more depression and self-harm than heterosexuals throughout their school years, and that

these mental health problems persist to young adulthood. This is concerning, given that the cohort has lived through a period in which non-heterosexual orientation and lifestyles have been met with increasing acceptance. Our evidence that mental health disparities between sexual minorities and heterosexuals are present very early in adolescence indicates that prevention of these mental health problems must be a priority, as well as efforts at early intervention.

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Table 1. Characteristics of the analytic samples according to sexual orientation. Values are n (%).

Characteristic	Depressive symptoms (n=3,885)		P[a]	Self-harm (n=3,266)		P[a]
	Heterosexuals	Sexual minority		Heterosexuals	Sexual minority	
Sex						
Females	1750 (52%)	332 (66%)		1571 (56)	300 (67)	
Males	1634 (48%)	169 (34%)	<·0001	1250 (44)	145 (33)	<·0001
Social class						
Manual	477 (14%)	80 (16%)		382 (14)	67 (15)	
Non-manual	2907 (86%)	421 (84%)	0·264	2439 (86)	378 (85)	0·388
Maternal education						
Compulsory	1722 (51%)	234 (47%)		1367 (48)	199 (45)	
Non-compulsory	1662 (49%)	267 (43%)	0·081	1454 (52)	246 (55)	0·142

[a]p values obtained using chi-squared tests.

Table 2. Binary multilevel regression models for associations between sexual orientation at age 16 and self-harm in the past-year at 16 and 21 years of age (n=3,266).

Self-harm in the past-year, n (%)		
	Age 16	Age 21
Heterosexual (ref)	223 (9%)	107 (6%)
Sexual minority	88 (22%)	47 (16%)
Odds ratio (95% CI) p		
Overall, unadjusted model	4·94 (3·30 to 7·41) <0·0001	
Overall, adjusted model[a]	4·23 (2·90 to 6·16) <0·0001	
At each time-point, unadjusted model [b]	4·88 (3·09 to 7·72)	5·04 (2·94 to 8·63)
At each time-point, adjusted model[a] [b]	4·11 (2·67 to 6·33)	4·42 (2·64 to 7·40)
Group by time interaction P value, unadjusted model: 0·914		
Group by time interaction P value, adjusted model: 0·798		

[a]Covariates: sex, maternal education and social class, age when exposure was measured.
[b]In models stratified by time-point p values are not reported because p values based on sub-groups can be unreliable.

Table 3. Multinomial regression models for associations between sexual orientation at age 16 and whether self-harm has ever involved suicidal intent reported at age 21 (n=2,222).

Sexual orientation	n (%) self-harm	Lifetime self-harm with suicidal intent			
		Unadjusted RRR (95% CI)	p	Adjusted RRR[a] (95% CI)	p
Heterosexual	84 (4%)	Ref		Ref	
Sexual minority	41 (14%)	4·53 (3·02 to 6·78)	<·0001	4·51 (2·99 to 6·80)	<·0001
Sexual orientation	n (%) self-harm	Lifetime self-harm without suicidal intent			
		Unadjusted RRR (95% CI)	p	Adjusted RRR[a] (95% CI)	p
Heterosexual	235 (12%)	Ref		Ref	
Sexual minority	75 (26%)	2·99 (2·21 to 4·06)	<·0001	2·90 (2·13 to 3·95)	<·0001

[a] Covariates: sex, maternal education and social class, age when exposure was measured.
Note: estimates from multinomial logistic regressions are described as 'multinomial relative risk ratios (RRR)' (the exponentiated coefficient on the log odds scale from the 'mlogit' command in STATA, which is the ratio of two relative risks)