# Sexual orientation identity in relation to cigarette smoking and hazardous alcohol use: Longitudinal Study of Young People in England (LSYPE)

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<td>cigarette smoking, alcohol drinking, alcoholic intoxication, cohort studies, sexuality, social epidemiology</td>
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Sexual orientation identity in relation to cigarette smoking and hazardous alcohol use: Longitudinal Study of Young People in England (LSYPE)

Running head: Sexual orientation, smoking, alcohol use.

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Abstract

Objectives. Knowledge about the health behaviours of minority groups is necessary for monitoring health inequalities. The aim of our study was to evaluate the association between lesbian, gay or bisexual (LGB) sexual orientation identity and two major health behaviours (smoking and alcohol use) in population sample of young people in the UK.


Setting. Home visits across England involving interviews with each young person and questionnaires.

Participants. Data from 6656 participants (3318) with information on sexual orientation identity (at age 18-19) and health behaviours.

Outcome measures. Smoking history, current alcohol drinking frequency and frequency of drinking alcohol to intoxication.

Results. LGB identity was reported by 3.5% of participants (55 gay, 33 lesbian, 34 bisexual male, 108 bisexual female). Adjusting for age, sex, ethnic minority status and parental socio-economic status, identification as lesbian/gay (OR = 1.57, 95% CI 1.18, 2.09) or bisexual (OR = 1.50, 95% CI 1.21, 1.86) was associated with increased risk of smoking. No association was observed for alcohol drinking frequency. Gay-identified male drinkers were twice as likely to drink to intoxication during every or most drinking episodes (OR = 2.01, 95% CI 1.28, 3.15) compared to heterosexually identified men.

Conclusions. In a sample of over 6500 young people in England, LGB identity is associated with a history of cigarette smoking. Young gay males were more likely to demonstrate...
hazardous drinking patterns. Future studies should identify mechanisms that explain these associations.

Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies, Sexuality.
Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking

- LGB orientation may be associated with hazardous alcohol drinking, although previous results are mixed

Key messages

- LGB orientation is associated with higher rates of smoking history in a population sample of English 18-19 year-olds

- For men at age 18-19, gay identity is associated with alcohol intoxication on every or most drinking episodes

- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This is the first cohort study in the UK to record sexual orientation identity

- Smoking history but not current smoking status was recorded at age 18-19

- Alcohol drinking frequency but not quantity was measured
Funding statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.
Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high-risk groups for interventions. It is estimated that between 1.5% and 5% of the UK population are lesbian, gay, or bisexual (LGB). Estimates vary depending on whether identity, attraction, or sexual behaviour is used as to define sexual orientation.

Additionally, estimates are found to vary by age and ethnic group. Relatively few research studies include a measure of sexual orientation, particularly in the UK. Exceptions include the ONS Integrated Household Survey and the Longitudinal Study of Young People in England which both included the question for the first time in 2009. As a result, the evidence base on health inequalities for LGB groups is very sparse.

Cigarette smoking remains a prevalent behaviour among young people. Many studies have shown an association between LGB orientation and cigarette smoking, particularly in the US but also in different countries. The association appears to be robust, appearing in men and women and in different age groups, with some exceptions. Occasionally the association is found to be stronger in women. Some of the studies used sexual orientation identity as a measure of sexual orientation, some used same-sex attraction and some used multiple measures.

Evidence supporting an association between LGB identity and alcohol use is more mixed, with evidence for possible effect modification by sex. Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake, alcohol dependence, and hazardous alcohol drinking such as drunkenness and binge drinking. These associations have been found among adolescents in the transition to early adulthood, among University students, in...
midlife, across the adult age range, when using behavioural definitions of sexual orientation and in different countries including Mexico and the UK. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only. Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer, with one finding an association specific to those under 50. There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys.

The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of alcohol use and frequency of drinking alcohol to intoxication, from a population sample of young people (age 18-19) in England in 2009.

Methods

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups. At recruitment in 2004, participants (N = 15,770) were typically aged 13-14. The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited to participate by letter, using databases of schools to identify potential participants. Schools were defined as socio-economically deprived if they fell within the worst quintile of schools ranked according to the proportion of pupils in receipt of school meals. Deprived schools were over-sampled by a factor 1.5 and ethnic minority groups to N=1000 per group. Annual home interview visits incorporated a computer-assisted self-completion element, including questions about smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a home visit, telephone interview or web questionnaire.
Sexual orientation identity. Sexual orientation identity was measured in 2009 using the question ‘Which of the following best describes how you think of yourself?’ for the web questionnaire (N = 2690, 40.4%), and the question ‘I will now read out a list of terms people sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or lesbian; Bisexual, Other. As I read the list again please say ‘yes’ when you hear the option that best describes how you think of yourself’ for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%). These response options are recommended by the Office of National Statistics. The refusal rate for this question was 0.1%, with 0.3% reporting ‘Other’.

Regular cigarette smoking. Cigarette smoking was last measured in 2006 with the question ‘Do you ever smoke cigarettes at all?’ followed by six response options (I have never smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a cigarette now, I sometimes smoke cigarettes now but I don't smoke as many as one a week, I usually smoke between one and six cigarettes a week, I usually smoke more than six cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus non-smoker.

Weekly alcohol drinking. Alcohol drinking was measured in 2009 using the question ‘Thinking about the last 12 months, about how often did you usually have an alcoholic drink?’ with seven response options (Almost every day, Five or six days a week, Three or four days a week, Once or twice a week, Once or twice a month, Once every couple of months, Once or twice a year). Responses were grouped into ‘weekly’ versus ‘less than weekly’ categories.

Hazardous alcohol drinking. Hazardous alcohol drinking was measured in 2009 in response to a question about alcohol intoxication frequency, ‘On those days when you did have an
alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every time, Most times, Around half the time, Less than half the time, Rarely, Never).

Hazardous alcohol drinking was defined as reporting drunkenness every/most of the time, among weekly alcohol drinkers.

Demographic covariates. Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese. The maximum of either parent’s educational attainment was recorded on a six-point scale ranging from ‘no qualification’ (0) to ‘degree or equivalent’ (6). Occupational social class was recorded on an eight-point scale ranging from ‘never worked or long term unemployed’ (1) to ‘higher managerial and professional occupations’ (8), for one or both parents.

Statistical analysis. For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable. Linear trends were evaluated using logistic regression with heterosexual, bisexual and gay/lesbian categories entered into the model as a continuous parameter. Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We minimally adjusted the odds ratios for age and ethnic minority status, and then additionally adjusted the estimates for parental education and social class. Possible effect modification by sex, parental occupation, parental education and mode of survey administration (home visit, telephone interview, web survey) was evaluated by including interactions between sexual orientation and the possible effect modifier and conducting
global tests of interaction. In supplementary analyses, we also combined gay/lesbian and bisexual into a single ‘LGB’ category. Sample weights were used to obtain correct standard errors, allowing for over-sampling of schools with low socio-economic status and for ethnic minority pupils at recruitment. All analyses were performed in Mplus version 7.0.

Results

The analytic sample comprised 6656 participants with data on sexual orientation identity, smoking status and alcohol use in addition to covariates. In preliminary analyses, we found no significant interaction between sexual orientation identity and either sex or parental SES for smoking and alcohol drinking, leading us to analyse males and females together. For hazardous drinking among alcohol drinkers however, there was a significant interaction with sex. Models for hazardous drinking were therefore conducted separately for males and females. So that non-drinkers could be excluded from analyses of alcohol drinking patterns, a nested sample of 2371 male and 2056 female weekly alcohol drinkers was also used.

Compared to at recruitment, the analytic sample contained slightly fewer men (49.7% vs. 53.4%, p < 0.001), fewer ethnic minorities (6.6% vs. 17.8%, p < 0.001) and fewer participants with low parental occupational social class (40.5% vs. 51.9%, p < 0.001), fewer participants with low levels of parental educational attainment (15.2 vs. 30.3%, p < 0.001)

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3.5% were classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108 bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were a lower proportion of lesbian women (37.5%) compared to gay men (37.5%), but a higher proportion of bisexual women (76.1%) than gay men (23.9%). Lesbian/gay participants were significantly more likely to report a cigarette smoking history and a hazardous alcohol drinking pattern. A non-significant trend was observed for regular alcohol drinking. There
were no significant differences according to ethnic minority status or parental socio-economic status. A significant linear trend was observed however across heterosexual, bisexual, gay/lesbian categories for ethnic minority respondents, who were least likely to endorse LGB response options. Significant linear trends were also observed for cigarette smoking and drunkenness, and a non-significant trend for regular alcohol drinking. Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06). There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73). In supplementary descriptive analyses (not shown) using sample weights to adjust for the complex survey design, the proportion of participants classified as LGB increased marginally to 3.7% (95% CI 3.2% to 4.2%).

Results from logistic regression analyses are shown in Table 2, minimally adjusted for age, sex and ethnic minority status and then after further adjustments for parental educational attainment and occupational social class. The results are weighted to allow for over-sampling at recruitment. Identification as gay/lesbian was associated with increased odds of smoking (OR = 1.57, 95% CI 1.18, 2.08) which was little affected by further adjustment for parental SES (OR = 1.57, 95% CI 1.18, 2.09), likely reflecting the lack of association between sexual orientation and SES (Table 1). Identification as bisexual was also associated with smoking (OR = 1.49, 95% CI 1.20, 1.84) which remained after further adjustment (OR = 1.50, 95% CI 1.21, 1.86). In models combining gay/lesbian with bisexual categories, identifying as LGB was associated with smoking (OR = 1.52, 95% CI 1.27, 1.81) which was unchanged after further adjustment (OR = 1.52, 95% CI 1.28, 1.82). In supplementary analyses (not shown), the mode of survey administration was not found to modify the association (p for global interaction > 0.05).
Men and women were separated for analysis of alcohol drinking, because sex was found to
modify the association between sexual orientation identity and alcohol use. Weekly alcohol
drinking was not associated with lesbian identity in women (OR = 1.12, 95% CI 0.81, 1.57)
or bisexual identity (OR = 1.00, 95% CI 0.79, 1.26), including after further adjustment for
parental SES. Among male weekly alcohol drinkers however, gay (OR = 2.00, 95% CI 1.27,
3.15) and bisexual (OR = 2.00, 95% CI 1.17, 3.44) identities were associated with hazardous
alcohol drinking patterns. The association remained for gay identity following adjustment for
parental SES (OR = 2.01, 95% CI 1.28, 3.15) but was no longer significant for bisexual
identified males (OR = 0.90, 95% CI 0.67, 1.25). There was no significant effect
modification by the mode of survey administration (p for global interaction > 0.05). A
combined LGB category had no association with hazardous drinking (OR = 1.01, 95% CI
0.87, 1.35). Among female weekly alcohol drinkers, there was no association between lesbian
(OR = 0.92, 95% CI 0.55, 1.55) or bisexual (OR = 0.92, 95% CI 0.67, 1.25) or combined
LGB (OR = 0.93, 95% CI 0.70, 1.23) identity and hazardous drinking. There was little
change in these estimates after additional adjustment for parental SES.

Discussion

In a community-dwelling sample of over 6500 young adults in England, men and women
reporting a gay/lesbian or bisexual (LGB) identity were around 50% more likely to have a
history of cigarette smoking than those reporting a heterosexual identity at age 18-19. No
association was observed between LGB heterosexual identity and current weekly alcohol
drinking (for men and women). Among male weekly alcohol drinkers however, identifying as
gay/bisexual was associated with a two-fold increase in the likelihood of a hazardous alcohol
drinking pattern, defined as drinking to intoxication on every/most drinking occasions. There
was no association between lesbian identity and hazardous alcohol drinking.
Strengths of the study include the large sample which was representative of an entire school year in England at recruitment in 1990/91. Data from the UK on sexual orientation identity are exceptionally rare, particularly for young cohorts. Around 3% of this cohort identified as LGB. The refusal rate for the sexual orientation identity question was low, particularly in the web survey, and differences in how this question was administered were not found to influence results materially. Several major cohort studies in the US have included questions on sexual orientation identity in recent years. In the UK, data on health inequalities in LGB identified adults has historically come from cross-sectional surveys recruited using snowball sampling, gay pride events and internet surveys which do not address issues of representativeness fully, even when a heterosexual control group is available. Recruitment from recreational spaces, particularly before the smoking ban, may have introduced bias into earlier studies. To our knowledge, this is the first study to demonstrate that sex modifies the association between sexual orientation identity and drinking alcohol to intoxication in a young UK cohort. The long-demonstrated association between LGB orientation and smoking appears to have persisted.

A clear limitation of our study was that smoking status was last assessed in 2006, two years before sexual orientation was last recorded. Participants may have changed their sexual orientation identity or smoking status between 2006 and 2009, and so the data only allow the association with a smoking history to be evaluated. Smoking is not known to influence sexual orientation identity, and so we are not concerned about possible reverse causation. It is worth noting however, that young people who begin smoking tend to continue into adulthood and two-thirds of smokers begin before age 18. Second, statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups. A second limitation was that aspects of sexual orientation other than identity such as attraction and behaviours, were not recorded.
Although our finding that LGB orientation is associated with smoking is largely consistent with other studies, the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB women\textsuperscript{14,21,29-31} and in a systematic review, LB identity in women was associated with alcohol dependence and misuse; misuse defined as >21/14 units/week in men/women\textsuperscript{3}. It is important to emphasize however that our study measured alcohol drinking frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have reported associations with hazardous alcohol drinking for LGB men and women\textsuperscript{27,30}. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. Future international comparisons are necessary.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. We are not aware of evidence for genetic covariance between sexual orientation identity and health behaviours, and suggest that sexual orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed and require further study, most of which remain theoretical. The concept of ‘minority stress’\textsuperscript{28} is often invoked to explain how heterosexism and homophobia are internalised, perhaps leading people to self-medicate psychological distress with cigarettes or alcohol\textsuperscript{27}. Alternatively, LGB young people may socialize or have socialized in recreational spaces where cigarettes and alcohol are easily available, where peer norms encourage engagement in these behaviours\textsuperscript{30}, to appear older than their true age, or to signify a sexual preference involving tobacco. Concern with appearance could motivate smoking as a weight management strategy. Other commentators have noted the role of the tobacco industry in targeting LGB smokers\textsuperscript{40}. 
Early unhealthy behaviours among LGB young people may influence trajectories toward chronic disease in later life. Longitudinal repeated measures data will be necessary in order to identify the antecedents and consequences of unhealthy behaviours for LGB young people in the UK, across the life course.

Despite recent equality and diversity legislation and the inclusion of sexual orientation in the National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely monitored by NHS organisations or measured in epidemiological studies. To improve the evidence base, and support international comparisons, data about sexual orientation should be collected routinely. Questions about sexual orientation can be added at low cost and have relatively low refusal rates, particularly among young people. Wider measurement of sexual orientation would ultimately help reduce health inequalities.

Author contributions

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson performed the analyses. All authors contributed to writing the manuscript.

Data sharing statement

Data are available from the UK Data Archive. Syntax to reproduce the results presented here is available from the corresponding author on request.
References


Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%) or mean(SD)

<table>
<thead>
<tr>
<th></th>
<th>Lesbian or gay (N = 88, 1.3)</th>
<th>Bisexual (N = 142, 2.1)</th>
<th>Heterosexual (N = 6426, 96.5)</th>
<th>p&lt;sup&gt;c&lt;/sup&gt;</th>
<th>p&lt;sup&gt;d&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>Female</td>
<td>33 (37.5)</td>
<td>108 (76.1)</td>
<td>3197 (49.8)</td>
<td>0.02</td>
<td>0.19</td>
</tr>
<tr>
<td>Ethnic minority&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12 (13.6)</td>
<td>11 (7.7)</td>
<td>1169 (18.2)</td>
<td>0.27</td>
<td>0.01</td>
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<td>Parental education</td>
<td>35 (39.8)</td>
<td>53 (37.3)</td>
<td>2411 (37.5)</td>
<td>0.67</td>
<td>0.73</td>
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<tr>
<td>Parental occupation</td>
<td>25 (28.4)</td>
<td>37 (26.1)</td>
<td>1574 (24.5)</td>
<td>0.39</td>
<td>0.35</td>
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<td>History of cigarette smoking</td>
<td>35 (39.8)</td>
<td>60 (42.3)</td>
<td>1596 (24.8)</td>
<td>0.002</td>
<td>&lt;0.001</td>
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<td>Weekly alcohol drinker</td>
<td>67 (76.1)</td>
<td>97 (68.3)</td>
<td>4263 (66.3)</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>% of alcohol drinkers with hazardous drinking pattern</td>
<td>49 (73.1)</td>
<td>80 (56.3)</td>
<td>3300 (51.4)</td>
<td>0.02</td>
<td>0.04</td>
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</table>

<sup>a</sup>Analytic sample (N = 6656) comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking (2004) and alcohol use (2004 and 2009).

<sup>b</sup>Unweighted frequency.

<sup>c</sup>p value for gay/lesbian vs. heterosexual (chi-square test).

<sup>d</sup>p value for linear trend across gay/lesbian, bisexual and heterosexual.
Table 2. Association between sexual orientation identity and smoking

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<tr>
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<th>Cigarette smoker</th>
<th>Weekly alcohol drinker</th>
<th>Hazardous alcohol drinking pattern</th>
<th>Hazardous alcohol drinking pattern</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(among male weekly drinkers)</td>
<td>(among female weekly drinkers)</td>
</tr>
<tr>
<td>N = 6656&lt;sup&gt;a&lt;/sup&gt;</td>
<td>N = 6656&lt;sup&gt;a&lt;/sup&gt;</td>
<td>N = 2371</td>
<td>N = 2056</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimally adjusted&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Fully adjusted&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Minimally adjusted&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Fully adjusted&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Lesbian or gay</td>
<td>1.57</td>
<td>1.57</td>
<td>1.12</td>
<td>1.10</td>
</tr>
<tr>
<td>(vs. heterosexual)</td>
<td>(1.18,2.08)</td>
<td>(1.18,2.09)</td>
<td>(0.81,1.57)</td>
<td>(0.79,1.53)</td>
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<tr>
<td>Bisexual</td>
<td>1.49</td>
<td>1.50</td>
<td>1.00</td>
<td>0.97</td>
</tr>
<tr>
<td>(vs. heterosexual)</td>
<td>(1.20,1.84)</td>
<td>(1.21,1.86)</td>
<td>(0.79,1.26)</td>
<td>(0.76,1.22)</td>
</tr>
<tr>
<td>Lesbian, gay or</td>
<td>1.52</td>
<td>1.52</td>
<td>1.04</td>
<td>1.01</td>
</tr>
<tr>
<td>bisexual</td>
<td>(1.27,1.81)</td>
<td>(1.28,1.82)</td>
<td>(0.86,1.27)</td>
<td>(0.83,1.23)</td>
</tr>
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</table>
Analytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

Adjusted for age and sex

Adjusted for age, sex, parental educational attainment, parental occupational social class, ethnic minority status.
STROBE Statement—Checklist of items that should be included in reports of cohort studies

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<td><strong>Title and abstract</strong></td>
<td>1</td>
<td>(a) Indicate the study’s design with a commonly used term in the title or the abstract</td>
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<td>2</td>
<td>(b) Provide in the abstract an informative and balanced summary of what was done and what was found</td>
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<tr>
<td><strong>Introduction</strong></td>
<td>6</td>
<td>Explain the scientific background and rationale for the investigation being reported</td>
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<td>7</td>
<td>State specific objectives, including any prespecified hypotheses</td>
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<tr>
<td><strong>Methods</strong></td>
<td>7</td>
<td>Present key elements of study design early in the paper</td>
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<td>7</td>
<td>Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection</td>
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<td>7</td>
<td>(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</td>
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<td>7</td>
<td>(b) For matched studies, give matching criteria and number of exposed and unexposed</td>
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<tr>
<td><strong>Variables</strong></td>
<td>8</td>
<td>Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable</td>
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<tr>
<td>9</td>
<td>For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group</td>
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<tr>
<td><strong>Bias</strong></td>
<td>9</td>
<td>Describe any efforts to address potential sources of bias</td>
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<td>10</td>
<td>Explain how the study size was arrived at</td>
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<td><strong>Quantitative variables</strong></td>
<td>11</td>
<td>Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why</td>
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<td>12</td>
<td>(a) Describe all statistical methods, including those used to control for confounding</td>
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<td>12</td>
<td>(b) Describe any methods used to examine subgroups and interactions</td>
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<tr>
<td>12</td>
<td>(c) Explain how missing data were addressed</td>
<td></td>
</tr>
<tr>
<td><strong>Statistical methods</strong></td>
<td>13</td>
<td>N/A If applicable, explain how loss to follow-up was addressed</td>
</tr>
<tr>
<td>14</td>
<td>(g) Describe any sensitivity analyses</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td><strong>Results</strong></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>(b) Give reasons for non-participation at each stage</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>(c) Consider use of a flow diagram</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td><strong>Descriptive data</strong></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>(b) Indicate number of participants with missing data for each variable of interest</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome data</strong></td>
<td>22</td>
<td>(c) Summarise follow-up time (eg, average and total amount)</td>
</tr>
<tr>
<td><strong>Main results</strong></td>
<td>23</td>
<td>Report numbers of outcome events or summary measures over time</td>
</tr>
<tr>
<td>24</td>
<td>(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear</td>
<td></td>
</tr>
</tbody>
</table>
which confounders were adjusted for and why they were included

<table>
<thead>
<tr>
<th>7-9</th>
<th>(b) Report category boundaries when continuous variables were categorized</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period</td>
</tr>
</tbody>
</table>

Other analyses 17 | 10,12 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses |

**Discussion**

<table>
<thead>
<tr>
<th>Key results</th>
<th>18</th>
<th>12</th>
<th>Summarise key results with reference to study objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limitations</td>
<td>19</td>
<td></td>
<td>Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias</td>
</tr>
</tbody>
</table>

| Interpretation | 20 | 12-15 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence |

| Generalisability | 21 | 15 | Discuss the generalisability (external validity) of the study results |

**Other information**

| Funding | 22 | N/A | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based |

*Give information separately for exposed and unexposed groups.*

Sexual orientation identity in relation to smoking history and alcohol use at age 18/19: Cross-sectional associations from wave 6 of the Longitudinal Study of Young People in England (LSYPE)
Sexual orientation identity in relation to smoking history and alcohol use at age 18/19: Cross-sectional associations from wave 6 of the Longitudinal Study of Young People in England (LSYPE)

Running head: Sexual orientation, smoking, alcohol use.

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Word count: abstract 240; text 3302.

Number of figures, tables: 2. References: 55.
Abstract

Objectives. Information about the health behaviours of minority groups is essential for addressing health inequalities. We evaluated the association between lesbian, gay or bisexual (LGB) sexual orientation identity and smoking and alcohol use in young people in England.


Setting. Self-completion questionnaires during home visits, face-to-face interviews, and web-based questionnaires.

Participants. Data from 7698 participants (3762 men) with information on sexual orientation identity and health behaviours at age 18/19.

Outcome measures. Cigarette smoking history, alcohol drinking frequency, and risky single occasion drinking (RSOD).

Results. LGB identity was reported by 3.1% of participants (55 gay, 33 lesbian, 35 bisexual male, 111 bisexual female), 3.5% when adjusting for the survey design. Adjusting for a range of covariates, identification as lesbian/gay was found to be associated with smoking (OR = 2.28, 95% CI 1.46, 3.58), alcohol drinking >2 days/week (OR = 1.96, 95% CI 1.24, 3.11), and RSOD (OR = 1.76, 95% CI 1.11, 2.79) more than weekly. Bisexual identity was associated with smoking history (OR = 1.87, 95% CI 1.32, 2.64) and RSOD (OR = 1.02, 95% CI 1.02, 2.79), but not alcohol drinking >2 days/week (OR = 1.17, 95% CI 0.78, 1.77).

Conclusions. In a sample of over 7600 young people age 18/19 in England, lesbian/gay identity is associated smoking, drinking alcohol frequency and RSOD. Bisexual identity is associated with smoking and RSOD, but not alcohol drinking frequency.
Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies, Sexuality.
Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking

- Previous results for alcohol use are mixed, therefore the association should be tested

Key messages

- LGB orientation identity is associated with higher rates of smoking history in a population sample of English 18/19 year-olds

- Lesbian or gay orientation is associated with drinking alcohol more than twice per week and risky single occasion drinking

- Bisexual orientation is associated with risky single occasion drinking but not alcohol drinking frequency

- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This cohort is among the first in the UK to record sexual orientation identity

- Smoking history but not current smoking status was recorded at age 18/19

- Frequency but not quantity of alcohol consumption was available
Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high risk groups for interventions. It is estimated that between 1.5% and 5% of the UK population are lesbian, gay, or bisexual (LGB). Estimates tend to be larger when attraction or sexual behaviour are used to define sexual orientation. Additionally, estimates are found to vary by age and ethnic group. Relatively few research studies include a measure of sexual orientation identity, particularly in the UK. As a result, the evidence base on health inequalities for LGB groups is very sparse. Exceptions include the ONS Integrated Household Survey and the Longitudinal Study of Young People in England which both included the question for the first time in 2009, and the Scottish Household Survey from 2011.

Cigarette smoking is a prevalent behaviour among young people. Many studies have shown an association between LGB orientation and cigarette smoking, particularly in the US but also in different countries. The association is found in men and women and in different age groups, with some exceptions, but particularly in young LGB people. Occasionally the association is found to be stronger in women. Some studies have used sexual orientation identity as a measure of sexual orientation, some used same-sex attraction and some used multiple measures.

Alcohol use is also common among young people, but evidence supporting an association between LGB identity and alcohol use is mixed, with evidence for possible effect modification by sex. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only. A pooled analysis of data from 14 countries found greater alcohol intake and more risky single occasion drinking in lesbian women but not gay men, compared to heterosexuals. Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer, with one finding...
an association specific to those under 50\textsuperscript{20}. There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys\textsuperscript{33,34}.

Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake\textsuperscript{27,28,35-37}, alcohol dependence\textsuperscript{37,38}, and risky single occasion drinking\textsuperscript{15,23,37-42}. One study found elevated risk of alcohol use among lesbian/bisexual females and ‘mostly heterosexual’ males, but not gay males\textsuperscript{42}. Similar patterns have been found among adolescents in the transition to early adulthood\textsuperscript{29,42,43}, among University students\textsuperscript{40}, in midlife\textsuperscript{35}, across the adult age range\textsuperscript{23,38,39,41}, when using behavioural definitions of sexual orientation\textsuperscript{24} and in different countries including Mexico\textsuperscript{22} and the UK\textsuperscript{23,24,27,39}.

The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of drinking alcohol more than twice per week and risky single occasion drinking, in young people (age 18/19) in England.

**Methods**

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups\textsuperscript{9}. At recruitment in 2004, participants (N = 15,770) were typically aged 13/14. The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited to participate by letter, using databases of schools to identify potential participants. Schools were defined as socio-economically deprived if they fell within the lowest quintile of schools ranked according to the proportion of pupils in receipt of school meals. Socio-economically deprived schools were over-sampled by a factor 1.5 and ethnic minority groups to N=1000 per group. Annual home interview visits incorporated a computer-assisted self-completion element, including questions about smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a...
home visit (face-to-face interview and computer-assisted self-completion questionnaire), telephone interview or web questionnaire.

Sexual orientation identity. Sexual orientation identity was measured in 2009 using the question ‘Which of the following best describes how you think of yourself?’ for the web questionnaire (N = 2690, 40.4%), and for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%), ‘I will now read out a list of terms people sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or lesbian; Bisexual, Other. As I read the list again please say ‘yes’ when you hear the option that best describes how you think of yourself’. These response options are recommended by the Office of National Statistics. The refusal rate for this question was 0.1% and 0.3% reported ‘Other’.

Cigarette smoking. Cigarette smoking was last measured in 2006 (typical age 15/16) with the question ‘Do you ever smoke cigarettes at all?’ followed by six response options (I have never smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a cigarette now, I sometimes smoke cigarettes now but I don’t smoke as many as one a week, I usually smoke between one and six cigarettes a week, I usually smoke more than six cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus non-smoker.

Weekly alcohol drinking. Alcohol drinking was measured in 2009 using the question ‘Thinking about the last 12 months, about how often did you usually have an alcoholic drink?’ with seven response options (Almost every day, Five or six days a week, Three or four days a week, Once or twice a week, Once or twice a month, Once every couple of months, Once or twice a year). Responses were grouped into ‘more than twice per week’ versus ‘less than twice per week’.

Risky single occasion drinking. Participants were asked, ‘On those days when you did have an alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every time, Most times, Around half the time, Less than half the time, Rarely, Never). This information was combined with alcohol drinking frequency to identify participants who reported drunkenness
more than 52 times per year, equivalent to drinking alcohol to intoxication more than once per week.

**Demographic covariates.** Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese; grouped into ‘ethnic minority’ (1) or White (0). The maximum of either parent’s educational attainment was recorded on a six-point scale ranging from ‘no qualification’ (0) to ‘degree or equivalent’ (6). Occupational social class was recorded on an eight-point scale ranging from ‘never worked or long term unemployed’ (1) to ‘higher managerial and professional occupations’ (8), for one or both parents. Parental education attainment and occupational class are both considered indicators of parental socio-economic status (SES).

**Statistical analysis.** For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable. Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We minimally adjusted the odds ratios for age and sex, and then additionally adjusted the estimates for ethnic minority status, parental education and social class. Ethnicity and socio-economic status are possible confounding factors, because they may be associated both with sexual identity and with health behaviours. We also combined gay/lesbian and bisexual into a single ‘LGB’ category for additional analysis. Sample weights were used to obtain correct standard errors, allowing for oversampling of schools with low socio-economic status and for ethnic minority pupils at recruitment. Although statistical power for evaluating possible effect modification by gender and socio-economic status was low, previous studies have shown sex differences (particularly for alcohol
use). We therefore ran separate models for males and females in supplementary analyses. In sensitivity analysis, we additionally controlled for mode of survey administration, to evaluate if this influenced the results. All analyses were performed with Stata version 12.1.

Results

The analytic sample comprised 7698 participants with data on sexual orientation identity, smoking history and alcohol use in addition to covariates (home visit = 12.2%, telephone interview = 47.6%, web questionnaire = 40.1%). Compared to the recruitment sample and adjusting for the study design, the analytic sample contained slightly fewer men (49.4% vs. 53.9%, p < 0.001), fewer ethnic minorities (9.9% vs. 14.9%, p < 0.001), fewer participants whose parents had less than secondary school level educational qualifications (17.0% vs. 29.2%, p < 0.001) and fewer participants with parents who were unemployed or had routine occupations (8.1% vs. 15.5%, p < 0.001).

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3% were classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108 bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were fewer women (37.5%) in the ‘LG’ category than men, but more women (76.0%) in the ‘B’ category than men.

When using sample weights to correct for over-sampling of ethnic minority groups and schools with higher socio-economic deprivation however, the proportion of participants classified as LGB was 3.5% (1.3 LG, 2.2% B).

Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06). There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73), although this test may be under-powered (there were 33 LGB participants for face-to-face interviews, 86 for telephone interviews and 115 for web questionnaires).
Results from the logistic regression analyses are shown in Table 2, minimally adjusted for age and sex and then after further adjustments for ethnic minority status, parental educational attainment and occupational social class (parental SES). Sample weights were used in the models to correct for over-sampling of ethnic minority groups and socio-economically deprived schools at recruitment.

Lesbian or gay participants were more than twice as likely to have a history of cigarette smoking, and bisexual participants nearly twice as likely to have smoked. Adjustment for ethnic minority status and parental SES did not change these results materially. Similar results were found when combining participants into LGB vs. heterosexual.

Participants who identified themselves as lesbian or gay were nearly twice as likely to drink alcohol more than twice a week, even after adjustment for several covariates. There was no association between bisexual identity and drinking alcohol more than twice a week. When combining LGB participants together, the association was weaker but remained significant, in both minimally and fully adjusted models.

Lesbian or gay participants were around 1.8 times more likely to report risky single occasion drinking more than weekly. This association was only slightly weaker in the fully adjusted model. There was no association between bisexual identity and greater than weekly risky single occasion drinking. The combined LGB category was associated with this measure only in the fully adjusted model.

In supplementary analyses separating males and females, the pattern of results for smoking history was very similar for both genders (Table S1), although it was weaker for bisexual males. For alcohol drinking greater than twice per week however, the association was stronger in males than in females. The size of the association was similar for gay men and lesbian women, although confidence intervals were wider for lesbian women. No association was apparent for bisexual men, although there was a non-significant trend toward increased risk for bisexual women. For risky single occasion drinking, the association was stronger and significant in males but a weaker non-
significant trend was suggested for females. Bisexual males appeared to be at decreased risk of
risky single occasion drinking but this was not significant. These supplementary results should be
interpreted with caution, given the small numbers of participants involved. The study may be
underpowered to examine effect modification of the association between sexual orientation and
health behaviours.

Discussion

In a community-dwelling sample of over 7600 young adults in England, men and women reporting
a gay/lesbian or bisexual (LGB) identity were around twice as likely to have a history of cigarette
smoking at age 15/16 than those reporting a heterosexual identity at age 18/19. Lesbian or gay
participants were nearly twice as likely to report drinking alcohol more than twice per week, and
more likely to report risky single occasion drinking more often than weekly. Bisexual participants
were no more likely to report risky single occasion drinking than heterosexuals.

Strengths of the study include the large sample which was representative of an entire school year in
England at recruitment, typically from the birth years 1990/91. Data from the UK on sexual
orientation identity are exceptionally rare, particularly for young cohorts. Adjusting for the
sample design, 3.5% of this cohort identified as LGB at age 18/19. The refusal rate for the sexual
orientation identity question was low, particularly in the web survey, and differences in how this
question was administered were not found to influence results materially. Several major cohort
studies in the US have included questions on sexual orientation identity in recent years. In the
UK however, data on health inequalities in LGB identified adults has historically come from cross-
sectional surveys recruited using snowball sampling, gay pride events and internet surveys
which do not address issues of representativeness fully, even when a heterosexual control group is
available. Recruitment from recreational spaces, particularly before the smoking ban, may have
introduced bias into earlier studies. The long-demonstrated association between LGB orientation
and smoking appears to have persisted even in this young cohort.
A clear limitation of our study was that smoking status was last assessed in 2006 (age 15/16), two years before sexual orientation was last recorded. Participants may have changed their sexual orientation identity or smoking status between 2006 and 2009, and so the data cannot establish an association with current smoking. Smoking is not known to influence sexual orientation identity, making reverse causation an unlikely explanation. It is worth noting however, that young people who begin smoking tend to continue into adulthood and two-thirds of smokers begin before age 18, suggesting that many of those reporting a history of smoking are still current smokers. A second limitation is that statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups, particularly for supplementary analyses of men and women separately. A third limitation was that aspects of sexual orientation other than identity such as attraction and behaviours were not recorded. Finally, the percentage of participants identifying as LGB may have been underestimated, particularly if this had not been disclosed to parents, who might have been in the home during telephone and home interviews. Although the refusal rate for the question was low, some participants who identify as LGB might have responded ‘heterosexual’ for this and other reasons, which might include socially desirable responding. This would lead to misclassification bias, leading us to have under-estimated the size of any associations found. Results were similar when additionally controlling for mode of survey administration (home visit, telephone, web survey), mitigating concerns that the results are driven by the method of data collection.

Although our finding that LGB orientation is associated with smoking history is largely consistent with other studies, the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB women and in a systematic review, LB identity in women was associated with alcohol dependence and misuse; misuse defined as >21/14 units/week in men/women. It is important to emphasize however that our study measured alcohol drinking
frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have reported associations with hazardous alcohol drinking for LGB men and women. Overall, the picture is mixed. Some studies find a stronger association between LG or GB identity and alcohol use in women, some find a stronger association in men, and some an association for B but not L women. Our results show an association between LG identity in men and women combined, similar patterns when separating men and women, but with a stronger association in men (Table S1). L or G identity among English youth, but not B identity, is associated with more frequent and riskier single occasion drinking. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. A study of students with same-sex sexual experiences found that greater LGB resources were associated with less smoking in women but increased risk of binge drinking in men. Future international comparisons are necessary, and a pooled meta-analysis of individual participant data (MIPD) would be very valuable.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. There is apparently no evidence for genetic covariance between sexual orientation identity and health behaviours, and we suggest that sexual orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed, which require further investigation. The concept of ‘minority stress’ is often invoked to explain how heterosexism and homophobia are internalised, perhaps leading people to self-medicate psychological distress with cigarettes or alcohol. A recent review found support for this theory, particularly in explaining associations with victimisation and substance use. Alternatively, LGB young people may socialize or have socialized in recreational spaces where cigarettes and alcohol are easily available, where peer norms encourage engagement in these behaviours, or to appear older than their actual age. Concern with appearance could motivate smoking as a weight management strategy. For some,
smoking can be sexually arousing, particularly if it is associated with masculinity \(^5^4\) or where there is a sexual attraction to men smoking \(^5^5\). Other commentators have noted the role of the tobacco industry in targeting LGB smokers \(^5^4\). Early unhealthy behaviours among LGB young people may influence trajectories toward chronic disease in later life \(^1^5^2^7\). Longitudinal repeated measures data will be necessary in order to identify the antecedents and consequences of unhealthy behaviours for LGB young people in the UK, across the life course. In our view, there is a clear need for a repeated measures cohort study of LGB people.

Despite recent equality and diversity legislation and the inclusion of sexual orientation in the National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely monitored by NHS organisations or measured in epidemiological studies. To improve the evidence base, and support international comparisons, data about sexual orientation should be collected routinely \(^1^3\). In the Integrated Household Survey for example, it will now be possible to consider sexual orientation identity in relation to health status, smoking and subjective wellbeing, among other topics. Questions about sexual orientation can be added at low cost and have relatively low refusal rates, particularly among young people. Wider measurement of sexual orientation would ultimately help reduce health inequalities.

**Author contributions**

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson did the analyses. All authors contributed to writing the manuscript.

**Data sharing statement**

Data are available from the UK Data Archive.

**Funding statement**

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References


Colchester, Essex: UK Data Archive [distributor], August 2012. SN: 5545 http://dx.doi.org/10.5255/UKDA-SN-5545-3 (accessed 14/01/2013)


Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%)

<table>
<thead>
<tr>
<th>Study variables (N = 7698)</th>
<th>Lesbian or gay (n = 88, 1.1%)</th>
<th>Bisexual (n = 146, 1.9%)</th>
<th>Heterosexual (n = 7464, 97.0%)</th>
<th>p^c</th>
<th>p^d</th>
<th>p^e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>33 (37.5)</td>
<td>111 (76.0)</td>
<td>3792 (50.8)</td>
<td>0.001</td>
<td>0.014</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ethnic minority^f</td>
<td>12 (13.6)</td>
<td>12 (8.2)</td>
<td>2112 (28.3)</td>
<td>&lt;0.001</td>
<td>0.003</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Parental education (less than secondary)</td>
<td>13 (14.8)</td>
<td>26 (17.8)</td>
<td>1715 (23.0)</td>
<td>0.02</td>
<td>0.07</td>
<td>0.14</td>
</tr>
<tr>
<td>Parental occupation (routine or unemployed)</td>
<td>10 (11.4)</td>
<td>18 (12.3)</td>
<td>900 (12.1)</td>
<td>0.97</td>
<td>0.84</td>
<td>0.92</td>
</tr>
<tr>
<td>History of cigarette smoking (age 15/16)</td>
<td>35 (39.8)</td>
<td>60 (41.1)</td>
<td>1649 (22.1)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol drinking &gt;2 days/week (age 18/19)</td>
<td>33 (37.5)</td>
<td>38 (26.0)</td>
<td>1467 (19.7)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.057</td>
</tr>
<tr>
<td>Risky single occasion drinking (age 18/19)</td>
<td>40 (45.5)</td>
<td>48 (32.9)</td>
<td>1985 (26.6)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.090</td>
</tr>
</tbody>
</table>

^aAnalytic sample (N = 7698) comprises participants with available data on age, sex, ethnic group, parental education, occupational social class, smoking history and alcohol use. ^c p value for lesbian/gay/bisexual vs. heterosexual, ^d p value for gay/lesbian vs. heterosexual, ^e p bisexual vs. heterosexual. ^f Unweighted frequency (ethnic minority groups were over-sampled).
Table 2. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

<table>
<thead>
<tr>
<th>Model</th>
<th>Lesbian or gay (vs. heterosexual)</th>
<th>Bisexual (vs. heterosexual)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=7698</td>
<td>History of cigarette smoking vs. non-smoker</td>
<td>Alcohol drinking &gt;2 days/week vs. &lt;=2 days/week or never</td>
</tr>
<tr>
<td>Minimally adjusted</td>
<td>Fully adjusted</td>
<td>Minimally adjusted</td>
</tr>
<tr>
<td>Lesbian or gay</td>
<td>2.34***</td>
<td>2.23**</td>
</tr>
<tr>
<td>(vs. heterosexual)</td>
<td>(1.50, 3.65)</td>
<td>(1.42, 3.51)</td>
</tr>
<tr>
<td>Bisexual</td>
<td>1.94***</td>
<td>1.84**</td>
</tr>
<tr>
<td>(vs. heterosexual)</td>
<td>(1.37, 2.75)</td>
<td>(1.30, 2.61)</td>
</tr>
<tr>
<td><strong>Model 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesbian, gay or bisexual</td>
<td>2.08***</td>
<td>1.98***</td>
</tr>
<tr>
<td>(vs. heterosexual)</td>
<td>(1.57, 2.76)</td>
<td>(1.49, 2.63)</td>
</tr>
</tbody>
</table>
Values shown are odds ratios (95% confidence intervals). *** = p < 0.001, ** = p < 0.01, * = p < 0.05. \(^a\) Analytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

\(^b\) Adjusted for age and sex. \(^c\) Adjusted for age, sex, ethnic minority status, parental educational attainment, parental occupational social class.
Table S1. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

<table>
<thead>
<tr>
<th></th>
<th>History of cigarette smoking</th>
<th>Alcohol drinking &gt;2 days/week</th>
<th>&gt;Weekly risky single occasion drinking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>vs. non-smoker</td>
<td>vs. &lt;=2 days/week or never</td>
<td>vs. &lt;=weekly</td>
</tr>
<tr>
<td></td>
<td>Minimally adjusted&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Fully adjusted&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Males (n = 3762)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay (vs. heterosexual)</td>
<td>2.38** (1.31, 4.33)</td>
<td>1.92* (1.07, 3.55)</td>
<td>2.13* (1.21, 3.77)</td>
</tr>
<tr>
<td>Bisexual (vs. heterosexual)</td>
<td>1.93 (0.92, 4.09)</td>
<td>1.04 (0.49, 2.20)</td>
<td>0.67 (0.30, 1.46)</td>
</tr>
</tbody>
</table>

| **Females (n = 3936)**  |                              |                               |                                         |
| Gay (vs. heterosexual)  | 2.30* (1.14, 4.62)           | 2.10 (1.00, 4.42)             | 1.40 (0.68, 2.88)                      |
| Bisexual                | 1.93** (1.14, 4.62)          | 1.39 (0.84, 2.15)             | 1.32 (0.68, 2.88)                      |
Values shown are odds ratios (95% confidence intervals). *** = p < 0.001, ** = p < 0.01, * = p < 0.05. Analytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

Adjusted for age. Adjusted for age, ethnic minority status, parental educational attainment, parental occupational social class.
STROBE Statement—Checklist of items that should be included in reports of cohort studies

<table>
<thead>
<tr>
<th>Item No</th>
<th>Page No</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title and abstract</strong></td>
<td>1</td>
<td>(a) Indicate the study’s design with a commonly used term in the title or the abstract</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>(b) Provide in the abstract an informative and balanced summary of what was done and what was found</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Background/rationale</td>
<td>2</td>
<td>5 Explain the scientific background and rationale for the investigation being reported</td>
</tr>
<tr>
<td>Objectives</td>
<td>3</td>
<td>6 State specific objectives, including any prespecified hypotheses</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study design</td>
<td>4</td>
<td>6 Present key elements of study design early in the paper</td>
</tr>
<tr>
<td>Setting</td>
<td>5</td>
<td>Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection</td>
</tr>
<tr>
<td>Participants</td>
<td>6</td>
<td>6 (a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</td>
</tr>
<tr>
<td></td>
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<td>N/A (b) For matched studies, give matching criteria and number of exposed and unexposed</td>
</tr>
<tr>
<td>Variables</td>
<td>7</td>
<td>6-8 Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable</td>
</tr>
<tr>
<td>Data sources/measurement</td>
<td>8*</td>
<td>6-8 For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group</td>
</tr>
<tr>
<td>Bias</td>
<td>9</td>
<td>8 Describe any efforts to address potential sources of bias</td>
</tr>
<tr>
<td>Study size</td>
<td>10</td>
<td>9 Explain how the study size was arrived at</td>
</tr>
<tr>
<td>Quantitative variables</td>
<td>11</td>
<td>6-8 Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why</td>
</tr>
<tr>
<td>Statistical methods</td>
<td>12</td>
<td>8 (a) Describe all statistical methods, including those used to control for confounding</td>
</tr>
<tr>
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<td></td>
<td>8-9 (b) Describe any methods used to examine subgroups and interactions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 (c) Explain how missing data were addressed</td>
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<td>9 (d) If applicable, explain how loss to follow-up was addressed</td>
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<td>9 (e) Describe any sensitivity analyses</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participants</td>
<td>13*</td>
<td>9 (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed</td>
</tr>
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<td>9 (b) Give reasons for non-participation at each stage</td>
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<td>N/A (c) Consider use of a flow diagram</td>
</tr>
<tr>
<td>Descriptive data</td>
<td>14*</td>
<td>9 (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 (b) Indicate number of participants with missing data for each variable of interest</td>
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<td>N/A (c) Summarise follow-up time (eg, average and total amount)</td>
</tr>
<tr>
<td>Outcome data</td>
<td>15*</td>
<td>9, 21 Report numbers of outcome events or summary measures over time</td>
</tr>
<tr>
<td>Main results</td>
<td>16</td>
<td>22 (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear</td>
</tr>
</tbody>
</table>
which confounders were adjusted for and why they were included.

N/A  (b) Report category boundaries when continuous variables were categorized
N/A  (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period

Other analyses  17  24  Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion

Key results  18  11  Summarise key results with reference to study objectives

Limitations  19  Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias

Interpretation  20  12  Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence

Generalisability  21  12,13  Discuss the generalisability (external validity) of the study results

Other information

Funding  22  N/A  Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Sexual orientation identity in relation to cigarette smoking history and hazardous alcohol use at age 18/19: Cross-sectional associations from wave 6 of the Longitudinal Study of Young People in England (LSYPE)

Running head: Sexual orientation, smoking, alcohol use.

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Word count: abstract 240245; text 33022985
Number of figures, tables: 2. References: 5540.
Abstract

Objectives. Information about the health behaviours of minority groups is essential for addressing health inequalities. We evaluated the association between lesbian, gay or bisexual (LGB) sexual orientation identity and two major health behaviours (smoking and alcohol use) in a population sample of young people in England, the UK.

Design. Data were collected in 2006 and 2009 from wave 6 of the Longitudinal Study of Young People in England (LSYPE), a prospective cohort study.

Setting. Self-completion questionnaires were completed during home visits, face-to-face interviews, and web-based questionnaires.

Participants. Data were collected from 7698 participants (3762 men, 3318 women) with information on sexual orientation identity and health behaviours.

Outcome measures. Cigarette smoking history, current alcohol drinking frequency, and risky single occasion drinking (RSOD) were measured.

Results. LGB identity was reported by 3.15% of participants (55 gay, 33 lesbian, 3534 bisexual males, 11408 bisexual females), 3.5% when adjusting for the survey design. Adjusting for a range of covariates (age, sex, ethnic minority status, and parental socio-economic status), identification as lesbian/gay was found to be associated with smoking (OR = 2.28, 95% CI 1.46, 3.58), alcohol drinking >2 days/week (OR = 1.96, 95% CI 1.24, 3.11), and RSOD (OR = 1.86) was associated with increased risk of smoking. No association was observed for alcohol drinking frequency. Gay-identified males
drinkers were twice as likely to drink to intoxication during every or most drinking episodes (OR = 1.762.01, 95% CI 1.11, 2.79) more than weekly. Bisexual identity was associated with smoking history (OR = 1.87, 95% CI 1.32, 2.64) and RSOD (OR = 1.02, 95% CI 1.02, 2.79), but not alcohol drinking >2 days/week (OR = 1.17, 95% CI 0.78, 1.77) compared to heterosexually identified men.

Conclusions. In a sample of over 76006500 young people age 18/19 in England, lesbian/gay identity is associated smoking, drinking alcohol frequency and RSOD. Bisexual/LGB identity is associated with smoking and RSOD, but not alcohol drinking frequencya history of cigarette smoking. Young gay males were more likely to demonstrate hazardous drinking patterns. Future studies should identify mechanisms that explain these associations.

Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies, Sexuality.
Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking

- Previous LGB orientation may be associated with hazardous alcohol drinking, although previous results for alcohol use are mixed, therefore the association should be tested

Key messages

- LGB orientation identity is associated with higher rates of smoking history in a population sample of English 18–19 year-olds

- Lesbian or For men at age 18–19, gay orientation identity is associated with alcohol intoxication on every or most drinking alcohol more than twice per week and risky single occasion drinking episodes

- Bisexual orientation is associated with risky single occasion drinking but not alcohol drinking frequency

- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This cohort is among the first cohort study in the UK to record sexual orientation identity
• Smoking history but not current smoking status was recorded at age 18-19

• Alcohol drinking frequency but not quantity of alcohol consumption was available/measured
Funding statement

- This research received no specific grant from any funding agency in the public, commercial
  or not-for-profit sectors.
Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high-risk groups for interventions.\(^1\)\(^-\)\(^3\) It is estimated that between 1.5%\(^4\) and 5%\(^5\) of the UK population are lesbian, gay, or bisexual (LGB). Estimates tend to be larger when attraction or sexual behaviour are used to define sexual orientation\(^6\)\(^-\)\(^8\). Additionally, estimates are found to vary by age and ethnic group\(^4\). Relatively few research studies include a measure of sexual orientation identity, particularly in the UK. As a result, the evidence base on health inequalities for LGB groups is very sparse. Exceptions include the ONS Integrated Household Survey\(^4\) and the Longitudinal Study of Young People in England\(^9\) which both included the question for the first time in 2009, and the Scottish Household Survey from 2011.

Cigarette smoking is a prevalent behaviour among young people.\(^10\) Many studies have shown an association between LGB orientation and cigarette smoking\(^11\)\(^-\)\(^13\)\(^15\)\(^19\)\(^25\)\(^26\)\(^11\), particularly in the US\(^3\)\(^12\)\(^-\)\(^21\) but also in different countries\(^22\)\(^-\)\(^24\). The association is found in men and women and in different age groups, with some exceptions\(^23\)\(^25\)\(^-\)\(^28\), but particularly in young LGB people\(^11\)\(^29\). Occasionally the association is found to be stronger in women\(^23\)\(^25\)\(^-\)\(^27\). Some studies have used sexual orientation identity as a measure of sexual orientation\(^11\)\(^13\)\(^25\)\(^26\), some used same-sex attraction\(^18\)\(^27\) and some used multiple measures\(^3\)\(^30\).

Alcohol use is also common among young people, but evidence supporting an association between LGB identity and alcohol use is mixed\(^3\)\(^26\)\(^31\)\(^32\), with evidence for possible effect modification by sex\(^3\)\(^26\)\(^32\). A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only.\(^1\) A pooled analysis of data from 14 countries found greater alcohol intake and more risky
single occasion drinking in lesbian women but not gay men\textsuperscript{32}, compared to heterosexuals.

Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer, with one finding an association specific to those under 50\textsuperscript{20}.

There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys\textsuperscript{33 34}.

Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake\textsuperscript{27 28 35-37}, alcohol dependence\textsuperscript{37 38}, and risky single occasion drinking\textsuperscript{15 23 37-42}. One study found elevated risk of alcohol use among lesbian/bisexual females and ‘mostly heterosexual’ males, but not gay males\textsuperscript{42}. Similar patterns have been found among adolescents in the transition to early adulthood\textsuperscript{29 42 43}, among University students\textsuperscript{40}, in midlife\textsuperscript{35}, across the adult age range\textsuperscript{23 38 39}, when using behavioural definitions of sexual orientation\textsuperscript{24} and in different countries including Mexico\textsuperscript{22} and the UK\textsuperscript{23 24 27 39}. 
Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high-risk groups for interventions. It is estimated that between 1.5% and 5% of the UK population are lesbian, gay, or bisexual (LGB). Estimates vary depending on whether identity, attraction, or sexual behaviour is used as to define sexual orientation. Additionally, estimates are found to vary by age and ethnic group. Relatively few research studies include a measure of sexual orientation, particularly in the UK. Exceptions include the ONS Integrated Household Survey and the Longitudinal Study of Young People in England which both included the question for the first time in 2009. As a result, the evidence base on health inequalities for LGB groups is very sparse.

Cigarette smoking remains a prevalent behaviour among young people. Many studies have shown an association between LGB orientation and cigarette smoking, particularly in the US but also in different countries. The association appears to be robust, appearing in men and women and in different age groups, with some exceptions. Occasionally the association is found to be stronger in women. Some of the studies used sexual orientation identity as a measure of sexual orientation, some used same-sex attraction and some used multiple measures.

Evidence supporting an association between LGB identity and alcohol use is more mixed, with evidence for possible effect modification by sex. Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake, alcohol dependence, and hazardous alcohol drinking such as drunkenness and binge drinking. These associations have been found among adolescents in the transition to early adulthood among University students, in
midlife and across the adult age range, when using behavioural definitions of sexual orientation and in different countries including Mexico and the UK. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only. Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer, with one finding an association specific to those under 50. There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys.

The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of alcohol use and frequency of drinking alcohol more than twice per week and risky single occasion drinking into intoxication, from a population sample of young people (age 18-19) in England in 2009.

Methods

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups. At recruitment in 2004, participants (N = 15,770) were typically aged 13/14. At recruitment in 2004, participants (N = 15,770) were typically aged 13-14. The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited to participate by letter, using databases of schools to identify potential participants. Schools were defined as socio-economically deprived if they fell within the lowest quintile of schools ranked according to the proportion of pupils in receipt of school meals. Socio-economically deprived schools were over-sampled by a factor 1.5 and ethnic minority groups to N=1000 per group. Annual home interview visits incorporated a computer-assisted self-completion element, including questions about
smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a home visit (face-to-face interview and computer-assisted self-completion questionnaire), telephone interview or web questionnaire.

**Sexual orientation identity.** Sexual orientation identity was measured in 2009 using the question ‘Which of the following best describes how you think of yourself?’ for the web questionnaire (N = 2690, 40.4%), and for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%), the question ‘I will now read out a list of terms people sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or lesbian; Bisexual, Other. As I read the list again please say ‘yes’ when you hear the option that best describes how you think of yourself’. These response options are recommended by the Office of National Statistics. The refusal rate for this question was 0.1% and 0.3% reported for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%). These response options are recommended by the Office of National Statistics. The refusal rate for this question was 0.1%, with 0.3% reporting ‘Other’.

**CigaretteRegular cigarette smoking.** Cigarette smoking was last measured in 2006 (typical age 15/16) with the question ‘Do you ever smoke cigarettes at all?’ followed by six response options (I have never smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a cigarette now, I sometimes smoke cigarettes now but I don’t smoke as many as one a week, I usually smoke between one and six cigarettes a week, I usually smoke more than six cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus non-smoker.

**Weekly alcohol drinking.** Alcohol drinking was measured in 2009 using the question ‘Thinking about the last 12 months, about how often did you usually have an alcoholic
drink?’ with seven response options (Almost every day, Five or six days a week, Three or four days a week, Once or twice a week, Once or twice a month, Once every couple of months, Once or twice a year). Responses were grouped into ‘more than twice per week’ versus ‘less than twice per week’ categories.

Risky single occasion drinking. Participants were asked about Hazardous alcohol drinking. Hazardous alcohol drinking was measured in 2009 in response to a question about alcohol intoxication frequency, ‘On those days when you did have an alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every time, Most times, Around half the time, Less than half the time, Rarely, Never). This information was combined with Hazardous alcohol drinking frequency to identify participants who reported being drunk more than 52 times per year, equivalent to drinking every/most of the time, among weekly drinkers.

Demographic covariates. Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese; grouped into ‘ethnic minority’ (1) or White (0). The maximum of either parent’s educational attainment was recorded on a six-point scale ranging from ‘no qualification’ (0) to ‘degree or equivalent’ (6). Occupational social class was recorded on an eight-point scale ranging from ‘never worked or long term unemployed’ (1) to ‘higher managerial and professional occupations’ (8), for one or both parents. Parental education attainment and occupational class are both considered indicators of parental socio-economic status (SES).

Statistical analysis. For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable.
Linear trends were evaluated using logistic regression with heterosexual, bisexual and gay/lesbian categories entered into the model as a continuous parameter. Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We minimally adjusted the odds ratios for age and sex, ethnic minority status, and then additionally adjusted the estimates for ethnic minority status, parental education and social class. Ethnicity Possible effect modification by sex, parental occupation, parental education and socio-economic status are possible confounding factors, because they may be associated both with mode of survey administration (home visit, telephone interview, web survey) was evaluated by including interactions between sexual identity orientation and with health behaviours. We the possible effect modifier and conducting global tests of interaction. In supplementary analyses, we also combined gay/lesbian and bisexual into a single ‘LGB’ category for additional analysis. Sample weights were used to obtain correct standard errors, allowing for over-sampling of schools with low socio-economic status and for ethnic minority pupils at recruitment. Although statistical power for evaluating possible effect modification by gender and socio-economic status was low, previous studies have shown sex differences (particularly for alcohol use). We therefore ran separate models for males and females in supplementary analyses. In sensitivity analysis, we additionally controlled for mode of survey administration, to evaluate if this influenced the results. All analyses were performed with Stata version 12.1 All analyses were performed in Mplus version 7.0.

Results
The analytic sample comprised 769,866 participants with data on sexual orientation identity, smoking history status and alcohol use in addition to covariates (home visit = 12.2%, telephone interview = 47.6%, web questionnaire = 40.1%). Compared to the recruitment sample, in preliminary analyses, we found no significant interaction between sexual orientation identity and adjusting either sex or parental SES for the study design, smoking and alcohol drinking, leading us to analyse males and females together. For hazardous drinking among alcohol drinkers however, there was a significant interaction with sex. Models for hazardous drinking were therefore conducted separately for males and females. So that non-drinkers could be excluded from analyses of alcohol drinking patterns, a nested sample of 2371 male and 2056 female weekly alcohol drinkers was also used. Compared to at recruitment, the analytic sample contained slightly fewer men (49.47% vs. 53.94%, p < 0.001), fewer ethnic minorities (9.96% vs. 14.91%, p < 0.001) and fewer participants whose parents had less than secondary school level educational qualifications (17.0 with low parental occupational social class (40.5% vs. 29.25%, p < 0.001) and fewer participants with parents who were unemployed or had routine occupations (8.1% low levels of parental educational attainment (15.2% vs. 15.5%, p < 0.001).)

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3.5% were classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108 bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were fewer women (37.5%) in the ‘LG’ category than men, but more women (76.0%) in the ‘B’ category than men. When using sample weights to correct for over-sampling of ethnic minority groups and schools with higher socio-economic deprivation however, the proportion of participants classified as LGB was 3.5% (1.3 LG, 2.2% B).

There were a lower proportion of lesbian women (37.5%) compared to gay men (37.5%), but a higher proportion of bisexual women (76.1%) than gay men (23.9%). Lesbian/gay
participants were significantly more likely to report a cigarette smoking history and a hazardous alcohol drinking pattern. A non-significant trend was observed for regular alcohol drinking. There were no significant differences according to ethnic minority status or parental socio-economic status. A significant linear trend was observed however across heterosexual, bisexual, gay/lesbian categories for ethnic minority respondents, who were least likely to endorse LGB response options. Significant linear trends were also observed for cigarette smoking and drunkenness, and a non-significant trend for regular alcohol drinking.

Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06).

There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73), although this test may be underpowered (there were 33 LGB participants for face-to-face interviews, 86 for telephone interviews and 115 for web questionnaires). In supplementary descriptive analyses (not shown) using sample weights to adjust for the complex survey design, the proportion of participants classified as LGB increased marginally to 3.7% (95% CI 3.2% to 4.2%).

Results from the logistic regression analyses are shown in Table 2, minimally adjusted for age and sex and ethnic minority status and then after further adjustments for ethnic minority status, parental educational attainment and occupational social class (parental SES). Sample weights were used in the models to correct for over-sampling of ethnic minority groups and socio-economically deprived schools at recruitment.

Lesbian or gay participants were more than twice as likely to have a history of cigarette smoking, and bisexual participants nearly twice as likely to have smoked.

Adjustment for ethnic minority status and parental SES did not change these results materially. Similar results were found when combining participants into LGB vs. heterosexual.
Participants who identified themselves as gay/lesbian or gay were nearly twice as likely to drink alcohol more than twice a week, even after adjustment for several covariates. There was no association between bisexual identity and drinking alcohol more than twice a week. When combining LGB participants together, the association was weaker but remained significant, in both minimally and fully adjusted models.

Lesbian or gay participants were around 1.8 times more likely to report risky single occasion drinking more than weekly. This association was only slightly weaker in the fully adjusted model. There was no association between bisexual identity and greater than weekly risky single occasion drinking. The combined LGB category was associated with this measure only in the fully adjusted model.

In supplementary analyses separating males and females, the pattern of results for smoking history was very similar for both genders (Table S1), although it was weaker for bisexual males. For alcohol drinking greater than twice per week however, the association was stronger in males than in females. The size of the association was similar for gay men and lesbian women, although confidence intervals were wider for lesbian women. No association was apparent for bisexual men, although there was a non-significant trend toward increased risk for bisexual women. For risky single occasion drinking, the association was stronger and significant in males but a weaker non-significant trend was suggested for females. Bisexual males appeared to be at decreased risk of risky single occasion drinking but this was not significant. These supplementary results should be interpreted with caution, given the small numbers of participants involved. The study may be underpowered to examine effect modification of the odds of smoking (OR = 1.57, 95% CI 1.18, 2.08) which was little affected by further adjustment for parental SES (OR = 1.57, 95% CI 1.18, 2.09), likely reflecting the lack of association between sexual orientation and health behaviours SES (Table 1).

Identification as bisexual was also associated with smoking (OR = 1.49, 95% CI 1.20, 1.84)
which remained after further adjustment (OR = 1.50, 95% CI 1.21, 1.86). In models combining gay/lesbian with bisexual categories, identifying as LGB was associated with smoking (OR = 1.52, 95% CI 1.27, 1.81) which was unchanged after further adjustment (OR = 1.52, 95% CI 1.28, 1.82). In supplementary analyses (not shown), the mode of survey administration was not found to modify the association (p for global interaction > 0.05).

Men and women were separated for analysis of alcohol drinking, because sex was found to modify the association between sexual orientation identity and alcohol use. Weekly alcohol drinking was not associated with lesbian identity in women (OR = 1.12, 95% CI 0.81, 1.57) or bisexual identity (OR = 1.00, 95% CI 0.79, 1.26), including after further adjustment for parental SES. Among male weekly alcohol drinkers however, gay (OR = 2.00, 95% CI 1.27, 3.15) and bisexual (OR = 2.00, 95% CI 1.17, 3.44) identities were associated with hazardous alcohol drinking patterns. The association remained for gay identity following adjustment for parental SES (OR = 2.01, 95% CI 1.28, 3.15) but was no longer significant for bisexual identified males (OR = 0.90, 95% CI 0.67, 1.25). There was no significant effect modification by the mode of survey administration (p for global interaction > 0.05). A combined LGB category had no association with hazardous drinking (OR = 1.01, 95% CI 0.87, 1.35). Among female weekly alcohol drinkers, there was no association between lesbian (OR = 0.92, 95% CI 0.55, 1.55) or bisexual (OR = 0.92, 95% CI 0.67, 1.25) or combined LGB (OR = 0.93, 95% CI 0.70, 1.23) identity and hazardous drinking. There was little change in these estimates after additional adjustment for parental SES.

Discussion

In a community-dwelling sample of over 76006500 young adults in England, men and women reporting a gay/lesbian or bisexual (LGB) identity were around twice as50% more likely to have a history of cigarette smoking at age 15/16 than those reporting a heterosexual
Lesbian or gay participants were nearly twice as likely to report No association was observed between LGB heterosexual identity and current weekly alcohol drinking alcohol more than twice per week, and more likely to report risky single occasion (for men and women). Among male weekly alcohol drinkers however, identifying as gay/bisexual was associated with a two-fold increase in the likelihood of a hazardous alcohol drinking more often than weekly. Bisexual participants were no more likely to report risky single occasion pattern, defined as drinking than heterosexuals to intoxication on every/most drinking occasions. There was no association between lesbian identity and hazardous alcohol drinking.

Strengths of the study include the large sample which was representative of an entire school year in England at recruitment, typically from the birth years 1990/91. Data from the UK on sexual orientation identity are exceptionally rare, particularly for young cohorts. Adjusting for the sample design, Around 3.5% of this cohort identified as LGB at age 18/19. The refusal rate for the sexual orientation identity question was low, particularly in the web survey, and differences in how this question was administered were not found to influence results materially. Several major cohort studies in the US have included questions on sexual orientation identity in recent years. In the UK, however, data on health inequalities in LGB identified adults has historically come from cross-sectional surveys recruited using snowball sampling which do not address issues of representativeness fully, even when a heterosexual control group is available. Recruitment from recreational spaces, particularly before the smoking ban, may have introduced bias into earlier studies. To our knowledge, this the first study to demonstrate that sex modifies the association between sexual orientation identity and drinking alcohol to intoxication in a young UK cohort. The
long-demonstrated association between LGB orientation and smoking appears to have persisted even in this young cohort. A clear limitation of our study was that smoking status was last assessed in 2006 (age 15/16), two years before sexual orientation was last recorded. Participants may have changed their sexual orientation identity or smoking status between 2006 and 2009, and so the data cannot establish an only allow the association with current smoking history to be evaluated. Smoking is not known to influence sexual orientation identity, making and so we are not concerned about possible reverse causation an unlikely explanation. It is worth noting however, that young people who begin smoking tend to continue into adulthood and two-thirds of smokers begin before age 18, suggesting that many of those reporting a history of smoking are still current smokers. A second limitation is that, statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups, particularly for supplementary analyses of men and women separately. A third limitation was that aspects of sexual orientation other than identity such as attraction and behaviours were not recorded. Finally, the percentage of participants identifying as LGB may have been underestimated, particularly if this had not been disclosed to parents, who might have been in the home during telephone and home interviews. Although the refusal rate for the question was low, some participants who identify as LGB might have responded “heterosexual” for this and other reasons, which might include socially desirable responding. This would lead to misclassification bias, leading us to have under-estimated the size of any associations found. Results were similar when additionally controlling for mode of survey administration (home visit, telephone, web survey), mitigating concerns that the results are driven by the method of data collection.
Although our finding that LGB orientation is associated with smoking history is largely consistent with other studies, the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB women and in a systematic review, LB identity in women was associated with alcohol dependence and misuse; misuse defined as >21/14 units/week in men/women. It is important to emphasize, however, that our study measured alcohol drinking frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have reported associations with hazardous alcohol drinking for LGB men and women. Overall, the picture is mixed. Some studies find a stronger association between LG or GB identity and alcohol use in women, some find a stronger association in men, and some an association for B but not L women. Our results show an association between LG identity in men and women combined, similar patterns when separating men and women, but with a stronger association in men (Table S1). L or G identity among English youth, but not B identity, is associated with more frequent and riskier single occasion drinking for LGB men and women. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. A study of students with same-sex sexual experiences found that greater LGB resources were associated with less smoking in women but increased risk of binge drinking in men. Future international comparisons are necessary, and a pooled meta-analysis of individual participant data (MIPD) would be very valuable.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. There is apparently no evidence for genetic covariance between sexual orientation identity and health behaviours, and we suggest that sexual
orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed, which require further investigation, most of which remain theoretical. The concept of ‘minority stress’ is often invoked to explain how heterosexism and homophobia are internalised, perhaps leading people to self-medicate psychological distress with cigarettes or alcohol. A recent review found support for this theory, particularly in explaining associations with victimisation and substance use.

Alternatively, LGB young people may socialize or have socialized in recreational spaces where cigarettes and alcohol are easily available, where peer norms encourage engagement in these behaviours, to appear older than their actual age, or to signify a sexual preference involving tobacco. Concern with appearance could motivate smoking as a weight management strategy. For some, smoking can be sexually arousing, particularly if it is associated with masculinity or where there is a sexual attraction to men smoking. Other commentators have noted the role of the tobacco industry in targeting LGB smokers.

Early unhealthy behaviours among LGB young people may influence trajectories toward chronic disease in later life. Longitudinal repeated measures data will be necessary in order to identify the antecedents and consequences of unhealthy behaviours for LGB young people in the UK, across the life course. In our view, there is a clear need for a repeated measures cohort study of LGB people.

Despite recent equality and diversity legislation and the inclusion of sexual orientation in the National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely monitored by NHS organisations or measured in epidemiological studies. To improve the evidence base, and support international comparisons, data about sexual orientation should be collected routinely. In the Integrated Household Survey for example, it will now be possible to consider sexual orientation identity in relation to health status, smoking and subjective wellbeing, among other topics. Questions about sexual orientation can be added
at low cost and have relatively low refusal rates, particularly among young people. Wider measurement of sexual orientation would ultimately help reduce health inequalities.

**Author contributions**

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson *did perform* the analyses. All authors contributed to writing the manuscript.

**Data sharing statement**

Data are available from the UK Data Archive. *Syntax to reproduce the results presented here is available from the corresponding author on request.*

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**Funding statement**

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**References**


   http://dx.doi.org/10.5255/UKDA-SN-5545-3 (accessed 14/01/2013)


Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%) or mean(SD)

<table>
<thead>
<tr>
<th>Study variables (N = 7698)</th>
<th>Lesbian or gay</th>
<th>Bisexual</th>
<th>Heterosexual</th>
<th>p*</th>
<th>p*</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>(nN = 88, 1.1%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>33 (37.5)</td>
<td>111 (76.0)</td>
<td>379 (47.8)</td>
<td>0.00102</td>
<td>0.01449</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(13.6)</td>
<td>12 (13.6)</td>
<td>12 (81.6)</td>
<td>2112 (28.3)</td>
<td>&lt;0.00127</td>
<td>0.00304</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Parental education (less than secondarydegree level)</td>
<td>13 (1435 39.8)</td>
<td>26 (17.853 37.3)</td>
<td>1715 (23.02411)</td>
<td>0.0262</td>
<td>0.0723</td>
<td>0.14</td>
</tr>
<tr>
<td>Parental occupation (routine or unemployedprofessional)</td>
<td>10 (1125 28.4)</td>
<td>18 (12.3)</td>
<td>900 (1237 26.1)</td>
<td>0.971574</td>
<td>0.8439</td>
<td>0.9235</td>
</tr>
<tr>
<td>History of cigarette smoking (age 15/16)</td>
<td>35 (39.8)</td>
<td>60 (41142 24.8)</td>
<td>1649 (2214506)</td>
<td>&lt;0.00102</td>
<td>0.0106</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol drinking &gt;2 days/week (Weekly alcohol drinker (2009, age 18/19)</td>
<td>33 (37.5)</td>
<td>38 (26097 68.3)</td>
<td>1467 (1974263)</td>
<td>&lt;0.00106</td>
<td>&lt;0.00106</td>
<td>0.057</td>
</tr>
<tr>
<td>Risky single occasion% of alcohol drinkers with</td>
<td>40 (45549)</td>
<td>48 (32980 56.3)</td>
<td>1985 (2663300)</td>
<td>&lt;0.00102</td>
<td>&lt;0.00104</td>
<td>0.090</td>
</tr>
<tr>
<td>Hazardous drinking (pattern 2009, age 18/19)</td>
<td>(73.4)</td>
<td>(51.4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Analytic sample (N = 76986656) comprises participants with available data on age, sex, ethnic group, parental education, and occupational social class, smoking history (2004), and alcohol use (2004 and 2009).

Unweighted frequency.

p value for gay/lesbian vs. heterosexual, (chi-square test).

p value for linear trend across gay/lesbian vs. bisexual and heterosexual, p bisexual vs. heterosexual. Unweighted frequency (ethnic minority groups were over-sampled).
Table 2. Association between sexual orientation identity and smoking and alcohol drinking >2 days/week and risky single occasion drinking

<table>
<thead>
<tr>
<th></th>
<th>History of cigarette smoking vs. non-smoker</th>
<th>Weekly alcohol drinker of &gt;2 days/week vs. &lt;=2 days/week or never pattern (among male weekly drinkers)</th>
<th>Weekly risky single occasion hazardous alcohol drinking vs. (among female weekly drinkers)</th>
</tr>
</thead>
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<tr>
<td></td>
<td>N=7698</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N=6656*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N=2371</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N=2056</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Minimally adjusted</td>
<td>Fully adjusted</td>
<td>Minimally adjusted</td>
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<tr>
<td></td>
<td>adjusted</td>
<td>adjusted</td>
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<tr>
<td></td>
<td>Model 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesbian or</td>
<td>1.57</td>
<td>1.57                                               1.99***</td>
<td>1.99**</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>2.01                                               0.92</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>gay</td>
<td>heterosexual</td>
<td>Bisexual</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
<td>----------------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td>1.18, 2.34**</td>
<td>(1.18, 2.23*</td>
<td>(1.18, 2.23)</td>
</tr>
<tr>
<td>(vs.</td>
<td>*</td>
<td>*</td>
<td>1.50, 1.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.42, 3.045)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2.75, 1.844</td>
</tr>
<tr>
<td></td>
<td>3.6508</td>
<td>3.5109</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.94***49</td>
<td>1.84**50</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>(1.37)</td>
<td>(1.30)</td>
<td>(0.79, 1.26)</td>
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<tr>
<td></td>
<td>(1.42)</td>
<td>(3.0952)</td>
<td>(1.17, 1.44)</td>
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<tr>
<td></td>
<td>(1.42)</td>
<td>(3.0952)</td>
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<td>2.0322</td>
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Values shown are odds ratios (95% confidence intervals). *** = p < 0.001, ** = p < 0.01, * = p < 0.05. Analytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

Adjusted for age and sex.

Adjusted for age, sex, ethnic minority status, parental educational attainment, parental occupational social class.
Table S1. Association between sexual orientation identity and smoking, alcohol drinking ≥2 days/week and risky single occasion drinking

<table>
<thead>
<tr>
<th></th>
<th>History of cigarette smoking vs. non-smoker</th>
<th>Alcohol drinking ≥2 days/week vs. ≤2 days/week or never</th>
<th>&gt;Weekly risky single occasion drinking vs. ≤weekly</th>
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<tr>
<td></td>
<td>Minimally adjusted</td>
<td>Minimally adjusted</td>
<td>Fully adjusted</td>
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<tr>
<td></td>
<td>Fully adjusted</td>
<td>Fully adjusted</td>
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</tr>
<tr>
<td>Males (n = 3762)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay</td>
<td>2.38** (1.31, 4.33)</td>
<td>1.92* (1.10, 3.35)</td>
<td>2.13* (1.21, 3.77)</td>
</tr>
<tr>
<td></td>
<td>(vs. heterosexual)</td>
<td>(vs. heterosexual)</td>
<td>(vs. heterosexual)</td>
</tr>
<tr>
<td>Bisexual</td>
<td>1.93 (0.92, 4.09)</td>
<td>1.04 (0.49, 2.20)</td>
<td>0.67 (0.30, 1.46)</td>
</tr>
<tr>
<td></td>
<td>(vs. heterosexual)</td>
<td></td>
<td>(vs. heterosexual)</td>
</tr>
<tr>
<td>Females (n = 3936)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay</td>
<td>2.30* (1.14, 4.62)</td>
<td>2.10 (1.00, 4.42)</td>
<td>1.40 (0.68, 2.88)</td>
</tr>
<tr>
<td></td>
<td>(vs. heterosexual)</td>
<td>(vs. heterosexual)</td>
<td>(vs. heterosexual)</td>
</tr>
<tr>
<td>Bisexual</td>
<td>1.93** (1.04, 4.38)</td>
<td>1.39 (0.84, 2.15)</td>
<td>1.32 (0.63, 2.86)</td>
</tr>
<tr>
<td></td>
<td>(vs. heterosexual)</td>
<td>(1.30, 2.87)</td>
<td>(1.23, 2.69)</td>
</tr>
<tr>
<td>--------------------------</td>
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</table>

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Adjusted for age. \(^b\)Adjusted for age, ethnic minority status, sex, parental educational attainment, parental occupational social class.
Sexual orientation identity in relation to smoking history and alcohol use at age 18/19: Cross-sectional associations from the Longitudinal Study of Young People in England (LSYPE)

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Sexual orientation identity in relation to smoking history and alcohol use at age 18/19: Cross-sectional associations from the Longitudinal Study of Young People in England (LSYPE)

Running head: Sexual orientation, smoking, alcohol use.

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Word count: abstract 244; text 3231.

Number of figures, tables: 2. References: 40.
Abstract

Objectives. Information about the health behaviours of minority groups is essential for addressing health inequalities. We evaluated the association between lesbian, gay or bisexual (LGB) sexual orientation identity and smoking and alcohol use in young people in England.


Setting. Self-completion questionnaires during home visits, face-to-face interviews, and web-based questionnaires.

Participants. Data from 7698 participants (3762 men) with information on sexual orientation identity and health behaviours at age 18/19.

Outcome measures. Cigarette smoking history, alcohol drinking frequency, and risky single occasion drinking (RSOD).

Results. LGB identity was reported by 3.1% of participants (55 gay, 33 lesbian, 35 bisexual male, 111 bisexual female), 3.5% when adjusting for the survey design. Adjusting for a range of covariates, identification as lesbian/gay was found to be associated with smoking (OR = 2.23, 95% CI 1.42, 3.51), alcohol drinking >2 days/week (OR = 1.99, 95% CI 1.25, 3.17), and RSOD (OR = 1.80, 95% CI 1.13, 2.86) more than weekly. Bisexual identity was associated with smoking history (OR = 1.84, 95% CI 1.30, 2.61) but not alcohol drinking >2 days/week (OR = 1.20, 95% CI 0.79, 1.81) or RSOD (OR = 1.04, 95% CI 0.71, 2.86).

Conclusions. In a sample of over 7600 young people age 18/19 in England, lesbian/gay identity is associated with cigarette smoking, drinking alcohol frequency and RSOD. Bisexual identity is associated with smoking but not RSOD or frequent alcohol drinking.
Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies, Sexuality.
Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking

- Previous results for alcohol use are mixed, therefore the association should be evaluated

Key messages

- LGB orientation identity is associated with higher rates of smoking history in a population sample of English 18/19 year-olds, compared to heterosexual or ‘straight’ identity

- Lesbian or gay (compared to heterosexual) identity is associated with increased risk of drinking alcohol more than twice per week and risky single occasion drinking

- Bisexual (compared to heterosexual) identity is associated with smoking but not alcohol drinking frequently or risky single occasion drinking

- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This cohort is among the first in the UK to record sexual orientation identity

- Smoking history was available but not current smoking status at age 18/19

- Data on the quantity of alcohol typically consumed was not available

- Numbers of LGB participants were small, which could be addressed by a large prospective cohort study of LGB people
Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high risk groups for interventions.\(^1\)\(^2\) It is estimated that between 1.5%\(^3\) and around 5%\(^4\) of the UK population are lesbian, gay, or bisexual (LGB). Estimates can vary depending on whether identity, sexual behaviour or same-sex attraction are used to define sexual orientation.\(^3\)\(^5\)\(^6\) Additionally, estimates can vary by age and ethnic group.\(^3\) Relatively few research studies include a measure of sexual orientation identity, particularly in the UK. As a result, the evidence base on health inequalities experienced by LGB people is very sparse. Exceptions include the National Attitudes of Sexual Attitudes and Lifestyles (NATSAL: 1990-91, 1999-01, 2010-12), National Statistics Opinions Survey (in 2008-09), ONS Integrated Household Survey (from 2009), the Longitudinal Study of Young People in England (from 2009), Health Survey for England (from 2010) and the Scottish Health Survey (from 2008).

Cigarette smoking is a prevalent behaviour among young people.\(^7\) Many studies have shown an association between LGB orientation and cigarette smoking,\(^8\)\(^-\)\(^13\) mostly in the US but also in Mexico\(^14\) and the UK.\(^15\) The association is usually found in men and women and in different age groups, particularly in young LGB people.\(^8\)\(^14\) Occasionally the association is found to be stronger in women.\(^15\) Some studies used sexual orientation identity as a measure of sexual orientation, some used same-sex attraction and some used multiple measures.\(^11\)

Alcohol use is also common among young people, but evidence supporting an association between LGB identity and alcohol use is mixed,\(^16\) with evidence for possible effect modification by sex. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only.\(^17\) A pooled analysis of data from 14 countries found greater alcohol intake and more risky single occasion drinking (RSOD) in lesbian women but not gay men, compared to heterosexuals.\(^16\) Studies reporting an association
between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer. One study found an association specific in relation to GB men under 50. There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys.

Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake, alcohol dependence, and risky single occasion drinking. One study found elevated risk of alcohol use among lesbian/bisexual females and ‘mostly heterosexual’ males, but not gay males. Similar patterns have been found among adolescents in the transition to early adulthood, among University students, in midlife, across the adult age range, when using behavioural definitions of sexual orientation and in different countries including Mexico and the UK.

The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of drinking alcohol more than twice per week and RSOD, in young people (age 18/19) in England.

**Methods**

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups. At recruitment in 2004, participants (N = 15,770) were typically aged 13/14. The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited to participate by letter, using databases of schools to identify potential participants. Schools were defined as socio-economically deprived if they fell within the lowest quintile of schools ranked according to the proportion of pupils in receipt of school meals. Socio-economically deprived schools were over-sampled by a factor 1.5 and ethnic minorities to achieve N=1000 per ethnic group. Annual home interview visits incorporated a computer-assisted self-completion element,
including questions about smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a home visit (face-to-face interview and computer-assisted self-completion questionnaire), telephone interview or web questionnaire.

**Sexual orientation identity.** Sexual orientation identity was measured in 2009 using the question ‘Which of the following best describes how you think of yourself?’ for the web questionnaire (N = 2690, 40.4%), and for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%), ‘I will now read out a list of terms people sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or lesbian; Bisexual, Other. As I read the list again please say ‘yes’ when you hear the option that best describes how you think of yourself’. These response options are recommended by the Office of National Statistics. The refusal rate for this question was 0.1% and 0.3% reported ‘Other’.

**Cigarette smoking.** Cigarette smoking was last measured in 2006 (typical age 15/16) with the question ‘Do you ever smoke cigarettes at all?’ followed by six response options (I have never smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a cigarette now, I sometimes smoke cigarettes now but I don't smoke as many as one a week, I usually smoke between one and six cigarettes a week, I usually smoke more than six cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus non-smoker.

**Weekly alcohol drinking.** Alcohol drinking was measured in 2009 using the question ‘Thinking about the last 12 months, about how often did you usually have an alcoholic drink?’ with seven response options (Almost every day, Five or six days a week, Three or four days a week, Once or twice a week, Once or twice a month, Once every couple of months, Once or twice a year). Responses were grouped into ‘more than twice per week’ versus ‘less than twice per week’.

**Risky single occasion drinking.** Participants were asked, ‘On those days when you did have an alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every
time, Most times, Around half the time, Less than half the time, Rarely, Never). This information was combined with alcohol drinking frequency to identify participants who reported drunkenness more than 52 times per year, equivalent to drinking alcohol to intoxication more than once per week.

**Demographic covariates.** Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese; grouped into ‘ethnic minority’ (1) or White (0). The maximum of either parent’s educational attainment was recorded on a six-point scale ranging from ‘no qualification’ (0) to ‘degree or equivalent’ (6). Occupational social class was recorded on an eight-point scale ranging from ‘never worked or long term unemployed’ (1) to ‘higher managerial and professional occupations’ (8), for one or both parents. Parental education attainment and occupational class are both considered indicators of parental socio-economic status (SES).

**Statistical analysis.** For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable. Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We minimally adjusted the odds ratios for age and sex, and then additionally adjusted the estimates for ethnic minority status, parental education and social class. Ethnicity and socio-economic status are possible confounding factors, because they may be associated both with sexual identity and with health behaviours. We also combined gay/lesbian and bisexual into a single ‘LGB’ category for additional analysis. Sample weights were used to obtain correct standard errors, allowing for oversampling of schools with low socio-economic status and for ethnic minority pupils at recruitment.
Although statistical power for evaluating possible effect modification by gender and socio-economic status was low, previous studies have shown sex differences (particularly for alcohol use). We therefore ran separate models for males and females in supplementary analyses. In sensitivity analysis, we additionally controlled for mode of survey administration, to evaluate if this influenced the results. All analyses were performed with Stata version 12.1.

Results

The analytic sample comprised 7698 participants with data on sexual orientation identity, smoking history and alcohol use in addition to covariates (home visit = 12.2%, telephone interview = 47.6%, web questionnaire = 40.1%). Compared to the recruitment sample and adjusting for the study design, the analytic sample contained slightly fewer men (49.4% vs. 53.9%, p < 0.001), fewer ethnic minorities (9.9% vs. 14.9%, p < 0.001), fewer participants whose parents had less than secondary school level educational qualifications (17.0% vs. 29.2%, p < 0.001) and fewer participants with parents who were unemployed or had routine occupations (8.1% vs. 15.5%, p < 0.001).

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3% were classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108 bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were fewer women (37.5%) in the ‘LG’ category than men, but more women (76.0%) in the ‘bisexual’ category than men. When using sample weights to correct for over-sampling of ethnic minority groups and schools with higher socio-economic deprivation however, the proportion of participants classified as LGB was 3.5% (1.3% LG, 2.2% bisexual).

Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06). There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73), although this test may be underpowered (there were 33 LGB
participants for face-to-face interviews, 86 for telephone interviews and 115 for web
questionnaires).

Results from the logistic regression analyses are shown in Table 2, minimally adjusted for age and
sex and then after further adjustments for ethnic minority status, parental educational attainment and
occupational social class (parental SES). Sample weights were used in the models to correct for
over-sampling of ethnic minority groups and socio-economically deprived schools at recruitment.

Lesbian or gay participants were more than twice as likely to have a history of cigarette smoking,
and bisexual participants nearly twice as likely to have smoked, compared to heterosexual
participants. Adjustment for ethnic minority status and parental SES did not change these results
materially. Similar results were found when combining participants into LGB vs. heterosexual.

Participants who identified themselves as lesbian or gay were nearly twice as likely to drink alcohol
more than twice a week, even after adjustment for several covariates, compared to heterosexuals.

There was no association between bisexual identity and drinking alcohol more than twice a week.

When combining LGB participants together, the association was weaker but remained significant,
in both minimally and fully adjusted models.

Lesbian or gay participants were around 1.8 times more likely to report risky single occasion
drinking more than weekly, compared to heterosexuals. This association was only slightly weaker
in the fully adjusted model. There was no association between bisexual identity and RSOD. The
combined LGB category was associated with this measure only in the minimally adjusted model.

In supplementary analyses separating males and females, the pattern of results for smoking history
was very similar for both genders (Table S1), although it was weaker for bisexual males. For
alcohol drinking greater than twice per week however, the association was stronger in males than in
females. The size of the association was similar for gay men and lesbian women, although
confidence intervals were wider for lesbian women. No association was apparent for bisexual men,
although there was a non-significant trend toward increased risk for bisexual women. For risky single occasion drinking, the association was stronger and significant in males but a weaker non-significant trend was suggested for females. Bisexual males appeared to be at decreased risk of risky single occasion drinking compared to heterosexuals, but this was not significant. These supplementary results should be interpreted with caution, given the small numbers of participants involved. The study may be underpowered to examine how sex modifies the association between sexual orientation and health behaviours.

Discussion

In a community-dwelling sample of over 7600 young adults in England, men and women reporting a gay/lesbian or bisexual (LGB) identity were around twice as likely to have a history of cigarette smoking than those reporting a heterosexual identity at age 18/19. LG participants were nearly twice as likely to report drinking alcohol more than twice per week, and more likely to report risky single occasion drinking more often than weekly. Bisexual participants were no more likely to report risky single occasion drinking than heterosexuals.

Strengths of the study include the large sample which was representative of an entire school year in England at recruitment, typically from the birth years 1990/91. Data from the UK on sexual orientation identity are exceptionally rare, particularly for young cohorts. Adjusting for the sample design, 3.5% of this cohort identified as LGB at age 18/19. The refusal rate for the sexual orientation identity question was low, particularly in the web survey, and differences in how this question was administered were not found to influence results materially. Several major cohort studies in the US have included questions on sexual orientation identity in recent years. In the UK however, data on health inequalities in LGB identified adults has historically come from cross-sectional surveys recruited using snowball sampling, gay pride events and internet surveys which do not address issues of representativeness fully, even when a heterosexual control group is available. Recruitment from recreational spaces, particularly before the smoking ban, may have
introduced bias into earlier studies. The long-demonstrated association between LGB orientation and smoking\textsuperscript{11-13} appears to have persisted, even in this young cohort.

A clear limitation of our study was that smoking status was last assessed in 2006 (age 15/16), two years before sexual orientation was last recorded. Participants may have changed their sexual orientation identity\textsuperscript{27} or smoking status between 2006 and 2009, and so the data cannot establish an association between LGB identity and current smoking. Smoking is not known to influence sexual orientation identity, making reverse causation unlikely. It is worth noting however, that young people who begin smoking tend to continue into adulthood\textsuperscript{30} and two-thirds of smokers begin before age 18,\textsuperscript{7} suggesting that many participants with a smoking history will have continued to smoke. A second limitation is that statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups, particularly for supplementary analyses of men and women separately. Larger sample sizes would allow more detailed comparisons to be made, such as LG vs. bisexual participants. A third limitation was that aspects of sexual orientation other than identity (e.g. attraction, behaviour) were not available. Finally, the percentage of participants identifying as LGB may have been underestimated, particularly if this had not been disclosed to parents, who might have been in the home during telephone and home interviews. Although the refusal rate for the question was low, some participants who identify as LGB might have responded ‘heterosexual’ for this and other reasons, which might include socially desirable responding. This would lead to misclassification bias, leading us to have under-estimated the size of any associations found. Results were similar when additionally controlling for mode of survey administration (home visit, telephone, web survey), mitigating concerns that the results are driven by the method of data collection. Results do not generalise to young people who adopt an LGB identity after age 18/19.
Although our finding that LGB orientation is associated with smoking history is largely consistent with other studies,\textsuperscript{11-13} the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB women\textsuperscript{16,17,24} and in a systematic review, LB identity in women was associated with alcohol dependence and heavy alcohol consumption (>14 units/week) but not GB identity in men.\textsuperscript{17} It is important to emphasize however that our study measured alcohol drinking frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have found similar associations to our own, between LGB identity and alcohol use.\textsuperscript{20,27,31-33} The extent to which gender modifies this association is not known however, and larger samples of LGB people will be needed for more detailed analyses.\textsuperscript{2434}

Our results show that LG (but not bisexual) identity among English young people, is associated with more frequent and riskier single occasion drinking. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. A study of students with same-sex sexual experiences found that greater LGB resources were associated with less smoking in women but increased risk of binge drinking in men.\textsuperscript{35} Future international comparisons are necessary, and a pooled meta-analysis of individual participant data (MIPD) would be very valuable.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. There is apparently no evidence for genetic covariance between sexual orientation identity and health behaviours, and we suggest that sexual orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed, which require further investigation. The concept of ‘minority stress’ is often invoked to explain how heterosexism and homophobia are internalised,\textsuperscript{22} perhaps leading people to self-medicate psychological distress with cigarettes or alcohol. A recent review found support for this theory, particularly in explaining associations with victimisation and substance use.\textsuperscript{36} Alternatively, LGB young people may socialize...
or have socialized in recreational spaces where cigarettes and alcohol are easily available, where peer norms encourage engagement in these behaviours, or to appear older than their actual age. Concern with appearance could motivate smoking as a weight management strategy. Smoking may be sexually arousing for some individuals and subcultures, particularly when seen to signify masculinity. Other commentators have noted the role of the tobacco industry in targeting LGB smokers. Early unhealthy behaviours among LGB young people may increase risk of chronic disease in later life. Longitudinal repeated measures data will be necessary in order to identify the antecedents and consequences of unhealthy behaviours for LGB young people in the UK, across the life course. In our view, there is a clear need for a large prospective cohort study of LGB people in the UK, with repeated measures of health behaviours and health outcomes. This may require a heterosexual control group.

Despite recent equality and diversity legislation and the inclusion of sexual orientation in the National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely monitored by NHS organisations or measured in epidemiological studies. To improve the evidence base, support international comparisons, and allocate public resources appropriately, data about sexual orientation should be collected routinely. Questions about sexual orientation can be adopted at low cost and have relatively low refusal rates, particularly among young people. Wider measurement of sexual orientation will ultimately help reduce health inequalities.
Author contributions

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson conducted the statistical analyses. All authors contributed to writing the manuscript.

Data sharing statement

Data are available from the UK Data Archive.

Funding statement

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References


Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%)

<table>
<thead>
<tr>
<th>Study variables (N = 7698)</th>
<th>Lesbian or gay (n = 88, 1.1%)</th>
<th>Bisexual (n = 146, 1.9%)</th>
<th>Heterosexual (n = 7464, 97.0%)</th>
<th>p&lt;sup&gt;c&lt;/sup&gt;</th>
<th>p&lt;sup&gt;d&lt;/sup&gt;</th>
<th>p&lt;sup&gt;e&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>33 (37.5)</td>
<td>111 (76.0)</td>
<td>3792 (50.8)</td>
<td>0.001</td>
<td>0.014</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ethnic minority</td>
<td>12 (13.6)</td>
<td>12 (8.2)</td>
<td>2112 (28.3)</td>
<td>&lt;0.001</td>
<td>0.003</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Parental education (less than secondary)</td>
<td>13 (14.8)</td>
<td>26 (17.8)</td>
<td>1715 (23.0)</td>
<td>0.02</td>
<td>0.07</td>
<td>0.14</td>
</tr>
<tr>
<td>Parental occupation (routine or unemployed)</td>
<td>10 (11.4)</td>
<td>18 (12.3)</td>
<td>900 (12.1)</td>
<td>0.97</td>
<td>0.84</td>
<td>0.92</td>
</tr>
<tr>
<td>History of cigarette smoking (age 15/16)</td>
<td>35 (39.8)</td>
<td>60 (41.1)</td>
<td>1649 (22.1)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol drinking &gt;2 days/week (age 18/19)</td>
<td>33 (37.5)</td>
<td>38 (26.0)</td>
<td>1467 (19.7)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.057</td>
</tr>
<tr>
<td>Risky single occasion drinking (age 18/19)</td>
<td>40 (45.5)</td>
<td>48 (32.9)</td>
<td>1985 (26.6)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.090</td>
</tr>
</tbody>
</table>

Analytic sample (N = 7698) comprises participants with available data on age, sex, ethnic group, parental education, occupational social class, smoking history and alcohol use. <sup>c</sup>p value for lesbian/gay/bisexual vs. heterosexual, <sup>d</sup>p value for gay/lesbian vs. heterosexual, <sup>e</sup>p bisexual vs. heterosexual. <sup>f</sup>Unweighted frequency (ethnic minority groups were over-sampled).
Table 2. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

<table>
<thead>
<tr>
<th></th>
<th>History of cigarette smoking vs. non-smoker</th>
<th>Alcohol drinking &gt;2 days/week vs. &lt;=2 days/week or never</th>
<th>&gt;Weekly risky single occasion drinking vs. &lt;=weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimally adjusted (^b)</td>
<td>Fully adjusted (^c)</td>
<td>Minimally adjusted (^b)</td>
</tr>
<tr>
<td>Model 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesbian or gay</td>
<td>2.34*** (1.50, 3.65)</td>
<td>1.99*** (1.28, 3.09)</td>
<td>1.82*** (1.16, 2.84)</td>
</tr>
<tr>
<td>(vs. heterosexual)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bisexual</td>
<td>1.94*** (1.37, 2.75)</td>
<td>1.26 (0.84, 1.89)</td>
<td>1.11 (0.76, 1.61)</td>
</tr>
<tr>
<td>(vs. heterosexual)</td>
<td>1.84** (1.30, 2.61)</td>
<td>1.20 (0.79, 1.81)</td>
<td></td>
</tr>
<tr>
<td>Model 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesbian, gay or bisexual</td>
<td>2.08*** (1.57, 2.76)</td>
<td>1.53*** (1.15, 2.03)</td>
<td>1.35* (1.01, 1.79)</td>
</tr>
<tr>
<td>(vs. heterosexual)</td>
<td>1.98*** (1.49, 2.63)</td>
<td>1.48* (1.10, 1.99)</td>
<td>1.29 (0.96, 1.74)</td>
</tr>
</tbody>
</table>

Values shown are odds ratios (95% confidence intervals). *** = p < 0.001, ** = p < 0.01, * = p < 0.05. \(^a\) Analytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied. \(^b\) Adjusted for age and sex. \(^c\) Adjusted for age, sex, ethnic minority status, parental educational attainment, parental occupational social class.
Table S1. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

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<tr>
<td></td>
<td>Minimally adjusted&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Minimally adjusted&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Minimally adjusted&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Males (n = 3762)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay (vs. heterosexual)</td>
<td>2.38** (1.31, 4.33)</td>
<td>1.92* (1.10, 3.35)</td>
<td>2.13* (1.21, 3.77)</td>
</tr>
<tr>
<td>Bisexual (vs. heterosexual)</td>
<td>1.93 (0.92, 4.09)</td>
<td>1.04 (0.49, 2.20)</td>
<td>0.67 (0.30, 1.46)</td>
</tr>
<tr>
<td>Females (n = 3936)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay (vs. heterosexual)</td>
<td>2.30* (1.14, 4.62)</td>
<td>2.10 (1.00, 4.42)</td>
<td>1.40 (0.68, 2.88)</td>
</tr>
<tr>
<td>Bisexual (vs. heterosexual)</td>
<td>1.93** (1.30, 2.87)</td>
<td>1.82* (0.87, 2.21)</td>
<td>1.32 (0.82, 2.00)</td>
</tr>
</tbody>
</table>

Values shown are odds ratios (95% confidence intervals). *** = p < 0.001, ** = p < 0.01, * = p < 0.05.<sup>a</sup> Analytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied. <sup>b</sup> Adjusted for age. <sup>c</sup> Adjusted for age, ethnic minority status, parental educational attainment, parental occupational social class.
Sexual orientation identity in relation to smoking history and alcohol use at age 18/19: Cross-sectional associations from wave 6 of the Longitudinal Study of Young People in England (LSYPE)

Running head: Sexual orientation, smoking, alcohol use.

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Number of figures, tables: 2. References: 5540.
Abstract

Objectives. Information about the health behaviours of minority groups is essential for addressing health inequalities. We evaluated the association between lesbian, gay or bisexual (LGB) sexual orientation identity and smoking and alcohol use in young people in England.


Setting. Self-completion questionnaires during home visits, face-to-face interviews, and web-based questionnaires.

Participants. Data from 7698 participants (3762 men) with information on sexual orientation identity and health behaviours at age 18/19.

Outcome measures. Cigarette smoking history, alcohol drinking frequency, and risky single occasion drinking (RSOD).

Results. LGB identity was reported by 3.1% of participants (55 gay, 33 lesbian, 35 bisexual male, 111 bisexual female), 3.5% when adjusting for the survey design. Adjusting for a range of covariates, identification as lesbian/gay was found to be associated with smoking (OR = 2.2823, 95% CI 1.4642, 3.5851), alcohol drinking >2 days/week (OR = 1.9699, 95% CI 1.2425, 3.4117), and RSOD (OR = 1.7680, 95% CI 1.1113, 2.7986) more than weekly. Bisexual identity was associated with smoking history (OR = 1.8784, 95% CI 1.3330, 2.64) and RSOD (OR = 1.02, 95% CI 1.02, 2.79) but not alcohol drinking >2 days/week (OR = 1.4270, 95% CI 0.79, 1.81) or RSOD (OR = 1.04, 95% CI 0.78, 1.3771, 2.86).

Conclusions. In a sample of over 7600 young people age 18/19 in England, lesbian/gay identity is associated with cigarette smoking, drinking alcohol frequency and RSOD. Bisexual identity is associated with smoking and RSOD, but not RSOD or frequent alcohol drinking frequency.
Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies, Sexuality.
Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking
- Previous results for alcohol use are mixed, therefore the association should be
tested evaluated

Key messages

- LGB orientation identity is associated with higher rates of smoking history in a population sample of English 18/19 year-olds, compared to heterosexual or ‘straight’ identity
- Lesbian or gay orientation (compared to heterosexual) identity is associated with increased risk of drinking alcohol more than twice per week and risky single occasion drinking
- Bisexual orientation (compared to heterosexual) identity is associated with smoking but not alcohol drinking frequently or risky single occasion drinking but not alcohol drinking frequency
- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This cohort is among the first in the UK to record sexual orientation identity
- Smoking history was available but not current smoking status was recorded at age 18/19
- Frequency but not Data on the quantity of alcohol consumption typically consumed was not available
- Numbers of LGB participants were small, which could be addressed by a large prospective cohort study of LGB people
**Introduction**

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high risk groups for interventions.\(^1\)\(^-\)\(^3\) It is estimated that between 1.5%\(^4\)\(^-\)\(^6\) and around 5%\(^7\)\(^-\)\(^9\) of the UK population are lesbian, gay, or bisexual (LGB). Estimates tend to be larger when attraction or can vary depending on whether identity, sexual behaviour or same-sex attraction are used to define sexual orientation.\(^5\)\(^6\)\(^8\)\(^-\)\(^10\) Additionally, estimates are found to vary by age and ethnic group.\(^4\)\(^-\)\(^6\)

Relatively few research studies include a measure of sexual orientation identity, particularly in the UK. As a result, the evidence base on health inequalities experienced by LGB groups is very sparse. Exceptions include the National Attitudes of Sexual Attitudes and Lifestyles (NATSAL; 1990-91, 1999-01, 2010-12), National Statistics Opinions Survey (in 2008-09), ONS Integrated Household Survey and (from 2009), the Longitudinal Study of Young People in England which both included the question for the first time in 2009, (from 2009), Health Survey for England (from 2010) and the Scottish Household Health Survey (from 2011-2008).

Cigarette smoking is a prevalent behaviour among young people.\(^11\)\(^-\)\(^13\) Many studies have shown an association between LGB orientation and cigarette smoking, particularly, mostly in the US but also in different countries, Mexico and the UK.\(^14\)\(^-\)\(^15\) The association is usually found in men and women and in different age groups, with some exceptions, but particularly in young LGB people.\(^16\)\(^-\)\(^18\) Occasionally the association is found to be stronger in women.\(^19\)\(^-\)\(^21\) Some studies have used sexual orientation identity as a measure of sexual orientation,\(^22\)\(^-\)\(^24\) some used same-sex attraction and some used multiple measures.\(^25\)\(^-\)\(^27\)

Alcohol use is also common among young people, but evidence supporting an association between LGB identity and alcohol use is mixed with evidence for possible effect modification by sex.\(^28\)\(^-\)\(^30\) A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only.\(^2\)\(^-\)\(^3\)
pooled analysis of data from 14 countries found greater alcohol intake and more risky single occasion drinking (RSOD) in lesbian women but not gay men, compared to heterosexuals. Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer, with one finding. One study found an association specific in relation to those GB men under 50. There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys.

Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake, alcohol dependence, and risky single occasion drinking. One study found elevated risk of alcohol use among lesbian/bisexual females and ‘mostly heterosexual’ males, but not gay males. Similar patterns have been found among adolescents in the transition to early adulthood, among University students, in midlife, across the adult age range, when using behavioural definitions of sexual orientation and in different countries including Mexico and the UK.

The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of drinking alcohol more than twice per week and risky single occasion drinking in young people (age 18/19) in England.

Methods

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups. At recruitment in 2004, participants (N = 15,770) were typically aged 13/14. The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited
to participate by letter, using databases of schools to identify potential participants. Schools were defined as socio-economically deprived if they fell within the lowest quintile of schools ranked according to the proportion of pupils in receipt of school meals. Socio-economically deprived schools were over-sampled by a factor 1.5 and ethnic minorities to achieve N=1000 per ethnic group. Annual home interview visits incorporated a computer-assisted self-completion element, including questions about smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a home visit (face-to-face interview and computer-assisted self-completion questionnaire), telephone interview or web questionnaire.

**Sexual orientation identity.** Sexual orientation identity was measured in 2009 using the question ‘Which of the following best describes how you think of yourself?’ for the web questionnaire (N = 2690, 40.4%), and for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%), ‘I will now read out a list of terms people sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or lesbian; Bisexual, Other. As I read the list again please say ‘yes’ when you hear the option that best describes how you think of yourself’. These response options are recommended by the Office of National Statistics.\(^4\) The refusal rate for this question was 0.1% and 0.3% reported ‘Other’.

**Cigarette smoking.** Cigarette smoking was last measured in 2006 (typical age 15/16) with the question ‘Do you ever smoke cigarettes at all?’ followed by six response options (I have never smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a cigarette now, I sometimes smoke cigarettes now but I don’t smoke as many as one a week, I usually smoke between one and six cigarettes a week, I usually smoke more than six cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus non-smoker.

**Weekly alcohol drinking.** Alcohol drinking was measured in 2009 using the question ‘Thinking about the last 12 months, about how often did you usually have an alcoholic drink?’ with seven
response options (Almost every day, Five or six days a week, Three or four days a week, Once or twice a week, Once or twice a month, Once every couple of months, Once or twice a year).

Responses were grouped into ‘more than twice per week’ versus ‘less than twice per week’.

*Risky single occasion drinking.* Participants were asked, ‘On those days when you did have an alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every time, Most times, Around half the time, Less than half the time, Rarely, Never). This information was combined with alcohol drinking frequency to identify participants who reported drunkenness more than 52 times per year, equivalent to drinking alcohol to intoxication more than once per week.

*Demographic covariates.* Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese; grouped into ‘ethnic minority’ (1) or White (0). The maximum of either parent’s educational attainment was recorded on a six-point scale ranging from ‘no qualification’ (0) to ‘degree or equivalent’ (6). Occupational social class was recorded on an eight-point scale ranging from ‘never worked or long term unemployed’ (1) to ‘higher managerial and professional occupations’ (8), for one or both parents. Parental education attainment and occupational class are both considered indicators of parental socio-economic status (SES).

*Statistical analysis.* For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable. Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We
minimally adjusted the odds ratios for age and sex, and then additionally adjusted the estimates for
ethnic minority status, parental education and social class. Ethnicity and socio-economic status are
possible confounding factors, because they may be associated both with sexual identity and with
health behaviours. We also combined gay/lesbian and bisexual into a single ‘LGB’ category for
additional analysis. Sample weights were used to obtain correct standard errors, allowing for over-
sampling of schools with low socio-economic status and for ethnic minority pupils at recruitment.
Although statistical power for evaluating possible effect modification by gender and socio-
economic status was low, previous studies have shown sex differences (particularly for alcohol
use). We therefore ran separate models for males and females in supplementary analyses. In
sensitivity analysis, we additionally controlled for mode of survey administration, to evaluate if this
influenced the results. All analyses were performed with Stata version 12.1.

Results

The analytic sample comprised 7698 participants with data on sexual orientation identity, smoking
history and alcohol use in addition to covariates (home visit = 12.2%, telephone interview = 47.6%,
web questionnaire = 40.1%). Compared to the recruitment sample and adjusting for the study
design, the analytic sample contained slightly fewer men (49.4% vs. 53.9%, \( p < 0.001 \)), fewer
ethnic minorities (9.9% vs. 14.9%, \( p < 0.001 \)), fewer participants whose parents had less than
secondary school level educational qualifications (17.0% vs. 29.2%, \( p < 0.001 \)) and fewer
participants with parents who were unemployed or had routine occupations (8.1% vs. 15.5%, \( p <
0.001 \)).

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3% were
classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108
bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were fewer women
(37.5%) in the ‘LG’ category than men, but more women (76.0%) in the ‘B-bisexual’ category than
men. When using sample weights to correct for over-sampling of ethnic minority groups and


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schools with higher socio-economic deprivation however, the proportion of participants classified as LGB was 3.5% (1.3% LG, 2.2% Bisexual).

Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06). There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73), although this test may be under-powered (there were 33 LGB participants for face-to-face interviews, 86 for telephone interviews and 115 for web questionnaires).

Results from the logistic regression analyses are shown in Table 2, minimally adjusted for age and sex and then after further adjustments for ethnic minority status, parental educational attainment and occupational social class (parental SES). Sample weights were used in the models to correct for over-sampling of ethnic minority groups and socio-economically deprived schools at recruitment.

Lesbian or gay participants were more than twice as likely to have a history of cigarette smoking, and bisexual participants nearly twice as likely to have smoked, compared to heterosexual participants. Adjustment for ethnic minority status and parental SES did not change these results materially. Similar results were found when combining participants into LGB vs. heterosexual.

Participants who identified themselves as lesbian or gay were nearly twice as likely to drink alcohol more than twice a week, even after adjustment for several covariates, compared to heterosexuals. There was no association between bisexual identity and drinking alcohol more than twice a week. When combining LGB participants together, the association was weaker but remained significant, in both minimally and fully adjusted models.

Lesbian or gay participants were around 1.8 times more likely to report risky single occasion drinking more than weekly, compared to heterosexuals. This association was only slightly weaker in the fully adjusted model. There was no association between bisexual identity and greater than...
The combined LGB category was associated with this measure only in the fully minimally adjusted model.

In supplementary analyses separating males and females, the pattern of results for smoking history was very similar for both genders (Table S1), although it was weaker for bisexual males. For alcohol drinking greater than twice per week however, the association was stronger in males than in females. The size of the association was similar for gay men and lesbian women, although confidence intervals were wider for lesbian women. No association was apparent for bisexual men, although there was a non-significant trend toward increased risk for bisexual women. For risky single occasion drinking, the association was stronger and significant in males but a weaker non-significant trend was suggested for females. Bisexual males appeared to be at decreased risk of risky single occasion drinking compared to heterosexuals, but this was not significant. These supplementary results should be interpreted with caution, given the small numbers of participants involved. The study may be underpowered to examine effect modification of how sex modifies the association between sexual orientation and health behaviours.

Discussion

In a community-dwelling sample of over 7600 young adults in England, men and women reporting a gay/lesbian or bisexual (LGB) identity were around twice as likely to have a history of cigarette smoking at age 15/16 than those reporting a heterosexual identity at age 18/19. Lesbian or gay LG participants were nearly twice as likely to report drinking alcohol more than twice per week, and more likely to report risky single occasion drinking more often than weekly. Bisexual participants were no more likely to report risky single occasion drinking than heterosexuals.

Strengths of the study include the large sample which was representative of an entire school year in England at recruitment, typically from the birth years 1990/91. Data from the UK on sexual orientation identity are exceptionally rare, particularly for young cohorts. Adjusting for the sample design, 3.5% of this cohort identified as LGB at age 18/19. The refusal rate for the sexual
orientation identity question was low, particularly in the web survey, and differences in how this question was administered were not found to influence results materially. Several major cohort studies in the US have included questions on sexual orientation identity in recent years. In the UK however, data on health inequalities in LGB identified adults has historically come from cross-sectional surveys recruited using snowball sampling, gay pride events and internet surveys, which do not address issues of representativeness fully, even when a heterosexual control group is available. Recruitment from recreational spaces, particularly before the smoking ban, may have introduced bias into earlier studies. The long-demonstrated association between LGB orientation and smoking appears to have persisted, even in this young cohort.

A clear limitation of our study was that smoking status was last assessed in 2006 (age 15/16), two years before sexual orientation was last recorded. Participants may have changed their sexual orientation identity or smoking status between 2006 and 2009, and so the data cannot establish an association between LGB identity and current smoking. Smoking is not known to influence sexual orientation identity, making reverse causation an unlikely explanation. It is worth noting however, that young people who begin smoking tend to continue into adulthood and two-thirds of smokers begin before age 18, suggesting that many of those reporting a smoking history of smoking are still current smokers will have continued to smoke. A second limitation is that statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups, particularly for supplementary analyses of men and women separately. Larger sample sizes would allow more detailed comparisons to be made, such as LG vs. bisexual participants. A third limitation was that aspects of sexual orientation other than identity such as attraction and behaviours were not recorded. Finally, the percentage of participants identifying as LGB may have been underestimated, particularly if this had not been disclosed to parents, who might have been in the home during telephone and home interviews.
Although the refusal rate for the question was low, some participants who identify as LGB might have responded ‘heterosexual’ for this and other reasons, which might include socially desirable responding. This would lead to misclassification bias, leading us to have under-estimated the size of any associations found. Results were similar when additionally controlling for mode of survey administration (home visit, telephone, web survey), mitigating concerns that the results are driven by the method of data collection. Results do not generalise to young people who adopt an LGB identity after age 18/19.

Although our finding that LGB orientation is associated with smoking history is largely consistent with other studies, the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB women and in a systematic review, LB identity in women was associated with alcohol dependence and misuse; misuse defined as >21 heavy alcohol consumption (>14 units/week) but not GB identity in men and women. It is important to emphasize however that our study measured alcohol drinking frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have reported associations with hazardous alcohol drinking for LGB men and women and found similar associations to our own, between LGB identity and alcohol use. The extent to which gender modifies this association is not known however, and larger samples of LGB people will be needed for more detailed analyses.

Our results show that LG (but not bisexual) identity among English young people. Overall, the picture is mixed. Some studies find a stronger association between LG or GB identity and alcohol use in women, some find a stronger association in men, and some an association for B but not L women. Our results show an association between LG identity in men and women combined, similar patterns when separating men and women, but with a stronger association in men (Table...
L or G identity among English youth, but not B identity, is associated with more frequent and riskier single occasion drinking. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. A study of students with same-sex sexual experiences found that greater LGB resources were associated with less smoking in women but increased risk of binge drinking in men. Future international comparisons are necessary, and a pooled meta-analysis of individual participant data (MIPD) would be very valuable.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. There is apparently no evidence for genetic covariance between sexual orientation identity and health behaviours, and we suggest that sexual orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed, which require further investigation. The concept of ‘minority stress’ is often invoked to explain how heterosexism and homophobia are internalised, perhaps leading people to self-medicate psychological distress with cigarettes or alcohol. A recent review found support for this theory, particularly in explaining associations with victimisation and substance use. Alternatively, LGB young people may socialize or have socialized in recreational spaces where cigarettes and alcohol are easily available, where peer norms encourage engagement in these behaviours or to appear older than their actual age. Concern with appearance could motivate smoking as a weight management strategy. For some, smoking may be sexually arousing for some individuals and subcultures, particularly if it is associated with masculinity or where there is a sexual attraction to smoking. Other commentators have noted the role of the tobacco industry in targeting LGB smokers. Early unhealthy behaviours among LGB young people may influence trajectories toward increased risk of chronic disease in later life. Longitudinal repeated measures data will be necessary in order to identify the antecedents and consequences of unhealthy behaviours for LGB young people in the UK, across the life course. In our view, there is
a clear need for a repeated measures large prospective cohort study of LGB people in the UK, with repeated measures of health behaviours and health outcomes. This may require a heterosexual control group.

Despite recent equality and diversity legislation and the inclusion of sexual orientation in the National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely monitored by NHS organisations or measured in epidemiological studies. To improve the evidence base, and support international comparisons, and allocate public resources appropriately, data about sexual orientation should be collected routinely. In the Integrated Household Survey for example, it will now be possible to consider sexual orientation identity in relation to health status, smoking and subjective wellbeing, among other topics. Questions about sexual orientation can be added/adopted at low cost and have relatively low refusal rates, particularly among young people.

Wider measurement of sexual orientation would will ultimately help reduce health inequalities.
Author contributions

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson conducted the statistical analyses. All authors contributed to writing the manuscript.

Data sharing statement

Data are available from the UK Data Archive.

Funding statement

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References


Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%)  

<table>
<thead>
<tr>
<th>Study variables (N = 7698)</th>
<th>Lesbian or gay (n = 88, 1.1%)</th>
<th>Bisexual (n = 146, 1.9%)</th>
<th>Heterosexual (n = 7464, 97.0%)</th>
<th>p²</th>
<th>p²</th>
<th>p²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>33 (37.5)</td>
<td>111 (76.0)</td>
<td>3792 (50.8)</td>
<td>0.001</td>
<td>0.014</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ethnic minority</td>
<td>12 (13.6)</td>
<td>12 (8.2)</td>
<td>2112 (28.3)</td>
<td>&lt;0.001</td>
<td>0.003</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Parental education (less than secondary)</td>
<td>13 (14.8)</td>
<td>26 (17.8)</td>
<td>1715 (23.0)</td>
<td>0.02</td>
<td>0.07</td>
<td>0.14</td>
</tr>
<tr>
<td>Parental occupation (routine or unemployed)</td>
<td>10 (11.4)</td>
<td>18 (12.3)</td>
<td>900 (12.1)</td>
<td>0.97</td>
<td>0.84</td>
<td>0.92</td>
</tr>
<tr>
<td>History of cigarette smoking (age 15/16)</td>
<td>35 (39.8)</td>
<td>60 (41.1)</td>
<td>1649 (22.1)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol drinking &gt;2 days/week (age 18/19)</td>
<td>33 (37.5)</td>
<td>38 (26.0)</td>
<td>1467 (19.7)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.057</td>
</tr>
<tr>
<td>Risky single occasion drinking (age 18/19)</td>
<td>40 (45.5)</td>
<td>48 (32.9)</td>
<td>1985 (26.6)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.090</td>
</tr>
</tbody>
</table>

*Analytic sample (N = 7698) comprises participants with available data on age, sex, ethnic group, parental education, occupational social class, smoking history and alcohol use. p value for lesbian/gay/bisexual vs. heterosexual, p value for gay/lesbian vs. heterosexual, p bisexual vs. heterosexual. Unweighted frequency (ethnic minority groups were over-sampled).
Table 2. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

<table>
<thead>
<tr>
<th>N=7698</th>
<th>History of cigarette smoking vs. non-smoker</th>
<th>Alcohol drinking &gt;2 days/week vs. &lt;=2 days/week or never</th>
<th>&gt;Weekly risky single occasion drinking vs. &lt;=weekly</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Minimally adjusted</td>
<td>Fully adjusted</td>
<td>Minimally adjusted</td>
</tr>
<tr>
<td>Model 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesbian or gay (vs. heterosexual)</td>
<td>2.34*** (1.50, 3.65)</td>
<td>2.23** (1.42, 3.51)</td>
<td>1.99*** (1.28, 3.09)</td>
</tr>
<tr>
<td>Bisexual (vs. heterosexual)</td>
<td>1.94*** (1.37, 2.75)</td>
<td>1.84** (1.30, 2.61)</td>
<td>1.26 (0.84, 1.89)</td>
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<tr>
<td>Model 2</td>
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<tr>
<td>Lesbian, gay or bisexual (vs. heterosexual)</td>
<td>2.08*** (1.57, 2.76)</td>
<td>1.98*** (1.49, 2.63)</td>
<td>1.53*** (1.15, 2.03)</td>
</tr>
</tbody>
</table>

Values shown are odds ratios (95% confidence intervals). *** = p < 0.001, ** = p < 0.01, * = p < 0.05. Analytic sample comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

Adjusted for age and sex. *Adjusted for age, sex, ethnic minority status, parental educational attainment, parental occupational social class.
Table S1. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

<table>
<thead>
<tr>
<th></th>
<th>History of cigarette smoking vs. non-smoker</th>
<th>Alcohol drinking &gt;2 days/week vs. &lt;=2 days/week or never</th>
<th>&gt;Weekly risky single occasion drinking vs. &lt;=weekly</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Minimally adjusted&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Fully adjusted&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Minimally adjusted&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Males (n = 3762)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay (vs. heterosexual)</td>
<td>2.38** (1.31, 4.33)</td>
<td>1.92* (1.04, 3.35)</td>
<td>1.95* (1.07, 3.55)</td>
</tr>
<tr>
<td>Bisexual (vs. heterosexual)</td>
<td>1.93 (0.92, 4.09)</td>
<td>1.88 (0.88, 4.00)</td>
<td>1.04 (0.49, 2.20)</td>
</tr>
<tr>
<td><strong>Females (n = 3936)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay (vs. heterosexual)</td>
<td>2.30* (1.14, 4.62)</td>
<td>2.10 (1.00, 4.42)</td>
<td>2.06 (0.84, 2.15)</td>
</tr>
<tr>
<td>Bisexual (vs. heterosexual)</td>
<td>1.93** (1.30, 2.87)</td>
<td>1.82* (1.23, 2.69)</td>
<td>1.39 (0.87, 2.21)</td>
</tr>
</tbody>
</table>

Values shown are odds ratios (95% confidence intervals). *** = p < 0.001, ** = p < 0.01, * = p < 0.05. Analytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.<sup>b</sup> Adjusted for age.<sup>c</sup> Adjusted for age, ethnic minority status, parental educational attainment, parental occupational social class.
STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

<table>
<thead>
<tr>
<th>Item No</th>
<th>Page No</th>
<th>Recommendation</th>
</tr>
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</table>
| **Title and abstract** | 1 1 | (a) Indicate the study’s design with a commonly used term in the title or the abstract  
(b) Provide in the abstract an informative and balanced summary of what was done and what was found |
| **Introduction** | | |
| Background/rationale | 2 5 | Explain the scientific background and rationale for the investigation being reported |
| Objectives | 3 6 | State specific objectives, including any prespecified hypotheses |
| **Methods** | | |
| Study design | 4 6 | Present key elements of study design early in the paper |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection |
| Participants | 6 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up  
N/A (b) For matched studies, give matching criteria and number of exposed and unexposed |
| Variables | 7 6-8 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable |
| Data sources/measurement | 8* 6-8 | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group |
| Bias | 9 8 | Describe any efforts to address potential sources of bias |
| Study size | 10 9 | Explain how the study size was arrived at |
| Quantitative variables | 11 6-8 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why |
| Statistical methods | 12 8 | (a) Describe all statistical methods, including those used to control for confounding  
8-9 (b) Describe any methods used to examine subgroups and interactions  
9 (c) Explain how missing data were addressed  
9 (d) If applicable, explain how loss to follow-up was addressed  
9 (e) Describe any sensitivity analyses |
| **Results** | | |
| Participants | 13* 9 | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed  
9 (b) Give reasons for non-participation at each stage  
N/A (c) Consider use of a flow diagram |
| Descriptive data | 14* 9 | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders  
9 (b) Indicate number of participants with missing data for each variable of interest  
N/A (c) Summarise follow-up time (eg, average and total amount) |
| Outcome data | 15* 9, 21 | Report numbers of outcome events or summary measures over time |
| Main results | 16 22 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear |
which confounders were adjusted for and why they were included

<p>| | | |</p>
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<tr>
<td>N/A</td>
<td>(b) Report category boundaries when continuous variables were categorized</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period</td>
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</table>

- **Other analyses**: 17 24 Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses |

**Discussion**

<table>
<thead>
<tr>
<th>Key results</th>
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<tbody>
<tr>
<td>18 11</td>
<td>Summarise key results with reference to study objectives</td>
<td></td>
</tr>
</tbody>
</table>

- **Limitations**: 19 Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias |

- **Interpretation**: 20 12 Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence |

- **Generalisability**: 21 12,13 Discuss the generalisability (external validity) of the study results |

**Other information**

<table>
<thead>
<tr>
<th>Funding</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>22 N/A</td>
<td>Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based</td>
<td></td>
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</table>

*Give information separately for exposed and unexposed groups.*