Full length article

Differential pathways into smoking among sexual orientation and social class groups in England: A structural equation model

Megan Davies, Nathaniel M. Lewis*, Graham Moon

Department of Geography and Environment, University of Southampton, Shackleton Building, Highfield Campus, SO17 1BJ, Southampton, UK

ABSTRACT

Purpose: Previous research has shown that lesbian, gay and bisexual (LGB) populations smoke more than their heterosexual counterparts. Little is known about the pathways into smoking among LGB populations in England relative to the lower social class populations that are the focus of the current Tobacco Control Plan (TCP).
Methods: Using the 2013/2014 waves of the Health Survey for England (HSE), we created a structural equation model to analyze pathways and interactions between sexual orientation, social class, and the number of cigarettes smoked daily. The path analysis assessed whether three intervening factors—age of initiation, mental wellbeing score, and exposure to smoke—are implicated similarly in smoking among LGB and lower social class populations, and whether interaction between sexual orientation and class is further associated with smoking.
Results: Bivariate analysis showed that LGB-identified individuals and individuals in lower occupational classes smoke more cigarettes daily, respectively, than heterosexual individuals and those in professional/managerial-class populations. Path analysis showed that the number of cigarettes smoked daily was mediated by age of initiation, mental wellbeing score and weekly exposure to smoke among routine and manual workers; by mental wellbeing score and exposure to smoke among intermediate class workers, and by mental wellbeing score in the LGB population. Interactions between sexual orientation and social class were not significant.
Conclusions: The differential nature of pathways into smoking for lower social classes and LGB populations in England suggests the need for tailored prevention and cessation efforts, with programming for LGB populations focused on the distinct stressors they face.

1. Introduction

Lesbian, gay, or bisexual (LGB) individuals in England are more likely to smoke than their heterosexual counterparts. A recent large-scale English study found that smoking prevalence for gay men (26%) and bisexual men (31%) exceeded that of heterosexual men (20%) while prevalence for lesbian women (25%) and bisexual women (32%) exceeded that of heterosexual women (18%), but that these differences were attenuated after controlling for sociodemographic factors (Shahab et al., 2017). Other English studies suggest that sexual orientation inequalities in smoking have persisted, particularly among men (Bourne et al., 2017) and adolescents (Hagger-Johnson et al., 2013), despite smoking rates for all populations in England (including LGB) decreasing during the past decade (see King and Nazareth, 2006).

England represents a distinct socio-historical context for LGB health and social inequalities. The United Kingdom (comprising England, Wales, Scotland, and Northern Ireland) began the process of decriminalizing homosexuality in 1967, almost forty years earlier than the

United States in 2003 (Hildebrandt, 2014). Despite this early advancement, LGB individuals in England experienced regressive policies in the 1980s and 1990s (e.g., Section 28 outlawing the public 'promotion' of homosexuality) and continue to experience stigma, bullying, and discrimination in homes, schools, and communities (Formby, 2013, 2017; Roberts et al., 2017; Scourfield et al., 2008).

The high smoking rates among LGB individuals in England, then, may owe to minority stress, or the chronic social stigma and stress faced by sexual and gender minority populations (Meyer, 2003; Semlyen et al., 2016). Minority stress may be exacerbated by structural factors, such as the absence of protective policies (Hatzenbuehler et al., 2014; Lewis, 2009; Pachankis et al., 2014), or by micro-level factors such as verbal slights and slurs known as microaggressions (Nadal et al., 2011). A recent review of smoking predictors in LGB populations (Blosnich et al., 2013) found that elevated levels of smoking are associated both with minority stressors related directly to sexual orientation and with other health outcomes (e.g., depression, alcohol use) experienced at higher rates in LGB populations. Internalized homophobia, sexual

---

orientation-related victimization, negative coming out experiences, and other aspects of minority stress may all contribute to `smoking or to other outcomes associated with smoking (Blosnich et al., 2013; Balsam et al., 2012).

The gravity of the smoking epidemic affecting the LGB population in England may not be fully captured in England's current public health policies and interventions. The Tobacco Control Plan (TCP) released in 2017 by the English Department of Health and Social Care (DHSC) aims to by 2022 reduce overall smoking prevalence in the general population from 15.5% to less than 12% and in 15-year olds (i.e., early initiators) from 8% to 3% (Department of Health and Social Care (DHSC, 2017, p.5). The TCP stresses the need to reduce smoking rates in individuals with diagnosed mental health conditions (pp. 13–14) and to limit exposure to smoke, particularly among 16–24-year olds (p.22). The TCP also indicates that those in the manual and routine occupational class are twice as likely to smoke as those in managerial professions (p.19). Previous research suggests that smoking among lower social class groups is associated with initiating smoking earlier in life (Green et al., 2016), having poorer mental wellbeing (Stewart-Brown et al., 2015), and being more exposed to smoke (Katainen, 2010; Sims et al., 2012).

The TCP acknowledges that individuals from the gay, lesbian and bisexual community 'remain far more likely to smoke than the general population' (p.19). The only stated target for reducing population-level inequalities, however, is 'to reduce the regional and socio-economic variations in smoking rates' (p. 6), particularly by targeting routine and manual workers through local stop smoking services (p.19). Existing research suggests, however, that many of the risk pathways into smoking outlined in the TCP, including early age of initiation, lower mental wellbeing, and exposure to smoke, may also be experienced among LGB individuals.

LGB individuals, especially lesbian and bisexual women, tend to initiate smoking earlier in life (Corliss et al., 2013; Fallin et al., 2015). Earlier initiation for LGB individuals may occur due to low self-esteem, social isolation, early recognition of stigmatization, or experiences with bullying at school (Rosario et al., 2011; Watson et al., 2018). Regardless of their sexual orientation, early initiators are more likely to become daily smokers (Lenk et al., 2009) and less likely to quit (Wilkinson et al., 2017).

LGB individuals experience higher rates of adverse mental health outcomes (e.g., anxiety, depression) due to minority stress (Meyer, 2003; Hatzenbuehler et al., 2014; Pachankis et al., 2014; Semlyen et al., 2016). Mental wellbeing, which is associated with a larger range of indicators (e.g., happiness, life satisfaction, self-esteem) beyond the presence or absence of a mental disorder, also varies by sexual orientation. Low wellbeing is 1.5–2.5 times more likely in LGB individuals (Semlyen et al., 2016) and the odds for low-wellbeing tend to increase in a linear fashion alongside higher volumes of smoking (Stranges et al., 2014). Smoking among LGB individuals can reflect a strategy to cope with lower levels of wellbeing or disinterest in other sources of pleasure, which is sometimes associated with depression (Leventhal and Zvolensky, 2015). The conditions of stress, lower mental wellbeing and smoking may therefore become syndemic (i.e., co-occurring and mutually reinforcing) within LGB populations (Stall et al., 2008; McDaid et al. 2017) and may persist across the LGB life course (Boehmer et al., 2012; Fredriksen-Goldsen et al., 2013).

As a historically marginalized population excluded from mainstream spaces and events, LGB individuals have often socialized in and around nightlife venues (e.g., gay bars and clubs) where smoking is common. LGB individuals therefore may be more exposed to smoking as a social practice (Fallin et al., 2014; Max et al., 2016) compared to heterosexual individuals. Frequent exposure to smoke in social settings can increase the likelihood of smoking through both negative mechanisms (e.g., the amplification of social distress from second-hand smoke) and positive ones, such as smoking-tolerant environments and smoking as a form of social belonging (Hamer et al., 2010; Bandiera et al., 2011).

Health agencies in England must weigh the needs of multiple, intersecting vulnerable groups and distribute resources accordingly. Most existing research, however, focuses on inequalities between two counterpart groups (e.g., between LGB and heterosexual individuals or between the managerial class and manual-level workers) rather than differences or interactions between pathways into smoking for these various groups. Lower social class status, for example, could further mediate the associations between sexual orientation and various pathways into smoking by exacerbating or compounding experiences of stigma (Keogh et al., 2004; McDermott, 2011). Research therefore also needs to understand the influence of sexual orientation on smoking independently of and in relation to social class. We address three key research aims: (1) to test the significance of sexual orientation differences in smoking and associated pathways, with social class as a potential confounder (and vice versa), (2) to identify interactions between sexual orientation and social class in shaping smoking pathways, and (3) to identify potential differences in these pathways for LGB and lower social class individuals.

2. Methods

2.1. Data source

The current study used data from the Health Survey for England (HSE), an annual cross-sectional survey that collects household and individual-level data on health conditions, treatments, medications, and behaviors (National Health Service (NHS, 2018). As a population-level survey including smoking-related variables, HSE offers an opportunity to better understand how differing vulnerabilities might influence pathways into smoking. HSE uses a hierarchical design where individuals are nested within primary sampling units (PSUs) represented by postcodes that are located within government office regions (GORs). All individuals in each included household are captured in the survey.

2.2. Sample

We analyzed data from the 2013 and 2014 waves of HSE (National Health Service (NHS, 2013, 2014). The 2013 wave incorporates 564 postcodes while the 2014 wave incorporates 588. These two waves were the most recent to contain both sexual orientation and smoking-related variables. The two waves were combined, resulting in an initial sample size of 21,060. Children under 16 and non-responses were excluded, resulting in a final sample size of 14,481 including 269 LGB respondents (see Table 1).

2.3. Measures

The variables for the study were selected based on the pathways into smoking suggested by existing studies and England's TCP (i.e., age of initiation, mental wellbeing, and exposure), as well as availability within the HSE. We use cigarettes smoked daily as a refined measure of smoking designed to capture the differentials in the frequency *and* volume of smoking. Previous studies have found, for example, that LGB individuals smoke higher volumes of cigarettes than their heterosexual counterparts in addition to being more likely to smoke (see Corliss et al., 2013; Fallin et al., 2015; Hatzenbuehler et al., 2014; Watson et al., 2018).

2.3.1. Sexual orientation

Sexual orientation was self-reported by participants over the age of 16. The response categories were 'heterosexual or straight', 'gay or lesbian', 'bisexual', 'prefer not to say' and 'other'. We created a new binary variable collapsing 'gay or lesbian' and bisexual into 'LGB' and excluded 'prefer not to say' or 'other'.

Table 1
Smoking Characteristics by Sexual Orientation and Occupational Class, Health Survey for England, 2013–2014.

	Ever smoked		Current smoker		Number of cigarettes smoked per day (grouped)										Mean age of initiation	Mean mental wellbeing score	Mean weekly exposure to smoke (hours)	Mean daily cigarettes smoked
	Yes		Yes		0		1-5		6-10		11-20		20+					
	n	%	n	%	n	%	n	%	n	%	n	%	n	%				
Sexual orientation																		
Heterosexual (ref)	7854	55	2615	18	11643	82	535	4	780	6	1013	7	198	1	17.33	51.21	2.28	2.15
LGB	174	65	78	29	192	72	17	6	24	9	28	10	7	3	16.94	48.87[a**]	3.74[a*]	3.35[a***]
Social class																		
Managerial (ref)	2914	52	713	13	4912	88	186	3	219	4	219	4	37	0.7	18.03[b**]	52.64[b**]	1.15[b**]	1.26[b**]
Intermediate	2122	54	625	16	3302	85	129	3	192	5	219	6	42	1	17.87	51.33	3.19	1.77
Routine and manual	3785	62	1617	26`	4564	75	252	4	456	7	676	11	141	2	16.83	49.60	3.34	3.19

[a] Bivariate analysis using Welch's t-test.
[b] Bivariate analysis using one-way ANOVA (difference across all three social class categories).
* significant at $p < .05$, ** significant at $p < .01$.

2.3.2. Social class

Social class was determined using the National Statistics Socio-Economic Classification (NS-SEC) and refined by HSE into three categories that reflect income, social position, and occupational prestige: 'managerial or professional occupation', intermediate occupation' and 'routine or manual workers'. Dummy variables were created with 'managerial or professional occupation' as the referent category.

2.3.3. Age and sex

Age and sex were included, respectively, as a continuous covariate and a binary covariate. Male is coded as '1' and female is coded as '2'.

2.3.4. Race

Race was included as a control variable with 'white', 'black' 'Asian' and 'mixed/other' as the categories.

2.3.5. Index of multiple deprivation (IMD)

IMD is an indicator of socioeconomic status at the area level, comprising income, employment, health, education, housing, crime and living environment. IMD is grouped into quintiles, with 1 indicating residence in area within the least deprived quintile and 5 indicating residence in an area within the most deprived quintile. We use the 2015 index, which uses data mostly from 2012 and 2013 (Ministry of Housing, Communities, and Local Government (MHCLG, 2015) and is included here as a control variable.

2.3.6. Number of cigarettes smoked daily

This outcome is derived from two questions. Participants were asked 'About how many cigarettes do you usually smoke on weekdays?', with the same question asked for weekends. These responses were aggregated into an average number of cigarettes smoked daily based on weekday and weekend amounts. Non-smokers were also included in this derived variable, coded as smoking zero cigarettes per day.

2.3.7. Ever smoking

Ever smoking, used as a descriptive variable only, was measured by the question, 'May I just check, have you every smoked a cigarette, cigar or pipe?', with 'yes' or 'no' as the response options.

2.3.8. Current smoking

Current smoking, also a descriptive variable, was measured by asking 'do you smoke cigarettes nowadays at all?', with 'yes' or 'no' as the options.

2.3.9. Age of initiating smoking

The age of initiating smoking was determined by asking those who currently smoke regularly about the age at which they began smoking.

2.3.10. Mental wellbeing score

Mental wellbeing was measured by a score calculated from the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS), which measures mental wellbeing in the general population (Tennant et al., 2007). This is a validated scale with 14 items, with scores ranging from 14–70. Scores below 40 indicate possibly poorer than average mental wellbeing and scores below 32 are defined as low wellbeing scores.

2.3.11. Hours of exposure to smoke per week

Weekly hours of exposure to tobacco smoke were self-reported by both smokers and non-smokers. Exposure was measured by asking, 'Now, in most weeks, how many hours a week are you exposed to other people's tobacco smoke?', with hours recorded on a continuous scale.
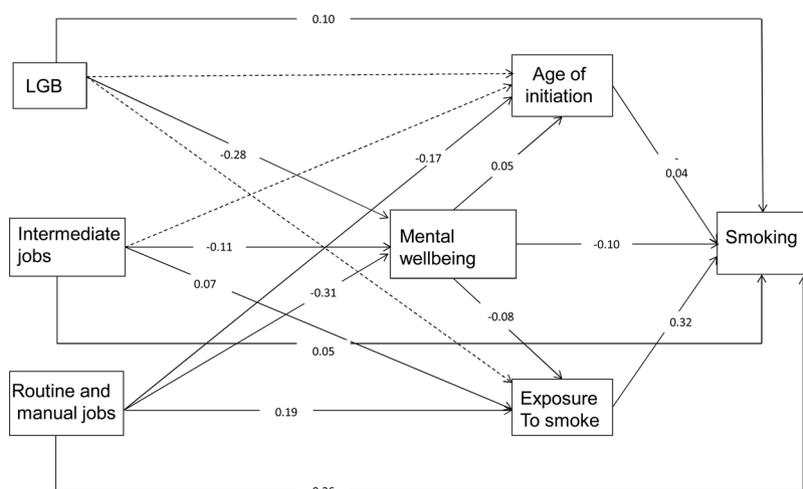
Fig. 1. A path model showing standardized estimates of path coefficients of daily cigarettes smoked. Broken lines indicate paths that were not statistically significant at p = .05. All other paths were significant at p < .05. Control variables age, sex, ethnicity and IMD quintiles were included in the model but not reported.

2.4. Analysis

2.4.1. Bivariate analysis

Data were prepared using SPSS. A Welch's *t*-test was used to test for significant difference between LGB and heterosexual individuals in the number of cigarettes smoked daily, age of initiating smoking, mental wellbeing score, and weekly exposure to smoke. A one-way analysis of variance (ANOVA) was used to test for significant difference between social class groups for the same four variables.

2.4.2. Multilevel analysis

We used multilevel path analysis to examine the associations between two predictor variables (sexual orientation and social class), three mediating variables (age of initiation, mental wellbeing score, and weekly exposure to smoke), and the outcome variable of cigarettes smoked daily. We first tested the model using only main effects, and then ran a separate model to examine effects of the interaction between sexual orientation and social class on cigarettes smoked daily. A multilevel path analysis using Mplus version 8 was employed to determine associations between the predictor, mediator, and outcome variables (Muthén and Muthén, 2017). Missing data were handled using pairwise deletions. As a structural equation modelling technique, path analysis aims to predict the sequential pathways leading to health behaviors and outcomes and has been used previously to explain both smoking uptake (Tickle et al., 2006) and smoking cessation (Businelle et al., 2010).

We used a multilevel model design to obtain and control for correct standard errors as HSE data are structured in a geographic hierarchy of individuals within PSUs based on postcode sectors nested within GORs. We used only individual-level variables in our model but specified PSU as level two and GOR as level three to reflect the HSE sample design. We estimated our model using a Bayesian approach with Markov Chain Monte Carlo (MCMC) to accommodate the small size of the LGB sample relative to the larger heterosexual sample. This approach ensured that we had robust results using simulations given the sparse nature of LGB sexual orientation relative to the outcome. A posterior predictive p (PPP) value was used to determine model fit, with values greater than 0.05 indicating good fit (Asparouhov and Muthén, 2010).

3. Results

3.1. Differences in smoking by sexual orientation and social class

The prevalence of both smoking history and current smoking were higher in the LGB population compared to the heterosexual population (see Table 1). The rate of current smoking for the LGB population (29%)

mirrored recent English studies and was higher than that for any social class group. LGB individuals smoked more cigarettes daily than heterosexual individuals [t (274.29) = -2.91, p < .01], had lower mental wellbeing scores [t (276.01) = 4.04, p < .01], and were exposed to more hours of smoke per week [t (272.16) = -2.44, p < .05]. The age of initiating smoking did not differ between LGB and heterosexual individuals [t (139.84) = .81, p = .419].

One-way ANOVA showed significant difference across social class groups for the number of cigarettes smoked daily [F (2, 15665) = 211.20, p < .01], age of initiation [F (2, 7216) = 29.61, p < .01], mental wellbeing score [F (2, 13860) = 161.25 p < .01], and weekly exposure to smoke [F (2, 15608) = 80.83, p < .01]. As suggested by recent studies, the managerial class had the most desirable outcomes in terms of mean values (i.e., fewest cigarettes daily, oldest age of initiation, highest mental wellbeing score, and fewest weekly hours of exposure to smoke) while manual and routine workers had the least desirable outcomes. There was no significant difference in the social class composition of the LGB sample versus the heterosexual sample.

3.2. Pathways into smoking by sexual orientation and social class

Fig. 1 shows the standardized path coefficients in our model. Solid lines indicate paths that were statistically significant (p < .05) while broken lines indicate paths that were not significant (p > .05). The PPP fit index for the path analysis indicated that the model was a good fit (0.242). The unexplained residual variance for number of cigarettes smoked daily was 26.34 (p < .001) at the individual level, 0.12 (p < .001) at the PSU level, and 0.53 (p < .001) at the GOR level.

3.2.1. Number of cigarettes smoked daily

Three predictors were associated with the number of cigarettes smoked daily: identifying as LGB (β = 0.10, SD = 0.058, p < .05), having an intermediate job versus a professional or managerial job (β = 0.05, SD = 0.020, p < .01), and having a routine or manual job versus a professional or managerial job (β = 0.26, SE = 0.018, p < .01). Age of initiation was associated negatively with number of cigarettes smoked daily (β = -0.04, SD = 0.009, p < .001), with more cigarettes smoked daily among those who began smoking younger. Lower mental wellbeing scores were also associated with more cigarettes smoked daily (β = -0.10, SD = 0.007, p < .001). Finally, those who were exposed to more hours of smoke per week smoked more cigarettes daily (β = 0.32, SD = 0.008, p < .001). The interaction effect of LGB orientation and having a manual or routine occupation was not associated with cigarettes smoked daily (β = 0.14, SD = 0.13,

p = 0.141), nor was the interaction between LGB orientation and having an intermediate occupation (β = -1.52, SD = 0.06, p = 0.06).

Males smoked more cigarettes daily than women (β = -0.08, SD = 0.02, p < .001). Age was associated negatively with the number of cigarettes smoked daily, with younger individuals smoking more (β = -0.06, SD = 0.01, p < .001). White individuals smoked more cigarettes daily than black individuals (β = -0.22, SD = 0.05, p < .001) and Asian individuals (β = -0.25, SD = 0.04, p < .001), but not individuals of mixed or other races (β = -0.05, SD = 0.06, p = 0.19). Across IMD categories, the number of cigarettes smoked daily did not vary between those in the first (least deprived) and second, third, or fourth quintiles, but those in the fifth (most deprived) quintile smoked fewer cigarettes per day than those in the first (β = -0.05, SD = 0.03, p < .05).

3.2.2. Age of initiating smoking

Those who worked in routine and manual jobs had tended to start smoking younger than those in professional or managerial positions (β = -0.17, SD = 0.029, p < .001). Mental wellbeing was associated positively with age of initiation (β = 0.05, SD = 0.012, p < .001); those who had better mental wellbeing scores had initiated smoking later in life. Males initiated smoking younger than females (β = 0.17, SD = 0.02, p < . 001) and white individuals initiated smoking younger than black individuals (β = 0.44, SD = 0.11, p < . 001), Asian individuals (β = 0.55, SD = 0.09, p < .001), and individuals of mixed or other races (β = 0.15, SD = 0.09, p < 0.05). Age of initiation was not associated with identifying as LGB (β = -0.007, SD = 0.085, p = .465) or with working in an intermediate position rather than a professional or managerial position (β = -0.02, SD = 0.033 p = .279).

3.2.3. Mental wellbeing

Identifying as LGB was associated negatively with mental wellbeing score (β = -0.28, SD = 0.060, p < .001). Compared to those in professional or managerial positions, mental wellbeing scores were lower among those with manual or routine jobs (β = -0.31 SE = 0.019, p < .001) or intermediate jobs (β = -0.11, SD = 0.022, p < .001). Age was associated positively with mental wellbeing score (β = 0.03, SD = 0.01, p < .01); older individuals reported better mental wellbeing. Black individuals reported better mental wellbeing than white individuals (β = 0.20, SD = 0.06, p < .001), as did Asian individuals (β = 0.12, SD = 0.04, p < .01). Wellbeing score was not associated with being mixed race or another race rather than white (β = 0.10, SD = 0.06, p = 0.059), nor was sex (β = -0.02, SD = 0.02, p = 0.142).

3.2.4. Exposure to smoke

Greater weekly exposure to smoke was associated both with working in an intermediate job (β = 0.07, SD = 0.021, p < .01) and working in a routine or manual job (β = 0.19, SD = 0.018, p < .01), as compared to working in a professional or managerial job. Mental wellbeing score was associated negatively with exposure to smoke, (β = -0.08, SD = 0.008, p < .01), those with lower wellbeing scores were exposed to more smoke weekly. Age was associated negatively with exposure to smoke, with younger individuals exposed to more smoke weekly (β = -0.12, SD = 0.01, p < .001). Males were exposed to more smoke than females (β = -0.07, SD = 0.02, p < .001). White individuals were exposed to more smoke than Asian individuals (β = -0.14, SD = 0.04, p < . 001), and black individuals (β = -0.09, SD = 0.06, p < .05) but not mixed-race or other race individuals (β = -0.01, SD – 0.06, p = .447). LGB orientation was not associated with exposure to smoke (β = 0.07, SD = 0.061, p = 0.103) despite a significant sexual orientation difference observed in the bivariate analysis.

4. Discussion

Both LGB-identified individuals and those in lower social classes in England smoke significantly more cigarettes daily than their respective referent populations. In their analysis of the Smoking and Alcohol Toolkit Studies in England, Shahab et al. (2017) found that the independent effect of sexual orientation on smoking was erased after controlling for other sociodemographic factors. Our model, in contrast, retained a modest but significant sexual orientation effect on smoking after incorporating (and thus controlling for) age, sex, ethnicity, and social class.

The pathways mediating smoking, however, appear to differ across sexual orientation and social class groups. Smoking is mediated by all three intervening variables (mental wellbeing score, age of initiation, and exposure to smoke) among manual and routine workers, by two (mental wellbeing score and exposure to smoke) among intermediate social class individuals, and by one (mental wellbeing score) among LGB individuals. The significance of the path between LGB orientation, mental wellbeing score, and cigarettes smoked daily within our model confirms findings from previous studies that LGB individuals may turn to smoking as a coping mechanism to deal with minority stress and associated mental health and wellbeing outcomes (Blosnich et al., 2014; Johns et al., 2013). Although the mean wellbeing score for the LGB population (48.87) is above the cut-off scores of 40 and 32 for below-average and poor wellbeing, respectively, it is the lowest among all sexual orientation and social class groups and suggests that there are likely more LGB individuals below these cut-offs compared to heterosexual individuals. Our findings also lend support to the theory that poor mental health and smoking are potentially syndemic within English LGB populations.

We did not find an association between LGB orientation and age of initiating smoking or amount of exposure to smoke despite the results of past studies suggesting that LGB individuals may share these vulnerabilities with lower social class populations. This distinction may owe to possible commonalities of experience based on lower social class, such as spending less time in education, observing parents and friends who smoke, and smoking at work (Green et al., 2016; Katainen, 2010), which are less consistent among LGB individuals with diverse class backgrounds. The absence of an expected exposure pathway may also reflect cultural differences between England and the more frequently researched United States, where smoking has long been associated with purposeful advertising in gay and lesbian nightlife spaces (Max et al., 2016) and the successful cultivation of a gay and lesbian market segment for tobacco and alcohol products (Smith et al., 2008). The ban on most forms of tobacco advertising in England since 2002 (Government of the UK, 2002) may have therefore also reduced sexual orientation inequalities in exposure to smoke, or the degree to which they influence the onward uptake or volume of smoking among LGB individuals.

We applied interactions between sexual orientation and each of the lower two social class categories to assess whether LGB orientation and lower social class status together might further influence the number of cigarettes smoked daily. Past research has suggested that working-class LGB individuals face distinct stressors that could lead to smoking, such as workplace bullying and feeling inferior in both heterosexual working-class environments and gay or lesbian environments (Keogh et al., 2004; McDermott, 2011). The interaction of LGB orientation and having a manual or routine occupation was not associated with more cigarettes smoked daily nor was the interaction of LGB orientation and having an intermediate occupation, but this second interaction approached significance (p = .06). The implication that sexual orientation could have more of an association with smoking within intermediate class populations compared to working class populations merits further research (see also Katainen, 2010). The non-significance of the interaction effects also suggests that there are distinct factors driving smoking in LGB populations that would not be captured by interventions targeting lower social class groups alone.

5. Conclusions

Our findings must be considered within the context of some

limitations that could be addressed in future research. First, about 1.0% of HSE respondents identified as LGB compared to the 1.9% national average (Office of National Statistics (ONS, 2016). As sexual orientation was self-reported rather than assessed through a question on sexual attraction or behavior, it could be that some respondents did not ascribe to an LGB identity or feel comfortable in declaring one. Our selection of other variables was also limited by HSE's definitions of smoking and associated factors. More pathways might therefore be illuminated in a larger or more representative survey, or one with more variables.

Second, we used an aggregate LGB sample rather than groups disaggregated by sex or sexual orientation to ensure good fit within a model comprising a small LGB sample and a much larger heterosexual sample. Differences across LGB subgroups, however, could weaken associations in an aggregate LGB sample or reveal new associations when subgroups are analyzed separately. For example, an early age of smoking initiation may be more prominent in lesbian and bisexual women than gay and bisexual men (Corliss et al., 2013, 2014; Fallin et al., 2015; Watson et al., 2018) and exposure to smoke at home may be more common among bisexual women than their heterosexual or lesbian counterparts (Pizacani et al., 2009). Our descriptive results also showed that bisexual individuals, as compared to gay and lesbian individuals, started smoking earlier in life (15.1 vs. 17.8, respectively), were exposed to smoke more hours per week (5.6 vs. 2.7), smoked more cigarettes per day (3.43 vs. 3.19) and had poorer mental wellbeing scores (46.7 vs. 50.1). These trends mirror past studies showing potentially higher smoking rates among bisexual individuals (Balsam et al., 2012) and emerging work on distinct stressors they face, including peer rejection of bisexual identity and the need to escape uncomfortable social environments (McQuoid et al., 2018). Differences between these subgroups within England's LGB population should be further investigated using alternative models or data sources.

Finally, the smoking-related variables tested in our model do not reflect an exhaustive list of factors influencing smoking in LGB populations. Rather, they were selected based on previous population-based studies, availability in HSE, and the potential they offered to understand whether the pathways into smoking suggested in England's tobacco control plan were associated with sexual orientation. Further studies tailored to the LGB population in England will be important for understanding how smoking rates in this population are affected by homophobia, biphobia, bullying, discrimination, community connectedness, and other factors.

This study is one of the first to examine pathways between sexual orientation and smoking in the English context. Our use of a multi-level structural equation model, which considers LGB individuals in the context of the broader English population, offers a novel opportunity to think for the first time about the relative importance of pathways into smoking for different vulnerable groups. Although the rates of current smoking in LGB individuals are at least as high as those in manual and routine workers, socioeconomically deprived populations have emerged as the main targets for smoking prevention and cessation interventions in England. Continued work is also needed to understand the root causes of smoking among LGB individuals in this country as their pathways into smoking are likely somewhat distinct.

The significance of poorer mental wellbeing as a potential pathway into smoking for LGB individuals suggests both a need for targeted interventions focused on reducing stigma, managing stress, and reducing the use of smoking as a coping mechanism. The observed strength of the link between wellbeing and smoking in England's LGB population also suggests that counsellors, psychologists, and psychiatrists serving LGB individuals must be familiar the links between smoking and minority stress, as well as referral processes for cessation programs. The use of LGB-specific venues for smoking cessation campaigns has been effective in decreasing smoking rates in the United States (Leibel et al., 2011) and gay and lesbian pubs may be useful sites for reaching LGB individuals in areas of England, particularly in regions less exposed to national LGB health campaigns (Taylor and Falconer, 2015). Continued

research comparing the factors driving high smoking rates in LGB and other vulnerable populations within the same geographic context may also better guide public health intervention to ensure that sexual orientation inequalities are not overlooked.

Contributors

Funding

Conflict of interest

None.

Acknowledgements

References

Asparouhov, T., Muthén, B., 2010. Bayesian analysis of latent variable models using Mplus. Available at http://www.statmodel.com/download/BayesAdvantages18.pdf Accessed June 20, 2018. .

Balsam, K.F., Beadnell, B., Riggs, K.R., 2012. Understanding sexual orientation health disparities in smoking: a population-based analysis. Am. J. Orthopsychiatry 82, 482–493.

Bandiera, F.C., Kalaydijan Richardson, A., Lee, D.J., He, J.-P., Merikangas, K.R., 2011. Secondhand smoke exposure and mental health among children and adolescents. Arch. Pediatr. Adolesc. Med. 165, 332–338.

Blosnich, J.R., Farmer, G.W., Lee, J.G., Silenzio, V.M., Bowen, D.J., 2014. Health inequalities among sexual minority adults: evidence from ten U.S. states, 2010. Am. J. Prev. Med. 46, 337–349.

Blosnich, J., Lee, J.G., Horn, K., 2013. A systematic review of the aetiology of tobacco disparities for sexual minorities. Tob. Control 22, 66–73.

Boehmer, U., Miao, X., Linkletter, C., Clark, M.A., 2012. Adult health behaviors over the life course by sexual orientation. Am. J. Public Health 102, 292–300.

Bourne, A., Davey, C., Hickson, F., Weatherburn, P., 2017. Physical health inequalities among gay and bisexual men in England: a large community-based cross-sectional survey. J. Public Health 39, 290–296.

Businelle, M.S., Kendzor, D.E., Reitzel, L.R., Costello, T.J., Cofta-Woerpel, L., Li, Y., Mazas, C.A., Vidrine, J.I., Cinciripini, P.M., Greisinger, A.J., Wetter, D.W., 2010. Mechanisms linking socioeconomic status to smoking cessation: a structural equation modelling approach. Health Psychol. 9, 262–273.

Corliss, H.L., Wadler, B.M., Jun, H.-J., Rosario, M., Wypji, D., Frazier, A.L., Austin, B., 2013. Sexual-orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. Nicotine Tob. Res. 15, 213–222.

Corliss, H.L., Rosario, M., Birkett, M.A., Newcomb, M.E., Buchting, F.O., Matthews, A.K., 2014. Sexual orientation disparities in adolescent cigarette smoking: intersections with race/ethnicity, gender, and age. Am. J. Public Health 104, 1137–1147.

Department of Health and Social Care (DHSC), 2017. Towards a Smoke Free Generation: a Tobacco Control Plan for England. London: Government of the United Kingdom. Available at Accessed October 30, 2017. https://www.gov.uk/government/publications/towards-a-smoke-free-generation-tobacco-control-plan-for-england.

Fallin, A., Neilands, T.B., Jordan, J.W., Ling, P.M., 2014. Secondhand smoke exposure among young adult sexual minority bar and nightclub patrons. Am. J. Public Health 104, e148–e153.

Fallin, A., Goodin, A., Lee, Y.O., Bennett, K., 2015. Smoking characteristics among lesbian, gay and bisexual adults. Prev. Med. 74, 123–130.

Formby, E., 2013. Understanding and responding to homophobia and bullying: contrasting staff and young people's views within community settings in England. Sex. Res. Social Policy 10, 302–316.

Formby, E., 2017. Exploring LGBT Spaces and Communities: Contrasting Identities, Belongings and Wellbeing. Routledge, New York.

Fredriksen-Goldsen, K.I., Kim, H.J., Barkan, S.E., Muraco, A., Hoy-Ellis, C.P., 2013. Health disparities among lesbian, gay, and bisexual older adults: results from a population-based study. Am. J. Public Health 103, 1802–1809.

Government of the United Kingdom (UK), 2002. Tobacco Advertising and Promotion Act 2002. Available at Accessed June 30, 2018. https://www.legislation.gov.uk/ukpga/2002/36/pdfs/ukpga_20020036_en.pdf.

Green, M.J., Leyland, A.H., Sweeting, H., Benzeval, M., 2016. Socioeconomic position and early adolescent smoking development: evidence from the British Youth Panel Survey (1994-2008). Tob. Control 25, 203–210.

Hagger-Johnson, G., Taibjee, R., Semlyen, J., Fitchie, I., Fish, J., Meads, C., Varney, J., 2013. 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). BMJ Open 3, e002810.

Hatzenbuehler, M., Jun, H.J., Corliss, H.L., Austin, S.B., 2014. Structural stigma and cigarette smoking in a prospective cohort study of sexual minority and heterosexual youth. Ann. Behav. Med. 47, 48–56.

Hamer, M., Stamatakis, E., Batty, G.D., 2010. Objectively assessed secondhand smoke exposure and mental health in adults: cross-sectional and prospective evidence from the Scottish Health Survey. Arch. Gen. Psychiatry 67, 850–855.

Hildebrandt, A., 2014. Routes to decriminalization: a comparative analysis of the legalization of same-sex sexual acts. Sexualities 17, 230–253.

Johns, M.M., Pingel, E.S., Youatt, E.J., Soler, J.H., McClelland, S.I., Bauermeister, J.A., 2013. LGBT community, social network characteristics, and smoking behaviours in young sexual minority women. Am. J. Community Psychol. 52, 141–154.

Katainen, A., 2010. Social class differences in the accounts of smoking–striving for distinction? Sociol. Health Illn. 32, 1087–1101.

King, M., Nazareth, I., 2006. The health of people classified as lesbian, gay and bisexual attending family practitioners in London: a controlled study. BMC Pub. Health 6, 127.

Keogh, P., Dodds, C., Henderson, L., 2004. Working Class Gay Men: Redefining Community, Restoring Identity. Sigma Research, London. Available at:http://oro.open.ac.uk/45010/1/report04a.pdfAccessed October 30, 2018.

Leibel, K., Lee, J.G., Goldstein, A.O., Ranney, L.M., 2011. Barring intervention? Lesbian and gay bars as an underutilized venue for tobacco interventions. Nicotine Tob. Res. 13, 507–511.

Lenk, K.M., Chen, V., Bernat, D.H., Forster, J.L., Rode, P.A., 2009. Characterising and comparing young adult intermittent and daily smokers. Subst. Use Misuse 44, 2128–2140.

Leventhal, A., Zvolensky, A.M., 2015. Anxiety, depression, and cigarette smoking: a transdiagnostic vulnerability framework to understanding emotion–smoking comorbidity. Psychol. Bull. 141, 176–212.

Lewis, N.M., 2009. Mental health in sexual minorities: recent indicators, trends, and their relationships to place in North America and Europe. Health Place 15, 1029–1045.

Max, W.B., Stark, B., Sung, H.Y., Offen, N., 2016. Sexual identity disparities in smoking and secondhand smoke exposure in California: 2003-2013. Am. J. Public Health 106, 1136–1142.

McQuoid, J., Thrul, J., Ling, P., 2018. A geographically explicit ecological momentary assessment (GEMA) mixed method for understanding substance use. Soc. Sci. Med. 202, 89–98.

McDermott, E., 2011. The world some have won: sexuality, class and inequality. Sexualities 14, 63–78.

Meyer, I.H., 2003. Prejudice, social stress, and mental health in lesbian, gay and bisexual populations: conceptual issues and research evidence. Psychol. Bull. 129, 674–697.

Ministry of Housing, Communities, and Local Government (MHCLG), 2015. English Indices of Deprivation. Available at Accessed March 5, 2019. https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015.

Muthén, L.K., Muthén, B.O., 2017. Mplus User's Guide, 8th edition. Muthén and Muthén, Los Angeles.

Nadal, K.L., Wong, Y., Issa, M.A., Meterko, V., Leon, J., Wideman, M., 2011. Sexual orientation microaggressions: processes and coping mechanisms for lesbian, gay, and bisexual individuals. J. LGBT Issues Couns. 5, 21–46.

National Health Service (NHS), 2018. Wellbeing Self-assessment. Available at Accessed June 30, 2018. https://www.nhs.uk/Tools/Documents/Wellbeing%20self-assessment.htm.

National Health Service (NHS), 2013. Health Survey for England 2013. Available at Accessed November 1, 2018. https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/health-survey-for-england-2013.

National Health Service (NHS), 2014. Health Survey for England 2014. Available at Accessed November 1, 2018. https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/health-survey-for-england-2014.

Office of National Statistics (ONS), 2016. Sexual identity, UK 2016. Available at Accessed June 22, 2018. https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/sexuality/bulletins/sexualidentityuk/2016.

Pachankis, J.E., Hatzenbuehler, M.L., Starks, T.J., 2014. The influence of structural stigma and rejection sensitivity on young sexual minority men's daily tobacco and alcohol use. Soc. Sci. Med. 103, 67–75.

Pizacani, B.A., Rohde, K., Bushore, C., Stark, M.J., Maher, J.E., Dilley, J.A., Boysun, M.J., 2009. Smoking-related knowledge, attitudes and behaviors in the lesbian, gay and bisexual community: a population-based study from the U.S. Pacific Northwest. Prev. Med. 48, 555–561.

Roberts, L., Heyworth, B., Gilliver, A., Mackereth, P., 2017. Smoking and vaping among lesbian, gay, bisexual and trans people: results of a Proud2BSmokefree survey. Cancer Nurs. Pract. 16, 35–41.

Rosario, M., Schrimshaw, E.W., Hunter, J., 2011. Cigarette smoking as a coping strategy: negative implications for subsequent psychological distress among lesbian, gay, and bisexual youths. J. Pediatr. Psychol. 36, 731–742.

Scourfield, J., Roen, K., McDermott, E., 2008. Lesbian, gay, bisexual and transgender young people's experiences of distress: resilience, ambivalence and self-destructive behaviour. Health Soc. Care Community 16, 329–336.

Semlyen, J., King, M., Varney, J., Hagger-Johnson, J., 2016. Sexual orientation and symptoms of common mental disorder or low wellbeing: combined meta-analysis of 12 UK population health surveys. BMC Psychiatry 16, 67.

Shahab, L., Brown, J., Hagger-Johnson, G., 2017. Sexual orientation identity and tobacco and hazardous alcohol use: findings from a cross-sectional English population survey. BMJ Open 7, e015058.

Sims, M., Mindell, J.S., Jarvis, M.J., Feyerabend, C., Wardle, H., Gilmore, A., 2012. Did smoke free legislation in England reduce exposure to secondhand smoke among nonsmoking adults? Cotinine analysis from the Health Survey for England. Environ. Health Perspect. 120, 425–430.

Smith, E.A., Thomson, K., Offen, N., Malone, R.E., 2008. 'If you know you exist, it's just marketing poison': meanings of tobacco industry targeting in the lesbian, gay, bisexual, and transgender community. Am. J. Public Health 98, 996–1003.

Stall, R., Friedman, M., Catania, J.A., 2008. Interacting epidemics and gay men's health: a theory of syndemic production among urban gay men. In: Stall, R., Wolitski, R.J., Valiserri, R.O. (Eds.), Unequal Opportunity: Health Disparities Affecting Gay and Bisexual Men in the United States. Oxford University Press, New York, pp. 251–274.

Stewart-Brown, S., Chandimali, P., Taggart, F., Ngianga-Bakwin, K., 2015. Socioeconomic gradients and mental health: implications for public health. Br. J. Psychiatry 206, 461–465.

Stranges, S., Samaraweera, P.C., Taggart, F., Kandala, N.B., Stewart-Brown, S., 2014. Major health-related behaviours and mental well-being in the general population: the Health Survey for England. BMJ Open 4, e005878.

Taylor, Y., Falconer, E., 2015. 'Seedy bars and grotty pints': close encounters in queer leisure spaces. Soc. Cult. Geogr. 16, 43–57.

Tennant, R., Hiller, L., Fishwick, R., Platt, S., Joseph, S., Weich, S., Parkinson, J., Secker, J., Stewart-Brown, S., 2007. The warwick-edinburgh mental well-being scale (WEMWBS): development and UK validation. Health Qual. Life Outcomes 63.

Tickle, J.J.J., Hull, J.G., Sargent, J.D., Dalton, M.A., Heatherton, T.F., 2006. A Structural equation model of social influences and exposure to media smoking on adolescent smoking. Basic Appl. Soc. Psychol. 28, 117–129.

Watson, R.J., Lewis, N.M., Fish, J.N., Goodenow, C., 2018. Sexual minority youth continue to smoke cigarettes earlier and more often than heterosexuals: findings from populations-based data. Drug Alcohol Depend. 184, 64–70.

Wilkinson, A.V., Schabath, M.B., Prokhorov, A.V., Spitz, M.R., 2017. Age-related differences in factors associated with smoking initiation. Cancer Causes Control 18, 635–644.