BMJ Public Health

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Journal:	*BMJ Public Health*
Manuscript ID	bmjph-2025-002828.R1
Article Type:	Original research
Date Submitted by the Author:	06-Aug-2025
Complete List of Authors:	Burke, Lucy; The University of Sheffield, School for Health and Related Research Angus, Colin ; The University of Sheffield Brown, Jamie; University College London, Public Health and Epidemiology Kersbergen, Inge; The University of Sheffield, School of Medicine and Population Health
Keywords:	Public Health, Cross-Sectional Studies, Sociodemographic Factors, statistics and numerical data

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Is why we drink alcohol important when considering the potential public health benefit of alcohol-free and low-alcohol drinks? A cross-sectional study investigating associations between alcohol drinking motives and alcohol-free and low-alcohol drink consumption amongst adults in Great Britain.

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Running title: Alcohol drinking motives and no/lo drinks

Word count: 4869

KEY WORDS

Alcohol, drinking motives, alcohol-free, low-alcohol, adults, public health

ABSTRACT

Introduction

The UK has promoted increased availability of alcohol-free and low-alcohol drinks (no/lo, ≤1.2% ABV) as a public health strategy. To be effective, no/lo beverages must replace, and not supplement, standard alcoholic drinks. Emerging evidence suggests the reasons people drink alcohol may be an important determinant of the potential public health impact of these drinks.

This study aimed to determine whether alcohol drinking motives were associated with no/lo consumption after accounting for sociodemographic characteristics and alcohol consumption.

Methods

A cross-sectional sample of adults residing in Great Britain (aged 16-93) who had drunk alcohol in the past year were recruited via the Alcohol Toolkit Study (N = 2555; 49.0% female). The dependent variable was frequency of no/lo consumption (less than versus at least monthly). Five questions captured respondents' alcohol drinking motives (enhancement, social, conformity, coping-anxiety, coping-depression), derived from the Drinking Motives Questionnaire-Revised. Sociodemographic characteristics, including age, gender, social grade, education, index of multiple deprivation (a UK-wide measure of relative deprivation for small geographic areas), and hazardous alcohol use (AUDIT-C) were also assessed.

Descriptive analysis presents the proportion of respondents drinking no/lo at least monthly amongst low endorsement (i.e., drinking for a motive less than half the time) versus high endorsement (i.e., drinking for a motive at least half the time) of each drinking motive. Quasibinomial regression modelling explored relationships between alcohol drinking motives and no/lo consumption, accounting for sociodemographic characteristics and hazardous drinking.

Results

Drinking alcohol to conform was associated with an increased likelihood of at least monthly no/lo consumption after accounting for sociodemographic characteristics and hazardous drinking (OR = 1.10, 95% CI 1.00-1.21, p=0.041).

Conclusions

No/lo drinks may facilitate reduced alcohol consumption by offering an alternative for individuals wishing to participate in alcogenic environments. However, those who drink alcohol to conform are not typically higher-risk drinkers, which may limit the public health benefit of no/lo drinks. Further research is needed to explicitly explore substitution effects.

Key Messages

What is already known on this topic

- Since 2019, alcohol-free and low-alcohol (no/lo) drinks have been endorsed by successive UK governments as a public health strategy.
- Qualitative studies indicate that the reasons people drink alcohol may be important when investigating whether no/lo drinks are an acceptable substitute to standard alcohol.

What this study adds

- This is the first study to *quantitatively* explore whether the reasons people drink alcohol are associated with no/lo consumption.
- Respondents who reported drinking alcohol to conform were more likely to report drinking no/lo at least monthly after controlling for sociodemographic characteristics and hazardous drinking.

How this study might affect research, practice or policy

- Further research is needed to explicitly explore substitution effects. To maximise the public health benefit of the "no/lo policy", additional strategies may be required to encourage some at risk drinking groups to substitute standard alcohol with no/lo alternatives.

INTRODUCTION

Reducing alcohol harm is a critical public health priority in the UK. Whilst growing numbers of drinkers seek to moderate their consumption, a large minority is drinking alcohol at increasingly

harmful levels [1, 2]. This could lead to a 20% increase in alcohol related mortality over the next 20 years, costing the NHS up to £5.2 billion [3].

Increasing the availability of alcohol-free and low-alcohol (no/lo) drinks has been promoted as a public health strategy by the UK Department of Health and Social Care [4, 5]. Since 2015 there has been a proliferation of these products emerging onto the UK market and elsewhere, with further growth predicted [6-8]. If consumers can be encouraged to substitute standard alcohol with no/lo alternatives this could lead to a public health benefit [4, 9].

In the UK, no/lo drinks are defined as alcoholic or alcoholic type (e.g. beer, wine, spirits) drinks that contain ≤1.2% alcohol by volume [ABV, 10], a threshold which aligns with current UK alcohol duty rates [11]. They do *not* include soft drinks or lower-strength alcoholic drinks that have an ABV above 1.2% ABV. Whilst some no/lo beverages include a small amount of alcohol, they are unlikely to lead to intoxication [12]. In Great Britain, whilst currently not illegal, there is a voluntary agreement amongst alcohol licence holders that no/lo drinks are not sold to individuals aged under 18, in line with the legal age for purchasing alcoholic drinks.

Given that the objective of the "no/lo policy" is for drinkers to substitute alcohol with no/lo, it is pertinent to consider the reasons why people drink alcohol and how well no/lo drinks may satisfy these motives [13, 14]. People drink alcohol for many reasons: alcohol can signify celebration, serve as a social lubricant, and make people feel happy [15, 16]. Some people use alcohol to self-medicate, believing it will help them cope with anxiety or depression [17-19]. In many countries, including the UK, alcohol is central to social culture [20]. Both academics and policy makers support a consideration of alcohol drinking motives when developing alcohol reduction interventions [14, 21-23].

Cox and Klinger's (1988) motivational model of alcohol use places alcohol drinking motives along two dimensions [24]. Firstly, motives are identified as having an internal (the self) or external (social environment) source, and secondly, motives are driven by positive (e.g., drinking alcohol for the buzz, making social occasions more enjoyable), or negative (e.g. coping with low mood or anxiety, conforming to expectations) reinforcement. Several measures of drinking motives exist [18, 25, 26]. Cooper et al's (1994) drinking motives questionnaire captures drinking alcohol for enhancement, conformity, social, and coping reasons, and is a widely used and well-validated tool [25]. Its psychometric properties have been tested in multiple countries, and importantly, on adult populations [27-30].

The emerging literature regarding no/lo consumption supports the idea that considering alcohol drinking motives is important. Studies have found that no/lo consumers acknowledge social participation and adhering to social norms as key benefits of no/lo [31-35]. An Australian qualitative study of adults who had reduced their alcohol consumption reported alcohol-free drinks allowed participants to masquerade as "drinkers", a key strategy in their successful reduction attempts, allowing them to remain aligned with cultural expectations [32]. Studies conducted in the UK, including consumers of no/lo drinks and pregnant women, found no/lo drinks facilitated social occasions, enabling participation where alcohol consumption was typical, and allowing those not drinking alcohol to avoid scrutiny from peers [31, 33, 36]. Conversely, studies including those who did not consume no/lo drinks, found that these respondents often *did not see the point of no/lo drinks* if the goal was to feel inebriated [33-35, 37].

These studies suggest that those who drink for external reasons, particularly what is defined as "conformity" in Cox and Klinger's motivational model of alcohol use [24], may be more likely to consume no/lo drinks than those who drink for internal reasons. This is concerning because "internal drinkers" are most at risk of alcohol harm [38]. Furthermore, those drinking to cope are likely to be

less socially advantaged [21], a group less likely to consume no/lo drinks [39]. To date, there are no studies which have explicitly explored whether the reasons people drink alcohol are associated with no/lo consumption using quantitative methods. This is important from a public health perspective where we are specifically interested in considering how well no/lo drinks may encourage a reduction in alcohol consumption, rather than looking to understand no/lo behaviour more generally.

The present study

The current study uses data from a nationally representative survey of adults residing in Great Britain to explore: i. whether there are direct associations between alcohol drinking motives and no/lo consumption, and ii. whether alcohol drinking motives help to explain no/lo consumption after accounting for sociodemographic characteristics. The study addressed the following hypotheses: People who endorse drinking alcohol for internal reasons (enhancement and to cope with anxiety or depression) will have significantly lower odds of consuming no/lo drinks at least monthly than those who do not drink alcohol for these reasons after accounting for sociodemographic characteristics and hazardous drinking. We did not expect an association between external motives and no/lo consumption. We also expected to find a higher odds of regular no/lo consumption amongst those who were socially advantaged, assessed using measures of social grade and highest level of education received: and higher risk drinkers, as found with previous work [39]. We explored whether neighbourhood level deprivation was associated with no/lo consumption, using the index of multiple deprivation [IMD, 40].

METHOD

Design

A cross-sectional study of adults aged sixteen and over, recruited via the February 2023 and April 2023 waves of the Alcohol Toolkit Study [41]. This is a monthly telephone survey of adults residing in Great Britain, capturing respondents' alcohol drinking behaviour. The sampling process aims to

recruit a study population that is nationally representative in terms of gender, working status, prevalence of children in the household, age, social grade and region [41]. A rim (marginal) weighting technique is used to ensure the target profiles were met [42]. Alongside routinely administered questions capturing respondent demographics and alcohol use, respondents also reported how often they consumed no/lo drinks. In these two waves only, five additional questions capturing respondents' alcohol drinking motives were included.

Sample

Across the two waves there were 2920 respondents who had drunk alcohol at least once in the previous 12 months as recorded by the Alcohol Use Disorder Identification Test [AUDIT-C, 43]. After removing those whose responses made them ineligible for inclusion, there remained a sample of 2555. This sample of 2555 included 440 cases with missing data, typically single items, which had then been imputed to provide a complete dataset(see Supplementary Material, Figure 1 for a participant flow-chart, and Analysis for further detail). The weighted sample was 2597. This was powered to detect odds-ratios greater than 1.15 at 80% power and 5% alpha in a logistic regression (33).

Measures

Alcohol-free and low-alcohol (no/lo) drinking behaviour

We measured frequency of no/lo consumption as a single item [39]. Participants were asked "How often do you have an alcohol-free or low-alcohol drink (beer, wine, cider, spirits or other type of alcoholic drink under 1.2% ABV)?". Participants responded on an 8-point scale, ranging from Never - Nearly every day. Due to low numbers responding at higher frequencies, responses were recoded as a binary variable – less than monthly / at least monthly, to capture whether respondents were a regular consumer of no/lo drinks or not.

Alcohol drinking motives

Alcohol drinking motives were captured using five items from Cooper et al's (1994) Drinking Motives Questionnaire Revised [DMQ-R, 25]. This measure captures emergent themes from the qualitative literature around no/lo consumption, and has been validated in several countries, including England, and on adult populations [27, 30]. Due to financial constraints, single items were chosen to capture each alcohol drinking motive. Single items have been used to capture alcohol drinking motives, including the motives captured in the DMQ-R, elsewhere [44, 45]. We also chose to distinguish between coping-anxiety and coping-depression by selecting two items from the coping subscale which represent these different aspects of coping. This distinction was made due to evidence that these motives are differentially associated with drinking patterns and socioeconomic status [18, 46]. Whilst the modified DMQ-R distinguishes between these two motives, its authors note it has unsatisfactory psychometric properties for its social scale and has not yet been validated on adults [18]. Therefore, we chose to use items from the DMQ-R [25].

Item selection was informed by each item's psychometric properties and patient and public involvement (PPI, see PPI statement). The selected items were:

ii. Because it gives you a pleasant feeling (Enhancement)

iii. Because it makes social gatherings more fun (Social)

iiii. To fit in with a group that you like (Conformity)

ivi. Because you feel more self-confident and sure of yourself (Coping–anxiety)

vi. To forget about your problems (Coping–depression)

Responses were recorded on a 5-point scale (1 = Never/Almost Never, 2 = Some of the time, Half of the time, 4 = Most of the time, 5 = Almost Always/Always). Alcohol drinking motives were treated as continuous variables in the main analyses, but to aid interpretation in the descriptive analysis they were presented as binary variables (responses of Never, Almost Never, and Some of the time = Low endorser, responses of Half the time, Most of the time, and Almost always/Always = High endorser).

Harmful alcohol consumption

The Alcohol Use Disorders Identification Test-C (AUDIT-C) measured hazardous alcohol consumption [43]. It discriminates between those at higher or lower risk of alcohol-related harm. A three-item scale captures frequency of alcohol consumption, numbers of units of alcohol consumed during a typical drinking occasion, and frequency of heavy episodic drinking (6 or more units of alcohol in a single drinking occasion). Responses were recoded to correspond with validated AUDIT-C scoring to produce a total score between 0 and 12, treated as a continuous variable. Non-drinkers were excluded, therefore, scores in the study sample ranged from 1-12.

Sociodemographic variables

The routinely collected variables in the ATS that were used in the analysis included:

- Age (16-24, 25-34, 35-44, 45-54, 55-64, 65+);
- Gender (male, female);
- Highest level of education attained (secondary school education or equivalent; pre-university qualification, e.g. A-levels, International Baccalaureate Diploma, or equivalent; bachelor's degree or equivalent undergraduate degree; post-graduate qualification or equivalent);
- Social grade (AB = higher/intermediate managerial, administrative or professional, C1 = supervisory, clerical and junior managerial, administrative or professional, C2 = skilled manual workers, DE = semi-skilled and unskilled manual workers, pensioners, casual and lowest grade workers, unemployed and in receipt of state benefits only [47]);
- Index of multiple deprivation (IMD) based on a respondent's postcode. IMD captures local level data on income, health, education, crime, environment, barriers to housing and living environment. Five response levels range from: 1 = most deprived quintile to 5 = least deprived quintile [40].

Age, social grade, and education were treated as factors, whereas IMD was treated as a continuous variable. Ethnicity is reported descriptively (White, Black, Asian, Mixed heritage, other, Table 1), but was not included in the regression model due to small numbers of Black, Asian, and other ethnically diverse groups in the sample population.

Patient and public involvement (PPI)

The Alcohol Toolkit Study is a well-established survey, therefore PPI work focused on the selection of outcome measures specifically added for this study. Seven members of the University of Stirling's Alcohol and Food Discussion Group (https://spectrum.ed.ac.uk/about/public-involvement), an established PPI group that supports research in this area, assisted in selecting items from the DMQ-R to be included in the survey. In response to participant preferences, the PPI meeting was held online. Participants brought their own lived experience with regards to alcohol consumption to the discussion. All participants drank alcohol at least occasionally, and the group comprised of both those who did and did not consume no/lo drinks.

Following a general introduction and warm-up session about no/lo, participants were asked to contribute to: i. a general discussion of the reasons why they drank alcohol, and ii. a discussion about how well they felt the shortlisted alcohol drinking motives captured each of the overarching alcohol drinking motives. The group supported the selection of the shortlisted items for enhancement, coping–anxiety, coping-depression, and social subscales. For the conformity subscale, the group recommended an alternative item. The recommended item had good factor loadings and face-validity; therefore, the shortlisted item for conformity was replaced to reflect the views of the PPI group.

In addition to academic dissemination of the findings of this study, dissemination with the wider public is ongoing. Preliminary findings have been shared at two public events , i. a Pint of Science

event in 2024 (https://pintofscience.co.uk/, https://pintofscience.co.uk/event/mocktails-and-chemtrails) and ii. a webinar run by the University of Sheffield that was advertised and accessible to all (https://www.sheffield.ac.uk/alumni/bright-minds). Further dissemination with the public, including those involved in the PPI work, and relevant stakeholders is ongoing.

Ethics

Ethics approval for data collection was obtained by The University College London, who has overall ownership of the Alcohol Toolkit Study (ID 0498/001). Researchers explained the survey to potential participants and provided assurance that it is being conducted in line with the Market Research Society Code of Conduct [48]. Prior to participating, respondents provided verbal consent.

Pre-registration

The study's analytical plan was pre-registered on the Open Science Framework (osf.io/6rn3w). The analysis plan documents the planned analysis presented here and an additional path analysis which will be published separately. Changes to the analytical plan included:

- Analyses exploring location and rurality were not pursued. This decision was based on a recently published analysis (40), which used a larger dataset from the same source and yielded inconclusive findings. We determined that a similar analysis with our smaller sample would be unlikely to provide meaningful insights. Analyses exploring direct relationships between alcohol drinking motives, sociodemographic characteristics, hazardous drinking, and no/lo consumption were combined into a single regression model.
- Analyses were population weighted.
- Regression models using rank ordering are not presented. We had been interested in exploring whether both relative and absolute endorsement of the alcohol drinking motives were important. However, very few respondents rated drinking alcohol for depression

(n=31, 1.2%), anxiety (n=50, 2.0%), and conformity (n=94, 3.7%) as their primary motive, meaning this analysis was not possible.

- A sensitivity analysis using alcohol drinking motives recoded as binary variables (low vs. high endorsers) was included.

Analysis

Data preparation and analyses were undertaken in R 4.3.1 [49]. The following groups of respondents were removed:

i. Respondents who answered inconsistently regarding their no/lo consumption (i.e., responding that they engaged in situation specific no/lo consumption: hybrid, on-trade, or off-trade more often than they reported drinking no/lo overall, n=163). This follows good practice advice for data cleaning [50] and aligns with practice used in other studies reporting on this data [39].

ii. Respondents who reported that they did not know whether they drank alcohol for any of the drinking motives (n=189). Whilst a debate exists as to whether "don't know" responses should be treated as missing, or identified as a substantive response [51], for our research we chose to exclude these participants. Individuals providing a "don't know" response for the drinking motives did not differ from the rest of the sample on key demographic variables (age, sex, social grade, education level, alcohol consumption, no/lo consumption).

iii. Respondents describing their gender in another way (n=13). This final group were removed due to their small number, meaning it was not possible to meaningfully include them in the analysis.

Complete data was available for 2115 of 2555 respondents (82.8%). A flow-chart illustrating participant eligibility and missing data is presented in the Supplementary materials (Supplementary Figure 1). The following variables had missing data: gender, n = 6; social grade, n = 106, IMD, n = 358.

Little's MCAR test was significant, indicating it was not appropriate to treat data as missing completely at random [52]. By investigating patterns of missing data, there was no evidence of systematic missingness, therefore we felt it was appropriate to assume the data was missing at random and proceeded with multiple imputation, using the mice package in R [53, 54]. Eighteen datasets were imputed. Trace plots of the means and standard deviations of the imputed values for the variables with missing data (IMD, social grade, sex) indicated that the imputation chains converged well. The primary analyses present pooled results from the imputed datasets which were then population weighted. The impact of survey weighting was evaluated (Supplementary Table 1). It appeared to effectively adjust the sample to better represent the target population without unduly distorting key variable means.

Descriptive analysis and regression modelling

Descriptive analyses illustrate the proportions of respondents consuming no/lo drinks at least monthly for low and high endorsers of each alcohol drinking motive. Quasibinomial logistic regression models, including drinking motives as continuous variables tested for associations between regular no/lo consumption (dependent variable) and alcohol drinking motives. This method is a robust approach for binary outcomes when overdispersion is present [55, 56], which was a concern given the low base rate of at least monthly no/lo consumption (21%) in our sample. While negative binomial or zero-inflated regression models are valuable for addressing overdispersion, they are primarily designed for count data rather than the binary (yes/no) outcome capturing no/lo consumption in this study. The quasibinomial approach, which models a dispersion parameter, was thus the most appropriate method to account for overdispersion while maintaining the binary nature of our dependent variable.

The unadjusted regression model included drinking motives and no/lo consumption. The adjusted model controlled for sociodemographic characteristics (gender, age, education, social grade, IMD)

and hazardous drinking (AUDIT-C). Ordinal variables (age, education, and social grade) were presented as factors. All analyses were population weighted and tests for the key assumptions of this anis were undertaken [57]. The data breached the linearity of log-odds assumption for AUDIT-C therefore an exploration of higher polynomial terms for AUDIT-C was undertaken. This indicated that AUDIT-C had a quadratic relationship with the dependent variable, consequently a linear and quadratic term for AUDIT-C were included in the model. There was no evidence of multicollinearity among independent variables using Variance Inflation Factors (VIFs, Supplementary Table 2). The discriminative power of the primary model was assessed using Receiver Operating Characteristic (ROC) Area Under the Curve (AUC).

Sensitivity analyses

Two sensitivity analyses were undertaken:

i. using complete cases

ii. including alcohol drinking motives coded as binary variables (low vs. high endorsers)

RESULTS

Participant characteristics

A summary of the weighted study sample is provided in Table 1. Twenty-one percent of respondents were consuming no/lo drinks at least monthly (n = 550). Respondents were most likely to report drinking alcohol for enhancement and social reasons and least likely to report drinking alcohol to cope with depression. Twelve percent of respondents (n=306) reported never drinking alcohol for any of the motives presented.

INSERT TABLE 1 ABOUT HERE

Exploring associations between alcohol drinking motives and no/lo consumption

Figure 1 compares the proportion of respondents consuming no/lo drinks at least monthly for low and high endorsers of each alcohol drinking motive. Across all alcohol drinking motives, approximately 20% of low endorsers reported consuming no/lo drinks at least monthly (range: 19.1% -21.2%). Amongst high endorsers of each motive, no/lo consumption ranged from 20.5% for those drinking to cope with depression, to 26.5% for those drinking to cope with anxiety (Supplementary Table 3).

INSERT FIGURE 1 ABOUT HERE

The unadjusted quasibinomial logistic regression revealed that among the alcohol drinking motives assessed, only the enhancement motive was significantly associated with the likelihood of consuming no/lo drinks at least monthly (Odds Ratio = 1.09, 95% CI [1.01, 1.18], p=0.030). For every unit increase in the enhancement motive score, the odds of consuming no/lo drinks increased by approximately 9%, whilst holding other drinking motives constant. The remaining motives were not significantly related to no/low alcohol consumption (Table 2).

INSERT TABLE 2 ABOUT HERE

In the adjusted model, enhancement was no longer significantly associated with no/lo consumption. In this model, drinking alcohol to conform was the only motive significantly associated with at least monthly no/lo alcohol consumption (Odds Ratio = 1.10, 95% CI [1.00, 1.21], p=0.041, Table 3). For every one-unit increase in the conformity motive score, the odds of consuming no/lo drinks at least monthly increased by approximately 10%, assuming all other variables in the model were held constant. The remaining drinking motives did not show a significant association with no/lo consumption in this model.

Regarding the sociodemographic characteristics, the analysis revealed a curvilinear relationship between AUDIT-C score (a measure of alcohol use severity) and no/lo alcohol consumption. While Audit-C scores were positively linearly associated with an increased likelihood of consuming no/lo drinks at least monthly, the strength of this association weakened at higher levels of Audit-C (Table 3). Furthermore, compared to the reference group (secondary school education or equivalent), respondents with higher education and post-graduate levels of education were significantly more likely to consume no/lo drinks at least monthly. Sex, age, social grade, and IMD were not significant predictors in this model. The AUC was 0.61, indicating fair discrimination in distinguishing between respondents who consume no/lo drinks at least monthly and those who do not.

INSERT TABLE 3 ABOUT HERE

Sensitivity analyses

Complete case analysis (n=2118) replicated the primary findings (see Supplementary Material, Table 4). When binary classifications of the alcohol drinking motives replaced continuous variables, no significant effects between alcohol drinking motives and at least monthly no/lo consumption were found (Supplementary Material, Table 5). Other relationships remained unchanged.

DISCUSSION

This is the first study to quantitatively explore associations between the reasons adults drink alcohol and the consumption of alcohol-free and low-alcohol (no/lo) drinks. Qualitative research in the UK and Australia has already indicated drinking motives may influence why some people choose to consume no/lo drinks and others do not [31-33, 36]. If no/lo drinks are promoted to improve public health via substitution, it is important to develop our understanding of how this change may occur.

We hypothesised that those respondents who primarily drank alcohol for internal reasons (enhancement and coping) would be less likely to consume no/lo drinks than those who primarily drink alcohol for other reasons, evident through decreased odds of no/lo consumption amongst those drinking for these reasons. Drinking for enhancement was associated with an *increased* rather than decreased odds of drinking no/lo in the unadjusted model. However, this association disappeared once sociodemographic characteristics and hazardous drinking were accounted for, suggesting it was a spurious relationship. In the adjusted model, we found an increased odds of drinking no/lo for those who endorsed drinking alcohol to conform. This corroborates the broader literature, where consumers of no/lo reference the ability to "join in" social occasions, no/lo drinks enabling their "non-drinking" to go un-questioned or un-challenged [31-33, 35, 36]. In line with Perman-Howe et al [2024, 39], those who reported higher educational qualifications and higher AUDIT-C scores were also statistically more likely to report drinking no/lo at least monthly. We did not find evidence of an association between neighbourhood level deprivation, measured using the IMD, and no/lo consumption.

Implications for public health and further work

Currently, alcohol-free and low-alcohol drinks are regularly consumed by a minority of adults who drink alcohol. In this study, approximately one-fifth of respondents reported consuming no/lo drinks at least monthly. However, this market is outperforming a declining standard alcohol market [58]. If consumption increases, there remains potential for no/lo to be of significant public health benefit.

Our study indicates that who may benefit may be contingent on the reasons people drink alcohol in the first place. The regression model results indicate that people who drink to conform are more likely to drink no/lo regularly after accounting for sociodemographic characteristics and hazardous drinking. In the UK, where drinking alcohol is normalised [59], no/lo drinks may serve as a welcome alternative for those wishing to reduce their alcohol consumption whilst circumventing the pressure

to conform to the social consensus. However, we must note that the overall effect size was small and the sensitivity analysis which explored drinking motives on a binary scale did not consistently support the associations observed in the primary model. The AUC was 0.61 suggesting that there are other important factors that are associated with no/lo consumption that are not included in this model.

Further work is needed to better understand the nuanced relationship between drinking alcohol to conform and consuming no/lo drinks, particularly amongst those who are using the drinks as a substitute to standard strength alcohol. The current study explores overall no/lo consumption, including consumption amongst those who would probably not been drinking alcohol otherwise, e.g. those who are pregnant, or driving; and no/lo consumption that does not specifically serve to replace alcohol consumption, therefore, it is likely the effect of drinking motives amongst those who are directly substituting is diluted in this study

It is also important to note that drinking alcohol to conform is typically not one of the most strongly endorsed reasons to drink alcohol at a population level, with just fourteen percent of respondents in this study reporting drinking for this reason at least half of the time. Research indicates that people who predominantly drink for this reason already tend to drink at less harmful levels which may limit the reach of the policy for heavier drinkers drinking alcohol for other reasons [38].

The most common reasons for drinking alcohol in this study were social and enhancement (Table 1), which corresponds with other research of adult alcohol drinking motives in the UK and internationally [21, 60]. Drinking for enhancement is directly associated with heavier drinking, with drinking for social reasons and to cope also directly or indirectly associated with alcohol harms [38]. If no/lo drinks prove effective for reducing hazardous drinking, it would be important to consider strategies to encourage those who use alcohol as a coping mechanism, for its mood enhancement

properties, or to make social occasions more enjoyable to switch to no/lo products, whilst being mindful that additional approaches may be needed.

Regular consumption of no/lo drinks is positively associated with metrics of social advantage, particularly higher levels of education [39, 61]. Further research is required to understand why this might be. One explanation may be that no/lo drinks are not satisfying the alcohol drinking motives predominant amongst less advantaged socioeconomic groups, who are more likely to drink alcohol as a coping mechanism than those who are more socioeconomically advantaged [21, 22, 46]. Further analysis has explored whether alcohol drinking motives mediate pathways between sociodemographic variables, hazardous drinking and no/lo consumption [62]

Strengths and Limitations

This study was informed by the qualitative literature on no/lo consumption, which was then mapped onto Cox and Klinger's motivational model of drinking motives [24, 25, 31, 33, 37]. We used a nationally representative sample of adults aged 16 and over, and living in Great Britain, incorporating sample weights. The items selected, taken from a well-validated scale of drinking motives, were felt to be the most appropriate based on the qualitative literature, and were supported by PPI.

A trade-off by using the ATS was that it was not feasible to include the full DMQ-R [25]. This is not uncommon when using large surveys, where the constructs of interest comprise a small aspect of the survey. Using single items rather than the full scale may limit the validity and reliability of our findings by not fully capturing the dimension it represents, This may have been further compounded by respondents who reported "don't know" in response to the drinking motive items, whom we excluded from the analysis. If we had chosen different items to represent our constructs, for example if we had measured enhancement using "Because it's exciting" rather than "Because you

like the feeling" we may have had different findings. However, we took a considered approach to our item selection. The patterns of endorsement for our selected items are consistent with a recently conducted, cross-national study of drinking motives (including Great Britain), supporting the reliability of our estimates (60).

Due to the cross-sectional design, we are unable to infer causation or explore temporal trends. It was also not possible to explicitly identify whether no/lo drinks are replacing alcoholic beverages. Finally, whilst representative at the population level, certain at-risk groups are underrepresented in surveys like the ATS, including those residing in care homes, or hospitals, prison inhabitants and the military. It is important to be mindful of this when estimating the impact of this policy on alcohol-specific harms.

Conclusions

Our study results indicate that regular consumption of no/lo drinks amongst adults in Great Britain is associated with those who endorse drinking to conform. This aligns with qualitative data on this topic. There was no evidence to suggest a direct association between no/lo consumption and drinking alcohol for how it makes you feel, to make social occasions more enjoyable, or as a coping strategy, once sociodemographic characteristics and alcohol consumption were accounted for. Understanding the potential for benefit of no/lo drinks remains a public health priority, given their inclusion in the incumbent UK government's 10-year health plan [5]. The importance of our findings depends on the extent no/lo drinks are being used to substitute standard alcoholic drinks. Future work should consider replicating our findings using the full DMQ-R, or similar, exploring the influence of alcohol drinking motives under circumstances where consumers are specifically replacing alcohol with no/lo drinks, and if and how they help to explain sociodemographic differences in consumption.

ACKNOWLEDGEMENTS

We would like to thank colleagues at The University of Stirling and the University of Sheffield who supported recruitment for PPI, members from the Stirling Alcohol and Food Discussion Group who reviewed the selected alcohol drinking motive items for the questionnaire, all survey respondents, Ipsos for conducting the research interviews, and University College London who have overall ownership of the Alcohol Toolkit Study.

DECLARATION OF INTERESTS

LB, JB, and IB have received funding for ongoing, unrelated research on alcohol-free and low-alcohol drinks from Alcohol Change UK (ACUK), which received <0.6% of its funds in 2024-5 from Lucky Saint, an organisation that produces and sells non-alcoholic drinks, and owns a pub that sells standard alcoholic drinks. In March 2025, Lucky Saint became an associate member of The Portman Group, a self-regulatory organisation that is fully funded and controlled by the alcohol industry. ACUK has a policy of not accepting any funds from, nor being subject to any influence whatsoever from, the alcohol industry, including through its investment portfolio. ACUK has stated that it is in full compliance with its policy. The research team is discussing its responses to these recent developments.

FUNDING STATEMENT

This study was funded by a Wellcome Trust PhD grant (218462/Z/19/Z, grant recipient LB). Overall Alcohol Toolkit data collection is funded by Cancer Research UK (grant ref: PRCRPG-Nov21\100002) in England and the UK Prevention Research Partnership (via SPECTRUM, grant ref: MR/S037519/1) in Scotland and Wales. The collection of no/lo consumption frequency data was funded by the NIHR Public Health Research programme (NIHR135310). The collection of alcohol drinking motives data

was funded by Wellcome (218462/Z/19/Z). The funders were not involved in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. The views expressed are those of the author(s) and not necessarily those of Wellcome, Cancer Research UK, NIHR, or the Department of Health and Social Care.

DATA AVAILABILITY STATEMENT

Study syntax are openly available at: https://doi.org/10.5281/zenodo.14616172. Non-identifiable anonymised data used in the analysis may be available on request. Please direct any enquiries to the study authors.

TRANSPARENCY DECLARATION

The lead author (LB) is the guarantor of this manuscript. LB confirms this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the pre-registration have been explained.

AUTHOR CONTRIBUTIONS

Lucy Burke: Conceptualisation (lead); data curation (lead); methodology (lead); project administration (lead); formal analysis (lead); writing—original draft (lead); writing—review and editing (lead). **Colin Angus:** Conceptualisation (supporting), methodology (supporting); formal analysis (supporting); writing—review and editing (supporting), **Jamie Brown:** data curation (supporting) methodology (supporting); formal analysis (supporting); writing—review and editing (supporting). **Inge Kersbergen:** Conceptualisation (supporting), methodology (supporting); project administration (supporting); formal analysis (supporting); writing—review and editing (supporting).

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TABLE 1 Sample characteristics (weighted, *n* = 2597)

Characteristic	**Statistic**
No/lo consumption	*n* (%)
At least monthly	550 (21.2)
Less than once a month	2047 (78.8)
Drinking motives (ordinal)	*M, (SD, range, 95% CI)*
Enhancement	2.71 (1.44,1-5, 2.65, 2.77)
Social	2.64 (1.38, 1-5, 2.58-2.70)
Conformity	1.61 (1.07, 1-5, 1.56, 1.65)
Coping-anxiety	1.60 (1.07, 1-5, 1.55, 1.65)
Coping-depression	1.30 (0.80, 1-5, 1.27, 1.34)
Drinking motives (at least half the time/high endorsers)	*n* (%)
Enhancement	1158 (44.6%)
Social	1105 (42.5%)
Conformity	352 (13.6%)
Coping-anxiety	362 (13.9%)
Coping-depression	164 (6.3%)
Hazardous alcohol consumption	Mean (SD, 95% CI)
AUDIT-C	4.36 (2.54, 4.25 - 4.67)
AUDIT-C score risk classifications	*n* (%)
Low risk (score 0-4)	1551 (59.7%)
Increasing risk (score 5-7)	687 (26.5%)
Higher risk (score 8-10)	321 (12.4%)
Possible dependence (score 11-12)	38 (1.5%)
Age	*n* (%)
16-24	308 (11.8%)
25-34	414 (15.9%)
35-44	440 (16.9%)
45-54	455 (17.5%)
55-64	435 (16.7%)
65+	545 (21.0%)
Gender[a]	*n* (%)
Male	1325 (51.0%)
Female	1272 (49.0%)
Social grade[a]	*n* (%)
AB (higher or intermediate managerial)	782 (30.1%)
C1 (supervisory/clerical, junior managerial administrative/ professional)	769 (29.6%)
C2 (skilled manual)	554 (21.3%)
	492 (18.9%)

Characteristic		Statistic
DE (semi-/un-skilled manual, casual or lowest grade, pensioners, others who depend on the welfare state for their income).		
Highest level of education attained	*n* (%)	
Secondary school/ equivalent		673 (25.9%)
College (A Levels)/ equivalent		668 (25.7%)
Undergraduate degree/ equivalent		822 (31.7%)
Postgraduate degree/ equivalent		434 (16.7%)
IMD quintile[ab]	*n* (%)	
1 (most deprived)		431 (16.6%)
2		502 (19.3%)
3		552 (21.2%)
4		555 (21.4%)
5 (least deprived)		558 (21.5%)
Ethnicity	*n* (%)	
White British/Other		2327 (89.6%)
Black British/Other		96 (3.7%)
Asian British/Other		65 (2.5%)
Mixed heritage		62 (2.4%)
Other ethnicities including not specified		47 (1.8%)

[a] Uses imputed estimates where values were missing.

[b] IMD captures local level data on income, health, education, crime, environment, barriers to housing and living environment to produce a measure of relative deprivation. Five response levels range from: 1 = most deprived quintile to 5 = least deprived quintile [40].

TABLE 2 Associations between regular no/lo consumption and alcohol drinking motives (weighted, *n* = 2597)

Indicator	Odds Ratio	95% CI	p value
(Intercept)	0.18	0.13, 0.24	0.000
Enhancement	**1.09**	**1.01, 1.18**	**0.030**
Social	0.97	0.89, 1.06	0.503
Conformity	1.10	0.99, 1.21	0.072
Anxiety	1.08	0.96, 1.20	0.190
Depression	0.99	0.86, 1.13	0.874

Significant relationships (<.05) are highlighted in bold.

* p <.05

TABLE 3 Associations between regular no/lo consumption and alcohol drinking motives, after accounting for sociodemographic characteristics and alcohol consumption (weighted, *n* = 2597)

Indicator	Odds Ratio	95% CI	p value
(Intercept)	0.08	(0.04, 0.14)	0.000
Enhancement	1.03	(0.95, 1.11)	0.532
Social	0.94	(0.86, 1.02)	0.131
Conformity	**1.10**	**(1, 1.21)**	**0.041***
Anxiety	1.09	(0.99, 1.21)	0.092
Depression	1.02	(0.9, 1.15)	0.799
AUDIT-C (linear)	**1.41**	**(1.21, 1.64)**	**0.000*****
AUDIT-C (quadratic)	**0.98**	**(0.96, 0.99)**	**0.000*****
Women (compared to men)	0.86	(0.71, 1.05)	0.149
Age 25-34[a]	0.94	(0.64, 1.38)	0.756
Age 35-44[a]	1.00	(0.68, 1.47)	0.985
Age 45-54[a]	0.88	(0.6, 1.29)	0.514
Age 55-64[a]	0.94	(0.63, 1.39)	0.744
Age 65+[a]	1.03	(0.7, 1.5)	0.894
A levels / equivalent[b]	0.90	(0.67, 1.21)	0.493
Undergraduate degree/ equivalent[b]	**1.43**	**(1.08, 1.89)**	**0.013***
Postgraduate degree/ equivalent[b]	**1.57**	**(1.13, 2.18)**	**0.007****
Skilled manual workers[c]	1.05	(0.75, 1.45)	0.791
Supervisory, clerical and junior managerial, administrative or professional[c]	1.18	(0.86, 1.62)	0.295

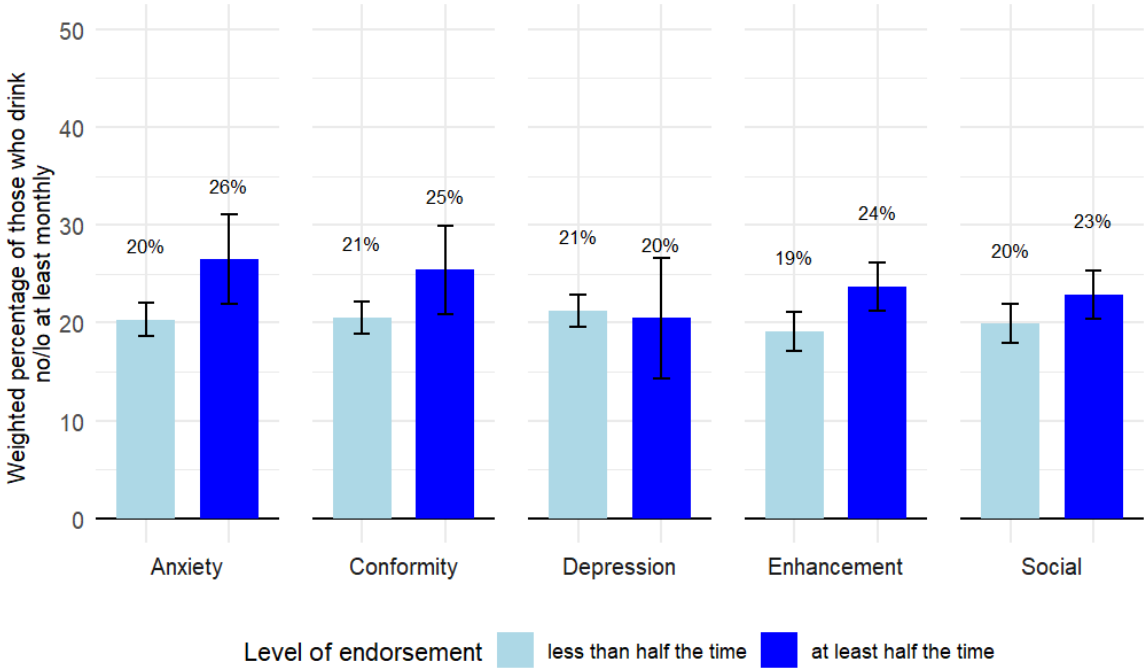
Indicator	Odds Ratio	95% CI	p value
Higher/intermediate managerial, administrative or professional[c]	1.18	(0.85, 1.63)	0.315
IMD	0.99	(0.92, 1.08)	0.881

Significant relationships (<.05) are highlighted in bold.

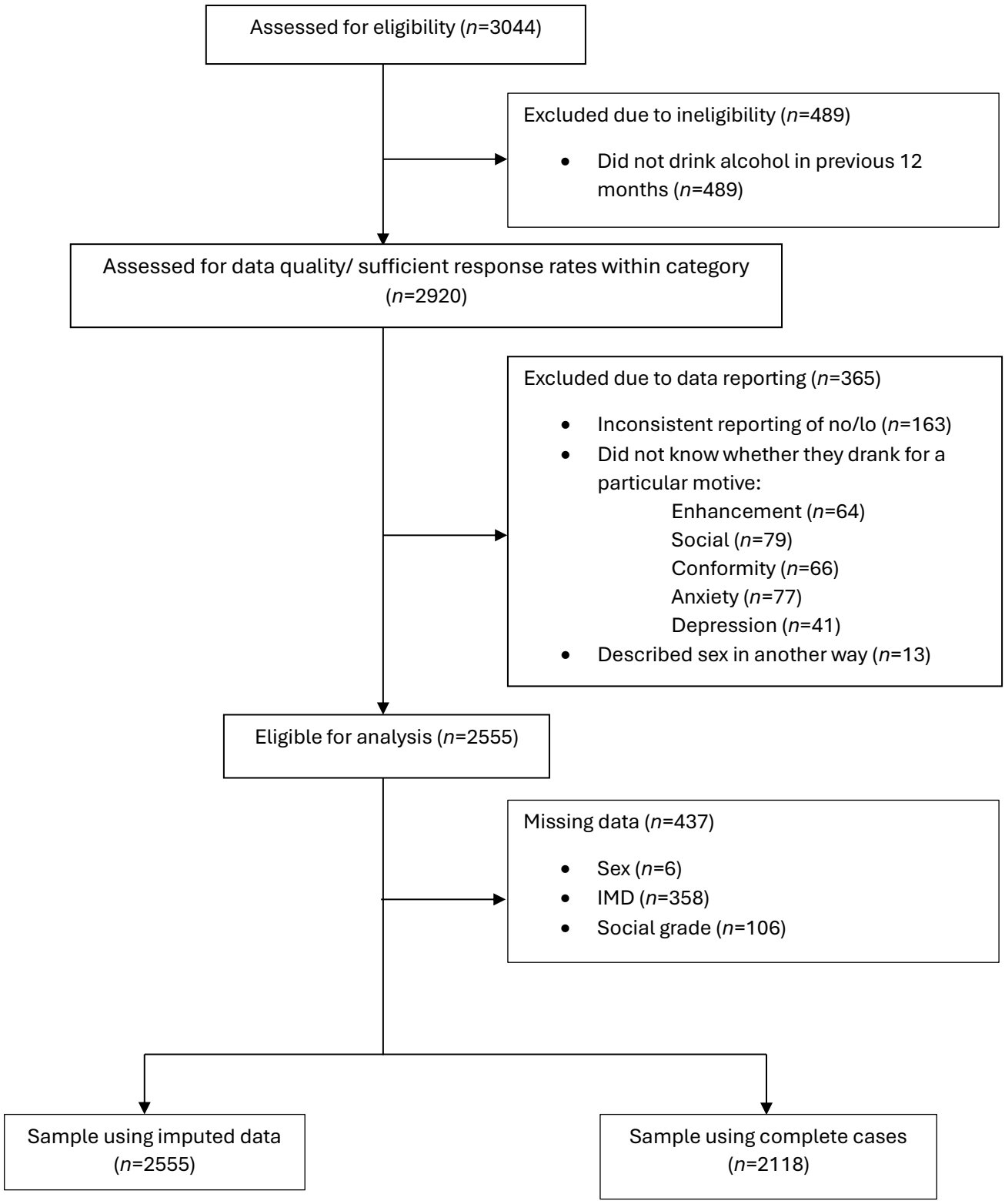
* p <.05, ** p <.01, p <.001***

Reference cases: [a] Age 16-24, [b] Secondary school or equivalent, [c] Semi-skilled and unskilled manual workers, pensioners, casual and lowest grade workers, unemployed and in receipt of state benefits only.

FIGURE 1 The percentage of low and high endorsers of each alcohol drinking motive who reported regular no/lo consumption, with 95% Confidence Intervals, weighted (n=2597)



SUPPLEMENTARY FIGURE 1 Participant recruitment and inclusion in the study



SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE 1 An evaluation of the impact of population weighting on the study sample

Weighting Metric		**Value**	
Weight Distribution (Range)		0.27 – 3.20	
Initial Sample Size (N)		2555	
Effective Sample Size (ESS)		2053	
Design Effect (DEFF)		1.24	
Variable	**Category**	**Unweighted %**	**Weighted % (SE)**
Gender	Men	53.2%	51% (1.1)
	Women	46.8%	49% (1.1)
Social Grade	DE	13.5%	19.2% (1)
	C2	14.6%	21.5% (1)
	C1	42.9%	29.1% (0.9)
	AB	29%	30.1% (1)
Education	Secondary School/equivalent	24%	25.9% (1)
	Further education 16+/equivalent	24.9%	25.7% (1)
	Undergraduate degree/ equivalent	33.1%	31.7% (1)
	Post-graduate degree/ equivalent	18%	16.7% (0.8)
AUDIT-C	Mean	4.39	4.36 (0.06)
IMD	Mean	3.2	3.12 (0.03)

SUPPLEMENTARY TABLE 2 Testing for multicollinearity among independent variables using Variance Inflation Factors (VIFs)

Indicator	Odds Ratio	95% CI	p value	VIF
(Intercept)	0.08	(0.04, 0.14)	0.000	
Enhancement	1.03	(0.95, 1.11)	0.532	1.34
Social	0.94	(0.86, 1.02)	0.131	1.50
Conformity	1.10	(1, 1.21)	0.041	1.23
Anxiety	1.09	(0.99, 1.21)	0.092	1.40
Depression	1.02	(0.9, 1.15)	0.799	1.21
AUDIT-C (linear)	1.41	(1.21, 1.64)	0.000	15.22
AUDIT-C (quadratic)	0.98	(0.96, 0.99)	0.000	14.92
Women (compared to men)	0.86	(0.71, 1.05)	0.149	1.07
Age 25-34[a]	0.94	(0.64, 1.38)	0.756	1.34
Age 35-44[a]	1.00	(0.68, 1.47)	0.985	1.34
Age 45-54[a]	0.88	(0.6, 1.29)	0.514	1.34
Age 55-64[a]	0.94	(0.63, 1.39)	0.744	1.34
Age 65+[a]	1.03	(0.7, 1.5)	0.894	1.34
A levels / equivalent[b]	0.90	(0.67, 1.21)	0.493	1.38
Undergraduate degree/ equivalent[b]	1.43	(1.08, 1.89)	0.013	1.38
Postgraduate degree/ equivalent[b]	1.57	(1.13, 2.18)	0.007	1.38
Skilled manual workers[c]	1.05	(0.75, 1.45)	0.791	1.32
Supervisory, clerical and junior managerial, administrative or professional[c]	1.18	(0.86, 1.62)	0.295	1.32
Higher/intermediate managerial, administrative or professional[c]	1.18	(0.85, 1.63)	0.315	1.32
IMD	0.99	(0.92, 1.08)	0.881	1.08

Reference cases: [a] Age 16-24, [b] No formal qualifications, [c] Semi-skilled and unskilled manual workers, pensioners, casual and lowest grade workers, unemployed and in receipt of state benefits only.

Interpretation Guide for VIFs:

- VIF = 1: No multicollinearity
- VIF < 5: Generally acceptable
- VIF > 5: Potential multicollinearity issues
- VIF > 10: Severe multicollinearity issues

Note: The 'structural multicollinearity' between the audit variables does not violate the assumptions of the regression model.

SUPPLEMENTARY TABLE 3 The percentage of low and high endorsers of each alcohol drinking motive who reported regular no/lo consumption, with 95% Confidence Intervals (weighted, *n*=2597)

Drinking Motive	Endorsement Level	Percentage (%)	Lower 95% CI	Upper 95% CI
Enhancement	less than half the time	19.1	16.9	21.4
Enhancement	at least half the time	23.7	21.0	26.4
Social	less than half the time	19.9	17.7	22.1
Social	at least half the time	22.9	20.1	25.7
Conformity	less than half the time	20.5	18.7	22.4
Conformity	at least half the time	25.4	20.4	30.3
Anxiety	less than half the time	20.3	18.5	22.1
Anxiety	at least half the time	26.5	21.2	31.8
Depression	less than half the time	21.2	19.4	23.0
Depression	at least half the time	20.5	13.4	27.5

SUPPLEMENTARY TABLE 4 Results from the sensitivity analysis using complete data (weighted)

Indicator	Odds Ratio	95% CI	p value
(Intercept)	0.09	(0.04, 0.17)	0.000
Enhancement	1.04	(0.95, 1.13)	0.412
Depression	0.97	(0.83, 1.12)	0.656
Social	0.91	(0.83, 1)	0.051
Conformity	**1.12**	**(1.01, 1.25)**	**0.033***
Anxiety	1.03	(0.91, 1.16)	0.636
AUDIT-C (linear)	**1.48**	**(1.25, 1.75)**	**0.000*****
AUDIT-C (quadratic)	**0.97**	**(0.96, 0.99)**	**0.000*****
Women (compared to men)	0.86	(0.69, 1.08)	0.193
Age 25-34[a]	0.91	(0.58, 1.42)	0.670
Age 35-44[a]	0.93	(0.6, 1.45)	0.746
Age 45-54[a]	0.77	(0.49, 1.21)	0.261
Age 55-64[a]	0.81	(0.51, 1.27)	0.354
Age 65+[a]	0.91	(0.58, 1.41)	0.665
A levels / equivalent[b]	0.98	(0.7, 1.37)	0.911
Undergraduate degree/ equivalent[b]	**1.58**	**(1.16, 2.17)**	**0.004****
Postgraduate degree/ equivalent[b]	**1.77**	**(1.23, 2.54)**	**0.002****
Skilled manual workers[c]	1.09	(0.75, 1.57)	0.650
Supervisory, clerical and junior managerial, administrative or professional[c]	1.15	(0.81, 1.63)	0.423

Indicator	Odds Ratio	95% CI	p value
Higher/intermediate managerial, administrative or professional[c]	1.21	(0.85, 1.73)	0.299
IMD	0.97	(0.9, 1.06)	0.525

Significant relationships (<.05) are highlighted in bold
*p <.05, *** p <.001
Reference cases: [a] Age 16-24, [b] No formal qualifications, [c] Semi-skilled and unskilled manual workers, pensioners, casual and lowest grade workers, unemployed and in receipt of state benefits only.

SUPPLEMENTARY TABLE 5 Results from the sensitivity analysis using binary endorsement levels for alcohol drinking motives (weighted)

Indicator	Odds Ratio	95% CI	p value
(Intercept)	0.09	(0.05, 0.16)	0.000
High vs low endorsers Enhancement	1.05	(0.85, 1.31)	0.643
High vs low endorsers Social	0.96	(0.77, 1.21)	0.734
High vs low endorsers Conformity	1.18	(0.88, 1.57)	0.273
High vs low endorsers Anxiety	1.33	(0.99, 1.79)	0.060
High vs low endorsers Depression	0.84	(0.55, 1.29)	0.423
AUDIT-C (linear)	**1.39**	**(1.19, 1.62)**	**0.000**
AUDIT-C (quadratic)	**0.98**	**(0.96, 0.99)**	**0.001**
Women (compared to men)	0.87	(0.71, 1.06)	0.163
Age 25-34[a]	0.95	(0.65, 1.4)	0.801
Age 35-44 [a]	1.02	(0.69, 1.49)	0.935
Age 45-54 [a]	0.89	(0.61, 1.31)	0.563
Age 55-64 [a]	0.95	(0.64, 1.41)	0.807
Age 65+ [a]	1.04	(0.72, 1.52)	0.825
A levels / equivalent[b]	0.89	(0.66, 1.19)	0.424
Undergraduate degree/ equivalent[b]	**1.40**	**(1.06, 1.86)**	**0.018**
Postgraduate degree/ equivalent[b]	**1.55**	**(1.12, 2.14)**	**0.009**
Skilled manual workers[c]	1.04	(0.75, 1.44)	0.828
Supervisory, clerical and junior managerial, administrative or professional[c]	1.17	(0.85, 1.6)	0.330

Indicator	Odds Ratio	95% CI	p value
Higher/intermediate managerial, administrative or professional[c]	1.17	(0.85, 1.62)	0.338
IMD	0.99	(0.92, 1.08)	0.877

Significant relationships (<.05) are highlighted in bold

* p <.05, ** p <.01, ***p<.001

Reference cases: [a] Age 16-24, [b] No formal qualifications, [c] Semi-skilled and unskilled manual workers, pensioners, casual and lowest grade workers, unemployed and in receipt of state benefits only.

~~Does~~ Is why we drink alcohol ~~matter~~important when considering the potential public health benefit of alcohol-free and low-alcohol drinks? A cross-sectional study investigating associations between alcohol drinking motives and alcohol-free and low-alcohol drink consumption amongst adults in Great Britain.

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Running title: Alcohol drinking motives and no/lo drinks

Word count: ~~3845~~4869

KEY WORDS

Alcohol, drinking motives, alcohol-free, low-alcohol, adults, public health

ABSTRACT

Introduction

The UK has promoted increased~~ing the~~ availability of alcohol-free and low-alcohol drinks (no/lo, ≤1.2% ABV) as a public health strategy. To be effective, no/lo beverages must replace, and not supplement, standard alcoholic drinks. Emerging ~~qualitative~~ evidence suggests the reasons people drink alcohol ~~may be important when investigating the potential public health impact of these~~

drinks. This has not yet been explored quantitatively. may be an important determinant of the potential public health impact of these drinks.

This study aimed to determine whether alcohol drinking motives were associated with no/lo consumption after accounting for sociodemographic characteristics and alcohol consumption.

Methods

A cross-sectional sample of adults residing in Great Britain (aged 16-93) who had drunk alcohol in the past year were recruited via the Alcohol Toolkit Study (N = 2555; 49.0% female). The dependent variable was frequency of no/lo consumption (less than/ versus at least monthly). Five questions captured respondents' alcohol drinking motives (enhancement, social, conformity, coping-anxiety, coping-depression), derived from the Drinking Motives Questionnaire-Revised. Sociodemographic characteristics, (including age, gender, social grade, education, index of multiple deprivation (a UK-wide measure of relative deprivation for small geographic areas), and hazardous alcohol use (AUDIT-C) were included in the analysesalso assessed.

Descriptive analysis presents the proportion of respondents drinking no/lo at least monthly amongst low endorsement (i.e., drinking for a motive less than half the time) versus high endorsement (i.e., drinking for a motive at least half the time) of each drinking motive. The proportion of respondents who reported drinking no/lo at high and low levels of endorsement of each drinking motive is presented. Quasibinomial regression modelling explored relationships between alcohol drinking motives and no/lo consumption, accounting for sociodemographic characteristics and hazardous drinking.

Results

Drinking alcohol to conform was the only drinking motive associated with an increased likelihood of at least monthly no/lo consumption after accounting for sociodemographic characteristics and

hazardous drinking (OR = 1.10, 95% CI 1.00-1.21, p=0.041). ~~A higher frequency of drinking alcohol to conform was associated with an increased probability of drinking no/lo at least monthly.~~

Conclusions

No/lo drinks may facilitate reduced alcohol consumption by offering an alternative for individuals wishing to participate in alcogenic environments. However, ~~be a useful substitute for those wishing to reduce their alcohol consumption whilst avoiding pressure to conform to social norms.~~ t~~T~~hose who drink~~ing~~ alcohol to conform ~~were~~ are not typically higher-risk drinkers, which may limit the public health benefit of no/lo drinks. Further research is needed to explicitly explore substitution effects.

Key Messages

What is already known on this topic

- Since 2019, a~~A~~lcohol-free and low-alcohol (no/lo) drinks have been endorsed by ~~the~~ successive UK~~'s~~ governments ~~Department of Health and Social Care~~ as a public health strategy.
- Qualitative studies indicate that the reasons people drink alcohol may be important when investigating whether no/lo drinks are an acceptable substitute to standard alcohol.

What this study adds

- This is the first study to *quantitatively* explore whether the reasons people drink alcohol are associated with no/lo consumption.
- Respondents who reported drinking alcohol to conform were more likely to report drinking no/lo at least monthly after controlling for sociodemographic characteristics and hazardous drinking.

How this study might affect research, practice or policy

- Further research is needed to explicitly explore substitution effects. To maximise the public health benefit of ~~increasing the availability of no/lo drinks~~the "no/lo policy", additional strategies may be required to encourage some at risk drinking groups to substitute standard alcohol with no/lo alternatives.

INTRODUCTION

Reducing alcohol harm is a critical public health priority in the UK. Whilst growing numbers of drinkers seek to moderate their consumption, a large minority is drinking alcohol at increasingly harmful levels [1, 2]. This could lead to a 20% increase in alcohol related mortality over the next 20 years, costing the NHS up to £5.2 billion [3].

Increasing the availability of alcohol-free and low-alcohol (no/lo) drinks has been promoted as a public health strategy by the UK Department of Health and Social Care [4, 5]. Since 2015 there has been a proliferation of these products emerging onto the UK market and elsewhere, with further growth predicted [6-8]. If consumers can be encouraged to substitute standard alcohol with ~~lower-strength~~no/lo alternatives this could lead to a public health benefit [4, 9].

In the UK, no/lo drinks are defined as alcoholic or alcoholic type (e.g. beer, wine, spirits) drinks that contain ≤1.2% alcohol by volume ~~ABV~~ [ABV, 10], a threshold which aligns with current UK alcohol duty rates [11]. They do *not* include soft drinks or lower-strength alcoholic drinks that have an ABV above 1.2% ABV. Whilst some no/lo beverages include a small amount of alcohol, they are unlikely to lead to intoxication [12]. In Great Britain, whilst currently not illegal, there is a voluntary agreement amongst alcohol licence holders that no/lo drinks are not sold to individuals aged under 18, in line with the legal age for purchasing alcoholic drinks.

Given that the objective of the "no/lo policy" is for drinkers to substitute alcohol with no/lo, it is pertinent to consider the reasons why people drink alcohol and how well no/lo drinks may satisfy these motives [13, 14]. People drink alcohol for many reasons: alcohol can signify celebration, serve as a social lubricant, and make people feel happy [15, 16]. Some people use alcohol ~~as a form of self-medication~~to self-medicate, believing it will help them cope with anxiety or depression [17-19]. In many countries, including the UK, alcohol is central to social culture [20]. Both academics and policy makers support a consideration of alcohol drinking motives when developing alcohol reduction interventions [14, 21-23].

Cox and Klinger's (1988) motivational model of alcohol use places alcohol drinking motives along two dimensions [24]. Firstly, motives are identified as having an internal (the self) or external (social environment) source, and secondly, motives are driven by positive (e.g., drinking alcohol for the buzz, making social occasions more enjoyable), or negative (e.g. coping with low mood or anxiety, conforming to expectations) reinforcement. Several measures of drinking motives exist [18, 25, 26]. Cooper et al's (1994) drinking motives questionnaire captures drinking alcohol for enhancement, conformity, social, and coping reasons, and is a widely used and well-validated tool [25]. Its psychometric properties have been tested in multiple countries, and importantly, on adult populations [27-30]. [26]~~Grant et al's (2007) modified DMQ-R extends this model by distinguishing between coping with anxiety and depression~~[18]~~, potentially relevant when considering different drinking patterns~~ [31]~~. However, the social subscale has unsatisfactory psychometric properties, and this measure has not yet been validated on an adult population. A drinking motives questionnaire developed specifically for adults, the DMQ-Adults, has recently been published, which whilst promising, requires further validation~~ [26]~~. Interestingly, this measure, developed in Australia, did not retain conformity as a drinking motive. However, a qualitative systematic review of adults in the UK concluded that peer pressure, which drives drinking to conform, persists throughout adulthood~~

[32]~~. This indicates that in UK contexts, conformity remains an important alcohol drinking motive in adulthood.~~

The emerging ~~qualitative~~ literature regarding no/lo consumption supports the idea that considering alcohol drinking motives is important. Studies ~~in Australia and the UK~~ have found that no/lo consumers acknowledge social participation and adhering to social norms as key benefits of no/lo [33-37]. An Australian qualitative study of adults who had reduced their alcohol consumption reported alcohol-free drinks allowed participants to masquerade as "drinkers", a key strategy in their successful reduction attempts, allowing them to remain aligned with cultural expectations [34]. Studies conducted in the UK, including consumers of no/lo drinks and pregnant women, found no/lo drinks facilitated social occasions, enabling participation where alcohol consumption was typical, and allowing those not drinking alcohol to avoid scrutiny from peers [33, 35, 38]. Conversely, studies including those who did not ~~drink~~ consume no/lo drinks, found that these respondents often *did not see the point of no/lo drinks* if the goal was to feel inebriated [35-37, 39].

These studies suggest that those who drink for external reasons, particularly what is defined as "conformity" in Cox and Klinger's motivational model of alcohol use [24], may be more likely to consume no/lo drinks than those who drink for internal reasons. This is concerning because "internal drinkers" are most at risk of alcohol harm [40]. Furthermore, those drinking to cope are likely to be less socially advantaged [21], a group less likely to consume no/lo drinks [41]. To date, there are no studies which have ~~quantitatively~~ explicitly explored whether the reasons people drink alcohol are associated with no/lo consumption using quantitative methods. This is important from a public health perspective where we are specifically interested in considering how well no/lo drinks may ~~serve as a substitute to alcohol~~encourage a reduction in alcohol consumption, rather than looking to understand no/lo behaviour more generally.

The present study

The current study uses data from a nationally representative survey of adults residing in Great Britain to explore: i. whether there are direct associations between alcohol drinking motives and no/lo consumption, and ii. whether alcohol drinking motives help to explain no/lo consumption after accounting for sociodemographic characteristics. The study addressed the following hypothese~~i~~s: People who endorse drinking alcohol for internal reasons (enhancement and to cope with anxiety or depression) will have significantly lower odds of consuming ~~are less likely to drink no/lo~~ no/lo drinks at least monthly than those who do not drink alcohol for ~~external reasons (social and conformity reasons)~~these reasons after accounting for sociodemographic characteristics and hazardous drinking. We did not expect an association between external motives and no/lo consumption. We also expected to find a higher odds of regular ~~that~~ no/lo ~~drinks~~ consumption amongst ~~were more likely to be consumed by~~ those who were socially advantaged, assessed using measures of social grade and highest level of education received~~,~~: and higher risk drinkers, as found with previous work [41]. We explored whether neighbourhood level deprivation was associated with no/lo consumption, using the index of multiple deprivation [IMD, 42].

METHOD

Design

A cross-sectional study of adults aged sixteen and over, recruited via the February 2023 and April 2023 waves of the Alcohol Toolkit Study [43]. This is a monthly ~~, nationally representative,~~ telephone survey of adults residing in Great Britain, capturing respondents' alcohol drinking behaviour. The sampling process aims to recruit a study population that is nationally representative in terms of gender, working status, prevalence of children in the household, age, social grade and region [43]. A rim (marginal) weighting technique is used to ensure the target profiles were met [44]. Alongside routinely administered questions capturing respondent demographics and alcohol use, respondents

also reported how often they consumed no/lo drinks. In these two waves only, fFive additional questions capturing respondents' alcohol drinking motives were included for the selected waves.

Sample

Across the two waves there were 2920 respondents who had drunk alcohol at least once in the previous 12 months as recorded by the Alcohol Use Disorder Identification Test [AUDIT-C, 45]. After removing those whose responses made them ineligible for inclusion, there remained a sample of 2555. This sample of 2555 included 440 cases with missing data, typically single items, which had then been imputed to provide a complete dataset (see Supplementary Material, Figure 1 for a participant flow-chart, and Analysis for further detail). The weighted sample was 2597. This was powered to detect odds-ratios greater than 1.15 at 80% power and 5% alpha in a logistic regression (33).

Measures

Alcohol-free and low-alcohol (no/lo) drinking behaviour

We measured frequency of no/lo consumption as a single item [41]. Participants were asked "How often do you have an alcohol-free or low-alcohol drink (beer, wine, cider, spirits or other type of alcoholic drink under 1.2% ABV)?". Participants respondent responded on an 8-point scale, ranging from Never - Nearly every day. Due to low numbers responding at higher frequencies, responses were recoded as a binary variable – less than monthly / at least monthly, in order toto capture whether respondents were a regular consumer of no/lo drinks or not.

Alcohol drinking motives

Alcohol drinking motives were captured using five items from Cooper et al's (1994) Drinking Motives Questionnaire Revised (DMQ-R) [DMQ-R, 25]. This measure has excellent psychometric properties, captures emergent themes from the qualitative literature around no/lo consumption, and has been

validated in ~~many~~ several countries, including England, and on adult populations [27, 30]. Due to financial constraints, single items were chosen to capture each alcohol drinking motive. Single items have been used to capture alcohol drinking motives, including the motives captured in the DMQ-R, elsewhere [46, 47].

We also chose to ~~,~~ distinguish~~ing~~ between coping-anxiety and coping-depression by selecting two items from the coping subscale which represent these different aspects of coping. This distinction was made due to evidence that these motives are differentially associated with drinking patterns and socioeconomic status [18, 48]. Whilst the modified DMQ-R distinguishes between these two motives, its authors note it has unsatisfactory psychometric properties for its social scale and has not yet been validated on adults [18]. Therefore, we chose to use items from the DMQ-R [25]. ~~Single items have been used to capture alcohol drinking motives elsewhere~~ [46, 47]~~.~~

Item selection was informed by each item's psychometric properties and p~~ersona~~atient~~l~~ and public involvement ~~and engagement~~ (PPI~~E~~, see PPI~~E~~ statement). The selected items were:

ii. Because it gives you a pleasant feeling (Enhancement)

iii. Because it makes social gatherings more fun (Social)

iiii. To fit in with a group that you like (Conformity)

ivi. Because you feel more self-confident and sure of yourself (Coping–anxiety)

vi. To forget about your problems (Coping–depression)

Responses were recorded on a 5-point scale (1 = Never/Almost Never, 2 = Some of the time, Half of the time, 4 = Most of the time, 5 = Almost Always/Always). Alcohol drinking motives were treated as continuous variables in the ~~primary regression~~main analyses~~model~~, but to aid interpretation in the descriptive analysis they were ~~recoded~~ presented as binary variables (responses of Never, Almost Never, and Some of the time = Low endorser, responses of Half the time, Most of the time, and Almost always/Always = High endorser).

Harmful alcohol consumption

The Alcohol Use Disorders Identification Test-C (AUDIT-C) measured hazardous alcohol consumption [45]. It discriminates between those at higher or lower risk of alcohol-related harm. A three-item scale captures frequency of alcohol consumption, ~~typical~~ numbers of units of alcohol consumed during a typical drinking occasion, and frequency of heavy episodic drinking (6 or more units of alcohol in a single drinking occasion). Responses were recoded to correspond with validated AUDIT-C scoring to produce a total score between 0 and 12, treated as a continuous variable. Non-drinkers were excluded, therefore, scores in the study sample ranged from 1-12.

Sociodemographic variables

The routinely collected variables in the ATS that were used in the analysis included:

- Age (16-24, 25-34, 35-44, 45-54, 55-64, 65+);
- Gender (male, female);
- ~~Education~~ Highest level of education attained (secondary school education or equivalent~~;~~, pre-university qualification, e.g. A~~-~~levels, International Baccalaureate Diploma, or equivalent~~;~~ ~~undergraduate~~ bachelor's degree or equivalent undergraduate degree; ~~,~~ post-graduate ~~degree~~ qualification or equivalent)~~;~~;
- Social grade (AB = higher/intermediate managerial, administrative or professional, C1 = supervisory, clerical and junior managerial, administrative or professional, C2 = skilled manual workers, DE = semi-skilled and unskilled manual workers, pensioners, casual and lowest grade workers, unemployed and in receipt of state benefits only [49]);
- Index of multiple deprivation (IMD) based on a respondent's postcode. IMD captures local level data on income, health, education, crime, environment, barriers to housing and living environment. Five response levels range from: 1 = most deprived quintile to 5 = least deprived quintile [42].

Age, social grade, and education were treated as ~~ordinal variables~~factors, whereas IMD was treated as a continuous variable. ~~Social grade was reverse coded so that a higher value denoted a higher social grade.~~ Ethnicity is reported descriptively (White, Black, Asian, Mixed heritage, other, Table 1), but was not included in the regression model due to small numbers of Black, Asian, and other ethnically diverse groups in the sample population.

~~Personal~~ Patient and public involvement ~~and engagement~~ (PPI~~E~~)

The Alcohol Toolkit Study is a well-established survey, therefore ~~the~~ PPI~~E~~ work focused on the selection of outcome measures specifically added for this study. Seven members of the University of Stirling's Alcohol and Food Discussion Group (https://spectrum.ed.ac.uk/about/public-involvement), an established PPI~~E~~ group that supports research in this area, assisted in selecting items from the DMQ-R to be included in the survey. In response to participant preferences, the PPI~~E~~ meeting was held online. Participants brought their own lived experience with regards to alcohol consumption to the discussion. All participants drank alcohol at least occasionally, and ~~there~~ the group comprised ~~was a mix~~ of both those who did and did not consume no/lo drinks.

Following a general introduction and warm-up session about no/lo, participants were asked to contribute to: i. a general discussion of the reasons why they drank alcohol, and ii. a discussion about how well they felt the shortlisted alcohol drinking motives captured each of the overarching alcohol drinking motives. The group supported the selection of the shortlisted items for enhancement, coping–anxiety, coping-depression, and social subscales. For the conformity subscale, the group recommended an alternative item. The recommended item had good factor loadings and face-validity; therefore, the shortlisted item for conformity was replaced to reflect the views of the PPI~~E~~ group.

In addition to academic dissemination of the findings of this study, dissemination with the wider public is ongoing. Preliminary findings have been shared at two public events , i. a Pint of Science event in 2024 (https://pintofscience.co.uk/, https://pintofscience.co.uk/event/mocktails-and-chemtrails) and ii. a webinar run by the University of Sheffield that was advertised and accessible to all (https://www.sheffield.ac.uk/alumni/bright-minds). Further dissemination with the public, including those involved in the PPI~~E~~ work, and relevant ~~policy makers~~stakeholders is ~~planned~~ongoing.

Ethics

Ethics approval for data collection was obtained by The University College London, who has overall ownership of the Alcohol Toolkit Study (ID 0498/001). Researchers explained the survey to potential participants and provided assurance that it is being conducted in line with the Market Research Society Code of Conduct [50]. Prior to participating, respondents provided verbal consent.

Pre-registration

The study's analytical plan was pre-registered on the Open Science Framework (osf.io/6rn3w). The analysis plan documents the planned analysis presented here and an additional path analysis which will be published separately. Changes to the analytical plan included:

- ~~•~~ Analyses exploring location and rurality were not pursued. This decision was based on a recently published analysis (40), which used a larger dataset from the same source and yielded inconclusive findings. We determined that a similar analysis with our smaller sample would be unlikely to provide meaningful insights. ~~Analyses exploring location and rurality were not explored due to being published elsewhere~~ [41]~~.~~
- Analyses exploring direct relationships between alcohol drinking motives, sociodemographic characteristics, hazardous drinking, and no/lo consumption were combined into a single regression model.

- Analyses were population weighted.
- Regression models using rank ordering are not presented. We had been interested in exploring whether both relative and absolute endorsement of the alcohol drinking motives were important. However, very few respondents rated drinking alcohol for depression (n=31, 1.2%), anxiety (n=50, 2.0%), and conformity (n=94, 3.7%) as their primary motive, meaning this analysis was not possible.
- Aa sensitivity analysis using alcohol drinking motives recoded as binary variables (low vs. high endorsers) was included.

Analysis

Data preparation and analyses were undertaken in R 4.3.1 [51]. The following groups of respondents were removed:

i. Respondents who answered inconsistently regarding their no/lo consumption (i.e., responding that they engaged in situation specific no/lo consumption: hybrid, on-trade, or off-trade more often than they reported drinking no/lo overall, n=163). This follows good practice advice for data cleaning [52] and aligns with practice used in other studies reporting on this data [41].

ii. Respondents who reported that they did not know whether they drank alcohol for any of the drinking motives (n=189). Whilst a debate exists as to whether "don't know" responses should be treated as missing, or identified as a substantive response [53], for our research we chose to exclude these participants. Individuals providing a "don't know" response for the drinking motives did not differ from the rest of the sample on key demographic variables (age, sex, social grade, education level, alcohol consumption, no/lo consumption). [53]

iii. Respondents describing their gender in another way (n=13). This final group were removed due to their small number, meaning it was not possible to meaningfully include them in the analysis.

Complete data was available for 2115 of 2555 respondents (82.8%). A flow-chart illustrating participant eligibility and missing data is presented in the Supplementary materials (Supplementary Figure 1). The following variables had missing data: gender, n = 6; social grade, n = 106, IMD, n = 358. Little's MCAR test was significant, indicating it was not appropriate to treat data as missing completely at random [54]. By investigating patterns of missing data, there was no evidence of systematic missingness, therefore we felt it was appropriate to assume the data was missing at random and proceeded with mMultiple imputation, using the mice package in R [55, 56]., ~~was undertaken and 18~~Eighteen datasets were imputed. Trace plots of the means and standard deviations of the imputed values for the variables with missing data (IMD, social grade, sex) indicated that the imputation chains converged well. The primary analyses present pooled results from the imputed datasets which were then population weighted. The impact of survey weighting was evaluated (Supplementary Table 1). It appeared to effectively adjust the sample to better represent the target population without unduly distorting key variable means.

Descriptive analysis and regression modelling

Descriptive analyses illustrate the proportions of respondents ~~regularly~~ consuming no/lo drinks at least monthly for low and high endorsers of each alcohol drinking motive. ~~Rao-Scott adjusted Chi-square tests, which account for survey weighting, assessed for unadjusted associations between each alcohol drinking motive and no/lo consumption~~[57]. A q Quasibinomial logistic regression models, including drinking motives as continuous variables tested for associations between regular no/lo consumption (dependent variable) and, alcohol drinking motives. This method is a robust approach for binary outcomes when overdispersion is present [58, 59], which was a concern given the low base rate of at least monthly no/lo consumption (21%) in our sample. While negative

binomial or zero-inflated regression models are valuable for addressing overdispersion, they are primarily designed for count data rather than the binary (yes/no) outcome capturing no/lo consumption in this study. The quasibinomial approach, which models a dispersion parameter, was thus the most appropriate method to account for overdispersion while maintaining the binary nature of our dependent variable.

The unadjusted regression model included drinking motives and no/lo consumption. The adjusted model controlled for~~,~~ sociodemographic characteristics (gender, age, education, social grade, IMD) and hazardous drinking (AUDIT-C). Ordinal variables (age, education, and social grade) were presented as factors~~a series of higher polynomial contrasts~~. ~~This allows for data at all levels of an ordinal factor to be included in a single co-efficient.~~ All analyses were population weighted and tests for the key assumptions of this anis were undertaken [60]. The data breached the linearity of log-odds assumption for AUDIT-C therefore an exploration of higher polynomial terms for AUDIT-C was undertaken. This indicated that AUDIT-C had a quadratic relationship with the dependent variable, consequently a linear and quadratic term for AUDIT-C were included in the model. There was no evidence of multicollinearity among independent variables using Variance Inflation Factors (VIFs, Supplementary Table 2). The discriminative power of the primary model was assessed using Receiver Operating Characteristic (ROC) Area Under the Curve (AUC). ~~The data breached the linearity of log-odds assumption for AUDIT-C therefore an exploration of higher polynomial terms for AUDIT-C was undertaken. This indicated that AUDIT-C had a quadratic relationship with the dependent variable, consequently a linear and quadratic term for AUDIT-C were included in the model.~~

Sensitivity analyses

Two sensitivity analyses were undertaken:

i. using complete cases

ii. including alcohol drinking motives coded as binary variables (low vs. high endorsers)

RESULTS

Participant characteristics

A summary of the weighted study sample is provided in Table 1. Twenty-one percent of respondents were ~~drinking~~ consuming no/lo drinks at least monthly (n = 550). Respondents were most likely to report drinking alcohol for enhancement and social reasons~~, with 44.6% and 42.5% of the sample reporting high endorsement of each of these motives, respectively. 13.9% of respondents were high endorsers of drinking to cope with anxiety, and 13.6% were high endorsers of drinking to conform and. Respondents were~~ least likely to report drinking alcohol to cope with depression~~, with 6.3% of respondents categorised as high endorsers of this motive~~. Twelve percent of respondents (n=306) reported never drinking alcohol for any of the motives presented.

INSERT TABLE 1 ABOUT HERE

Exploring associations between alcohol drinking motives and no/lo consumption

Figure 1 compares the proportion of respondents ~~regularly~~ consuming no/lo drinks at least monthly for low and high endorsers of each alcohol drinking motive. Across all alcohol drinking motives, approximately 20% of low endorsers reported ~~regularly drinking~~ consuming no/lo drinks at least monthly (range: 19.1% -21.2%). Amongst high endorsers of each motive, ~~regular~~ no/lo consumption ~~was most common amongst those who drank alcohol to cope with anxiety (26.5%, 95% CI 21.93-31.0.43), followed by conformity (25.4%, 95% CI 20.85-29.94)~~ranged from 20.5% for those drinking to cope with depression, to 26.5% for those drinking to cope with anxiety (Supplementary Table 3)~~, enhancement (23.7%, 95% CI 21.28-26.18), and social motives (22.9%, 95% CI 20.43-25.38)~~.

INSERT FIGURE 1 ABOUT HERE

The unadjusted quasibinomial logistic regression revealed that among the alcohol drinking motives assessed, only the enhancement motive was significantly associated with the likelihood of consuming no/lo drinks at least monthly (Odds Ratio = 1.09, 95% CI [1.01, 1.18], p=0.030). For every unit increase in the enhancement motive score, the odds of consuming no/lo drinks increased by approximately 9%, whilst holding other drinking motives constant. The remaining motives were not significantly related to no/low alcohol consumption (Table 2). ~~High and low endorsers of drinking to cope with depression reported similar levels of regular no/lo consumption (21.2%, 95% CI 19.61-22.86 vs. 20.5%, 95% 14.28-26.64). Differences were statistically significant for enhancement (Rao-Scott adjusted X^2, F(1, 2554) = 6.68, p=0.009) and anxiety (Rao-Scott adjusted X^2, F(1, 2554) = 5.35, p=0.02).~~

INSERT ~~FIGURE 1~~TABLE 2 ABOUT HERE

In the adjusted model, enhancement was no longer significantly associated with no/lo consumption. In this model, drinking alcohol to conform was the only motive significantly associated with at least monthly no/lo alcohol consumption (Odds Ratio = 1.10, 95% CI [1.00, 1.21], p=0.041, Table 3). For every one-unit increase in the conformity motive score, the odds of consuming no/lo drinks at least monthly increased by approximately 10%, assuming all other variables in the model were held constant. The remaining drinking motives did not show a significant association with no/lo consumption in this model.

Regarding the sociodemographic characteristics, the analysis revealed a curvilinear relationship between AUDIT-C score (a measure of alcohol use severity) and no/lo alcohol consumption. While Audit-C scores were positively linearly associated with an increased likelihood of consuming no/lo drinks at least monthly, the strength of this association weakened at higher levels of Audit-C (Table

3). Furthermore, compared to the reference group (secondary school education or equivalent), respondents with higher education and post-graduate levels of education were significantly more likely to consume no/lo drinks at least monthly. Sex, age, social grade, and IMD were not significant predictors in this model. The AUC was 0.61, indicating fair discrimination in distinguishing between respondents who consume no/lo drinks at least monthly and those who do not.

~~In the regression model only drinking alcohol to conform was significantly associated with regular no/lo consumption after accounting for sociodemographic characteristics and hazardous alcohol consumption. As the frequency of drinking alcohol to conform increased, so did the likelihood of drinking no/lo at least monthly (OR = 1.10, 95% CI 1.00-1.21, Table 2). Relationships between the remaining alcohol drinking motives and no/lo consumption were all statistically non-significant. Higher levels of education (linear and cubic relationships) and hazardous drinking (linear and quadratic relationships) were also associated with a greater likelihood of drinking no/lo.~~

INSERT TABLE 3~~2~~ ABOUT HERE

Sensitivity analyses

Complete case analysis (n=2118) ~~largely~~ replicated the primary findings~~, however relationships between education and no/lo were only linear and not cubic~~ (see Supplementary Material, Table 4~~1~~). When binary classifications of the alcohol drinking motives replaced continuous variables, no significant effects between alcohol drinking motives and at least monthly no/lo consumption were found (Supplementary Material, Table 5~~2~~). Other relationships remained ~~the same~~unchanged.

DISCUSSION

This is the first study to quantitatively explore associations between the reasons ~~people~~ adults drink alcohol and the consumption of alcohol-free and low-alcohol (no/lo) ~~products~~drinks. Qualitative research in the UK and Australia has already indicated ~~this~~ drinking motives may ~~be~~ influence why some people choose to consume no/lo drinks and others do not [33-35, 38]. ~~It is important from a public health perspective, where no/lo drinks are being promoted as a substitute to standard alcohol as a strategy to reduce alcohol harms, to develop our understanding.~~If no/lo drinks are promoted to improve public health via substitution, it is important to develop our understanding of how this change may occur.

We hypothesised that those respondents who primarily drank alcohol for internal reasons (enhancement and coping) would be less likely to consume no/lo drinks than those who primarily drink alcohol for other reasons, evident through decreased odds of no/lo consumption amongst those drinking for these reasons. Drinking for enhancement was associated with an *increased* rather than decreased odds of drinking no/lo in the unadjusted model. However, this association disappeared once sociodemographic characteristics and hazardous drinking were accounted for, suggesting it was a spurious relationship. In the adjusted model, we found an increased odds of drinking no/lo for those who endorsed drinking alcohol to conform. ~~After adjusting for sociodemographic characteristics and hazardous drinking, conformity was the only alcohol drinking motive significantly associated with regular no/lo consumption. For each unit level increase in endorsement of conformity, the likelihood of reporting drinking no/lo regularly increased by 10% (Table 2).~~ This ~~finding aligns~~corroborates ~~the~~with ~~qualitative research~~broader literature, where consumers of no/lo reference the ability to "join in" social occasions, no/lo drinks enabling their "non-drinking" to go un-questioned or un-challenged [33-35, 37, 38]. In line with Perman-Howe et al [2024, 41], those who reported higher educational qualifications and higher AUDIT-C scores were also statistically more likely to report drinking no/lo at least monthly. We did not find evidence of an

association between neighbourhood level deprivation, measured using the IMD, and no/lo consumption.

Implications for public health and further work

Currently, alcohol-free and low-alcohol drinks are regularly consumed by a minority of adults who drink alcohol. In this study, approximately one-fifth of respondents reported consuming no/lo drinks at least monthly. However, this market is outperforming a declining standard alcohol market [61]. If consumption increases, there remains potential for no/lo to be of significant public health benefit.

Our study indicates that who may benefit may be contingent on the reasons people drink alcohol in the first place. The regression model results indicate that people who drink to conform are more likely to drink no/lo regularly after accounting for sociodemographic characteristics and hazardous drinking. In the UK, where drinking alcohol is ~~peer pressureits may be overt, but often subtle and friendly~~normalised [32], no/lo drinks may serve as a welcome alternative for those wishing to reduce their alcohol consumption whilst circumventing the pressure to conform to the social ~~norms~~consensus. However, we must note that the overall effect size was small and the sensitivity analysis which explored drinking motives on a binary scale did not consistently support the associations observed in the primary model. The AUC was 0.61 suggesting that there are other important factors that are associated with no/lo consumption that are not included in this model.

Further work is needed to better understand the nuanced relationship between drinking alcohol to conform and consuming no/lo drinks, particularly amongst those who are using the drinks as a substitute to standard strength alcohol. The current study explores overall no/lo consumption, including consumption amongst those who would probably not been drinking alcohol otherwise, e.g. those who are pregnant, or driving; and ~~not~~ no/lo consumption that does not specifically serve to

specifically replaces alcohol consumption, therefore, it is likely the effect of drinking motives amongst those who are directly substituting is diluted in this study

HoweverIt is also important to note that, drinking alcohol to conform is typically not one of the most strongly endorsed reasons to drink alcohol at a population level, with just fourteen percent of respondents in this study reporting drinking for this reason at least half of the time. Research indicates that people who predominantly drink for this reason already tend to drink at less harmful levels which may limit the reach of the policy for heavier drinkers drinking alcohol for other reasons [40].

The most common reasons for drinking alcohol in this study were social and enhancement (Table 1), which corresponds with other research of adult alcohol drinking motives in the UK and internationally [21, 62]. Drinking for enhancement is directly associated with heavier drinking, with drinking for social reasons and to cope also directly or indirectly associated with alcohol harms [40]. If no/lo productsno/lo drinks prove effective for reducing hazardous drinking, it would be important to consider strategies to encourage these groupsthose who use alcohol as a coping mechanism, for its mood enhancement properties, or to make social occasions more enjoyable to switch to lower strengthno/lo products, whilst being mindful that additional approaches may be needed.

Regular consumption of no/lo drinks is positively associated with metrics of social advantage, particularly higher levels of education [41, 63]. Further research is required to understand why this might be. One explanation may be that no/lo drinks, which are typically broadly comparable in price to their standard alcoholic equivalent, are not satisfying the alcohol drinking motives predominant amongst lower less advantaged socioeconomic groups, who are more likely to drink alcohol as a coping mechanism than those who are more socioeconomically advantaged [21, 22, 48]. Further

~~work~~ analysis ~~will~~ has explored whether alcohol drinking motives mediate pathways between sociodemographic variables, hazardous drinking and no/lo consumption [64]~~.~~

Strengths and Limitations

This study was informed by the qualitative literature on no/lo consumption, which was then mapped onto Cox and Klinger's motivational model of drinking motives ~~This study was informed by psychological theory and qualitative evidence making it possible to triangulate several types of data to better understand our findings~~ [24, 25, 33, 35, 39]. We used a nationally representative sample of adults aged 16 and over, and living in Great Britain, incorporating sample weights.~~ ~~The items selected, taken from a well-validated scale of drinking motives, were felt to be the most appropriate based on the qualitative literature, and were supported by PPI~~E~~.

A trade-off by using the ATS was that it was not feasible to include the full DMQ-R [25]. This is not uncommon when using large surveys, where the constructs of interest comprise a small aspect of the survey [65, 66]. ~~Attempting to~~We ~~acknowledge that capture the complexity of alcohol drinking motives with single items~~ ~~u~~Using single items rather than the full scale may limit the validity and reliability of ~~the study data~~our findings~~,~~ by not fully capturing the dimension it represents, This~~, and~~ may have been further compounded by respondents who reported "don't know" in response to the drinking motive items, whom we excluded from the analysis. If we had chosen different items to represent our constructs, for example if we had measured enhancement using "Because it's exciting" rather than "Because you like the feeling" we may have had different findings. However, we took a considered approach to our item selection. The patterns of endorsement for our selected items are consistent with a recently conducted, cross-national study of drinking motives (including Great Britain), supporting the reliability of our estimates (60). ~~, however due to budget constraints it was not possible to include the full scale. The patterns of endorsement broadly align with previous research in the UK~~[62] [21]~~, although the proportion of respondents reporting to drink to cope with~~

depression was lower [21]. Over one in ten respondents did not identify drinking for any of the motives, suggesting that for a minority, the items selected were not capturing the reasons that they drank alcohol.

Due to the cross-sectional design, we are unable to infer causation or explore temporal trends. It was also not possible to explicitly identify whether no/lo drinks are replacing alcoholic beverages.The cross-sectional design means it is not possible to infer causation, and this study does not explicitly identify whether no/lo drinks are replacing alcoholic drinks, or identify participants who were aiming to reduce their alcohol consumption. Attempting to capture the complexity of alcohol drinking motives with single items may limit the validity and reliability of the study data, however due to budget constraints it was not possible to include the full scale. The patterns of endorsement broadly align with previous research in the UK, although the proportion of respondents reporting to drink to cope with depression was lower [21]. Over one in ten respondents did not identify drinking for any of the motives, suggesting that for a minority, the items selected were not capturing the reasons that they drank alcohol. chis Finally, whilst representative at the population level, certain at-risk groups are underrepresented in surveys like the ATS, including those residing in care homes, or hospitals, prison inhabitants and the military. It is important to be mindful of this when estimating the impact of this policy on alcohol-specific harms.

Conclusions

Our study results indicate that regular consumption of no/lo drinks amongst adults in Great Britain is associated with those who endorse drinking to conform. This aligns with qualitative data on this topic. There was no evidence to suggest a direct association between no/lo consumption and drinking alcohol for how itf makes you feel, to make social occasions more enjoyable, or as a coping strategy, once sociodemographic characteristics and alcohol consumption were accounted for. Understanding the potential for benefit of no/lo drinks remains a public health priority, given their

inclusion in the incumbent UK government's 10-year health plan [5]. The importance of our findings depends on the extent no/lo ~~is~~ drinks are being used to substitute standard alcoholic drinks. Future work should ~~will~~ consider replicating our findings using the full DMQ-R, or similar, exploring the influence of alcohol drinking motives under circumstances where consumers are specifically replacing alcohol with no/lo drinks, and if and how they help to explain sociodemographic differences in consumption.

ACKNOWLEDGEMENTS

We would like to thank colleagues at The University of Stirling and the University of Sheffield who supported recruitment for PPI~~E~~, members from the Stirling Alcohol and Food Discussion Group who reviewed the selected alcohol drinking motive items for the questionnaire, all survey respondents, Ipsos for conducting the research interviews, and University College London who have overall ownership of the Alcohol Toolkit Study.

DECLARATION OF INTERESTS

LB, JB, and IB have received funding for ongoing, unrelated research on alcohol-free and low-alcohol drinks from Alcohol Change UK (ACUK), which received <0.6% of its funds in 2024-5 from Lucky Saint, an organisation that produces and sells non-alcoholic drinks, and owns a pub that sells standard alcoholic drinks. In March 2025, Lucky Saint became an associate member of The Portman Group, a self-regulatory organisation that is fully funded and controlled by the alcohol industry. ACUK has a policy of not accepting any funds from, nor being subject to any influence whatsoever from, the alcohol industry, including through its investment portfolio. ACUK has stated that it is in full compliance with its policy. The research team is discussing its responses to these recent developments. ~~None of the authors have any financial relationship with any organisation(s) that may have an interest in the submitted work, or other relationships or activities that could have influenced the submitted work.~~

FUNDING STATEMENT

This study was funded by a Wellcome Trust PhD grant (218462/Z/19/Z, grant recipient LB). Overall Alcohol Toolkit data collection is funded by Cancer Research UK (grant ref: PRCRPG-Nov21\100002) in England and the UK Prevention Research Partnership (via SPECTRUM, grant ref: MR/S037519/1) in Scotland and Wales. The collection of no/lo consumption frequency data was funded by the NIHR Public Health Research programme (NIHR135310). The collection of alcohol drinking motives data was funded by Wellcome (218462/Z/19/Z). The funders were not involved in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. The views expressed are those of the author(s) and not necessarily those of Wellcome, Cancer Research UK, NIHR, or the Department of Health and Social Care.

DATA AVAILABILITY STATEMENT

Study syntax are openly available at: https://doi.org/10.5281/zenodo.14616172. Non-identifiable anonymised data used in the analysis may be available on request. Please direct any enquiries to the study authors.

TRANSPARENCY DECLARATION

The lead author (LB) is the guarantor of this manuscript. LB confirms this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the pre-registration have been explained.

AUTHOR CONTRIBUTIONS

Lucy Burke: Conceptualisation (lead); data curation (lead); methodology (lead); project administration (lead); formal analysis (lead); writing—original draft (lead); writing—review and

editing (lead). **Colin Angus:** Conceptualisation (supporting), methodology (supporting); formal analysis (supporting); writing—review and editing (supporting), **Jamie Brown:** data curation (supporting) methodology (supporting); formal analysis (supporting); writing—review and editing (supporting). **Inge Kersbergen:** Conceptualisation (supporting), methodology (supporting); project administration (supporting); formal analysis (supporting); writing—review and editing (supporting).

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TABLE 1 Sample characteristics (weighted, *n* = 2597)

Characteristic	**Statistic**
No/lo consumption	*n* (%)
At least monthly	550 (21.2)
Less than once a month	2047 (78.8)
Drinking motives (ordinal)	*M, (SD, range, 95% CI)*
Enhancement	2.71 (1.44,1-5, 2.65, 2.77)
Social	2.64 (1.38, 1-5, 2.58-2.70)
Conformity	1.61 (1.07, 1-5, 1.56, 1.65)
Coping-anxiety	1.60 (1.07, 1-5, 1.55, 1.65)
Coping-depression	1.30 (0.80, 1-5, 1.27, 1.34)
Drinking motives (at least half the time/high endorsers)	*n* (%)
Enhancement	1158 (44.6%)
Social	1105 (42.5%)
Conformity	352 (13.6%)
Coping-anxiety	362 (13.9%)
Coping-depression	164 (6.3%)
Hazardous alcohol consumption	Mean (SD, 95% CI)
AUDIT-C	4.36 (2.54, 4.25 - 4.67)
AUDIT-C score risk classifications	*n* (%)
Low risk (score 0-4)	1551 (59.7%)
Increasing risk (score 5-7)	687 (26.5%)
Higher risk (score 8-10)	321 (12.4%)
Possible dependence (score 11-12)	38 (1.5%)
Age	*n* (%)
16-24	308 (11.8%)

Characteristic		Statistic
25-34		414 (15.9%)
35-44		440 (16.9%)
45-54		455 (17.5%)
55-64		435 (16.7%)
65+		545 (21.0%)
Gender[a]	*n* (%)	
Male		1325 (51.0%)
Female		1272 (49.0%)
Social grade[a]	*n* (%)	
AB (higher or intermediate managerial)		782 (30.1%)
C1 (supervisory/clerical, junior managerial administrative/ professional)		769 (29.6%)
C2 (skilled manual)		554 (21.3%)
DE (semi-/un-skilled manual, casual or lowest grade, pensioners, others who depend on the welfare state for their income).		492 (18.9%)
Highest level of e~~E~~ducation attained	*n* (%)	
Secondary school/ equivalent		673 (25.9%)
College (A Levels)/ equivalent		668 (25.7%)
Undergraduate degree/ equivalent		822 (31.7%)
Postgraduate degree/ equivalent		434 (16.7%)
IMD quintile[ab]	*n* (%)	
1 (most deprived)		431 (16.6%)
2		502 (19.3%)
3		552 (21.2%)
4		555 (21.4%)
5 (least deprived)		558 (21.5%)
Ethnicity	*n* (%)	
White British/Other		2327 (89.6%)
Black British/Other		96 (3.7%)
Asian British/Other		65 (2.5%)
Mixed heritage		62 (2.4%)
Other ethnicities including not specified		47 (1.8%)

[a] Uses imputed estimates where values were missing.

[b] IMD captures local level data on income, health, education, crime, environment, barriers to housing and living environment to produce a measure of relative deprivation. Five response levels range from: 1 = most deprived quintile to 5 = least deprived quintile [42].

TABLE 2 Associations between regular no/lo consumption and alcohol drinking motives (weighted, *n* = 2597)

Indicator	Odds Ratio	95% CI	p value
(Intercept)	0.18	0.13, 0.24	0.000
Enhancement	**1.09**	**1.01, 1.18**	**0.030**
Social	0.97	0.89, 1.06	0.503
Conformity	1.10	0.99, 1.21	0.072
Anxiety	1.08	0.96, 1.20	0.190

Indicator	Odds Ratio	95% CI	p value
Depression	0.99	0.86, 1.13	0.874

Significant relationships (<.05) are highlighted in bold.
* p <.05

TABLE ~~2~~ 3 Associations between regular no/lo consumption and alcohol drinking motives, after accounting for sociodemographic characteristics~~,~~ and alcohol consumption (weighted, *n* = 2597)

Indicator	Odds Ratio	95% CI	p value
(Intercept)	0.08	(0.04, 0.14)	0.000
Enhancement	1.03	(0.95, 1.11)	0.532
Social	0.94	(0.86, 1.02)	0.131
Conformity	**1.10**	**(1, 1.21)**	**0.041***
Anxiety	1.09	(0.99, 1.21)	0.092
Depression	1.02	(0.9, 1.15)	0.799
AUDIT-C (linear)	**1.41**	**(1.21, 1.64)**	**0.000*****
AUDIT-C (quadratic)	**0.98**	**(0.96, 0.99)**	**0.000*****
Women (compared to men)	0.86	(0.71, 1.05)	0.149
Age 25-34[a]	0.94	(0.64, 1.38)	0.756
Age 35-44[a]	1.00	(0.68, 1.47)	0.985

Indicator	Odds Ratio	95% CI	p value
Age 45-54[a]	0.88	(0.6, 1.29)	0.514
Age 55-64[a]	0.94	(0.63, 1.39)	0.744
Age 65+[a]	1.03	(0.7, 1.5)	0.894
A levels / equivalent[b]	0.90	(0.67, 1.21)	0.493
Undergraduate degree/ equivalent[b]	**1.43**	**(1.08, 1.89)**	**0.013***
Postgraduate degree/ equivalent[b]	**1.57**	**(1.13, 2.18)**	**0.007****
Skilled manual workers[c]	1.05	(0.75, 1.45)	0.791
Supervisory, clerical and junior managerial, administrative or professional[c]	1.18	(0.86, 1.62)	0.295
Higher/intermediate managerial, administrative or professional[c]	1.18	(0.85, 1.63)	0.315
IMD	0.99	(0.92, 1.08)	0.881

~~Indicator~~	~~Odds Ratio~~	~~95% CI~~		~~p value~~
		~~Lower~~	~~Upper~~	
~~Intercept~~	~~0.10~~	~~0.06~~	~~0.16~~	~~<0.001~~
~~Enhancement~~	~~1.03~~	~~0.95~~	~~1.11~~	~~0.532~~
~~Social~~	~~0.94~~	~~0.86~~	~~1.02~~	~~0.131~~
~~**Conformity**~~	~~**1.10**~~	~~**1.00**~~	~~**1.21**~~	~~**0.041***~~
~~Anxiety~~	~~1.09~~	~~0.99~~	~~1.21~~	~~0.092~~
~~Depression~~	~~1.02~~	~~0.90~~	~~1.15~~	~~0.799~~
~~**AUDIT-C (linear)**~~	~~**1.41**~~	~~**1.21**~~	~~**1.64**~~	~~**<0.001****~~
~~**AUDIT-C (quadratic)**~~	~~**0.98**~~	~~**0.96**~~	~~**0.99**~~	~~**<0.001****~~
~~Age (linear)~~	~~1.00~~	~~0.76~~	~~1.30~~	~~0.988~~
~~Age (quadratic)~~	~~1.09~~	~~0.84~~	~~1.40~~	~~0.523~~
~~Age (cubic)~~	~~1.05~~	~~0.82~~	~~1.34~~	~~0.679~~
~~Age (^4)~~	~~1.03~~	~~0.81~~	~~1.31~~	~~0.809~~
~~Age (^5)~~	~~0.92~~	~~0.73~~	~~1.17~~	~~0.500~~
~~Women (compared to men)~~	~~0.86~~	~~0.71~~	~~1.05~~	~~0.149~~
~~**Education (linear)**~~	~~**1.50**~~	~~**1.19**~~	~~**1.90**~~	~~**<0.001****~~
~~Education (quadratic)~~	~~1.10~~	~~0.90~~	~~1.35~~	~~0.331~~
~~**Education (cubic)**~~	~~**0.81**~~	~~**0.67**~~	~~**0.98**~~	~~**0.034***~~
~~Social grade (linear)~~	~~1.14~~	~~0.91~~	~~1.44~~	~~0.238~~
~~Social grade (quadratic)~~	~~0.98~~	~~0.79~~	~~1.20~~	~~0.827~~
~~Social grade (cubic)~~	~~0.96~~	~~0.79~~	~~1.17~~	~~0.657~~
~~IMD~~	~~0.99~~	~~0.92~~	~~1.08~~	~~0.881~~

Significant relationships (<.05) are highlighted in bold.

* p <.05, ** p <.0~~0~~1, p <.001***

Reference cases: [a] Age 16-24, [b] Secondary school or equivalent, [c] Semi-skilled and unskilled manual workers, pensioners, casual and lowest grade workers, unemployed and in receipt of state benefits only.

bmjph-2025-002828 - "Does why we drink alcohol matter? A cross-sectional study investigating associations between alcohol drinking motives and alcohol-free and low-alcohol drink consumption amongst adults in Great Britain."

Dear Mrs. Burke,

Following review of your article to BMJ Public Health, we invite you to submit a major revision.

The review comments can be found at the end of this email, together with any comments from the Editorial Office regarding formatting changes or additional information required to meet the journal's policies at this time.

Please note that your revision may be subject to further review and that this initial decision does not guarantee acceptance.

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The reviewers' comments, your response, and the previous versions of your article will be published as supplementary information alongside the final version of your article.

Pay close attention to detail when you submit your revision. In addition to the main content please ensure the accuracy of information relating to your article, including author names and affiliations, title, abstract and required statements (e.g. competing interests, contributorship, funding). These details will be taken directly from the information held in ScholarOne, and not from the article file. Please check that this information has been entered correctly and has been updated as appropriate.

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Please submit your revised article by 20-Jul-2025. If we have not received it by this date, the opportunity to submit a revision will expire and your article may be treated as a new submission. If you need to request an extension, please contact the Editorial Office as soon as possible.

Thank you for submitting your article to BMJ Public Health; we look forward to receiving your revision.

If you have any queries, please contact the Editorial Office at info.bmjph@bmj.com.

Kind regards,

Dr. Thomas Phillips
Research Editor, BMJ Public Health

Editor(s)' Comments to Author (if any):

*** Your Response**

Authors' response

Comment	Author response
Editor's comments	
In your ethics statement, please indicate whether or not participants provided informed consent.	The following text has been added under the **ethics** subheading. *Researchers explain the survey to potential participants and provide assurance that it is being conducted in line with the Market Research Society Code of Conduct. Prior to participating, respondents provide verbal consent.*
Formatting Amendments (where applicable): 1. Please ensure that the key messages has the following headings. This section should be no more than 3-5 sentences and should be distinct from the abstract; be succinct, specific and accurate. What is already known on this topic What this study adds How this study might affect research, practice or policy	These headings have now been included for the **key messages.**
2. Please include a Patient and Public Involvement statement in the methods section of their papers, under the subheading 'Patient and public involvement'	The Personal and Public Involvement and Engagement (PPIE) statement, page 10, has been renamed Patient and public involvement (PPI).

If there's none, please state 'No 'Patient and public involvement'.	
Reviewer 1	
Comments to the Author The present study describes a **cross-sectional analysis of the relationship between drinking motives and no/lo consumption, accounting for sociodemographic factors**. A key strength is that these data are from a **nationally representative sample**. I commend the authors for assessing a **key aspect of alcohol use (i.e., motives) that may help to explain the potential public health benefits of no/lo drinks, yet has not been examined previously.** While many of my recommendations are related to enhancing readability, some are more substantive, regarding: **justification for the approach taken in defining drinking motives**; **hypotheses**; **aspects of the analytic approach**; and integrating **interpretation of primary analyses with sensitivity analyses in the discussion.** Also note that **informed consent needs to be described.**	Thank you for your review. We provide our responses to your comments below, highlighting where changes have been made in the manuscript.
Title 1. I defer to the authors, but you might consider altering the title. The first part "Does why we drink alcohol matter?" does not include any reference to the second part of the research question which is "does it matter for no/lo drink consumption." Would recommend removing or rephrasing.	The title has been updated. *Is why we drink alcohol important when considering the potential public health benefit of alcohol-free and low-alcohol drinks? A cross-sectional study investigating associations between alcohol drinking motives and alcohol-free and low-alcohol drink consumption amongst adults in Great Britain.*
Abstract	
1. P. 1 Line 50: Change "increasing the" to "increased"	We have updated the text.

	*The UK has promoted **increased** availability of alcohol-free and low-alcohol drinks (no/lo, ≤1.2% ABV) as a public health strategy.*
2. P.1 Line 57: Consider rewording "may be important when investigating the potential public health impact of these drinks" more directly to "may be an important determinant of the potential public health impact of these drinks."	We have updated the text *Emerging qualitative evidence suggests the reasons people drink alcohol **may be an important determinant of the potential public health impact of these drinks.***
3. P.2 Line 17: Change to "less than vs. at least monthly" if that is what this is meant to indicate.	We have updated the text *The dependent variable was frequency of no/lo consumption **(less than versus at least monthly**).*
4. P.2 Line 19: I recommend noting that that items were derived from the DMQ-R.	We have updated the text *Five questions captured respondents' alcohol drinking motives (enhancement, social, conformity, coping-anxiety, coping-depression), **derived from the Drinking Motives Questionnaire-Revised.***
5. P.2 Line 22-23: I was not familiar with "index of deprivation" and suspect other readers may not be either. Consider clarifying what this means (and using "Index of multiple deprivation" for consistency with main text.)	We have corrected the omission of 'multiple' and have updated the text to provide clarity. *Sociodemographic characteristics, (including age, gender, social grade, education, **index of multiple deprivation (a UK-wide measure of relative deprivation for small geographic areas),** and hazardous alcohol use (AUDIT-C) were **also assessed.***
6. P.2 Line 24: Consider changing "were included in analyses" to "were also assessed" so that it is not redundant with the next paragraph that says these variables were accounted for.	We have updated the text (see 5)
7. P.2 Line 26-28: Recommend rephrasing for clarity.	We have updated the text to improve clarity.

	The analysis presents the relative frequency of high endorsement (i.e., drinking for a motive at least half the time) versus low endorsement (i.e., drinking for a motive less than half the time) of each drinking motive among at-least monthly no/lo drinkers.
Introduction	
8. P.4 Line 6: Define ABV at first use.	We have updated the text *In the UK, no/lo drinks are defined as alcoholic or alcoholic type (e.g. beer, wine, spirits) drinks that contain ≤1.2%* ***alcohol by volume*** *(ABV, 10),*
9. P.4: I recommend condensing the paragraph about different drinking motive scales. I'm not clear how the DMQ-A is relevant. More generally, it seems that this paragraph is meant to justify the approach taken in separating coping-anxiet and coping-dep based on Cooper's DMQ-R items, but I'm not entirely convinced that approach was needed. Perhaps in condensing, that justification will come across more clearly.	We have substantially edited this paragraph and have focussed on the selected measure. A justification of the measure selected is now provided in the methods section. **Updated paragraph in introduction** *Cox and Klinger's (1988) motivational model of alcohol use places alcohol drinking motives along two dimensions (24). Firstly, motives are identified as having an internal (the self) or external (social environment) source, and secondly, motives are driven by positive (e.g., drinking alcohol for the buzz, making social occasions more enjoyable), or negative (e.g. coping with low mood or anxiety, conforming to expectations) reinforcement. Several measures of drinking motives exist (18, 25, 26). Cooper et al's (1994) drinking motives questionnaire captures drinking alcohol for enhancement, conformity, social, and coping reasons, and is a widely used and well-validated tool (25). Its psychometric properties have been tested in multiple countries, and importantly, on adult populations (27-30).* **Updated section in methods** *We also chose to distinguish between coping-anxiety and coping-depression by selecting two items from the coping subscale which represent these different aspects of coping. This distinction was made due to evidence that these motives are differentially associated with drinking patterns and socioeconomic status (18, 47). Whilst the modified DMQ-R*

	distinguishes between these two motives, its authors note it has unsatisfactory psychometric properties for its social scale and has not yet been validated on adults (18). Therefore, we chose to use items from the DMQ-R (25).
10. P.6 Lines 14-19: The hypothesis should be worded differently as two groups were not compared. Based on the analytic approach, it seems that the hypothesis was that external motives would be associated with higher odds of drinking no/lo at least monthly, and that either internal motives would be associated with lower odds or not significantly associated. Please also clarify how you are operationalizing "socially advantaged."	We have reworded the hypotheses and included details regarding how socially advantaged was operationalised. We have included a sentence stating that we also explored whether neighbourhood level deprivation was associated with no/lo consumption, as this has not yet been explored. *The study addressed the following hypotheses:* *People who endorse drinking alcohol for internal reasons (enhancement and to cope with anxiety or depression) will have significantly lower odds of consuming no/lo drinks at least monthly than those who do not drink alcohol for these reasons after accounting for sociodemographic characteristics and hazardous drinking. We did not expect an association between external motives and no/lo consumption. We also expected to find a higher odds of regular no/lo consumption amongst those who were socially advantaged, assessed using measures of social grade and highest level of education received, and higher risk drinkers, as found with previous work (40). We explored whether neighbourhood level deprivation was associated with no/lo consumption, using the index of multiple deprivation (IMD, 41).*
11. P.6 Line 32: Recommend reporting the legal age to drink alcohol in the UK and offering justification for including 16-17yo, who cannot legally drink. [I see later that age is captured as 16-24 so probably cannot differentiate 16-17yos, in which case, consider noting this as a limitation in the discussion.]	We have added a sentence in paragraph 3 to describe the UK legal age for **purchasing** alcohol and the current arrangements regarding no/lo purchasing. It is not illegal for young people aged 16-17 to consume alcohol in certain settings e.g. at home, or in some licensed premises when accompanied by adults. *In Great Britain, whilst currently not illegal, there is a voluntary agreement amongst alcohol licence holders that no/lo drinks are not sold to individuals*

	aged under 18, in line with the legal age for purchasing alcoholic drinks. This may be formally legislated
Methods	
12. P.6 Line 35: Consider clarifying in what ways this is nationally representative (e.g., in terms of age, gender, etc.)	Details have now been provided. *The sampling process aims to recruit a study population that is nationally representative in terms of gender, working status, prevalence of children in the household, age, social grade and region (42). A rim (marginal) weighting technique is used to ensure the target profiles were met (43).*
13. P.6 Line 57: Define weighted sample and clarify that the sample of 2555 involved imputed data.	The use of rim weighting is now described in the **design** section with further detail to clarify that the sample includes imputed data within the **sample** paragraph. **Sentence from Design** (see point 12) **Sentence from Sample** *After removing those whose responses made them ineligible for inclusion, there remained a sample of 2555. This included 440 cases with missing data, typically single items missing, using imputed data for missing items (see Supplementary Material, Figure 1 for a participant flow-chart, and Analysis for further detail).*
14. P.7 Line 19: “respondent” should be “responded”	Text has been updated. *Participants **responded** on an 8-point scale, ranging from Never - Nearly every day*
15. P.7 Line 35: Recommend removing this line about psychometric properties, since the full scale was not used in this study.	This has been removed. The text has been updated to include detail removed from the introduction regarding the justification of the selected measure (see point 9 for the updated text).
16. P.7 Line 46: Clarify whether single items of the DMQ-R have been used to represent motives in prior research.	Have specified that these references include a study which included single items to capture the individual drinking motives identified in Cooper’s DMQ-R.

	Single items have been used to capture alcohol drinking motives, including the motives captured in the DMQ-R, elsewhere (45, 46).
17. P.8 Line 17: Has this binary approach been taken before? If you choose to retain it, I would recommend still reporting descriptives on the continuous outcome (e.g., mean, SD).	We sought feedback on our paper from topic experts at the Kettil Bruun conference in 2024 where it was suggested that dichotomising the drinking motive responses may be a worthwhile sensitivity analysis due to the small cell sizes for some response options. It was also felt it could aid interpretation of the descriptive data. We have now also reported the drinking motives items continuously as well as binary in the text on page 8 and in table 1. We have changed our analysis from a chi-square to a regression. **Methods: Descriptive analysis and regression modelling** *Descriptive analyses illustrate the proportions of respondents regularly consuming no/lo drinks for low and high endorsers of each alcohol drinking motive. Quasibinomial logistic regression models including drinking motives as continuous variables tested for associations between regular no/lo consumption (dependent variable) and alcohol drinking motives.*
18. P.11 Line 12: Please offer justification for why the sensitivity analytic approach shifted form rank ordering to binary motives. Treating them as binary would seem to just reduce power unnecessarily.	Whilst we were interested in including rank ordering to explore the relative importance of drinking motives as well as their absolute importance, this was not possible due to the low numbers of respondents ranking depression, anxiety, and conformity as their 'top motive'. Further explanation is now provided in the methods section where we explain deviations from the pre-registration. *Regression models using rank ordering are not presented. We had been interested in exploring whether both relative and absolute endorsement of the alcohol drinking motives was important. However, very few respondents rated drinking alcohol for depression (n=31, 1.2%), anxiety (n=50, 2.0%),*

	and conformity (n=94, 3.7%) as their primary motive, meaning this analysis was not possible.
19. P.12 Line 19-21: Please provide a citation for this approach.	We have replaced the chi-square test with an unadjusted regression model. Whilst the findings are equivalent, this model uses the continuous variables (recommended in 17) and is comparable with the primary analysis. *Quasibinomial logistic regression models tested for associations between regular no/lo consumption (dependent variable) and, alcohol drinking motives. The first unadjusted model included drinking motives and no/lo consumption.*
Results	
20. P.13 Line 53: Use “odds” in place of “likelihood”	Have updated the text *In the adjusted model which included key sociodemographic characteristics , enhancement was no longer significantly associated with no/lo consumption. In this model, drinking alcohol to conform was the only motive significantly associated with an increased odds of consuming no/lo alcohol drinks at least monthly (Odds Ratio = 1.10, 95% CI [1.00, 1.21], p=0.041). For every one-unit increase in the conformity motive score, the odds of consuming no/lo drinks at least monthly increased by approximately 10%, assuming all other variables in the model were held constant.*
21. P.13 Line 57: Please rephrase to “none were significant” rather than “all were non-significant.”	We have updated the text *The remaining drinking motives did not show a significant association.*
22. P.14 Lines 3-5: Linear should not be interpreted when there is a higher order term – only need to comment on the higher order term (at least for the AUDIT-C; I’m not familiar with the polynomial approach taken for education).	We have rewritten the results of the adjusted regression to provide more clarity regarding our interpretation of the linear and quadratic relationships between Audit C and No/lo consumption. To improve and further aid interpretation we have rerun the analysis for age, social grade, and education, using factors rather than higher order polynomials. This allows the reader to interpret each level against the reference category (Table 2).

	Regarding the sociodemographic characteristics, the analysis revealed a curvilinear relationship between AUDIT-C score (a measure of alcohol use severity) and no/lo alcohol consumption. While Audit-C scores were positively linearly associated with an increased likelihood of consuming no/lo drinks at least monthly (OR = 1.41, 95% CI [1.21, 1.64], p<0.001), the strength of this association weakened at higher levels of Audit-C (OR = 0.98, 95% CI [0.96, 0.98], p<0.001). Furthermore, compared to the reference group (secondary school education or equivalent), individuals with higher education levels (Higher Education/equivalent: OR = 1.43, 95% CI [1.08, 1.89], p=0.013; Post-graduate/equivalent: OR = 1.57, 95% CI [1.13, 2.18], p=0.007) were significantly more likely to consume no/lo drinks at least monthly.
Discussion	
23. P.14 Line 37: Change “this” to “drinking motives.”	We have updated the text *Qualitative research in the UK and Australia has already indicated **drinking motives** may influence why some people choose to consume no/lo drinks and others do not (33-35, 37).*
24. P.14 Lines 39-44: Rephrase for readability.	We have updated the text *If no/lo drinks are promoted to improve public health via substitution, it is important to develop our understanding of how this change may occur.*
25. P.14 Lines 55-6: Rephrase for readability.	We have updated the text *We hypothesised that we would see a decreased odds of no/lo consumption amongst those drinking for internal reasons and no effect for those drinking alcohol for external reasons. What we found was no association between internal drinking motives and no/lo consumption, and an increased odds of drinking no/lo for those who endorsed drinking alcohol to conform. In the adjusted model, conformity was the only drinking motive associated with regular no/lo consumption. For each unit level increase in*

	endorsement of conformity, the likelihood odds of reporting consuming no/lo drinks regularly increased by 10% (Table 2).
26. P.15 Line 12 (and throughout): Use consistent terminology. There is some alternating between "alcohol-free and low-alcohol drinks" and "no/lo" and "no/lo drinks". One option would be to say "no-alcohol and low-alcohol (no/lo) drinks" the first time then using "no/lo drinks" subsequently.	We have edited the text to use alcohol-free and low-alcohol drinks on first mention in the introduction and discussion and then no/lo drinks subsequently.
27. P.16 Line 6: Reword as it is not clear what "groups" are being referred to (keeping in mind that people may hold multiple motives) – e.g., "encourage people with x and y motives…"	We have updated the text. *If no/lo drinks prove effective for reducing hazardous drinking, it would be important to consider strategies to encourage those who use alcohol as a coping mechanism, for its mood enhancement properties, or to make social occasions more enjoyable to switch to lower strength products, whilst being mindful that additional approaches may be needed.*
28. P.16 Line 16: Consider providing examples of drinking motives predominant among less advantaged groups, if available.	Have inserted three references for studies exploring how drinking motives vary as a function of socioeconomic status. *21. Heim D, Monk RL, Qureshi AW. An examination of the extent to which drinking motives and problem alcohol consumption vary as a function of deprivation, gender and age. Drug Alcohol Rev. 2021;40(5):817-25.* *22. Martin G, Inchley J, Currie C. Do Drinking Motives Mediate the Relationship between Neighborhood Characteristics and Alcohol Use among Adolescents? Int J Environ Res Public Health. 2019;16(5).* *47. Karriker-Jaffe KJ, Liu H, Kaplan LM. Understanding Associations Between Neighborhood Socioeconomic Status and Negative Consequences of Drinking: a Moderated Mediation Analysis. Prev Sci. 2016;17(4):513-24.*
29. P.16 Line 28: Remind the reader what theory is being referred to.	Have respecified that the theory is Cox and Klinger's motivation model of alcohol use.

	This study was informed by the qualitative literature on no/lo consumption, which was then mapped onto Cox and Klinger's motivational model of drinking motives (24, 25, 33, 35, 38).
30. P.16 Line 30: Clarify the "several types of data" being referred to (seems like it is just quantitative and qualitative). In general, the latter part of this sentence is a bit unclear.	We have updated the text and the second part of the sentence has been removed (see updated text in point 29).
31. P.16 Line 55: Consider explaining how the lower rates of drinking to cope may have impacted results – e.g., what would you expect had the rates mirrored prior work.	This has been updated to align with more recent data. *The patterns of endorsement for our selected items were consistent with a recently conducted, cross-national study of drinking motives (including Great Britain), supporting the reliability of our estimates (60).*
32. P.17 Line 12: "if" should be "it"	We have updated the text. *There was no evidence to suggest a direct association between no/lo consumption and drinking alcohol for how **it** makes you feel, to make social occasions more enjoyable, or as a coping strategy, once sociodemographic characteristics and alcohol consumption were accounted for.*
33. Need to interpret results of sensitivity analyses.	The discussion has been updated to incorporate the findings from the sensitivity analyses. *However, we must note that the overall effect size was small and the sensitivity analysis which explored drinking motives on a binary scale did not consistently support the individual associations observed in the primary model regarding these motives.*
Table 2/Supplementary materials	
34. Define "IMD"	Have added a definition for IMD for Table 1
Reviewer 2	
Minor notes: --The discussion of how motives have been measured	Have updated this section and largely removed the discussion regarding alternative drinking motive measures. Please see reviewer 1 point 9 for the revised text.

by different researchers on pages 4-5 seems unnecessary and off topic.	
--On page 7, the first sentence of the alcohol drinking motives measure description isn't complete.	This has been updated. *Alcohol drinking motives were captured using five items from Cooper et al's (1994) Drinking Motives Questionnaire Revised (DMQ-R, 25).*
--The text should not repeat the numbers that are already presented in the tables.	We have removed some of the numbers from the text. However, where we felt that retaining the numbers aided the flow of the manuscript without having to review the table, these have remained.
--Figure 1 could be changed into a table so that it includes the confidence intervals now included in the text.	We have added a table to the supplementary materials (Supplementary Table 3), whilst retaining the graph within the main manuscript.
Reviewer 3	
Comments to the Author Thank you for the opportunity to review this timely manuscript exploring whether drinking motives are related to the use of low alcohol and alcohol free drinks. I think this is an interesting question, in fact one I had thought of exploring myself, so I am pleased to see this study using the Alcohol Toolkit data. Overall this is a clear paper with a useful message about drinking to conform, which we might expect given existing information about drinking motives and the role of No/lo. I have a few suggestions as to how to strengthen the manuscript for clarity.	Thank you for your review. We have responded to your comments below, identifying where we have edited the manuscript.
I have a few suggestions as to how to strengthen the manuscript for clarity. 1. Re the key messages – it was the previous government who made the endorsement about No/lo –	We have updated the text in response to the publication of the current government's 10-year plan. *Since 2019, alcohol-free and low-alcohol (no/lo) drinks have been endorsed by successive UK's governments as a public health strategy.*

I think we are still waiting to see what the new government might think on this.	
2. Introduction: Terminology: At the start of the introduction the authors use both “alcohol-free and low-alcohol (no/lo)” and “lower-strength alternatives.” It would be good to use one set of terminology.	We have updated the text. *If consumers can be encouraged to substitute standard alcohol with no/lo alternatives this could lead to a public health benefit (4, 9).*
3. Although not a UK only study like this, a recent Global Drug Survey study on No/Lo and reasons for use/not use does touch on drinking motives and could be useful to cite if you see fit – and would support your point about intoxication as well. https://onlinelibrary.wiley.com/doi/10.1111/dar.14006	We became aware of this paper following submission, and have now included this reference in our introduction and discussion regarding the relationship between alcohol drinking motives and no/lo consumption, and who these drinks may benefit.
4. The paper is quite critical of the adult DMQ measure, yet only uses five single items to measure drinking motives. I would temper the discussion and conclusions based on this limitation of the study. I think the argument that this was for financial reasons does not fully account for the limitation.	The limitations of using single items and our strategies to mitigate those are described in the discussion, now including a recommendation for future work to include the full measure. **From the limitations section** *A trade-off by using the ATS was that it was not feasible to include the full DMQ-R. This is not uncommon when using large surveys, where the constructs of interest comprise a small aspect of the survey (63, 64). Using single items rather than the full scale may limit the validity and reliability of our findings, by not fully capturing the dimension it represents, and may have been further compounded by respondents who reported “don’t know” in response to the drinking motive items, whom we excluded from the analysis. If we had chosen different items to represent our constructs, for example if we had measured enhancement using “Because it’s exciting” rather than “Because you like the feeling” we may have had different findings. However, we took a considered approach to our item selection. The patterns of endorsement for our selected items are consistent with a recently conducted, cross-national study of drinking motives (including Great Britain), supporting the reliability of our estimates (60).*

	From Conclusions *Future work should consider replicating our findings using the full DMQ-R, and exploring the influence of alcohol drinking motives under circumstances where consumers are specifically replacing alcohol with no/lo drinks, and if and how they help to explain sociodemographic differences in consumption.*
5. Linked to the above point, one way to develop this would be to give clearer direction for future research to further explore and confirm that drinking to conform is linked to NoLo use.	We have described future work and specified that we will use the full measure (see updated text in point 4). There remains limitations in the current measure with regards to capturing conformity. Whilst that is unfortunately beyond the scope of this current work, it is something we would welcome and are investigating further.
Reviewer 4	
Comments to the Author 1. Data I have following points about data that need to be acknowledged in limitations or addressed in the main text: a. Limited Sample Size for Analysis: Although the Alcohol Toolkit Study is nationally representative, the analytical sample used in this study (n = 2,555) was drawn from only two monthly waves (February and April 2023). The final effective sample used in the regression models was further reduced due to missing data and exclusions. This narrowing of the sample limits statistical power, particularly for subgroup analyses and for detecting interaction effects.	Thank you for your detailed response. We have provided details of where we have updated the text to improve the clarity of our paper and provide further responses below. a. The drinking motives items were purchased specifically for these 2 waves. We have edited our text to make this clearer which should explain why some of the reviewer's queries were not addressed in our paper. Our sample is sufficient for the analyses proposed.
b. Exclusion of a Significant Proportion of Respondents: Over 400 respondents were excluded due to missing or inconsistent data, such as uncertainty about their drinking motives or inconsistencies in reporting no/lo consumption. These	We recognise that there are debates as to the most appropriate methods for dealing with inconsistent reporting and data from respondents who 'don't know'. Both including and excluding these participants can introduce bias.

exclusions raise concerns about potential systematic bias, especially if excluded individuals differed in meaningful ways—such as having lower literacy, being from minority ethnic groups, or exhibiting higher-risk drinking behavior—compared to those retained in the analysis.	Regarding inconsistent reporting, our methods align with published work using this data (Perman-Howe et al, 2024) and are recognised as common practice for dealing with unreliable data (Ward et al, 2023). Further detail of our approach is now provided in the text, including these references. For those who had responded that they didn't know how often they drank for a particular motive, we felt that it was not appropriate to impute responses. (see Purdam et al, 2020). This did not influence key observed characteristics. We expect that further research using the full scale would make it easier to overcome these issues. *Data preparation and analyses were undertaken in R 4.3.1 (50). The following groups of respondents were removed:* *i. Respondents who answered inconsistently regarding their no/lo consumption (i.e., responding that they engaged in situation specific no/lo consumption: hybrid, on-trade, or off-trade more often than they reported drinking no/lo overall, n=163).* ***This follows good practice advice for data cleaning (51) and aligns with practice used in other studies reporting on this data (40).*** *ii. Respondents who reported that they did not know whether they drank alcohol for any of the drinking motives (n=189).* ***Whilst a debate exists as to whether 'don't know' responses should be treated as missing, or identified as a substantive response (52), for our research we chose to exclude these participants. We found that individuals providing a don't know response for the drinking motives did not differ from the rest of the sample on key demographic variables (age, sex, social grade, education level, alcohol consumption, no/lo consumption). (52)***
c. Use of Single Items to Measure Complex Constructs: Key psychological constructs like drinking motives were measured using single-item indicators due to budget limitations. This reduces the validity and	This is identified as a limitation of the study in the discussion. We compare our findings with other recent studies which have used the full scale and acknowledge that if we had selected different items we may have found different conclusions.

reliability of the measures. Complex motivations are difficult to capture in a single question, and such simplification may result in weaker associations or underestimation of effects in the statistical analysis.	**Please see reviewer 3 point 4 for the updated text.**
d. Exclusion of Key Independent Variables: Several relevant variables available in the Alcohol Toolkit Study were not included in the regression models. These include region (England, Scotland, Wales), rural versus urban residence, mental health status, employment and income levels, and household composition or social support. These variables could have acted as important covariates or moderators, providing a richer understanding of the dynamics between drinking motives and no/lo consumption.	We chose not to include region and rurality in our current study due to findings from another study (Perman Howe et al, 2024) already publishing findings on regional differences using a larger data set. *Analyses exploring location and rurality were not pursued. This decision was based on a recently published analysis (40), which used a larger dataset from the same source and yielded inconclusive findings. We determined that a similar analysis with our smaller sample would be unlikely to provide meaningful insights.* The interaction effects proposed would be interesting to explore in future research, but are beyond the scope of this pre-registered study.
e. Underutilization of Survey's Rich Longitudinal and Policy-Relevant Variables: The Alcohol Toolkit Study collects additional data on policy exposure, past attempts to reduce alcohol consumption, and public attitudes toward alcohol-free alternatives. None of these variables were incorporated in the current analysis. Including them would have allowed for a more holistic model that accounts for behavioral intention, policy responsiveness, and social context. f. Minimal Representation of Minority Ethnic Groups: Although ethnicity was recorded and reported descriptively, it was not included in the regression analysis due to the small number of respondents in non-White ethnic groups. This limits the	e. These are interesting considerations, but beyond the scope of the current study which was a novel study exploring whether alcohol drinking motives are associated with no/lo consumption. We agree extending our exploratory work to incorporate items from the theory of planned behaviour could be a worthwhile future avenue for this work. f. We believe that questions regarding cultural and community patterns of alcohol use and substitution behaviour are important, and would be better answered with a different dataset with larger samples of minority groups to specifically explore this. g. The cross-sectional design is cited as a limitation. The ATS is not a longitudinal survey, so whilst a longitudinal analysis would be interesting it is beyond the scope of this study.

generalizability of the findings and overlooks possible cultural or community-specific patterns in alcohol use and substitution behavior. g. Cross-Sectional Design and Temporal Limitations: The study relies on data from only two time points, which restricts the ability to observe seasonal patterns, responses to policy changes, or broader behavioral trends. A more robust longitudinal analysis using multiple survey waves would enhance causal inference and allow for time-based analysis of substitution effects.	
h. Potential Non-Random Missingness: The results of Little's MCAR test indicated that the missing data were not completely at random. Although the authors used multiple imputation to handle missing values, the presence of non-random missingness suggests that residual bias from unobserved or unmeasured factors may still affect the results.	h. We have now specified our assumption that data was MAR and therefore MI was suitable. *By investigating patterns of missing data, there was no evidence of systematic missingness, therefore we felt it was appropriate to assume the data was missing at random and proceeded with multiple imputation, using the mice package in R (54, 55).*
2. Suggestions: The manuscript would benefit from a minor revision focused on expanding the limitations section and clarifying the analytical scope. Specifically, the authors should acknowledge that the use of single-item measures for complex constructs like drinking motives may limit the depth and reliability of the findings.	The limitations of using single items is now further addressed in the discussion. Please see Reviewer 3, point 4.
3. Additionally, the exclusion of a significant portion of the sample due to missing or inconsistent data raises concerns about potential selection bias, which could affect the generalizability of the results. The authors	These suggestions are responded to above (see points b, c, d).

should also explain the rationale for not including key variables—such as geographic region, rural-urban location, employment status, and mental health—that are available in the Alcohol Toolkit Study and may influence both drinking motives and no/lo consumption.	
4. Finally, the limitations section should more clearly state that the study's findings are based on only two survey waves and a cross-sectional design, restricting causal interpretation and the ability to observe temporal or policy-related patterns. Addressing these points will improve the transparency and interpretability of the findings.	The limitations of using a cross-sectional design are included within the limitations section. Temporal and policy-related patterns are beyond the scope of this study. *Due to the cross-sectional design, we are unable to infer causation or* ***explore temporal trends****. It was also not possible to explicitly identify whether no/lo drinks are replacing alcoholic beverages.*
5. Literature Review The literature review may consider including recent publications: a. Anderson P, Kokole D, et al. (2021). "Is buying and drinking zero and low alcohol beer a higher socio-economic phenomenon?" b. Bresin K & Mekawi Y. (2021). "The 'Why' of Drinking Matters: A Meta-Analysis of the Association Between Drinking Motives and Drinking Outcomes." c. Vasiljevic M, Couturier DL, Marteau TM. (2018). "Impact of low-alcohol and alcohol-free product availability and labeling on alcohol consumption: A systematic review."	A and B are already included in the paper. We were unable to retrieve reference C to determine its relevance. We did find a similar reference Vasiljevic M, Couturier DL, Frings D, Moss AC, Albery IP, Marteau TM. Impact of lower strength alcohol labeling on consumption: A randomized controlled trial. Health Psychol. 2018 Jul;37(7):658-667. doi: 10.1037/hea0000622. Epub 2018 Apr 26. PMID: 29698021; PMCID: PMC6001942. But this is about lower strength and not low-strength and zero-alcohol, so did not believe it was sufficiently related to the paper to include.
6. Other limitations of the study that need to be highlighted • First, alcohol consumption and related behaviors	This limitation is now included within the study limitations.

were self-reported, which may result in underreporting due to social desirability and recall bias.	*The analysis uses self-report data, which is subject to recall and social desirability bias and influenced by individual interpretations of the items.*
• Second, the statistical models used may not fully account for selection bias or unmeasured confounding.	We have acknowledged this by framing our findings as associations rather than suggesting cause and effect.
• Third, the sample excludes institutionalized and unhoused individuals, potentially underrepresenting populations with high alcohol-related harm.	We have added detail about underrepresented populations and the impact this has when estimating the impact of the policy on alcohol-related harms. *Finally, whilst representative at the population level, certain at-risk groups are underrepresented in surveys like the ATS, including those residing in care homes, or hospitals, prison inhabitants and the military. It is important to be mindful of this when estimating the impact of this policy on alcohol-specific harms.*
Model fit and sensitivity analysis While the study employed a quasibinomial regression model to account for overdispersion and included polynomial terms to adjust for non-linearity, formal tests of model fit such as the Hosmer–Lemeshow test or discrimination metrics like the ROC curve were not conducted. We also did not assess multicollinearity or influential observations, which may affect the stability of regression estimates. Furthermore, while multiple imputation was used for missing data, imputation diagnostics and the impact of survey weighting were not systematically evaluated. These omissions should be considered when interpreting the robustness and generalizability of the findings.	We have added detail regarding testing the assumptions of the primary analysis. This included testing for collinearity and influential observations. *All analyses were population weighted and tests for the key assumptions of this analysis were undertaken (57). The data breached the linearity of log-odds assumption for AUDIT-C therefore an exploration of higher polynomial terms for AUDIT-C was undertaken. This indicated that AUDIT-C had a quadratic relationship with the dependent variable, consequently a linear and quadratic term for AUDIT-C were included in the model. There was no evidence of multicollinearity among independent variables using Variance Inflation Factors (VIFs, Supplementary Table 2). The discriminative power of the primary model was assessed using Receiver Operating Characteristic (ROC) Area Under the Curve (AUC).* We acknowledge the omission of formal tests of model fit and discrimination metrics in the original submission. We have now calculated the Area Under the Receiver Operating Characteristic (ROC) Curve (AUC) for our pooled model. The AUC was found to be **0.605**, indicating **fair discrimination** in

	distinguishing between respondents who drink no/lo monthly and those who do not. We have included this metric in the revised manuscript. *The AUC was 0.61, indicating fair discrimination in distinguishing between respondents who consume no/lo drinks at least monthly and those who do not*.
Editorial Page 27 or 30, Supplementary Table 1: p-value need to be corrected to as follows – ** p<0.05. *** p<0.01; please check if conformity is *** or **. Try to have a consisted p-value rating across the paper. Table 2 has different star rating of p-values. Table 2 – title may indicate that the results are based sample after excluding some variables. Sample size of the model may be given along with	This has been updated throughout the paper so that : ** p< .05, ** p<.01, *** p<.001* We have updated the title of table 2 to include the study sample *n.* ***TABLE 2*** *Associations between regular no/lo consumption and alcohol drinking motives, after accounting for sociodemographic characteristics and alcohol consumption (weighted, n = 2597)*
Reviewer 5	
Comments to the Author Referee Report on Manuscript bmjph-2025-002828 This manuscript addresses an important and increasingly policy-relevant issue: whether drinking motives are associated with the consumption of alcohol-free and low-alcohol (no/lo) drinks. The topic is well aligned with public health interests in alcohol harm reduction. However, the manuscript suffers from several methodological and interpretative weaknesses that require significant revision before it can be considered for publication.	Thank you for your comments. We address each suggestion in turn below, indicating where this has led to revisions in the manuscript.
1. Using single-item measures to capture each drinking motive is a significant limitation. While the authors note budget constraints and PPIE	We have expanded our discussion of this limitation in our discussion with the recommendation that future studies use the full scale. We acknowledge that this is a significant limitation which we have done our best to mitigate

involvement, this does not sufficiently mitigate concerns about measurement validity. These are multidimensional psychological constructs, and reducing them to one item increases measurement error and interpretative ambiguity, mainly since the primary conclusion relies on a single item (conformity).	by comparing our findings with other studies that have used the DMQ-SF and the qualitative literature. We also highlight that whilst the ideal would certainly be to use the full scale, it is not uncommon when items are being included as part of a larger survey that single items are used. Please refer to **reviewer 3, point 4** for the revised text. We acknowledge there is the trade-off between the advantages of the representative sample and the increased measurement error associated with single items. Finally, we'd like to highlight this is a novel area of research, therefore a key objective is determining whether it warrants further investigation, which we believe it does.
/2. The central finding—that endorsement of conformity motives is associated with higher no/lo consumption—is weak both statistically (OR = 1.10, p = 0.041) and in terms of robustness. The association disappears when motive variables are recoded as binary, suggesting it is sensitive to model specification. This fragility should be more explicitly acknowledged, and the overall conclusion should be made more cautiously.	We have updated our discussion (see paragraph 3 of implications for public health and further work) to respond to these comments. *However, we must note that the overall effect size was small and the sensitivity analysis which explored drinking motives on a binary scale did not consistently support the individual associations observed in the primary model regarding these motives. The AUC was 0.61 suggesting that there are other important factors that are associated with no/lo consumption that are not included in this model.* *Whilst the qualitative literature and a recently published study using a self-selected sample in the Global Drug Survey supports our findings (33-35, 37, 59), further work is needed to better understand the nuanced relationship between drinking alcohol to conform and consuming no/lo drinks, particularly amongst those who are using the drinks as a substitute to standard strength alcohol. The current study explores overall no/lo consumption, including consumption amongst those who would probably not been drinking alcohol otherwise, e.g. those who are pregnant, or driving; and no/lo consumption that does not specifically serve to*

	specifically replaces alcohol consumption, therefore, it is likely the effect of drinking motives amongst those who are directly substituting is diluted in this study
3. The authors repeatedly frame the study as addressing substitution (i.e., no/lo replacing standard alcohol). Yet, the outcome measure only captures the frequency of no/low use, not whether it replaces or supplements alcohol consumption. Since public health impact hinges on substitution, this is a significant limitation and should be more clearly reflected in both the abstract and the discussion.	Our discussion now acknowledges this limitation with recommendations for future research. **From Abstract** *No/lo drinks may facilitate reduced alcohol consumption by offering an alternative for individuals seeking to avoid social pressure to conform. However, those drinking alcohol to conform are not typically higher-risk drinkers, which may limit the public health benefit of no/lo drinks.* ***Further research is needed to explicitly explore substitution effects.*** **From Limitations section** *It was also not possible to explicitly identify whether no/lo drinks are replacing alcoholic beverages.* ***From Conclusions*** *The importance of our findings depends on the extent no/lo drinks are being used to substitute standard alcoholic drinks. Future work should consider replicating our findings using the full DMQ-R, or similar, exploring the influence of alcohol drinking motives under circumstances where consumers are specifically replacing alcohol with no/lo drinks, and if and how they help to explain sociodemographic differences in consumption.*
4. The discussion refers several times to social advantage and structural determinants, yet the regression model does not find significant associations with social grade or deprivation (IMD). The authors should either test for relevant interactions (e.g. between motives and SES), or moderate their claims accordingly to avoid overstating what their data show.	Have added text to specify education as a proxy indicator of social advantage in the introduction. In the discussion we have also added a sentence to detail our non-significant finding regarding an association between neighbourhood level deprivation and no/lo consumption.

	Introduction: final paragraph *We also expected to find a higher-odds of regular no/lo consumption amongst those who were socially advantaged, assessed using measures of social grade and highest level of education received; and higher risk drinkers, as found with previous work (40).* **Discussion: Implications for public health, paragraph 6** *Regular consumption of no/lo drinks is positively associated with social advantage, particularly higher levels of education (40, 61).* **Discussion: paragraph 2** *We did not find evidence of an association between neighbourhood level deprivation, measured using the IMD, and no/lo consumption.*
5. Some interpretative leaps—e.g., that peer pressure explains the conformity finding, or that price limits access among lower SES groups—are plausible but not directly tested. These should be flagged as speculative and not presented as evidence-based conclusions.	We have removed the statement about price being equivalent for no/los. **Discussion: Implications for public health, paragraph 6** *One explanation may be that no/lo drinks, ~~which are typically broadly comparable in price to their standard alcoholic equivalent,~~ are not satisfying the alcohol drinking motives predominant amongst lower socioeconomic groups, who are more likely to drink alcohol as a coping mechanism than those who are more socioeconomically advantaged (21, 22, 47).* We have updated the text to replace peer pressure to a more generic term of conformity to alcohol norms. **Discussion: paragraph 2** *In the UK, where ~~peer pressure~~ **pressure to conform** in its alcocentric culture may be overt, but often implicit and normalised (32), no/lo drinks may serve as a welcome alternative for those wishing to reduce their*

	alcohol consumption whilst circumventing the pressure to conform to the social consensus.
6. All key measures, including no/lo consumption, drinking motives, and hazardous drinking, are self-reported. This introduces the risk of recall bias and social desirability bias, particularly when asking about sensitive behaviours like alcohol use. While common in this field, the current manuscript does not adequately acknowledge the limitation.	This is now included within the limitations section. Please see review 6, point 2, for the modified text.
7. No mention is made of multicollinearity diagnostics, despite including multiple correlated predictors (e.g., education, social grade, IMD, drinking motives). Reporting variance inflation factors (VIFs) or correlation matrices could strengthen the robustness claims.	We have now included variance inflation factors for the primary analysis in the manuscript. **Results: Descriptive analysis and regression modelling** *There was no evidence of multicollinearity among independent variables using Variance Inflation Factors (VIFs, Supplementary Table 2).*
8. Using quasibinomial logistic regression is appropriate to address overdispersion in binary outcomes. Still, the paper does not explain why this approach was preferred over negative binomial or zero-inflated models, given the low base rate of no/lo consumption (21%). Some brief justification would be helpful.	We have now updated our text to provide further detail regarding our decision to use a quasibinomial logistic regression. **Methods: Descriptive analysis and regression modelling** *Quasibinomial logistic regression models tested for associations between regular no/lo consumption (dependent variable) and alcohol drinking motives. This method is a robust approach for binary outcomes when overdispersion is present (55, 56), which was a concern given the low base rate of at least monthly no/lo consumption (21%) in our sample. While negative binomial or zero-inflated regression models are valuable for addressing overdispersion, they are primarily designed for count data rather than the binary (yes/no) outcome capturing no/lo consumption in this study. The quasibinomial approach, which models a dispersion parameter, was thus the most appropriate method to account for overdispersion while maintaining the binary nature of our dependent variable.*

9. Several minor issues in grammar, consistency, and clarity should be addressed: • Page 3 (abstract): “Those drinking alcohol to conform…” would read better as “Those who drink alcohol to conform...”. • Page 8: “Participants respondent on an 8-point scale” → “respondent” should be “responded”. • Page 17: “...drinking alcohol for how if makes you...” → “if” should be “it”. • Standardise occasional inconsistent terminology (e.g., “no/lo drinks” vs. “no/lo products”). • On page 2, the phrase “...after accounting for sociodemographic characteristics and alcohol consumption” may be misleading, as the variable used is hazardous drinking (AUDIT-C), not general consumption; this could be made more explicit.	Page 3 – ***Those who drink alcohol to conform*** *were not typically higher-risk drinkers, which may limit the public health benefit of no/lo drinks.* Page 8 - updated (see Reviewer 1, point 14) Page 17 – updated Terminology updated throughout Page 2 - *Drinking alcohol to conform was the only drinking motive associated with no/lo consumption after accounting for sociodemographic characteristics and* ***hazardous drinking*** *(OR = 1.10, 95% CI 1.00-1.21, p=0.041).*

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