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RESEARCH REPORT

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The impact of introducing alcohol-free beer options in bars and public houses on alcohol sales and revenue: A randomised crossover field trial

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Abstract

Aims: The study aimed to estimate the impact of introducing a draught alcohol-free beer, thereby increasing the relative availability of these products, on alcohol sales and monetary takings in bars and pubs in England.

Design: Randomised crossover field trial.

Setting: England.

Participants: Fourteen venues that did not previously sell draught alcohol-free beer.

Intervention and comparator: Venues completed two intervention periods and two control periods in a randomised order over 8 weeks. Intervention periods involved replacing one draught alcoholic beer with an alcohol-free beer. Control periods operated business as usual.

Measurements: The primary outcome was mean weekly volume (in litres) of draught alcoholic beer sold. The secondary outcome was mean weekly revenue [in GBP (£)] from all drinks. Analyses adjusted for randomised order, special events, season and busyness.

Findings: The adjusted mean difference in weekly sales of draught alcoholic beer was −20 L [95% confidence interval (CI) = −41 to +0.4], equivalent to a 4% reduction (95% CI = 8% reduction to 0.1% increase) in the volume of alcoholic draught beer sold when draught alcohol-free beer was available. Excluding venues that failed at least one fidelity check resulted in an adjusted mean difference of −29 L per week (95% CI = −53 to −5), equivalent to a 5% reduction (95% CI = 8% reduction to 0.8% reduction). The adjusted mean difference in weekly revenue was +61 GBP per week (95% CI = −328 to +450), equivalent to a 1% increase (95% CI = 5% decrease to 7% increase) when draught alcohol-free beer was available.

Conclusions: Introducing a draught alcohol-free beer in bars and pubs in England reduced the volume of draught alcoholic beer sold by 4% to 5%, with no evidence of the intervention impacting net revenue.

KEYWORDS
alcohol, alcohol-free, draught beer, public health, revenue, sales

INTRODUCTION

Excessive alcohol consumption is a causal risk factor in more than 200 diseases, injuries and other health conditions globally [1]. In England, alcohol consumption causes death and disability relatively early in life; ∼13.5% of total deaths in people ages 20 to 39 years can be attributed to alcohol use [1]. Beyond the health consequences, harmful use of alcohol brings significant social and economic losses to individuals and society. It creates a substantial burden on public services, including over half a million hospital admissions per year in England [2].

Current policies to reduce alcohol consumption focus on price increases, regulated marketing, providing education, altering the drinking environment (such as increasing enforcement, removal of high strength alcohol and improving serving practices) and temporal and spatial availability of alcohol. Current evidence most strongly supports price and marketing [3], although there is evidence that reducing the temporal availability of alcohol is effective [3]. However, there is a lack of evidence to inform policy on the relative availability of alcohol products within retail establishments [4, 5].

Therefore, one way to reduce alcohol consumption could be through increasing the availability (i.e. proportion) of alcohol-free and low-alcohol products within environments that sell alcohol. The development of such products is encouraged as part of a broader range of evidence-based strategies to reduce alcohol-related harm [6]. The United Kingdom Government has pledged to increase the availability of alcohol-free and low-alcohol products by 2025 [7]. There is some evidence to suggest that the public will be amenable to this change: recently there has been an increase in the popularity of alcohol-free drinks, with the global market growing substantially in the last 4 years, and in the United Kingdom, this is forecasted to continue to increase [8]. Widening the choice available to consumers and increasing alcohol-free drink availability could encourage their selection and shift social norms [9, 10]. Increased availability of these products has been found to be associated with an increase in their sales [11] and reductions in grams of alcohol purchased [12, 13] in off-trade settings. Such products also provide an opportunity for licensed venues to take positive action to address licensing objectives regarding public safety, crime and disorder, and to broaden their offerings to customers while maintaining revenue [14, 15]. Indeed, licensed venues such as pubs can have a significant positive impact for communities as they provide a space for people to congregate and socialise [16–19]. Therefore, there is great value in being able to maintain these spaces while reducing alcohol-related harms. Increasing alcohol-free options in pubs is one way in which this can be accomplished.

Interventions that alter the availability of healthier and less healthy food products, within the environments from which they are purchased or consumed, have been shown to facilitate healthier consumption behaviour [4, 20–23] in off- and on-trade settings. A 2019 Cochrane review of the impact of reducing the availability of food, alcohol and tobacco products on their selection and consumption, reported large effect sizes with respect to selection and moderate effect sizes with respect to consumption [4]. However, the review only identified studies that focused on food products, with no eligible studies focusing on alcoholic drinks, and highlighted concerns regarding study quality and sample size.

An online experimental study in 2020 found that the odds of selecting an alcohol-free drink were 71% higher when the proportion of alcohol-free drinks compared to alcoholic drink options increased from half to three-quarters, and 37% lower when the proportion decreased to one-quarter [24]. A subsequent online experimental purchasing study in a naturalistic context (an online supermarket) indicated that increasing the proportion of non-alcoholic drinks available—from 25% to 50% or 75%—reduced alcohol selection and purchasing [5]. Although both studies provide initial support for the efficacy of availability interventions in relation to alcohol products, replication in real-world uncontrolled environments is required.

The aim of this study was, therefore, to estimate the impact of introducing draught alcohol-free beer (i.e. increasing relative availability) on alcohol sales in bars and public houses in England. We also investigated the impact on revenue given that a negative impact on revenue might lead to resistance from landlords and/or discourage policymakers from considering this as a policy option. In this study, 'alcohol-free' is defined as ≤0.5% alcohol by volume.

Hypothesis

We hypothesised that replacing one draught alcoholic beer with one draught alcohol-free beer would lower the volume of draught alcoholic beer sold in licensed premises, and not reduce the revenue from all drinks sold in licensed premises (i.e. alcoholic and alcohol-free drinks, including soft drinks, combined).

METHOD

The study was prospectively registered on the Open Science Framework (OSF) before the commencement of data collection on 12 July 2022 (https://doi.org/10.17605/OSF.IO/Z95SJ), along with the study protocol and statistical analysis plan (https://osf.io/7ky4q/). There were no deviations from the pre-registered protocol or statistical analysis plan. The study was approved by the School of Psychological Science Research Ethics Committee at the University of Bristol (reference no: 12005). The reporting of results follows CONSORT 2010 guidelines.

Study design

This study used a four-period randomised crossover (i.e. multiple-treatment reversal) design. All participating venues completed two intervention periods (A) and two control periods (B) in a randomised order (BABA; BAAB; ABBA; ABAB). Each period lasted 2 weeks, and therefore, each venue was monitored for 8 weeks in total. During the intervention period, venues removed one draught alcoholic beer and replaced it with one draught alcohol-free beer (lager or ale). During the control period, venues did not sell alcohol-free beer on draught (i.e. usual practice).

Setting

The study was conducted in venues (licensed premises such as public houses and bars) located in and around the Bristol area of South-West England that did not already sell alcohol-free beer on draught before taking part in the study.

Recruitment

Venues were contacted either by directly contacting owners and managers of bars and public houses that had taken part in at least one of our previous field studies [25, 26] or from a list of bars and public houses collected on Google Maps. Venues were contacted via phone and email. If eligible, and willing to take part in the study, owners or managers provided written informed consent. Financial compensation of £500 was paid to each venue at the end of the study for participation. All data collection took place between 1 August 2022 and 19 November 2022.

Venues were eligible to take part in the study if they (1) already sold at least three alcoholic beers (lager or ale) on draught; (2) did not sell any alcohol-free beers (lager or ale) on draught before the study; (3) were willing to remove one draught alcoholic beer and replace it with one draught alcohol-free beer during the study; (4) used an electronic point of sale (EPOS) till system to record itemised sales of all drinks; (5) were willing to update the EPOS system to include 'draught alcohol-free beer' during intervention periods; (6) were willing to share itemised EPOS data with the research team for the duration of the study; and (7) were willing to advertise the new draught beer in the same way the venue would with any other new product (tap badges, signs behind the bar and information on menus and any apps).

Sample size calculation

A previous field trial of a different intervention (glass shape) in 24 venues with a similar design to the current study found a mean difference of −35 L in the volume of draught alcoholic beer sold between intervention and control periods (A-B) [25]. The SD of this mean difference was 141 L. Table S1 reports the precision achieved (95% CI of the SD) for increasing number of venues (N). This suggests that a minimum of 12 and up to 16 venues is required to provide sufficient precision—at this point the relationship between increasing N and increasing precision (i.e. narrower 95% CI of the SD) starts to plateau. We consider this to be an opportunistic study providing preliminary evidence to inform future research, including more precise estimation of the likely effect size and the required sample size for future studies.

Randomisation and masking

The randomised order for the four periods (BABA; BAAB; ABBA; ABAB) was generated at the start of the study using a computer-generated list of random numbers orders of AABB and BBAA were not used during this study as we wanted to have at least two changes (i.e. reversal) of the conditions and, therefore, these possibilities were not included in the randomisation. This list was held by an independent researcher who was not involved with subsequent data handling or analysis. Blocked randomisation was used to ensure that an equal number of venues were assigned to each of four possible orders. The order was concealed until after the venue owner/manager had agreed to the study protocol. Because of the nature of the study, it was not possible to blind the research team or the participating venues to order allocation. However, the research team requested that venue staff did not reveal the purpose of the study to customers.

Intervention

During the intervention period, venues removed one draught alcoholic beer (i.e. alcoholic lager or ale) and replaced it with one draught alcohol-free beer (i.e. alcohol-free lager or ale). Venues were able to choose which draught alcoholic beer to remove and which draught alcohol-free beer to replace it with. Venues were encouraged to choose a like-for-like replacement (i.e. replace a draught alcoholic lager with a draught non-alcoholic lager). All replacements throughout the study were kept consistent across intervention periods (i.e. if an alcoholic lager was replaced by an alcohol-free lager, then the same brand/type replacement was used throughout the study). As part of the intervention, venues were encouraged to advertise the new draught alcohol-free beer in the same way as it would with any other new product (e.g. tap badges, signs behind the bar and information on menus and any apps).

Within the typology of interventions in proximal physical micro-environments (TIPPME) [27] framework, this intervention is classified as an 'availability × product' intervention. Applying a more detailed conceptual framework specific to availability interventions [28], this is categorised as a 'relative availability' intervention because it involves removing products from one product category (alcoholic drinks) and adding products from another category (alcohol-free drinks), therefore, altering their relative proportions.

Procedures

A member of the research team visited each venue to confirm its eligibility for the study. During both intervention periods, an alcohol-free draught beer was available. If customers asked about the change, venue staff were instructed to follow a standardised script in an attempt to conceal the study hypothesis from customers: 'We have been receiving requests for alcohol-free beer on draught, so we are trying out some changes for a few months'. Venue owners or managers oversaw the sourcing and purchasing of the alcohol-free beer. During both control periods, no alcohol-free beer was available on draught in the venue. However, during the control and intervention periods, venues were still able to sell alcohol-free beer in bottles or cans.

Venue managers received a text or email reminder at least 24 h before each new period. During this time, any special events were also enquired about and recorded. Fidelity to the protocol was checked by visits to the venue organised by the research team in the first few days after each new period. If a venue failed any of the checks (i.e. the venue was selling a draught alcohol-free beer during a control period, or the venue was not selling a draught alcohol-free beer during an intervention period), they were asked to rectify the observed protocol violation before an additional fidelity check took place within 24 h. At the end of the study, venue owners and managers were debriefed and provided a brief report of the results.

Measures

At the end of the 8-week study period, all relevant till data were sent to the research team and used to derive the following outcome variables. All outcomes were an aggregated value of the two separate two-week intervention (A) periods and the two separate two-week control (B) periods, expressed as a weekly average.

Primary outcome

The primary outcome was the mean volume (in litres) of draught alcoholic beer (lager and ale combined) sold weekly. This was used as a proxy for alcohol consumption.

Secondary outcome

The secondary outcome was the mean weekly revenue from all drinks n Pound Sterling [GBP £)] (i.e. alcoholic and alcohol-free drinks combined).

Tertiary outcomes

Tertiary outcomes included (1) the mean volume (in litres) of alcoholic beer sold weekly in bottles and cans; (2) the mean volume (in litres) of all alcoholic beer sold weekly on draught and in bottles and cans; (3) the mean volume (in litres) of all other alcoholic drinks sold weekly excluding beer (therefore, including alcoholic wine, spirits and cider); (4) the mean volume (in litres) of draught alcohol-free beer sold weekly; (5) the mean volume (in litres) of alcohol-free beer sold weekly in bottles and cans; (6) the mean volume (in litres) of all alcohol-free beer sold weekly, on draught and in bottles and cans; and (7) the mean number of soft drinks sold weekly.

Additional measures

Additional measures included the total number of non-study drinks (i.e. not including any draught alcohol-free beer sold) sold weekly, which was used as a proxy measure of venue busyness, and the total number of special events during each period that were likely to have increased sales was also recorded. Special events included any event held by the venue that was outside of the normal schedule for that venue. This, therefore, excluded any regular events (i.e. weekly, fortnightly and monthly events), but did, for example, include any public holidays or major sporting events. The total number of alcohol-free drink options at baseline was also recorded.

Statistical plan

All data were analysed on an intention to treat basis (i.e. all data, including from venues that failed a fidelity check, were included in the analysis). Data analysis was conducted in SPSS version 27 [29] and R software version 4 [30]. The mean difference for the primary outcome (draught alcoholic beer sold weekly) was estimated according to whether alcohol-free draught was available or not available, using a mixed effects model for repeated measures (i.e. availability of alcohol-free draught beer compared to no availability of alcohol-free draught beer).

We report unadjusted and adjusted mean differences alongside 95% CIs. Adjustment, as per our pre-registered statistical analysis plan, was made for order (i.e. the four sequences of: BABA; BAAB; ABBA; ABAB); special event (the total number across study periods); season (summer or autumn) that the venue commenced the study in; and busyness (total number of non-study drinks sold weekly). As per our pre-registered statistical analysis plan, the unadjusted estimates represent our primary analysis, and the adjusted estimates represent our secondary analysis. All covariate estimates and *P* values can be seen in Tables S2 and S3.

Two interaction terms—alcohol-free availability × season and alcohol-free availability × order—were also added to the adjusted model, but the corresponding *P* values were >0.001 and, therefore, removed from the model (the exact interaction terms can be seen below Tables S2 and S3) as per our pre-registered statistical analysis plan.

The secondary outcome (revenue from all drinks sold weekly) was analysed in the same way as the primary outcome. We also calculated a Bayes factor for this outcome, as given our hypothesis, we were specifically interested in assessing the evidence for no difference in revenue between the study periods. We calculated the Bayes factor using SPSS [29] and an online calculator [31]. All tertiary outcomes are reported descriptively between study periods.

A pre-planned per-protocol analysis excluding any venues that failed at least one fidelity check (n = 4) is reported in Table 3. A pre-planned sensitivity analysis excluding any venue that did not use a like-for-like replacement for draught alcoholic beer (i.e. including only those venues that replaced an alcoholic lager with an alcohol-free lager or replaced an alcoholic ale with an alcohol-free ale) (n = 2) is also reported in Table 3.

RESULTS

Venues

Fifteen venues were recruited to the study—Figure 1 shows the flow of venues through the study. One venue dropped out after randomisation for logistical reasons (Figure 1), leaving 14 venues that completed the study and were included in data analysis. Venue information and additional measures can be seen in Table 1. All outcome data can be seen in Table 2. Five fidelity checks, across four venues (29%), were recorded as a failure (Table S4).

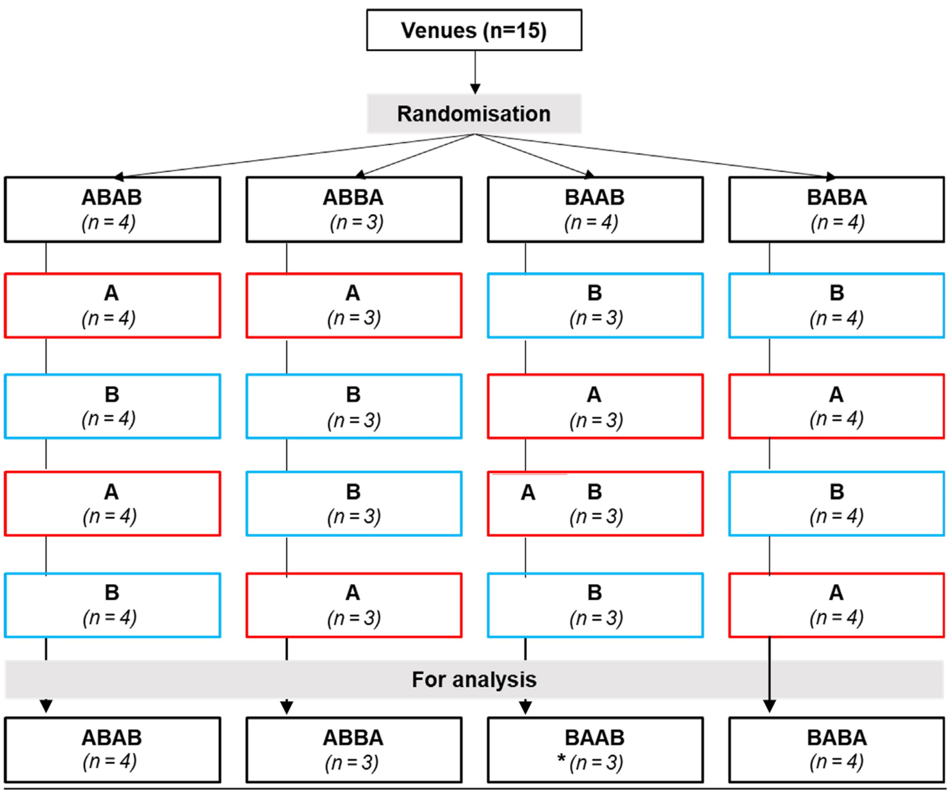
Primary outcome

The mean weekly volume of sales of draught alcoholic beer was 503 L (SD = 439) across the intervention periods (A) and 520 L (SD = 459) across the control periods (B). The unadjusted mean difference was −16 L per week (95% CI = −40 to +7), equivalent to a 3% reduction (95% CI = 8% reduction to 1% increase) in the volume of alcoholic draught beer sold when draught alcohol-free beer was available. The adjusted mean difference was −20 L per week (95% CI = −41 to +0.4), equivalent to a 4% reduction (95% CI = 8% reduction to 0.1% increase) in the volume of alcoholic draught beer sold when draught alcohol-free beer was available.

Results of the per-protocol and sensitivity analyses can be seen in Table 3. The per-protocol analysis, excluding any venue that failed at least one fidelity check (*n* = 4 venues removed), showed an adjusted mean difference for the primary outcome of −29 L per week (95% CI = −53 to −5), equivalent to a 5% reduction (95% CI = 8% reduction to 0.8% reduction). The sensitivity analysis, excluding any venue that did not use a like-for-like replacement for draught alcoholic beer (*n* = 2 venues removed), showed an adjusted mean difference for the primary outcome of −20 L per week (95% CI = −6 to 45).

Secondary outcome

Mean weekly revenue for all drinks was GBP (£) 6369 across the intervention periods (A) and GBP 5835 across the control periods (B). The unadjusted mean difference was GBP + 534 per week (95% CI = −957 to +2050), equivalent to a 9% increase (95% CI = 16% decrease to 35% increase) when draught alcohol-free beer was available. The adjusted mean difference was GBP +61 per week (95% CI = −328 to



Intervention period (A). Control period (B).

* One venue dropped out after randomisation for logistical reasons (the venue was unable to install the correct equipment in time to sell their chosen draught alcohol-free beer).

FIGURE 1 CONSORT flow diagram.

TABLE 1 Venue information (*n* = 14).

	Mean (SD)	Range (minimum, maximum)
No. of (non-draught) alcohol-free options at baseline	2 (2)	0, 5
No. of draught taps in venue	14 (6)	4, 24
Index of multiple deprivation decile[a]	5 (2)	2, 7
n (%)		
Draught alcoholic product removed		
IPA (alcoholic)		12 (86)
Other (alcoholic)		2 (14)
Draught alcohol-free product added		
IPA (alcohol-free)		14 (100)
Draught alcohol-free brand added		
Clear Head (Bristol Beer factory; alcohol-free)		11 (79)
Other (alcohol-free)		3 (21)

Abbreviation: IPA, India pale ale.
[a]English indices of deprivation 2019—measures relative deprivation in small areas in England; indices of deprivation decile range from 1–10, with 1 being the most deprived and 10 being the least deprived.

+450), equivalent to a 1% increase (95% CI = 5% decrease to 7% increase) when draught alcohol-free beer was available. Although all results suggested an increase in revenues during the intervention period, a Bayes factor of 1 for the adjusted analysis indicated that the results were inconclusive as to whether or not there was a difference in weekly revenue between conditions.

Tertiary outcome

Mean weekly volume of draught alcoholic-free beer was 15 L across the intervention periods and 0.6 L across the control periods. The adjusted mean difference was 15 L (95% CI = +6 to +25).

DISCUSSION

Our results suggest that replacing one draught alcoholic beer with one draught alcohol-free beer may decrease the volume of draught alcoholic beer sold in licensed premises by 4% to 5%, while not reducing the revenue from drinks sold. Our per-protocol analysis, which

TABLE 2 Differences in outcomes between the intervention (A) periods where a draught alcohol-free beer was available and the control (B) periods where a draught alcohol-free beer was not available.

	Unadjusted			Adjusted[c]		
	Intervention period (A) Mean (SD)	Control period (B) Mean (SD)	Mean difference (A-B) MD (95% CI)	Intervention period (A) Mean (SE)	Control period (B) Mean (SE)	Mean difference (A-B) MD (95% CI)
Revenue from all drinks (£/week)	6369 (8068)	5835 (7383)	534 (−957 to 2050)	6394 (1301)	6333 (1395)	61 (−328 to 450)
Draught alcoholic beer (L/week)	503 (439)	520 (459)	−16 (−40 to 7)	496 (89)	517 (95)	−20 (−41 to 0.4)
Bottle/cans alcoholic beer (L/week)	11 (13)	12 (10)	−0.2 (−4 to 4)	10 (2)	12 (2)	−2 (−6 to 1)
All alcoholic beer[a] (L/week)	515 (445)	531 (465)	−16 (−43 to 10)	507 (78)	527 (84)	−20 (−43 to 3)
All other alcoholic drinks[b] (L/week)	37 (57)	30 (35)	7 (−11 to 25)	35 (10)	34 (5)	1 (−12 to 14)
Draught alcohol-free beer (L/week)	15 (17)	0.6 (2)	14 (5–23)	16 (4)	0.3 (0.5)	15 (6–25)
Bottle/cans alcohol-free beer (L/week)	2 (3)	4 (4)	−2 (−3 to −0.7)	2 (0.6)	4 (0.5)	−2 (−4 to −0.5)
All alcohol-free beer[a] (L/week)	17 (19)	5 (5)	12 (4.0–21)	17 (3.9)	5.0 (0.8)	12 (3–21)
Soft drinks (total no./week)	152 (110)	111 (185)	38 (−31 to 108)	146 (71)	110 (43)	36 (−27 to 98)

Note: Two venues served draught alcohol-free beer during the control period. These mistakes were identified during the fidelity checks, and rectified by each venue within a 48-h time period (a per-protocol analysis can be seen in Table 3, which excludes these venues). Data from all outcomes is provided by all 14 venues, except for the secondary outcome (revenue from all drinks), which was only provided by 11 venues.
Abbreviation: MD, mean difference.
[a]Including draught, bottled and canned beer.
[b]Excluding alcoholic beer (therefore, only including alcoholic wine, spirits and cider).
[c]Adjusted for order (i.e. the four sequences of: BABA; BAAB; ABBA; ABAB); special event (total number across study periods); season (summer or autumn) that the venue commenced the study in; and busyness (total number of non-study drinks sold weekly).

TABLE 3 Per-protocol and sensitivity analyses for the primary outcome (mean volume [in litres] of draught alcoholic beer sold weekly).

	Intervention period (A) Raw mean (SD)	Control period (B) Raw mean (SD)	Unadjusted difference (A-B) MD (95% CI)	Adjusted difference[c] (A-B) MD (95% CI)
Per-protocol analysis[a]	610 (440)	631 (460)	−21 (−54 to 12)	−29 (−53 to −5)
Sensitivity analysis[b]	556 (450)	573 (473)	−17 (−45 to 11)	−20 (−6 to 45)

Abbreviations: CI, confidence interval; MD, mean difference; SD, standard deviation.

[a]Pre-planned per-protocol analysis, excluding any venue that failed ≥1 fidelity check (*n* = 4 excluded, 10 venues included in this analysis).

[b]Pre-planned sensitivity analysis excluding any venue that did not replace their alcoholic draught option with a like-for-like alcohol-free alternative (i.e. the venue replaced an alcoholic ale with an alcohol-free lager) (*n* = 2 excluded, 12 venues included in this analysis).

[c]Adjusted for order (i.e. the four sequences of: BABA; BAAB; ABBA; ABAB), special event (the total number across study periods); season (summer or autumn) that the venue commenced the study in; and busyness (total number of non-study drinks sold weekly).

represents the real effect of serving an alcohol-free draught beer, should such a change be reliably implemented by policy (e.g. licensing regulations), further supports these conclusions. Our findings are consistent with evidence from a previous online purchasing study that found that increasing the proportion of non-alcoholic drinks available—from 25% to 50% or 75%—led to reduced alcohol selection and purchasing [5]. It is worth noting that these studies are not directly comparable as in the present study we were focused on the introduction of alcohol-free draught beer into drinking establishments and, therefore, increased availability of the product from zero. An increase from 0% to 5% versus from 50% to 75% differs in baseline availability, as well as in the size of the relative and absolute change, and will likely yield different effects and should be examined in future research. Our findings also support a previous online experimental study, which found that the odds of selecting an alcohol-free drink higher when the proportion of alcohol-free drinks compared to alcoholic drink options increased [24]. These findings are also consistent with a growing body of studies that apply similar availability interventions to food [4, 32, 33], suggesting that similar interventions have the potential to be applied across different products [22].

To our knowledge, this is the first randomised field trial introducing alcohol-free beer on draught in a real-world setting. Additionally, this trial is the first trial to specifically introduce an alcohol-free beer on draught. Nevertheless, the study has some limitations. First, the outcome measure was volume of sales rather than alcohol consumption itself. However, evidence suggests people generally consume most alcohol they purchase, with low wastage levels [34]. Second, all of the participating venues were independent bars and public houses in and around the Bristol area of South-West England. This may limit the generalisability of our results to other areas of the United Kingdom or to other countries that have different drinking cultures. Third, the number of participating venues was limited to 14. Further—ideally larger—field trials that are able to add to this evidence base, and improve the precision of our estimates, are, therefore, also warranted. Fourth, the study involved a relatively minimal intervention—just one draught tap replacement, often relative to a substantial number of other alcoholic draught options (Table 1). A previous online purchasing study [5] made larger changes to the relative availability of alcohol options and saw larger effects, possibly because of the more substantial changes in relative availability of products. Further field trials that also investigate the impact of larger changes in the proportion of non-alcoholic drinks available, to determine whether this leads to larger changes in behaviour, are, therefore, warranted. Nonetheless, we also note that this being a relatively minimal intervention can also be construed as a strength, because it shows that a modest and relatively easily achievable change to retail environments can still elicit potentially meaningful effects.

Our study was designed to inform policy by providing evidence that could be used to guide decisions around the implementation of policy interventions to increase the availability of alcohol-free beer. Evidence from our tertiary outcomes suggests that customers were replacing draught alcoholic beer with draught alcoholic-free beer, rather than replacing draught alcoholic beer with soft drinks. Moreover, the lack of evidence of an impact on revenue suggests the intervention may be acceptable to businesses and could be attractive to policy makers.

Furthermore, although two recent reviews of availability interventions [35, 36], and broader conceptual literature [37, 38], suggest that these types of interventions are unlikely to exacerbate inequalities, more evidence is required to assess possible equity effects, particularly from real-world contexts. In particular, it is possible that the effects of introducing alcohol-free beer will differ according to the socio-demographic context within which that occurs. Although our study recorded level of deprivation (Table 1), it was not powered to consider any interactions between the outcomes and these areas. Future studies should, therefore, recruit bars and public houses from wider variety of socio-demographic areas and consider analysis between them. Future studies should also investigate potential mechanisms underlying the effects found in this study. In the context of food, there is some evidence that the effects of changing availability operate via social norms and/or alignment with prior preferences [28,39,40], but specific research on alcohol products is lacking. Finally, future changes to public house and bar policy should extend beyond a single intervention. In addition to increasing alcohol-free options, including on draught, additional approaches (e.g. smaller serving sizes, selecting lower alcohol-by-volume wines as house standards, providing more information on harms and alcoholic units) should be considered. Future studies should investigate the impact of various approaches, both singly and in combination.

In conclusion, this study provides preliminary evidence that introducing a draught alcohol-free beer may reduce the volume of draught alcoholic beer sold, without having a substantial impact on net revenue. A 4% to 5% reduction in sales of alcohol could have a positive impact on public health at a population level. Furthermore, the lack of evidence of an impact on revenue suggests the intervention may be acceptable to businesses and attractive to policy makers.

AUTHOR CONTRIBUTIONS

Katie De-Loyde: Data curation (lead); formal analysis (lead); methodology (lead); project administration (lead); writing—original draft (equal); writing—review and editing (lead). **Jennifer Ferrar:** Data curation (supporting); project administration (supporting); writing—review and editing (supporting). **Mark Pilling:** Formal analysis (supporting); writing—review and editing (supporting). **Gareth J Hollands:** Conceptualization (supporting); methodology (supporting); writing—review and editing (supporting). **Natasha Charlotte Clarke:** Methodology (supporting); writing—review and editing (supporting). **Joe A. Matthews:** Data curation (supporting); writing—review and editing (supporting). **Olivia Maynard:** Conceptualization (supporting); writing—review and editing (supporting). **Tiffany Wood:** Conceptualization (supporting); funding acquisition (supporting); writing—review and editing (supporting). **Carly Heath:** Funding acquisition (supporting); writing—review and editing (supporting). **Marcus Munafo:** Conceptualization (equal); funding acquisition (equal); methodology (equal); writing—original draft (equal); writing—review and editing (supporting). **Angela Suzanne Attwood:** Conceptualization (equal); funding acquisition (equal); methodology (equal); project administration (supporting); writing—original draft (supporting); writing—review and editing (supporting).

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DECLARATION OF INTERESTS

None. No author declares a financial relationship with any organisation(s) that might have an interest in the submitted work, and no other relationships or activities that could appear to have influenced the submitted work.

DATA AVAILABILITY STATEMENT

The data and analysis code that form the basis of the results presented here are available from the University of Bristol's Research Data Repository (http://data.bris.ac.uk/data/), https://doi.org/10.5523/bris.3s2f3wu1qbtmu2hilv14rp0l1f. Open access statement and link to data.bris repository to be added on manuscript acceptance.

ETHICS APPROVAL

The study was approved by the School of Psychological Science Research Ethics Committee at the University of Bristol (reference no: 12005).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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