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RESEARCH REPORT

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# Evaluating the impact of minimum unit pricing (MUP) on alcohol sales after 3 years of implementation in Scotland: A controlled interrupted time-series study

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## Abstract

**Background and aims:** On 1 May 2018, Scotland introduced minimum unit pricing (MUP), a strength-based floor price below which alcohol cannot be sold, throughout all alcoholic beverages. The legislation necessitates an evaluation of its impact across a range of outcomes that will inform whether MUP will continue beyond its sixth year. We measured the impact of MUP on per-adult alcohol sales (as a proxy for consumption) after 3 years of implementation.

**Design, setting and participants:** Controlled interrupted time-series regression was used to assess the impact of MUP on alcohol sales in Scotland after 3 years of implementation, with England and Wales (EW) being the control group. In adjusted analyses, we included household disposable income, on-trade alcohol sales (in off-trade analyses) and substitution between drink categories (in drink category analyses) as covariates.

**Measurements:** Weekly data were assessed on the volume of pure alcohol sold in Scotland and EW between January 2013 and May 2021, expressed as litres of pure alcohol per adult. The impact of MUP on total (on- and off-trade combined), off-trade and on-trade alcohol sales was assessed separately.

**Results:** The introduction of MUP in Scotland was associated with a 3.0% (95% confidence interval = 1.8–4.2%) net reduction in total alcohol sales per adult after adjustment for the best available geographical control, disposable income and substitution. This reflects a 1.1% fall in Scotland in contrast to a 2.4% increase in EW. The reduction in total alcohol sales in Scotland was driven by reduced sales of beer, spirits, cider and perry. The reduction in total sales was due to reductions in sales of alcohol through the off-trade. There was no evidence of any change in on-trade alcohol sales.

**Conclusion:** Minimum unit pricing has been effective in reducing population-level alcohol sales in Scotland in the 3 years since implementation.

KEYWORDS
Alcohol, consumption, interrupted time-series, minimum unit pricing, policy analysis, sales

## INTRODUCTION

Alcohol is a major contributor to the global burden of disease, particularly in the European region [1]. In Scotland, the rate of deaths related to liver cirrhosis, an indicator of alcohol harm, has been shown to be among the highest in western and central Europe [2]. Despite having fallen from a peak in 2003, rates of alcohol-specific deaths remain considerably higher than those seen in England and Wales (EW) [3].

In recognition of the harm alcohol was causing, the Scottish Government introduced a comprehensive package of measures through its 2009 Framework for Action [4] aimed at reducing population-level alcohol consumption and, in turn, associated levels of health and social harms. This included the Alcohol (Minimum Pricing) (Scotland) Act (hereafter 'MUP Act'), which passed in June 2012 [5]. The minimum unit price (MUP) was implemented on 1 May 2018 and set a minimum price of £0.50 per unit of alcohol (i.e. 10 ml or 8 g of pure alcohol), below which alcohol cannot be sold in licensed premises in Scotland.

There is strong and consistent evidence to show that increasing the price of alcohol, thereby reducing its affordability, is an effective approach in reducing population levels of alcohol consumption and related harms [6]. When controlling for sales in EW, and adjusting for household income and on-trade sales, our best estimate of the net reduction in per-adult off-trade sales in Scotland in the 12 months following MUP implementation was 3.5% [7]. The largest relative net reductions were observed for cider and perry, with smaller reductions estimated for spirits and beer [7].

This aim of this study was to update that work by reporting on the impact of MUP upon off-trade alcohol sales and to expand the previous work by examining the impact upon total and on-trade alcohol sales in Scotland in the 3 years following implementation. We used weekly alcohol sales data as a proxy for population consumption. Alcohol sales are not prone to self-reporting bias and are considered an objective and reliable approach for estimating consumption at a population level [8].

## METHODS

The methods for this study were guided by a pre-published protocol [9].

### Design

We used controlled interrupted time-series to assess whether the introduction of MUP was associated with a change in alcohol sales in Scotland. We assessed the impact of MUP on total (on- and off-trade combined) and off-trade alcohol sales per adult (primary outcomes) and on-trade sales per adult (secondary outcome). We examined the impact on specific drink categories: beer, wine, spirits, cider, fortified wine, ready-to-drink beverages (RTDs; RTDs are pre-mixed drinks such as cocktails) and perry (perry is an alcoholic beverage similar to cider but made of pears rather than apples). We used corresponding data for EW as a geographical control. Statistical models accounted for underlying seasonal and secular trends. Adjustments were made to account for potential substitution between drink categories (in drink category analyses), changes in on-trade alcohol sales (in off-trade analyses) and changes in disposable income. We adjusted for physical restrictions associated with the COVID-19 pandemic [10] and for the introduction of MUP in Wales in the post-intervention period. A range of pre-specified sensitivity analyses were performed to test the robustness of our main findings to changes in the analytical approach (primary outcomes only). In addition to the pre-specified analyses, we added sensitivity analyses using a shorter post-intervention period and using an alternative source of retail sales data.

### Data

We used alcohol retail sales data to estimate weekly alcohol consumption at a population level. Retail sales data for the off-trade and on-trade were obtained from market research companies NielsenIQ and CGA Strategy, respectively. NielsenIQ estimates off-trade alcohol sales in Great Britain using electronic sales records from large retailers (retailers with 10 or more retail shops operating under common ownership) and a weighted stratified random sample of smaller 'impulse' retailers (retailers in which the consumer mainly uses the store for impulse or top-up purchases, i.e. not the main grocery shop). CGA estimates on-trade alcohol sales based on modelling that uses product rate of sales derived from actual sales in a stratified sample of on-trade retailers and upweighted to represent total sales. We have previously provided a detailed description of the methods used by NielsenIQ and CGA to produce alcohol retail sales estimates [11].

We aggregated these to give total weekly alcohol sales; prior to aggregation, 4-weekly on-trade data were interpolated linearly to give weekly estimates. We converted natural volume (the volume of beverage sold) into pure alcohol volume using category-specific percentage alcohol by volume (ABV). Per-adult pure alcohol sales (litres per week) were calculated using mid-year estimates for the population aged 16 years and over [12, 13]. Weekly per-adult estimates were calculated for all alcohol combined and by drink category. Data were obtained for the geographical areas of Scotland, EW, North East (NE) England and North West (NW) England separately, between January 2013 and May 2021. On-trade analyses were truncated to 22 months post-MUP (February 2020) due to incomplete data following the introduction of COVID-related restrictions. Due to the availability and robustness of some data sources, pre- and post-intervention periods differ for some sensitivity analyses (see Table 1 and the Supporting information).

Quarterly gross disposable household income (GDHI) data were obtained for Scotland [14] and the United Kingdom [15] and expressed per adult aged 16 years and over. Equivalent quarterly data were not available for EW; a proxy measure was created by estimating the contribution of England and Wales from annual GDHI data [16]

**TABLE 1** Summary of sensitivity analyses.

| Model | Study period | Criteria changed compared to primary model |
|---|---|---|
| 1. Shorter post-intervention period | January 2013 to February 2020 | Post-intervention period truncated to end of February 2020 to eliminate the impact of the COVID-19 pandemic on alcohol sales and the introduction of MUP in Wales, part of the control area, on 1 March 2020 |
| 2. Net difference (S minus EW) | January 2013 to May 2021 | Net difference in weekly alcohol sales (Scotland minus EW) used as the outcome time-series; removal of EW series as a covariate |
| 3. Aldi/Lidl adjustment | January 2013 to May 2021 | Uplift applied to each drink category in the off-trade sales data series to account for the exclusion of sales through Aldi and Lidl; uplift was based on the estimated alcohol market share of Aldi and Lidl |
| 4. Per adult drinker | January 2013 to May 2021 | Weekly alcohol sales estimates expressed as per adult drinker, so as to exclude non-drinkers from the denominator |
| 5. NE England (5a) and NW England (5b) as control | January 2013 to May 2021 | Incorporated alcohol sales data for an alternative geographical control area (northern England) which is potentially more socio-demographically similar to Scotland than the whole of EW |
| 6. Alternative off-trade retail sales data | January 2017 to April 2021 | Used an alternative source of off-trade alcohol sales data |
| 7. False intervention date | January 2013 to May 2021 | Used two different false intervention dates [6 months before intervention (7a), 6 months after intervention (7b)] in order to test the plausibility of attributing any effect to the intervention |
| 8. No adjustment for potential substitution between trade sectors | January 2013 to May 2021 | Ran a fully controlled and adjusted Scottish off-trade model without adjusting for on-trade sales (a measure of possible switching from off-trade to on-trade consumption), as this was felt to be a potential source of over-adjustment |
| 9. No adjustment for potential substitution between drink categories | January 2013 to May 2021 | Ran fully controlled and adjusted Scottish models without adjustment for sales of other drink categories (a measure of possible switching between drink categories) |
| 10. Alternative analytical approach | January 2013 to May 2021 | Used a UCM, a form of structural time-series method, as an alternative to SARIMA |
| 11. Change in variability | January 2013 to May 2021 | Tested whether MUP had an impact on the variability (frequency and magnitude of peaks and troughs) in weekly alcohol sales |

All sensitivity analyses were run for total sales and off-trade sales with the exception of model 8 which is for off-trade sales only. Results from analyses 1–8 are plotted in Figure 2; full results of all analyses are presented in Supporting information.
Abbreviations: EW = England and Wales; MUP = minimum unit pricing; NE = North East; NW = North West; S = Scotland; SARIMA = seasonal autoregressive integrated moving average; UCM = unobserved components model.

and applying that to quarterly UK GDHI data. Weekly GDHI estimates were interpolated linearly from quarterly data.

To account for the impact of physical distancing measures on alcohol sales, we incorporated data on the level of imposed restrictions into our models using the stringency index from the Oxford COVID-19 Government Response Tracker (OxCGRT; see the Supporting information) [10]. Daily data for each of the UK devolved governments were available from January 2020 to the end of the study period. We calculated the mean weekly value from the daily data for Scotland and EW (population weighted average).

We used data from the Scottish Health Survey [17] and the Health Survey for England [18] to estimate the proportion of non-drinkers for Scotland and EW, respectively.

In sensitivity analyses we assessed the impact of using a different source of off-trade alcohol retail sales data. We obtained weekly off-trade alcohol sales data from market research company IRI for the period January 2017 to May 2021. Data were obtained for 13 regions in England, Scotland and Wales coterminous with the Broadcasters' Audience Research Board (BARB; see the Supporting information) and aggregated to form separate totals for Scotland and EW. IRI calculate pure alcohol volume at a product level using product-specific ABV percentages; this is then aggregated up to provide pure alcohol volume at a category level. We have previously provided a comparison of the methods employed by both companies and subsequent estimates of per-adult alcohol sales derived from those [19].

Alcohol sales by the discount retailers Aldi and Lidl are not included in off-trade alcohol sales estimates. We adjust for their exclusion in sensitivity analysis using alcohol volume market share estimates for calendar years 2013–21 provided by Kantar Worldpanel. Kantar Worldpanel data are collected by a panel of households (participants aged ≥ 18 years) who record their grocery purchases, including alcohol, using a barcode reader. Data are only collected on purchases brought into the home and include details such as quantity, price and the store of purchase. Linear interpolation between the annualized estimates provided was used to calculate weekly alcohol market share estimates for Aldi and Lidl, based on volume sales, by beverage category. Further information is available in the Supporting information.

## Descriptive analysis

The volume of pure alcohol sold per adult per week was calculated for Scotland and EW and plotted for both total (on- and off-trade combined) and off-trade sales. The overall trend for both outcomes was further decomposed to differentiate the seasonal component from the underlying trend. This was repeated for each drink category. The relative market share of each drink category both pre- and post-intervention was calculated.

## Statistical methods

We used controlled interrupted time-series regression with seasonal autoregressive integrated moving average (SARIMA) errors as our primary statistical method to assess the impact of MUP on alcohol sales in Scotland. SARIMA is particularly good when analysing aggregated data with a large number of data points, as it enables robust control of autocorrelation as well as secular and seasonal trends in the data series. This latter point is particularly important here, given the seasonality that is present in alcohol sales [20].

We carried out our analysis in line with the guidance produced by Beard *et al.* [20] and as we have conducted in earlier work evaluating the impact of alcohol policy in Scotland [7, 21]. Initially we modelled the alcohol sales data time-series to obtain an adequate preliminary model. We then modelled and tested the effect of the intervention with and without adjusting for covariates.

SARIMA modelling requires that the outcome measure is normally distributed. We assessed this using kernel density plots. Prior to modelling we log-transformed the data to stabilize the variance and to reduce the influence of outliers. Candidate models were investigated using autocorrelation and partial autocorrelation plots of the data, with the most appropriate and parsimonious models selected using the Akaike information criterion (AIC) and Bayesian information

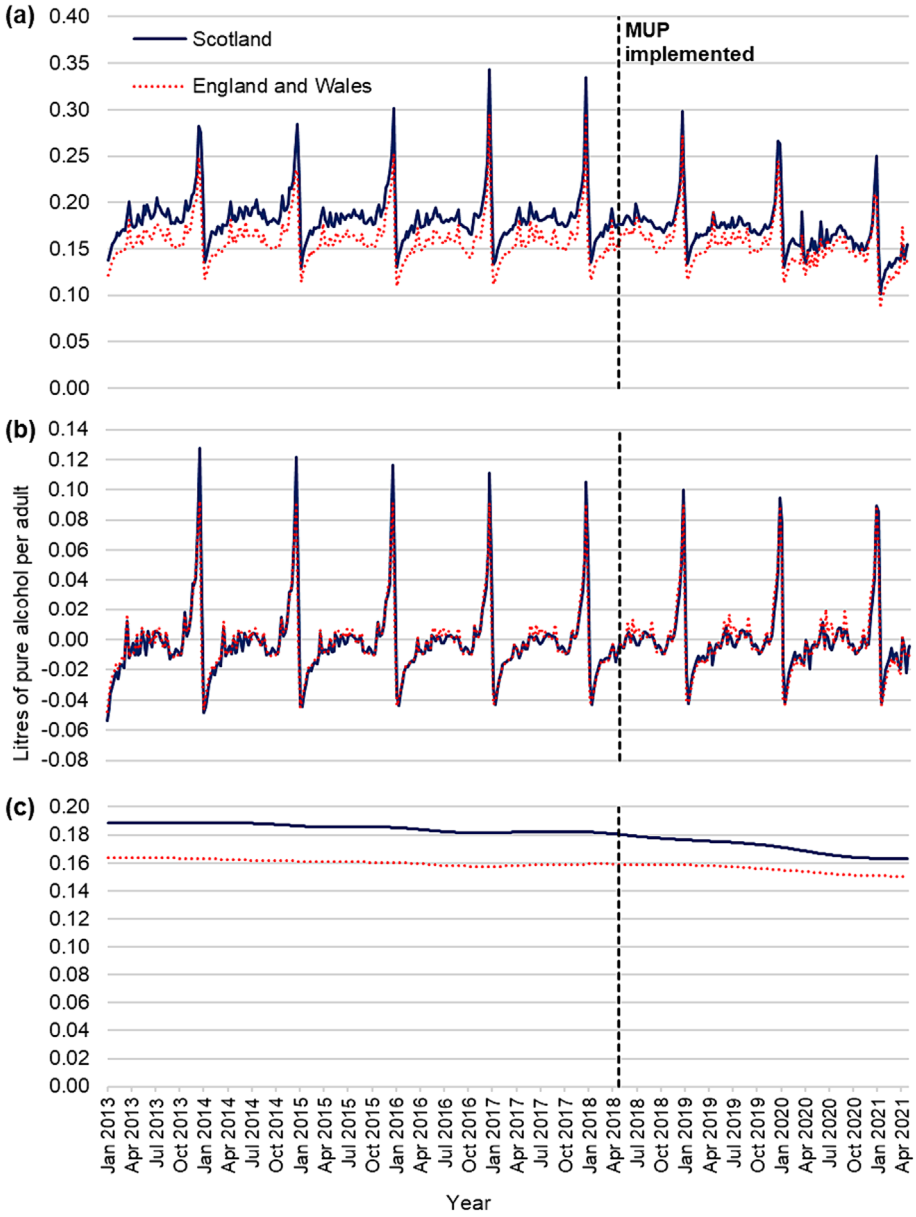


**FIGURE 1** Total volume of pure alcohol sold (on- and off-trade combined) in Scotland and England and Wales, weekly, January 2013 to April 2021, (a) weekly trend, and decomposed (b) seasonal and (c) trend components.

criteria (BIC) statistics. Lagged effects of MUP were not explored in light of findings from other studies in the MUP evaluation portfolio, which have shown that the legislation has been complied with, implemented effectively and had an immediate effect on alcohol purchases [22, 23]. Similarly, our preliminary analysis of data on the average sales price of off-trade alcohol did not suggest that there was an anticipatory effect prior to MUP being introduced in Scotland compared with EW [23].

We estimated the magnitude and uncertainty of the effect of MUP implementation on off-trade alcohol sales by including a binary explanatory variable in our SARIMA models, with the value of zero for the time before MUP is introduced (January 2013–April 2018) and the value of one after the introduction of MUP (May 2018–April 2021). Models were all fitted assuming a change in level. Further information on the SARIMA models is presented in the Supporting information.

In line with Lopez-Bernal *et al.*'s guidance [24], we used a two-step approach to incorporating our control group data. First, we fitted separate models to the intervention (Scotland) and control (EW) series to assess if there was a change in the level in one series that was not present in the other. We then entered the EW time-series data as a covariate in the SARIMA models for Scotland to produce a 'controlled' model. Models were fitted to the intervention series with and without adjustment for covariates: sales of other alcoholic beverage categories (in models of specific beverage categories); on-trade alcohol sales (Scotland only); and disposable household income.

In the Results section, we present the estimated impact of MUP from our primary analyses based on the fully controlled and adjusted model, as described above. We present the full results, as follows, in the Supporting information:

1. Separate unadjusted, uncontrolled models for Scotland and EW.
2. Unadjusted, controlled models for Scotland (in which the EW series is incorporated as a covariate).
3. Adjusted, controlled models for Scotland (as above but also including adjustment for the other covariates).

Presenting results from uncontrolled and controlled analyses, as well as from unadjusted and adjusted analyses, is consistent with reporting guidelines for this type of study [24, 25].

### Sensitivity analysis

We performed a number of additional analyses to test the robustness of our results. These additional analyses were carried out for the primary outcome measures [total (on- and off-trade combined) and off-trade sales] only. The analyses were performed for all alcohol sales and by drink category in both unadjusted and adjusted models for Scotland, unless specified otherwise. Full details of the sensitivity analyses performed are provided in the Supporting information and a summary is presented in Table 1.

### Changes to our published protocol

Our analytical approach was consistent with the pre-specified protocol published in our statistical analysis plan [9]. However, we made some changes to the analyses specified. We did not carry out a sensitivity analysis with balanced pre- and post-intervention data points, as this would have reduced our total number of pre-intervention time-points and subsequently reduced statistical power. We limited our falsification of the intervention dates to 6 months pre- and post-intervention, rather than 3 and 6 months pre- and post-intervention as specified, as this was felt proportionate to test the time sensitivity of the intervention alongside the multiple other sensitivity analyses conducted. In addition, we added sensitivity analyses with a shorter post-intervention period (to exclude the impact of COVID-19 restrictions and MUP in Wales), using an alternative source of retail sales data and re-running our primary model without including adjustment for Scottish on-trade sales. We also re-ran our primary model by drink category without including adjustment for sales of other drink categories.

### Software

MATLAB® (version 9.7 update 1) was used for all SARIMA modelling and Python version 3.7 for the UCM analysis (using the UCM procedure in the 'statsmodels version 0.10.2' package).

## RESULTS

### Descriptive analysis

The volume of pure alcohol sold per adult (Figure 1) remained relatively stable in Scotland and EW throughout the pre-intervention period. Per-adult sales were consistently higher in Scotland than in EW. Following the implementation of MUP, and throughout the remainder of the time-series in Scotland, a decline in total alcohol sales was observed and the gap between per-adult sales in Scotland and EW narrowed (Figure 1).

### Main analyses

Results presented here are for fully controlled and adjusted models. Full results for all models (uncontrolled and controlled) are presented in the Supporting information.

In fully controlled and adjusted analyses, MUP was associated with a 3.0% [95% confidence interval (CI) = 1.8–4.2%, $P < 0.001$] reduction in total per-adult alcohol sales in Scotland, relative to EW, in the 3 years following implementation (Figure 2). This reflects a 1.1% fall (−2.9 to 0.8%, $P = 0.263$) in Scotland and a 2.4% increase (0.0–4.9%, $P = 0.051$) in EW in uncontrolled models (see the Supporting information). Analysis by drink category showed net

reductions in sales of beer, spirits, cider and perry, little change in sales of wine and RTDs and a net increase in sales of fortified wine (Figure 2).

A net reduction of 3.6% (95% CI = 2.5−4.8%, $P < 0.001$) in per-adult sales of alcohol through the off-trade in Scotland, when controlling for off-trade sales in EW, was associated with the implementation of MUP (Figure 2). Analysis by drink category showed net reductions in per-adult sales of spirits, cider and perry, little change in sales of RTDs and a net increase in fortified wine sales. Net sales of wine through the off-trade increased, which was inconsistent with the results observed for total per adult wine sales, while the net reduction in off-trade beer sales was not statistically significant, unlike that for total beer sales.

Results from the on-trade analyses provided little evidence that MUP was associated with any change in per-adult on-trade sales in Scotland in the 3 years following implementation, with the only statistically significant result being found for a small decrease in wine [−0.2% (−0.4 to 0.0%, $P = 0.027$)] (Figure 2).

### Sensitivity analyses

The results from the main models for both total and off-trade sales were robust to a range of different conditions, as tested through our supplementary and sensitivity analyses. For total alcohol sales the sensitivity analyses suggested a net reduction in per-adult sales of pure alcohol in Scotland, relative to EW, in the range of 3.2 to 4.3%, and a reduction of 2.8 to 5.2% in sales through the off-trade, dependent upon the criteria imposed (for comparable analyses, e.g. excluding falsification tests), following the implementation of MUP (Figure 3).

## DISCUSSION

### Main findings

This study provides evidence that the introduction of MUP in Scotland on 1 May 2018 was associated with a reduction in per-adult alcohol sales after 3 years of implementation. Our best estimate when controlling for alcohol sales in a suitable geographical control area and other external factors is a 3.0% net reduction in per-adult sales, driven by a 3.6% net reduction in per-adult off-trade sales. We found net reductions in total per-adult sales of beer, spirits, cider and perry, little change in sales of wine and RTDs and a net increase in sales of fortified wine. As we accounted for underlying trends in our analyses, as well as other covariates that may explain part of the effect of MUP on alcohol sales, it is reasonable to conclude that MUP caused the reductions observed.

### Strengths

We used alcohol sales data (converted to litres of pure alcohol per adult) as our proxy for population consumption, which is considered the most objective and reliable approach [8]. Our study design incorporated data for EW as a geographical control. While the level of per-adult sales has consistently been higher in Scotland than EW the pre-intervention trend is very similar between the two areas (Figure 1), suggesting that EW makes a suitable geographical control area to Scotland. By controlling for the change in alcohol sales in EW after MUP was introduced in Scotland, we can be more confident that the observed reduction in Scotland was due to MUP rather than another unmeasured factor. Our analytical approach accounted for

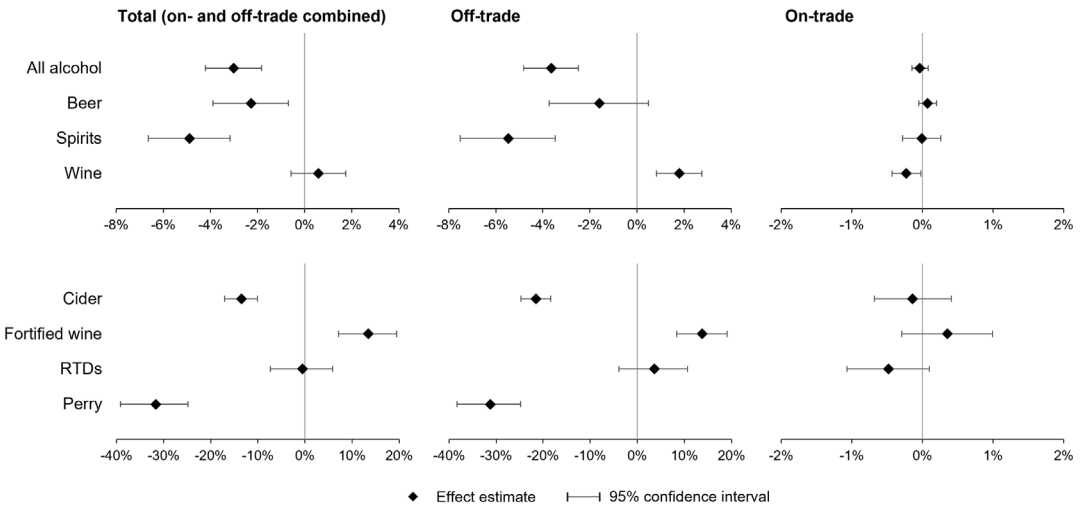


**FIGURE 2** Change (%) in alcohol sales in the 3 years after minimum unit pricing (MUP) was implemented in Scotland—estimates from controlled and adjusted models. All models include trends in alcohol sales in England and Wales (controlled), trends in household disposable income and, for analyses of specific drink categories, sales of the other drink categories as covariates (adjusted). All models are adjusted for underlying seasonal and secular trends. Off-trade-only models include trends in on-trade sales. On-trade analyses are truncated to 22 months post-MUP (February 2020) due to incomplete data following the introduction of COVID-related restrictions. RTDs = ready-to-drink beverages.

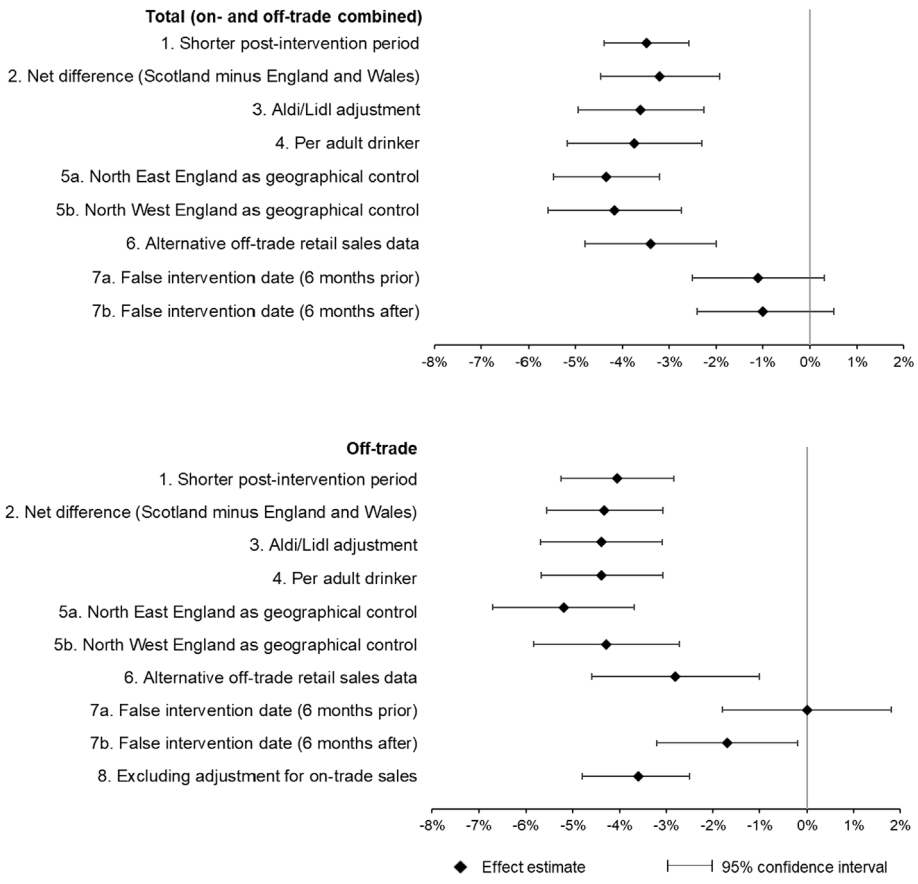


**FIGURE 3** Change (%) in alcohol sales in the 3 years after minimum unit pricing (MUP) was implemented in Scotland—estimates from multiple sensitivity analyses. See Table 1 and the Supporting information for details of each analysis. All models are adjusted for underlying seasonal and secular trends and include trends in household disposable income. Models 1, 3, 4, 6 and 7 incorporate alcohol sales in England and Wales as a control. Model 5a incorporates alcohol sales in North East England as a control. Model 5b incorporates alcohol sales in North West England as a control. Off-trade-only models include trends in on-trade sales, with the exception of model 8.

underlying trends in the data, as well as other important time-varying factors. Our estimated effects were robust to substitution between drink categories and changes in household income. We accounted for the impact of measures introduced during the COVID-19 pandemic on alcohol sales and for the introduction of MUP in Wales in our post-intervention time period. Finally, we performed a range of sensitivity analyses to test the robustness of our main findings to changes in the model specification and analytical method employed. We observed similar findings across these different approaches, which increases the reliability of our findings.

## Limitations

We were unable to disaggregate retail sales data to assess how alcohol sales, and the impact of MUP, may differ across population subgroups. Modelling has suggested that consumption among the heaviest drinkers, who typically consume the cheapest alcohol, was likely to be affected most by the introduction of MUP in Scotland, particularly those living in low-income households [26]. O'Donnell and colleagues have shown that the immediate reduction in alcohol purchasing in Scotland was driven by reductions among households purchasing the highest volumes of alcohol [22]. While we are unable to assess such differential impacts using retail sales data, we have shown the drink categories that tend to be consumed in greater quantities by heavier drinkers and those living in areas with higher levels of socioeconomic deprivation—cider, perry and spirits [27]—were those most affected by MUP. While retail sales data are considered the gold standard when monitoring alcohol consumption at a population level [8], due to the nature in which data from small retailers is estimated, and the application of an uplift to account for sales through Aldi and Lidl, some error may be present; this is reflected in the description of sales of pure alcohol as estimates.

## Interpretation

The largest net reductions in per-adult alcohol sales were observed for cider and perry. Smaller net reductions were observed for spirits and beer; as these make up a relatively large proportion of alcohol sales in Scotland, these smaller relative reductions make an important contribution to the reduction overall. An increase in per-adult sales of fortified wine, and wine through the off-trade, was observed during the same time-period, partly offsetting the overall reduction.

Our findings are consistent with the expected mechanism for the policy; drink categories with the greatest observed reduction in sales are typically those with the greatest increase in price [23, 28]. Similarly, where little or no change in price per unit occurred [23, 28] either no change or an increase in per-adult sales was seen, as for fortified wine. The reduction in total alcohol sales was entirely driven by changes to sales through the off-trade with no discernible

impact to on-trade sales; this indicates that the implementation of MUP did not cause a substantial shift towards on-trade alcohol consumption.

Our results at 3 years are similar to the off-trade results we reported at 1 year post-MUP implementation—a 3.5% net reduction in per-adult off-trade alcohol sales [7]. In both studies the largest relative reductions were observed for cider and perry, with smaller reductions being observed for spirits and beer. This is most probably explained by a relatively rapid industry and consumer response to the introduction of MUP, resulting in an initial reduction in total alcohol sales that was then maintained throughout the remainder of the post-implementation study period. In other work, we have shown that the retail industry responded to the introduction of MUP in a variety of ways, primarily aimed at pricing products impacted by the policy at a more attractive price point to the consumer [28]. Our findings are broadly consistent with those from other MUP studies, which found an initial reduction of 7.6% (9.5 g of alcohol per adult per household per week) in self-reported off-trade alcohol purchases [22], and a reduction in alcohol purchasing in Scotland, relative to northern England, that was maintained during the first half of 2020 [29].

## CONCLUSION

Our controlled natural experimental study suggests that MUP has been effective in reducing population-level alcohol sales in Scotland in the 3 years since implementation. These results provide an important contribution to the overall evaluation of MUP among a range of health, social and economic outcomes. The synthesis of evidence [30] among these outcomes will influence the future of this novel alcohol control policy.

### AUTHOR CONTRIBUTIONS

**Lucie Giles:** Conceptualization (equal); data curation (equal); formal analysis (equal); methodology (equal); writing—original draft (lead); writing—review and editing (lead). **Daniel Mackay:** Conceptualization (equal); formal analysis (equal); methodology (equal); writing—review and editing (equal). **Elizabeth Richardson:** Data curation (equal); formal analysis (equal); methodology (equal); writing—review and editing (equal). **James Lewsey:** Conceptualization (equal); methodology (equal); writing—review and editing (equal). **Mark Robinson:** Conceptualization (equal); methodology (equal); writing—review and editing (equal). **Clare Beeston:** Conceptualization (equal); funding acquisition (lead); writing—review and editing (equal).

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### DECLARATION OF INTERESTS

None to declare.

### DATA AVAILABILITY STATEMENT

Commercial restrictions apply to the availability of these data, which were used under license for this study.

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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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