Impact of minimum unit pricing on alcohol purchases in Scotland and Wales: controlled interrupted time series analyses

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Summary

Background As a policy option to reduce consumption of alcohol and the harm it does, on May 1, 2018, Scotland introduced a minimum price of 50 British pence (p) per unit of alcohol (8 g) sold; Wales followed suit on March 2, 2020, with the same minimum unit price (MUP). We analysed household purchase data based on bar codes to assess the impact of these policy options in the medium term for Scotland and in the immediate term for Wales.

Methods For these location-controlled, interrupted time series regression analyses, the data source was Kantar WorldPanel's household shopping panel, which, at the time of our analysis, included 35 242 British households providing detailed information on 1·24 million separate alcohol purchases in 2015–18 and the first half of 2020. With no data exclusions, we analysed the impact of introducing MUP in Scotland, using purchases in northern England as control, and in Wales, using western England as control. The studied changes associated with MUP were price paid per gram of alcohol purchased, grams of alcohol purchased, and amount of money spent on alcohol.

Findings In Scotland, price increases and purchase decreases following the introduction of MUP in 2018 were maintained during the first half of 2020. The difference between Scotland and northern England in 2020 was a price increase of 0·741 p per gram (95% CI 0·724–0·759), a 7·6% increase, and a purchase decrease of 7·063 g per adult per household per day that an alcohol purchase was made (6·656–7·470), a 7·7% decrease. In Wales, the introduction of MUP led to similar results. The difference between Wales and western England was a price increase 0·841 of 0·841 p per gram (0·732–0·951), an 8·2% increase, and a purchase decrease of 7·052 g per adult per household per day that an alcohol purchase was made (6·463–7·640), an 8·6% decrease. For both Scotland and Wales, reductions in overall purchases of alcohol were largely restricted to households that bought the most alcohol. The introduction of MUP was not associated with an increased expenditure on alcohol by households that generally bought small amounts of alcohol and, in particular, those with low incomes. The changes were not affected by the introduction of COVID-19 confinement in the UK on March 26, 2020.

Interpretation The evidence base supporting the positive, targeted impact of MUP is strengthened by the comparable results for Scotland and Wales. The short-term impact of MUP in Scotland during 2018 is maintained during the first half of 2020. MUP is an effective alcohol policy option to reduce off-trade purchases of alcohol and should be widely considered.

Funding None.

Introduction

Alcohol use is a leading risk factor for ill-health and premature death.[1] Although there is a global target to reduce the harmful use of alcohol by 10% between 2010 and 2025,[2] analyses indicate that this target will not be met.[3] Thus, there is a need to step up government action by implementing the five high-impact strategies[4] of the WHO SAFER initiative: (1) strengthen restrictions on alcohol availability; (2) advance and enforce drink driving countermeasures; (3) facilitate access to screening, brief interventions, and treatment; (4) enforce bans or comprehensive restrictions on alcohol advertising, sponsorship, and promotion; and (5) raise prices on alcohol through excise taxes and pricing policies, such as the introduction of a minimum price per gram of alcohol sold.[5]

Minimum unit price (MUP) is a pricing policy that sets a strength-based threshold price for alcohol products, below which they cannot be legally sold.[6] Drinkers at the greatest risk of harm tend to consume the cheapest alcohol,[7] particularly from shops and supermarkets, where prices are lowest;[8] thus, MUP specifically targets low-cost products.[9] Econometric modelling studies suggest that MUP is likely to produce greater reductions in the harm done by alcohol than either taxation on a volumetric basis (based on product strength or ethanol content) or an ad-valorem basis (proportionate to product value),[10] because it prevents producers and retailers from absorbing some of the tax increases by further reducing prices.[11]

MUP has, for several decades, been implemented and adjusted in several provinces in Canada[6] and in some

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Research in context

Evidence before this study

A search of Web of Science with the search term "alcohol AND (minimum pric* OR minimum unit) AND effect*)" for articles published between Jan 1, 2010, and Jan 31, 2021, with no language restrictions, resulted in 130 studies, eight of which reported results of empirical analyses (two in Scotland, five in Canadian provinces, and one in an Australian territory) of the impact of minimum unit price (MUP) on alcohol consumption and health outcomes. The evidence indicates that new implementation of MUP and changes in the level of MUP are associated with reductions in alcohol consumption and with declines in alcohol-attributable health burden. Our own previous work suggested that the introduction of MUP in Scotland on May 1, 2018, was associated with an immediate reduction in the amount of off-trade alcohol that households purchased. What we do not know is if the impact in Scotland is sustained over a longer period and if similar findings pertain to Wales, which introduced MUP on March 2, 2020. There are few data as to the extent to which MUP impacts the the households that generally buy the most alcohol and whether MUP increases the expenditure on alcohol among households that generally buy small amounts of alcohol, particularly those with low incomes.

Added value of this study

In this study, we address whether or not the impact of the introduction of MUP in Scotland on May 1, 2018, was maintained 2 years later, whether the introduction of MUP in Wales on March 2, 2020 has had an immediate impact on reducing the amount of alcohol (expressed in grams) purchased, whether lockdown restrictions due to COVID-19 impacted the effects of MUP, and whether households that buy small amounts of alcohol, particularly those with low incomes, increase their expenditure on alcohol following the introduction of MUP.

Implications of all the available evidence

Given the consistent results for both Scotland and Wales, the introduction of a MUP for sold alcohol appears to be an effective policy option that is associated with reductions in the numbers of grams purchased, particularly by households that purchase larger amounts, with no increase in expenditure on alcohol by households that generally buy small amounts of alcohol. Future work should assess the impact of introducing MUP in Scotland and Wales on actual consumption (as opposed to purchases) and on health outcomes.

countries of the former Soviet Union.[12] Scotland was the first country in the EU to implement a MUP of 50 British pence (p) per unit (8 g) of alcohol sold (6·25 p per gram) on the May 1, 2018,[13] following several years of delay, due to legal challenges by the alcohol industry.[14] On the basis of the findings of a 5-year independent evaluation led by NHS Health Scotland, the Scottish Parliament will vote on whether to continue implementation of MUP in March, 2023.[15] Wales introduced a MUP of 50 p per unit of alcohol sold on the March 2, 2020. England withdrew its commitment to introduce MUP in 2013,[16] with political concerns expressed regarding the potential adverse effect of MUP on increasing expenditure on alcohol among light drinkers, particularly those with less disposable income.[17] England, Scotland, and Wales have devolved responsibilities in implementing MUP. Because two of the jurisdictions have implemented MUP, and the third has not, we have an opportunity for natural policy experiments, defined by the UK Medical Research Council as evaluations of health-associated outcomes in which "exposure to the event of intention of interest has not been manipulated by the researcher".[18] Additionally, there have been no other alcohol policy regulatory measures put in place since the introduction of the MUPs that could confound outcomes of the natural experiments.

By use of household purchase data available for 2015–18, our own previous work suggested that the initial introduction of a MUP in Scotland increased the price of off-trade purchased alcohol by 0·64 p per gram (a 7·9% increase) and decreased off-trade purchases of alcohol by an average of 9·5 g per weekly purchases per adult per household (a 7·6% decrease), compared with England, during the first 7 months after implementation.[19] By use of similar purchase data that we obtained for the first half of 2020, we have also shown that, although COVID-19 lockdown measures introduced on March 26, 2020, increased household purchases of alcohol, there were no changes in overall alcohol purchases across Great Britain as a whole when accounting for on-trade alcohol purchases.[20] In this study, our objectives were to provide new evidence, by considering the mid-term effects of the Scottish MUP policy, provide the first evaluation of immediate MUP effects in Wales, and assess the extent to which any observed effects were sustained during the COVID-19 lockdown introduced on March 26, 2020.

Methods

Study design and data source

We did location-controlled, interrupted time series regression analyses of the mid-term impact of the introduction of MUP on Scottish household purchases, using purchases made by northern English households (those in the regions of North-West England, North-East England, and Yorkshire and the Humber) as a control, the immediate impact of the introduction of MUP on Welsh household purchases, using purchases made by western English households (those in the regions of North-West England, South West England, and West Midlands) as a control, and whether or not the changes were affected by the introduction of COVID-19 lockdown. We hypothesised that the short-term reduction in purchases of grams of

alcohol previously found[19] would be maintained in the mid-term in Scotland, that MUP implemented in Wales would be associated with similar reduced purchases of grams of alcohol, and that the MUP-attributable changes using location controls (ie, differences between Scotland and northern England and between Wales and western England) would be unaffected by COVID-19 lockdown measures. We analysed immediate and level changes in purchases, rather than changes in trends, in-line with the findings of our previous analysis.[19]

Our data source was Kantar Worldpanel's household shopping panel. This panel comprises around 30 000 British households at any one time, recruited through stratified sampling, with targets set for region, household size, age of main shopper, and occupational group. The same households provide longitudinal data over time, although there is movement of households, with some households leaving and others joining. In general, the panel remains representative of households in Great Britain as a whole. In the dataset we had, the average time between the first and last recorded alcohol purchase was just under 15·8 months per household for the years 2015–18. Kantar Worldpanel offers vouchers from high street retailers as compensation for participation. Households provide demographic information when joining the panel (age of the main shopper, number of adults in the household, income, social class, and life stage), followed by annual updates. Households record all off-trade purchases from all store types, including internet shopping, brought back into the home using barcode scanners. Households document all purchases, irrespective of where that purchase was made, including any cross-border shopping; the dataset does not include information on where the actual purchase was made (eg, in which supermarket in which town). To be included in Kantar Worldpanel's final datasets, households must meet quality control criteria (meeting thresholds for data recording and purchasing volume or spend [based on household size] every 4 weeks), with some 90–95% of households included.[21] Panellists also upload digital images of check-out receipts, which Kantar Worldpanel uses to verify the accuracy of scanner data and to match the price paid to the purchase record. Where no receipts are available, prices are taken from centralised databases of store-specific and product-specific prices.

Procedures

From Kantar Worldpanel's household shopping panel, we obtained raw data on take-home purchases of alcohol products in Great Britain for the 4 years covering 2015–18, on which we have previously reported[19] and for the first half of 2020 (to July 12), for which we have also reported on the impact of COVID-19 mitigation measures.[20] Data for 2019 were not available. The data we obtained had no missing values, with the exception of household income. 14·9% of households did not provide household income data, but this proportion did not differ by period (14·9%

in 2015–18, 14·9% in 2020), and slightly differed by geographical area (15·6% in Scotland, 14·6% in northern England, 14·4% in Wales, and 15·1% in western England).

Alcohol purchases are recorded daily. For each individual purchase, the data include the type and volume of the purchase using 19 drink categories, the brand, the price paid, and the alcohol by volume. The volume purchased was combined with alcohol by volume to calculate grams of alcohol purchased. To compare prices across all categories of products (beer, wine, spirits etc), we calculated the price paid per gram of alcohol purchased (appendix p 5).

We grouped households into five groups on the basis of the age of the main shopper, five social class groups based on the National Readership Survey,[22] and, creating similar sized groups of numbers of households, five household income groups and five groups of the number of grams of all alcohol regularly purchased. We grouped households into Scotland and northern England for analysis of the impact of Scottish MUP and into Wales and western England for analysis of the impact of Welsh MUP. We selected these English regions as controls because of their geographic proximity and relative cultural similarity to the focus countries.

We prepared the daily data for the interrupted time series analyses by, for any day that a household bought alcohol, summing the amount of alcohol purchased in grams, divided by the number of adults in the household; then, for each day, we calculated the mean of the sum of purchases across all households. In other words, the mean is for any day that any household made a purchase. To check that households did not change the frequency with which they made an alcohol purchase over time, we also calculated the number of days between each alcohol purchase for all households. For price, we took the mean price paid per gram of pure alcohol per purchase per household per day across all households. We also calculated the total amount spent (expenditure) on alcohol per adult per household on any day that the household bought alcohol, across all households.

For all three datasets, we plotted the seasonally adjusted dependent variables over time (study day) by the jurisdictional areas. On the basis of our previous approach,[19] we then generated a new series of dependent variables for each day, representing the differences between Scotland and northern England (for 2015–18 and 2020 data) and between Wales and western England (for 2020 data).

To assess the impact of Scottish MUP, we did two analyses. In the first, we assessed changes for the period 2015–18, and, in the second, we assessed the sustained impact of MUP on purchases in 2020, the changes for the period between Jan 1, 2015, and July 12 2020, excluding all dates from May 1, 2018, to Dec 31, 2019. In other words, all data for the period after introduction of MUP to end of December 2018 (we did not have data for 2019) were simply excluded, resulting in Jan 1, 2020, being set as the date of introduction of MUP. We also

***Figure 1:* Price paid per gram and grams purchased for Scotland minus northern England**
The solid black vertical line represents introduction of minimum unit price on May 1, 2018, and the coloured vertical line represents introduction of COVID-19 lockdown on March 26, 2020. Plots are of daily datapoints.

compared the means of price and purchased grams between the two periods, May 1, 2018 (post-MUP), to Dec 31, 2018, and Jan 1, 2020, to July 12, 2020. In our analyses of the immediate impact of Welsh MUP, we included only 2020 data, with one event, the introduction of MUP on March 2, 2020.

Statistical analysis
We adhered to published guidance for interrupted time series[23] and controlled interrupted time series[24] analyses in the health field. The dependent variables (Scotland minus northern England and Wales minus western England) were the mean price (in British pence) paid per gram of alcohol purchased per day of the study period, the mean sum of purchases in grams of alcohol per adult per household per day that a household made an alcohol purchase for each day of the study period, and the mean amount spent on alcohol in GB£ per adult per household per day that a household made an alcohol purchase for each day of the study period, which we used when analysing the impact of MUP by household income.

For each newly created dependent variable (Scotland minus northern England and Wales minus western England), we examined the distribution visually and with Q-Q plots and found all variables to be normally distributed. As recommended,[25] we used a time series modeller function[26] to estimate best fitting non-seasonal and seasonal ARIMA models that specify degrees of differencing or a square root or natural log transformation to ensure a stationary series and specify autoregressive and moving average orders. This eliminated the need to identify an appropriate ARIMA model through trial and error.

We examined immediate and level changes due to the event, the introduction of MUP in Scotland and Wales. The event variable was entered as a dummy variable coded with 0 for each day before the event and with 1 for each day from the event forwards. Thus, in our seasonal and non-seasonal ARIMA regression models, the dependent variables were price per gram of alcohol, purchased grams of alcohol, and expenditure on alcohol. The independent variable was the dummy variable event, with three covariates for Scotland, but not for Wales: the differences between the jurisdictions of mean age of main shopper, mean household income per adult household member, and proportion of households in class groups C2 to E. These covariates were used, because they changed slightly over time (appendix p 5). The model we tested and the non-seasonal and seasonal ARIMA terms and equations are described in the appendix (pp 14–15).

We repeated the models separately for the five household income groups within each of the five household purchase groups, adding expenditure on alcohol as a third dependent variable. Additionally, we examined the association between expenditure on alcohol and household income group, household purchase group, and the interaction income by purchase group through regression analysis.

To analyse the potential confounding effect of COVID-19 lockdown, on the basis of our previous methodology for multiple events,[27] we added a second event to the models, the introduction of confinement on March 26, 2020. This added an additional term to the equation, the impact of confinement, coded as 0 before the event and as 1 from the event forwards.

All analyses were done with SPSS version 26.

Role of the funding source
There was no funding source for this study.

Results
35242 households contributed to the dataset, with 1·24 million separate alcohol purchases (appendix p 16). Before the introduction of MUP in Scotland (Jan 1, 2015, to April 30, 2018), 92·4 g of alcohol were purchased (per adult per household per day that a household made a purchase) and the price per gram purchased was 9·71 p. The equivalent data for Wales for the period Jan 1 to Feb 29, 2020, was 82·8 g and 10·25 p per gram (appendix p 16). The distributions of the groups of age of main shopper, social class, and household income were broadly similar for Scotland and northern England for the two periods (2015–18 and 2020) and for Wales and western England for 2020 (appendix pp 5–8).

Seasonally adjusted dependent variables over time by the jurisdictional areas (appendix pp 9–12), showed parallel trends between Scotland and northern England and between Wales and western England before the introduction of MUP, illustrating the appropriateness of northern and western England as control areas.

	Immediate impact for Scotland minus Northern England (May 1–Dec 31, 2018)*		Mid-term impact for Scotland minus Northern England (Jan 1, 2015–July 12, 2020) excluding May 1, 2018–Dec 31, 2019*		Immediate impact for Wales minus Western England (March 2–July 12, 2020)	
	Price per gram, pence	Grams purchased†	Price per gram, pence	Grams purchased†	Price per gram, pence	Grams purchased†
Models with the one event, introduction of MUP						
Intercept‡	−0·207 (−0·217 to −0·197)	5·749 (5·532 to 5·965)	−0·204 (−0·214 to −0·195)	5·773 (5·556 to 5·989)	−0·143 (−0·246 to −0·040)	6·423 (5·881 to 6·964)
Level change	0·747 (0·733 to 0·761)	−7·570 (−7·878 to −7·262)	0·741 (0·724 to 0·759)	−7·063 (−7·470 to −6·656)	0·841 (0·732 to 0·951)	−7·052 (−7·640 to −6·463)
Models with the two events, introduction of MUP and COVID-19 confinement						
Intercept‡	..	..	−0·204 (−0·214 to −0·195)	5·771 (5·555 to 5·988)	−0·142 (−0·245 to −0·040)	6·423 (5·882 to 6·964)
Level change MUP	..	..	0·742 (0·717 to 0·767)	−6·823 (−7·398 to −6·248)	0·770 (0·602 to 0·938)	−7·171 (−8·093 to −6·250)
Level change confinement	..	..	−0·002 (−0·034 to 0·030)	−0·432 (−1·161 to 0·298)	0·087 (−0·069 to 0·243)	0·146 (−0·721 to 1·014)

MUP=minimum unit price. *Models control for changes in difference (Scotland minus Northern England) for age of main shopper, household income (adjusted for number of adults), and proportion of households in social class groups C2 to E. †Mean of the sum of purchases per adult per household per day that a household made an alcohol purchase across all households. ‡The mean of the differences between the geographical areas in price or purchases for each day across all days before the introduction of MUP.

Table: Coefficients for level changes in price per gram and grams purchased for all alcohol after introduction of MUP in Scotland and Wales

Furthermore, in terms of the amount of alcohol purchased, northern England was more like Scotland, and western England more like Wales, than England as a whole (appendix pp 9–12).

The plots of the ARIMA modelled series showed a stationary series, with no evidence of autocorrelation (Box-Llung Q statistic p=0·083; appendix pp 12–13). We repeated the time series modeller function and assessment of the residuals separately for all dependent variables and for all analyses, confirming in each case a stationary series, with no evidence of autocorrelation.

The immediate effects of MUP in Scotland on price increases and purchase reductions were maintained in 2020, with a similar associated reduction (Scotland minus northern England) in purchased grams of alcohol compared with 2018; a reduction of 7·063 g (95% CI 6·656–7·470) for Jan 1 to June 12, 2020, compared with a reduction of 7·570 g (7·262–7·878) in 2018 (figure 1; table). Reductions in grams purchased in Scotland were not due to changes in the frequency of shopping for alcohol, which did not change following the introduction of MUP (appendix p 17). There were no differences in the means between the data for 2018 after the introduction of MUP and the data for 2020 for price paid per gram of alcohol (mean difference −0·019 p per gram, 95% CI −0·041 to 0·003) and for purchased grams of alcohol (mean difference 0·29 g, 95% CI −0·21 to 0·79).

In Wales, with fewer overall datapoints over a shorter period than for Scotland, MUP had a less abrupt but relatively steady impact. The difference in price increase (Wales minus western England) was 0·841 p per gram (0·732–0·951), and the difference in purchase decrease was 7·052 g (6·463–7·640; figure 2; table). As for Scotland, reductions in grams purchased in Wales were not due to changes in the frequency of shopping for alcohol following the introduction of MUP (appendix p 17).

COVID-19 confinement did not affect the results in both geographical areas (table). Although household purchases of alcohol increased in all four areas (appendix pp 10, 12), the differences in the impacts of MUP between Scotland and northern England and between Wales and western England were maintained.

In both Scotland and Wales, changes occurred across all beverage groups to varying degrees. Price increases were higher for cider than for other beverages and drops in consumption, in grams, were higher for cider and spirits than for other beverages (appendix p 18).

Differences in the associated impact of MUP by income group within purchasing group were similar in Scotland and Wales (appendix pp 19–21). Before the introduction of MUP, the price per gram of alcohol purchased tended to be lower in groups that purchased larger volumes of alcohol and, within each purchasing group, was higher the larger the household income (appendix pp 19–21). After introduction of MUP, price increases tended to be only within the larger purchasing households, and, within purchasing groups, showed no systematic variation by household income (appendix pp 19–21). In other words, MUP seemed to preferentially increase the price of alcohol among households that generally bought the most alcohol.

Before the introduction of MUP, the number of grams of alcohol purchased tended to increase with household income within each household purchasing group (appendix pp 19–21). After introduction of MUP, the drops in alcohol purchases were largely confined to the largest household purchasing group, and, within this group, tended to be greater as household income increased (appendix pp 19–21). In other words, MUP targeted households that bought the most alcohol.

Before the introduction of MUP, the pattern of money spent on buying alcohol tended to follow the grams of alcohol purchased, increasing as household income increased
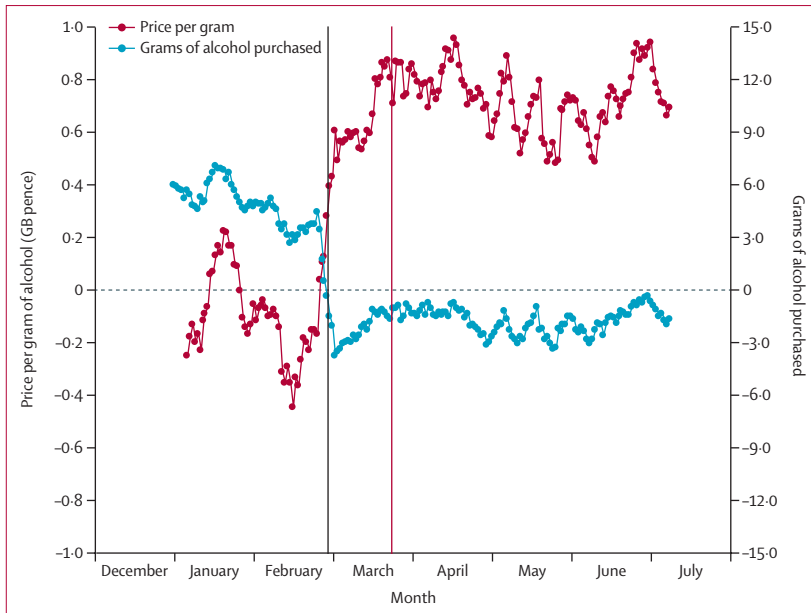
***Figure 2:* Price paid per gram and grams purchased for Wales minus western England**
The solid black vertical line represents introduction of minimum unit price on May 2, 2020, and the coloured vertical line represents introduction of COVID-19 lockdown on March 26, 2020. Plots are of daily datapoints for the year 2020.

within each purchasing group (appendix pp 19–21). Following introduction of MUP, increases in money spent tended to be confined to the larger purchasing groups, with hardly any increase in expenditure in the lowest two to three out of the five purchasing groups (appendix pp 19–21). When looking at both Scotland and Wales together, for every increase in purchase group from group one to group five, expenditure on alcohol increased by 87·4 p per purchase day following the introduction of MUP (95% CI 37·2 to 137·5). For every increase in income group from group one to group five, there was a non-significant increase in expenditure of 40·9 p per purchase day (–9·2 to 91·1). There was an interaction between purchase group and income group, such that moving from the smallest to the largest purchasing households, the increase in expenditure on alcohol following MUP was steeper for low-income than for high-income groups by 20·7 p per purchase day (5·6 to 35·8) for every decrease in income group from group five to group one. In other words, there was little or no increases in expenditure on alcohol among households by households that generally bought small amounts of alcohol following MUP, with no increase in expenditure amongst low-income, low-purchasing households.

Discussion

We previously showed that the introduction of MUP in Scotland in on May 1, 2018, was associated with an increase in the average price of alcohol and in reduced household purchases of alcohol, compared with England, at least for the rest of 2018.[19] By use of similar purchase data for the first half of 2020 (we were unable to obtain

data for 2019), we have been able to investigate whether the associated impact of MUP in Scotland was maintained into 2020 and the immediate impact of MUP in Wales. We also considered whether any changes in price or purchases associated with MUP were affected by the UK COVID-19 lockdown, implemented on March 26, 2020. This study differs from our previous analysis[19] in three ways: we used daily datapoints as opposed to weekly datapoints (to have sufficient number of datapoints before and after the introduction of MUP in Wales), we used closer geographical areas as controls (rather than England as a whole, although we previously compared with northern England as a secondary analysis), and we used non-seasonal and seasonal ARIMA models as opposed to linear regression in the presence of only minimal autocorrelation (to better ensure a stationary series with no autocorrelation).

We found that the impact of Scottish MUP was maintained during the first half of 2020 and that the immediate impact of MUP in Wales was very similar to that of Scotland. In both jurisdictions, greater reductions were found for purchases of cider and spirits than for other beverage categories. This is the same finding as our previous analyses and might reflect greater price increases for cider and, to a lesser extent, spirits.[19] Additionally, similar to our previous findings,[19] reductions in purchases of alcohol as a whole were largely confined to households purchasing the largest amount of alcohol. Before MUP, low-income households generally spent less money per day of purchase on alcohol compared with high-income households. Following the introduction of MUP, increased expenditure on alcohol was largely confined to high-purchasing households, although the association between expenditure after introduction of MUP and household income was insignificant. Households that generally purchased small amounts of alcohol, and in particular those with low household incomes did not increase their expenditure following the introduction of MUP. However, the amount of money spent on alcohol after introduction of MUP increased faster for low-income than for high-income households. In the quintile of households that bought the most alcohol, following the introduction of MUP, the lowest income households did not seem to reduce the amount of alcohol they purchased, and their expenditure on alcohol increased (appendix pp 20–21); however, this was not the case for the next lowest income group.

The difference between regions with and without MUP were not affected by the COVID-19 lockdown introduced on March 26, 2020, even though purchases of alcohol were not possible from on-trade premises, such as bars, pubs, and restaurants, because they were closed in all regions.[20] Thus, in principle, household purchases captured all legal alcohol purchases in Great Britain, because on-trade purchases were not possible during lockdown, with no evidence of overall increases in the amount of alcohol purchased due to lockdown.[20]

Our findings for Scotland are in line with reports made by Public Health Scotland,[28,29] which found increases in the price and decreases in consumption of alcohol. On the basis of electronic sales records from large retailers (retailers with ten or more retail shops operating under common ownership) and a weighted stratified random sample of smaller impulse retailers (stores mainly used for top-up purchases), Public Health Scotland found an increase in price of 7% (similar to our increase of 7·6%), and a decrease in sales of grams of alcohol of 4·2% in Scotland, when controlling for changes in England and Wales,[29] smaller than the drop we found of 7·7% on the basis of purchase data, controlling for northern England. Our findings are also consistent with the experiences of adjusting minimum unit prices in Canadian provinces, in which it is estimated that a 10% increase in minimum prices was associated with reductions in consumption of 10% for beer, 5·9% for spirits, and 4·6% for wine.[6]

Analyses based on purchase data have several strengths. We obtained data from a large number of households, with a large number of daily datapoints before and after the events. Furthermore, although they rely on compliance at the household level, purchase data based on product bar codes and verified through digital receipts are objective. In general, attrition rates and fatigue in recording over time is low and seems better with Kantar scanner-based data,[21] which also provide more detailed product descriptions and less under-reporting[30] than data from other regular in-person surveys. Households should document all purchases irrespective of where that purchase was made, including cross-border purchases (ie, a Scottish household should record an alcohol purchase even if that purchase was made outside of Scotland). Thus, although we do not have information on where the actual purchase was made, any cross-border purchases should be accounted for.

We did controlled interrupted time series analyses, using northern England as control for Scotland and western England as control for Wales, subtracting the differences between the respective areas for our analyses. The use of location controls helps to control for any confounding events that would affect both locations,[24] such as COVID-19 lockdown,[20] and any statistical concerns, such as regression to the mean as an explanation for the increased changes among households that bought large amounts of alcohol.[31] Plots of the dependent variables by the different areas over time (appendix pp 9–12) showed parallel trends before the introduction of MUP, demonstrating the validity of the chosen control areas. Furthermore, before the introduction of MUP, with respect to alcohol purchases, northern England appeared more like Scotland and western England more like Wales, than England as a whole.

Interrupted time series analyses based on purchase data also have limitations. A key limitation of our study is that we only measured off-trade alcohol purchases and not on-trade purchases, although this was less of an issue during COVID-19 lockdown (between March 21 and July 4, 2020), when on-licensed premises were closed. By way of example on-licence purchases accounted for 31·6% of all alcohol purchases (expressed in volume of absolute alcohol) in Great Britain in 2015, decreasing to 28·5% in 2018.[32]

Although quality control and compliance are regularly monitored by Kantar Worldpanel, with households only included in the final dataset if they adhere to pre-assigned quality control criteria (meeting thresholds for data recording and purchasing volume or spend based on household size every 4 weeks), the data have limitations. Alcohol purchases have been among the most under-reported categories in the panel data,[33] which might reflect the method of recording purchases if not all items purchased are taken home and scanned. Primary shopping is more likely to be done by women, who are therefore more accustomed to recording, whereas secondary top-up shopping is more likely to be done by men and might be less well recorded.[33] Under-recording of alcohol might also be more likely among households purchasing the largest amounts of alcohol, because they might become fatigued after recording large numbers of items. Additionally, we were only able to assess changes in off-trade alcohol purchases as opposed to alcohol consumption for these periods. Adults in a household might not have an equal share of the alcohol purchased.

We were also unable to control for any changes in the volume of unrecorded, smuggled alcohol or in home-brewed alcohol, which might have differed between the jurisdictions studied. For Great Britain as a whole, however, the volume of unrecorded, smuggled alcohol decreased between 2015 and 2019, with no evidence that this differed between the jurisdictions.[34]

That 14·9% households did not report household income might imply that subgroup analyses associated with household income, such as expenditure on alcohol, might not be generalisable to all households. However, we think this is probably not the case, given that non-reporting of household income did not differ by geographical area or period and that there were minimal or no differences between households that did not and did report household income for price paid per gram of alcohol purchased, amount of alcohol purchased, and expenditure on alcohol (appendix p 19).

Despite these concerns, by conducting a controlled interrupted time series analysis, quality issues are controlled for, and we have no reason to believe that quality issues differed between the geographical areas over time. We also checked whether households in Scotland and Wales changed the frequency of their shopping for alcohol following introduction of MUP, and we found that this was not the case.

We have not analysed the impact of MUP on the harms done by alcohol, although this is the subject of ongoing research.[35] MUP has been shown to reduce alcohol-associated harms in Canadian provinces, where a 10% increase in the average minimum price across

beverage types led to a 9% reduction in acute alcohol-attributable hospital admissions and a 9% reduction in chronic alcohol-attributable admissions 2 years later.[12]

In conclusion, our study has shown that the introduction of MUP in two jurisdictions within Great Britain is associated with increases in the price of alcohol and decreases in purchased alcohol to remarkably similar extents. The changes were much greater in households that bought the most alcohol. Households that bought small amounts of alcohol, and, in particular, those with low incomes, did not increase their expenditure on alcohol following the introduction of MUP. Although more evidence on health outcomes is needed, the evidence presented here suggests that MUP is a powerful and highly targeted pricing policy option to reduce alcohol purchases that could be widely implemented, as proposed by WHO's SAFER initiative.[5]

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