Impact of COVID-19 Confinement on Alcohol Purchases in Great Britain: Controlled Interrupted Time-Series Analysis During the First Half of 2020 Compared With 2015–2018

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Abstract

Aims: To investigate if COVID-19 confinement led to excess alcohol purchases by British households.

Methods: We undertake controlled interrupted time series analysis of the impact of COVID-19 confinement introduced on 26 March 2020, using purchase data from Kantar Worldpanel’s of 23,833 British households during January to early July 2020, compared with 53,428 British households for the same time period during 2015–2018.

Results: Excess purchases due to confinement during 2020 were 178 g of alcohol per 100 households per day (adjusted for numbers of adults in each household) above an expected base of 438 g based on averaged 2015–2018 data, representing a 40.6% increase. However, when adjusting for expected normal purchases from on-licenced premises (i.e. bars, restaurants, etc.), there was evidence for no excess purchases of grams of alcohol (a 0.7% increase). With these adjustments, beer purchases dropped by 40%, wine purchases increased by 15% and spirits purchases by 22%. Excess purchases increased the richer the household and the lower the age of the main shopper. Confinement was associated with a shift in purchases from lower to higher strength beers.

Conclusion: During the COVID-19 confinement, the evidence suggests that households did not buy more alcohol for the expected time of the year, when adjusting for what they normally would have purchased from on-licenced premises.

INTRODUCTION

Since early 2020, the population of Great Britain has been subject to a series of social distancing measures of varying intensity as part of the UK Government attempt to limit the spread of COVID-19 (Dunn et al., 2020). Following unsuccessful efforts to contain and delay the virus during February, lockdown regulations accelerated from March onwards, with schools shut for all but the children of identified key workers, the closure of bars, restaurants and non-essential shops, and the introduction of ‘stay-at-home’ orders for the majority of the population, with restrictions on international travel,
and social gatherings and events banned or severely constrained (HM Government, 2020). Some of these measures were relaxed during May and June, permitting further indoor and outdoor gatherings between households. However, bars, pubs and restaurants remained closed until 4th July in England, 15th July in Scotland and 3rd August in Wales, although varied ‘lockdown’ measures continue to be implemented in response to specific spikes in the prevalence of new cases.

The full impact of long-term social distancing on the physical and mental health of people in Great Britain remains unknown. However, available evidence suggests that the combination of severe restrictions in social contact, reduced access to public services and adverse effects on financial and employment security (ONS, 2020) have led to a significant deterioration in UK mental health compared with pre-COVID-19 trends (Pierce et al., 2020). There is a well-established link between alcohol use, stress and depression (Howell et al., 2010; Clay and Parker, 2020; The Lancet Gastroenterology and Hepatology, 2020), causing some concern that lockdown may have also contributed to the increased levels of drinking during this period (The Lancet Gastroenterology and Hepatology, 2020); indeed, one cross-sectional study of alcohol use in COVID-19 social lockdown found that using alcohol to cope was associated with higher rates of consumption in lockdown (Wardell et al., 2020). Furthermore, while in theory, there were reduced opportunities to consume alcohol outside the home, due to closure of consumption sites prior to July 2020, off-licence premises (i.e. shops selling alcohol) as well as supermarkets and pharmacies were permitted to remain open during even the early phase of lockdown as designated ‘essential’ businesses (Dunn et al., 2020). Initial reports suggest that many people responded to the closure of pubs and restaurants by stockpiling alcohol for home consumption (Eley, 2020).

Findings from previous surveys of alcohol use in the UK also suggest that consumption increased in many population groups during the COVID-19 pandemic. One study compared 2017–2019 data from the UK Household Longitudinal Study to those collected between 24th and 30th April, one month after the introduction of the stay-at-home order. It found that the prevalence of drinking on four or more occasions per week increased significantly during lockdown (14.2% in 2017–2019 compared with 23% in April 2020) and that there was also a rise in past-month occurrence of heavy episodic drinking, defined as women/men drinking 48/64 or more grams of alcohol on a single occasion (9.7% in 2017–2019 reported heavy episodic drinking compared with 16.6% in April 2020). Changes were largest in adults aged between 35 and 49 years, and women and those with middle or high incomes (Daly and Robinson, 2020). A cross-sectional survey of over 2000 UK residents by Opinium on behalf of the charity Alcohol Change UK found that more than a quarter (28%) of people agreed that they had drunk more alcohol than usual during lockdown, particularly younger drinkers, people in employment, those in higher socio-economic groups and heavier drinkers (Alcohol Change UK, 2020). People also reported drinking more frequently during lockdown, and one in five (19%) of those surveyed had drunk alcohol as a way to handle stress or anxiety, particularly parents of younger children and heavy drinkers. The Smoking and Alcohol Toolkit Survey found an increase in higher risk drinking, as measured by AUDIT-C, associated with lock-down (38 versus 25%), with an odds ratio of 1.85 (95% confidence interval = 1.67–2.06) (Jackson et al., 2020).

However, all surveys used self-report data to assess alcohol consumption and are thus potentially subject to recall bias and error (Greenfield and Kerr, 2008). Purchase data provide a more objective measure of potential alcohol intake, based on product bar codes, and verified via digital receipts. Moreover, as such data capture precise information on which types of alcohol products have been bought by which types of households, and when, they permit greater specificity in the analysis of purchasing trends over time. For example, we report elsewhere on a small but significant rise in the purchase of lower strength beers in recent years, resulting in reductions in overall household purchases of grams of alcohol (Anderson, Jané Llopis, Rehm, 2020; Anderson et al., 2020). Finally, and importantly, given restrictions in on-licenced purchases prior to 4th July 2020, such as in bars, pubs and restaurants and nightclubs, household purchase data represent a particularly valuable source of information about alcohol consumption during lockdown.

Using a large, representative dataset, this study aimed to assess the impact of confinement measures in Great Britain on household purchases of alcohol using interrupted time series analyses. More specifically, we sought to address the following three questions.

(a) Did COVID-19 lockdown lead to a change in purchases of total grams of alcohol?

(b) Did any change in purchases differ by household socio-demographic characteristics?

(c) Did COVID-19 confinement lead to shifts in purchases of different strength beers?

MATERIALS AND METHODS

Study design

We undertook controlled, interrupted time series regression analyses of the impact of the introduction of confinement in Great Britain (26 March 2020) on British household purchases of alcohol (including no- and low-alcohol products), using purchases made during the same calendar time period for 2015–2018 (averaged) as our control. We inferred that confinement would lead to excess purchases during confinement above the average level purchased during the same time period for 2015–2018, both to compensate for closure of bars, restaurants, etc.,—‘on-licenced premises’, and to use alcohol as an anxiolytic. Thus, we examine abrupt and persistent level changes in alcohol purchases, due to an event, the introduction of COVID-19 confinement.

Data source

Our data source is Kantar Worldpanel’s (KWP) household shopping panel. KWP comprises ~30,000 British households at any one time, recruited via stratified sampling, with targets set for region, household size, age of main shopper and occupational group. Households record all purchases (from all store types, including Internet shopping) brought into the home using barcode scanners. To be included in KWP’s final datasets, households must meet quality control criteria (meeting thresholds for data recording and purchasing volume/spend (based on household size) every 4 weeks). Panellists also upload digital images of checkout receipts, which KWP use to verify the accuracy of scanner data.

Households report the age of the main shopper, the number of adults in the household, income, social class and life stage of the household (e.g. with young family, retired, etc.). We grouped households into the following:

(a) five age groups of the age of the main shopper: 18–34; 35–44; 45–54; 55–64 and 65+ years (which correlated with life stage of the household);
Table 1. Socio-demographic distributions of samples for all households that made at least one alcohol purchase, during January to early July (study period), for 2015–2018 and 2020

| Age of main shopper (years) | 2015–2018 (over study period for each year) | 2020 (over study period) |
|----------------------------|---------------------------------------------|-------------------------|
|                            | Number | Percent | Number | Percent |
| 18–34                      | 8827   | 16.5    | 2558   | 10.9    |
| 35–44                      | 12,920 | 24.2    | 5174   | 22.1    |
| 45–54                      | 13,516 | 25.3    | 5868   | 25.1    |
| 55–64                      | 8865   | 16.6    | 4650   | 19.9    |
| 65+                        | 9300   | 17.4    | 5133   | 22.0    |
| Total                      | 53,428 | 100.0   | 23,383 | 100.0   |

| Household annual income per adult | 2015–2018 (over study period for each year) | 2020 (over study period) |
|-----------------------------------|---------------------------------------------|-------------------------|
|                                  | Number | Percent | Number | Percent |
| £0–7.5 k                          | 9696   | 21.4    | 3331   | 16.8    |
| >7.5–12.5 k                       | 9334   | 20.6    | 4000   | 20.2    |
| >12.5–17.5 k                      | 9938   | 21.9    | 4416   | 22.3    |
| >17.5–25 k                        | 7648   | 16.9    | 3771   | 19.0    |
| >25 k                             | 8696   | 19.2    | 4312   | 21.7    |
| Total                             | 45,312 | 100.0   | 19,830 | 100.0   |

| Class group | 2015–2018 (over study period for each year) | 2020 (over study period) |
|-------------|---------------------------------------------|-------------------------|
| AB          | 11,616 | 21.7 | 5068 | 21.7 |
| C1          | 21,117 | 39.5 | 9593 | 41.0 |
| C2          | 9679  | 18.1 | 4209 | 18.0 |
| D           | 7189  | 13.5 | 3013 | 12.9 |
| E           | 3827  | 7.2  | 1500 | 6.4  |
| Total       | 53,428 | 100.0 | 23,383 | 100.0 |

| Area of Great Britain | 2015–2018 (over study period for each year) | 2020 (over study period) |
|-----------------------|---------------------------------------------|-------------------------|
| South England         | 22,473 | 42.7 | 9748 | 42.3 |
| Mid England           | 9329   | 17.7 | 4140 | 18.0 |
| Wales                 | 2636   | 5.0  | 1194 | 5.2  |
| North England         | 13,864 | 26.3 | 5988 | 26.0 |
| Scotland              | 4326   | 8.2  | 1960 | 8.5  |
| Total                 | 52,628 | 100.0 | 23,030 | 100.0 |

*15.2% of households declined to state household income.
*For 1.5% of households, stated postcode did not match postcode look-up.

(b) five social class groupings, AB, C1, C2, D and E, based on a system of socio-demographic classification used in the UK, originally developed by the National Readership Survey to classify readers. AB includes higher and intermediate managerial, administrative or professional workers; C1 supervisory or clerical and junior managerial, administrative or professional workers; C2 skilled manual workers; D semi-skilled and unskilled manual workers and E states pensioners, casual and lowest grade workers, and unemployed with state benefits only (National Readership Survey, 2019);

(c) five income groups per adult per household per year of: £0–7.5 k, >7.5–12.5 k; >12.5–17.5 k, >17.5–25 k and > £25 k; and

(d) five geographic areas representing eleven regions across Great Britain, based on UK Office for National Statistics classifications for truncated postcode data look-ups: South England (South West, London, South East and Eastern regions); Mid England (West Midlands and East Midlands regions); Wales; North England (North West, North East and Yorkshire & Humber regions) and Scotland.

The distributions of household socio-demographic characteristics for all households that made at least one alcohol purchase for the first 6 months of 2015 to 2018 (averaged) and 2020 are shown in Table 1. Compared with the average of the first 6 months of each of 2015–2018, households for the first 6 months of 2020 tended to have a higher age of main shopper and a higher household income, but similar distribution of social class group and geographic area. We thus included the age of main shopper and household income as covariates in our models. We also undertook analyses separately for each household grouping, age, class group, household income and geographic area.

We obtained KWP data on all off-trade purchases of alcohol products in Great Britain, including non-alcoholic and low-alcohol products, for the 4 years covering 2015–2018, on which we have previously reported (O’Donnell et al., 2019; Anderson, Jané Llopis, Rehm, 2020; Anderson et al., 2020), and for the six and a quarter months between January and early July 2020. Because only items purchased and brought into the home are recorded, only off-trade alcohol purchases are included, that is, alcohol bought in supermarkets, other shops or via Internet shopping for consumption off the premises. Alcohol purchases are recorded daily. A detailed product description identifies the type and volume of the purchase using 19 drink categories, the brand and the alcohol by volume (ABV). Volume was combined with ABV to calculate grams of alcohol purchased.

We prepared data for the interrupted time series analyses by summing up daily records of purchases of alcohol in grams across all households, adjusted for the number of adults in each household, for each day during the first six and a quarter months of each year.
(2015–2018 and 2020). To take into account differences in the numbers of households between 2015–2018 and 2020, we express purchases per 100 households for each of the time periods. To match days of the week across the 6 years (i.e., Monday for Monday, etc.), we re-set day 1 for each year as the first Sunday after 1st January (2015: 4th January; 2016: 3rd January; 2017: 8th January; 2018: 7th January; 2020: 5th January). Confinement was introduced on 26th March 2020, day 82 for our re-set day numbers. We restricted our analyses for the re-set days 8–182. Re-set day 8 was chosen to give a greater number of days after New Year, when alcohol purchases are minimal. Day 182 was chosen as this coincides with 4th July 2020, when pubs were re-opened in England, where over 86% of the included households were located. We defined confinement as the period from re-set day 82 to re-set day 182. For our potentially confounding covariates, we used the mean age of the main shopper per day and the mean household income (adjusted for numbers of adults in the household) per day.

Statistical analyses

We adhered to published guidance for undertaking interrupted time series analyses in the health (Bhaskaran et al., 2013; Bernal et al., 2018) and addictions (Beard et al., 2019) fields. To conduct the main interrupted time series analyses, we adopted similar methodology to that previously used in our assessment of the impact of the introduction of minimum unit price in Scotland (O’Donnell et al., 2019), based on guidance for the use of controls in interrupted time series studies of public health interventions (Bernal et al., 2018). As such, we generated a new series of dependent variables representing the differences between 2020 and 2015–2018 (averaged) for each corresponding re-set day. The dependent variables were as follows:

(a) differences between 2020 and 2015–2018 (averaged) in means of sum of grams of alcohol purchased per 100 households (adjusted per adult in the household) per day for all alcohol and by beverage category;
(b) differences between 2020 and 2015–2018 (averaged) in the mean ABV of purchased beer per day;
(c) differences between 2020 and 2015–2018 (averaged) in the proportion of the volume of all purchased beer that had an ABV of 3.5% or less.

For the two potentially confounding covariates (mean age of main shopper and mean household income), we also generated a new set of independent variables, the differences between 2020 and the average of 2015–2018.

By creating the new series of differences for the dependent variable data, we largely removed seasonal variation in the data. For each dependent variable, we examined the distribution visually and with Q-Q plots and found all variables to be normally distributed. As recommended by a number of authors (Jebb et al., 2015; Beard et al., 2019), we used a time series modeler function (IBM Corp, 2017) to estimate best fitting ARIMA models that: (a) specify degrees of differencing and transformations to ensure a stationary series; and (b) specify autoregressive and moving average orders. This eliminated the need to identify an appropriate model through trial and error (Makridakis et al., 1983; McLaughlin, 1984).

Figure 1 plots the residuals, residual autocorrelations and residual partial autocorrelations for both the original and modelled series (from the time series modeler function) for our main dependent variable, the differenced sum of grams of purchased alcohol per 100 households. The plots of the modelled series, ARIMA (0,0,2,1,1,1)7, demonstrated a stationary series, with no evidence of autoregression. Our series was daily, and we set the seasonal function as daily, with a periodicity of 7 (i.e., a week). We repeated the time series modeller function separately for all dependent variables, including within subgroup analyses.

We examined abrupt level changes due to the single event, the introduction of confinement in Great Britain. 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 regression models, the dependent variables were ARIMA modelled purchased grams of alcohol, mean ABV of beer and proportion of beer with an ABV of 3.5% or less. The independent variable was the dummy variable confinement, with two covariates, the differences between 2020 and 2015–2018 (averaged) of mean age of main shopper and of mean household income.

The model we are testing is illustrated in Fig. 2, where, with ARIMA terms (0,0,2) (1,1,1)7, the equation is as follows:

\[(1 - \Phi_1 B^7)(1 - B)(Y_t) = \beta_{\text{intercept}} + (1 - \theta_1 B - \theta_2 B)(1 - \Theta_1 B)(\alpha_t + \beta_{\text{confine}} (1 - \Phi_1 B^7)(1 - B^7) X_t + \beta_\beta (1 - \Phi_1 B^7)(1 - B^7) A_t + \beta_i (1 - \Phi_1 B^7)(1 - B^7) H_t),\]

where we have:

(Seasonal AR (1) term) (seasonal difference (1) term) (dependent variable) = intercept + (non-seasonal MA (2) term) (seasonal MA (1) term) (random error) + (impact of confinement) (Seasonal AR (1) term) (seasonal difference (1) term) (confinement) + (coefficient age) (Seasonal AR (1) term) (seasonal difference (1) term) (age) + (coefficient income) (Seasonal AR (1) term) (seasonal difference (1) term) (income).

\[Y_t = \text{the dependent variable at day } t; \Phi_1 \text{ is seasonal autoregressive operator at lag 1; } B \text{ is the backshift operator; } \beta_{\text{intercept}} \text{ is the pre-event intercept, in this case, the average of the differences between 2020 and 2015–2018 in purchases for each day across all days prior to the event; } \theta_1 \text{ is the non-seasonal moving average operator at lag } 1, \text{ and } \theta_2 \text{ the non-seasonal moving average operator at lag } 2; \Theta_1 \text{ is the seasonal moving average operator at lag } 1; \alpha_t \text{ is the error term; } \beta_{\text{confine}} \text{ is the impact of confinement, in this case, the change of mean daily purchase in grams per household for the time period since the confinement took effect versus before confinement; } X_t \text{ is confinement; } \beta_\beta \text{ is the coefficient of age and } A_t \text{ is age; and, } \beta_i \text{ is the coefficient of income and } H_t \text{ is income.}

As results would be sensitive to the exact dates chosen for the event (introduction of confinement) and the end of the period of confinement chosen, we undertook sensitivity analyses for a range of alternative dates, detailed in the footnote to Table 3.

We repeated the ARIMA models for each of the four separate groupings of households (by age of main shopper, household income, class group and area of Great Britain), with the results reported per 100 households.

All analyses were performed with SSPIv25 (IBM Corp, 2017).

RESULT

Lockdown and overall purchases

Figure 3 plots the average daily purchases of alcohol in grams per 100 households by day (adjusted for the numbers of adults in each household) for the 6-month period early January to early July (days 8–182 of our re-set days), for 2015–2018 (average) minus 2020. Prior to the date of confinement, purchases of alcohol were similar between 2015–2018 and 2020 (difference = 15.6 g (95% confidence
The increase in purchases for the period of confinement was 178 g per 100 households per day for all alcohol (95% CI: 163–193) (Table 2, Column C) a 41% increase (95% CI: 39–46) (Table 2, Column D) over the estimated expected level of 438 g (95% CI: 417–458), Table 2 Column B. Increases were 49% for beer, 31% for wine and 45% for spirits. However, when adjusting for the proportion of grams of alcohol normally purchased from on-licences (Giles and Robinson, 2019) (Table 2, Column E), the real change in excess purchases for all alcohol was 0.68% (95% CI: 0.65–0.71) (Table 2, column F). The real changes were −40% for beer, +15% for wine and +22% for spirits. In other words, although the overall grams of alcohol purchased did not change, there was a relative shift in purchases from lower to higher strength products, when accounting for no on-licence purchases.

Sensitivity analyses

Table 3 summarizes the results of the sensitivity analyses, based on a range of different start and end dates for an analysed confinement period. The excess off-licence purchases due to confinement range from 25.6% with a start date of the Prime Ministers’ advice on 16th March to 13th May, when some partial relaxation of confinement occurred to 40.6% for a start date of 26th March, when confinement was actually put in place, to 4th July. The excess purchases for the different time periods match the plots of Fig. 3.

Purchases by socio-demographic characteristics of households

Proportional excess off-licence purchases increased the younger the age of the main shopper, were considerably lower among the lowest income households, were lower among households in class groupings D and E (in class group E, the age of the main shopper was 65 years or more in over two-fifths of households) and tended to be higher in the north as opposed to the south of Great Britain, Table 4.

Shifts in purchases of beers

Figure 4 plots the mean ABV% of purchased beer and the proportion (%) of all beer purchased with an ABV ≤ 3.5% by study day. Prior to confinement, the mean ABV(%) of beer was lower during 2020.
Fig. 3. Mean sum of grams of alcohol purchased (2020 minus average of 2015–2018) per 100 households (adjusted for numbers of adults in household) per day by study day.
Vertical black line: introduction of confinement.

Table 2. Estimate of excess grams of alcohol purchased (95% CIs), Column C, with percent increase due to confinement, Column D, by beverage category, Column A, with estimate of base for 2020, were purchases of 2015–2018 to apply, Column B; purchases, grams of alcohol per 100 households per day, adjusted for numbers of adults in each household. Accounting for proportion of grams of alcohol normally purchased from off-licences, Column E, and the excess purchases needed to compensate for this, Column F, the adjusted percent increase is shown in Column G

| Category          | Column A | Column B       | Column C          | Column D          | Column E           | Column F           | Column G                         |
|-------------------|----------|----------------|-------------------|-------------------|--------------------|--------------------|----------------------------------|
| All alcohol       | 437.697  | (417.246–458.148) | 177.779           | 40.617            | 0.7146             | 174.81             | 0.678 (0.648 to 0.712)          |
| Beer              | 86.110   | (81.676–90.545)  | 42.497            | 49.352            | 0.5293             | 76.58              | −39.577 (−41.726 to −37.639)    |
| Cider             | 33.679   | (32.069–35.289)  | 11.957            | 35.503            | 0.6680             | 16.74              | −14.198 (−14.910 to −13.550)    |
| Wine              | 166.058  | (157.977–174.139) | 51.304            | 30.895            | 0.8593             | 27.19              | 14.521 (13.848 to 15.264)       |
| Spirits           | 125.937  | 56.549          | 44.903            | 0.8152             | 28.55              | 15.264             | 22.233 (21.245 to 23.318)       |
| Fortified wines   | 23.160   | (22.129–24.190)  | 8.695 (7.463–9.928) | 37.544            | 0.9689             | 0.74               | 34.334 (32.871 to 35.934)       |
| Ready to drinks   | 2.753 (2.590–2.917) | 1.253 (1.082–1.423) | 45.506 (41.776–48.785) | 0.7793             | 0.78               | 17.185 (16.223 to 18.270)       |

a Adjusted for temporal changes in age of main shopper and household income.
b P-value for all estimates = 0.0000.
c Source: Giles and Robinson (2019).
than during 2015–2018 (−0.178), although not significant (95% CI: −0.40 to 0.045), but increased following confinement by 0.127 (95% CI: 0.012–0.241, \( P = 0.030 \)). Prior to confinement, the proportion of beer with an ABV of 3.5% or less was higher during 2020 than during 2015–2018 (1.06% higher, 95% CI: 0.71–1.40), but decreased following confinement (1.48% lower, 95% CI: 1.30–1.66).

### DISCUSSION

During the COVID-19 pandemic confinement, household purchases of alcohol increased by 41%, compared with expected purchases for the same time period averaged across 2015–2018, with no evidence of stockpiling. However, when adjusting for the proportion of alcohol normally purchased from only off-licences (71%), excess purchases did not change relative to other years (+0.7%), with decreases in purchases of beers and ciders and increases in purchases of wines and spirits. We used the 4-year period 2015–2018, averaged, as the control period, since we already had these data available (see O’Donnell et al., 2019). Excess purchases, without adjusting for normal off-licence purchases, were higher the lower the age of the main shopper and the higher the household income, and much lower for households in class group E, which tended to be of older age.

Within the off-licence purchases, there was a shift to buying higher, rather than lower, strength beer.

We are not aware of any published peer-reviewed studies that report objective data on alcohol purchases, such as household purchase data, during COVID-19 confinement in Great Britain. The trends reported here reflect the most recent HM Revenue and Customs data, which found increases in proportional year-to-date duty receipts for wine and spirits, of 8.3 and 8.6%, and decreases in beer and cider receipts of 22.9 and 19.8%, respectively (HMRC, 2020a, 2020b), similar to the direction of the changes of our results. Our results, however, show mixed consistency with the published results of the three surveys mentioned in the introduction (Daly and Robinson, 2020; Alcohol Change UK, 2020; Jackson et al. 2020). On the one hand, our results do not confirm the self-reported increases in alcohol consumption due to lockdown found in the surveys. However, we did find greater increases in off-licence purchases among younger and wealthier shoppers, consistent with the two groups that reported increased consumption during lockdown in the two surveys that reported such data (Alcohol Change UK, 2020; Daly and Robinson, 2020).

Our analyses have several important strengths. Data were obtained from a large number of households, with a large number of daily data points before and after the introduction of confinement.

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**Table 3.** Estimate of excess grams of alcohol purchased (95% CIs), with percent increase, due to confinement, with estimate of base for 2020, were purchases of 2015–2018 to apply; sensitivity analyses with different start and end dates for the period of analysed ‘confinement’; purchases, grams of alcohol per 100 households per day, adjusted for numbers of adults in each household

| Start date (re-set day) | End date (re-set day) | Base estimate of sum of grams purchased during confinement were purchases of 2015–2018 to apply | Estimate of excess grams purchased during confinement | Percentage increase of estimate of excess grams purchased |
|------------------------|----------------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------|
| 72^c                   | 130^d                | 428.480 (401.433–455.527)                                                                      | 109.833 (83.886–135.781)                                  | 25.633 (20.897–29.807)                       |
| 149^e                  |                      | 127.508 (100.682–154.334)                                                                      | 146.841 (124.630–169.053)                                  | 29.809 (25.213–33.831)                       |
| 163^f                  |                      | 322.358 (299.063–456.654)                                                                      | 136.441 (110.575–162.307)                                  | 33.922 (30.913–36.545)                       |
| 182^g                  |                      | 343.926 (307.708–416.143)                                                                      | 155.507 (129.915–181.098)                                  | 31.557 (27.031–35.621)                       |
| 77^h                   | 130^d                | 435.877 (410.907–460.847)                                                                      | 169.564 (149.031–190.097)                                  | 38.902 (36.269–41.249)                       |
| 149^e                  |                      | 333.279 (312.289–455.168)                                                                      | 150.221 (127.491–172.952)                                  | 34.635 (30.923–37.997)                       |
| 163^f                  |                      | 343.413 (311.246–455.581)                                                                      | 163.000 (141.677–184.323)                                  | 37.608 (34.451–40.459)                       |
| 182^g                  |                      | 436.845 (414.121–459.570)                                                                      | 171.972 (154.854–189.090)                                  | 39.367 (37.393–41.145)                       |
| 82^i                   | 130^d                | 435.206 (415.706–454.707)                                                                      | 161.483 (140.534–182.433)                                  | 37.105 (33.806–40.121)                       |
| 149^e                  |                      | 243.951 (241.903–454.998)                                                                      | 171.227 (152.186–190.268)                                  | 39.367 (36.680–41.817)                       |
| 163^f                  |                      | 437.697 (417.246–458.148)                                                                      | 177.779 (162.525–193.033)                                  | 40.617 (38.952–42.133)                       |

^a 16 March: Prime Minister Boris Johnson advises everyone in the UK against ‘non-essential’ travel and contact with others, to curb coronavirus, as well as to work from home if possible and avoid visiting social venues such as pubs, clubs or theatres.

^b 21 March: The Health Protection (Coronavirus, Business Closure) (England) Regulations 2020 (SI 327) come into legal effect at 2 pm, enforcing the closure in England of businesses selling food and drink for consumption on the premises.

^c 26 March: The Health Protection (Coronavirus, Restrictions) (England) Regulations 2020 (SI 350) (the ‘Lockdown Regulations’) come into effect, significantly extending the range of businesses that are required by law to close with immediate effect including all retail businesses not on an approved list. These regulations also include significant restrictions on freedom of movement: ‘no person may leave the place where they are living without reasonable excuse’.

^d 13 May: The Health Protection (Coronavirus, Restrictions) (England) (Amendment No. 2) Regulations 2020 (SI 500) come into effect, allowing the re-opening of garden centres, sports courts and recycling centres. In addition to outdoor exercise, open-air recreation is also permitted with no more than one member of another household.

^e 1 June: The Health Protection (Coronavirus, Restrictions) (England) (Amendment No. 3) Regulations 2020 (SI 558) come into effect. Car and caravan showrooms, outdoor sports amenities and outdoor non-food markets may re-open. The prohibitions on leaving home are replaced by a prohibition on staying overnight away from home, with certain specific exceptions. Gatherings of people from more than one household are limited to six people outdoors.

^f 21 June: The Health Protection (Coronavirus, Restrictions) (England) (Amendment No. 4) Regulations 2020 (SI 588) comes into full effect, allowing the general re-opening of English retail shops and public-facing businesses apart from those that are on a list of specific exclusions such as restaurants, bars, pubs, nightclubs, most cinemas, theatres, museums, hairdressers, indoor sports and leisure facilities.

^g 4 July: The Health Protection (Coronavirus, Restrictions) (No. 2) (England) Regulations 2020 came into force in England, replacing and relaxing the previous Lockdown Regulations (SI 350), and allowing pubs to re-open in England.
Table 4. Estimate of excess grams of alcohol purchased (95% CIs), with percent increase, due to confinement by household characteristics, with estimate of base for 2020, were purchases of 2015–2018 to apply; purchases, grams of alcohol per 100 households per day, adjusted for numbers of adults in each household.

| Category                      | Base estimate of sum of grams purchased during confinement were purchases of 2015–2018 to apply | Estimate of excess grams purchased following confinement | Percentage increase of estimate of excess grams purchased |
|-------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| **Age of main shopper**       |                                                                                                 |                                                        |                                                        |
| 18–34                         | 195.919 (181.586–210.252)                                                                      | 113.524 (104.948–122.100)                              | 57.944 (57.795–58.073)                                 |
| 35–44                         | 324.830 (300.879–348.781)                                                                       | 138.058 (127.816–148.300)                              | 42.502 (42.481–42.520)                                 |
| 45–54                         | 424.590 (392.776–456.405)                                                                       | 181.083 (170.534–191.632)                              | 42.649 (43.418–41.987)                                 |
| 55–64                         | 580.098 (541.560–618.635)                                                                       | 138.688 (126.911–150.466)                              | 23.908 (23.434–24.322)                                 |
| 65+                           | 613.005 (575.002–651.008)                                                                       | 97.748 (80.876–114.619)                                | 15.946 (14.065–17.606)                                 |
| **Annual household income per adult in household** |                                                                                                 |                                                        |                                                        |
| £0–7.5 k                      | 419.811 (396.141–443.481)                                                                       | 55.290 (49.327–61.253)                                 | 13.170 (12.452–13.812)                                 |
| > 7.5–12.5 k                  | 404.399 (377.151–431.647)                                                                       | 133.338 (123.603–143.073)                              | 32.972 (32.773–33.146)                                 |
| > 12.5–17.5 k                 | 482.297 (452.378–512.216)                                                                       | 121.839 (112.280–131.398)                              | 25.262 (24.820–25.653)                                 |
| > 17.5–25 k                   | 449.642 (415.035–484.250)                                                                       | 172.875 (159.848–185.902)                              | 38.447 (38.514–38.390)                                 |
| > 25 k                        | 448.655 (413.248–484.061)                                                                       | 186.957 (172.475–201.439)                              | 41.671 (41.736–41.614)                                 |
| **Class grouping**            |                                                                                                 |                                                        |                                                        |
| AB                            | 420.960 (391.942–449.978)                                                                       | 129.511 (117.739–141.284)                              | 30.766 (30.040–31.398)                                 |
| C1                            | 447.792 (417.573–478.011)                                                                       | 177.673 (166.082–189.264)                              | 39.678 (39.773–39.594)                                 |
| C2                            | 427.733 (397.947–457.519)                                                                       | 127.732 (117.775–137.689)                              | 29.862 (29.596–30.095)                                 |
| D                             | 429.113 (401.294–456.932)                                                                       | 86.264 (79.524–93.004)                                 | 20.103 (19.817–20.354)                                 |
| E                             | 476.431 (451.617–501.245)                                                                       | 77.836 (68.483–87.189)                                 | 16.337 (15.164–17.394)                                 |
| **Area of Great Britain**     |                                                                                                 |                                                        |                                                        |
| South England                  | 401.355 (372.502–430.207)                                                                       | 117.229 (107.044–127.414)                              | 29.208 (28.736–29.617)                                 |
| Mid England                   | 430.945 (398.309–463.581)                                                                       | 82.366 (74.076–90.656)                                 | 19.113 (18.598–19.536)                                 |
| Wales                         | 449.047 (416.373–481.720)                                                                       | 145.594 (131.727–159.460)                              | 32.423 (31.637–33.102)                                 |
| North England                 | 469.396 (433.141–503.650)                                                                       | 156.589 (144.347–168.831)                              | 33.360 (33.326–33.389)                                 |
| Scotland                      | 527.736 (492.036–563.476)                                                                       | 178.638 (162.495–194.780)                              | 33.848 (33.025–34.568)                                 |

**Fig. 4** Proportion (%) of all beer purchased with ABV ≤ 3.5% (left axis) and mean ABV% of purchased beer (right axis) per day by study day. Vertical black line: introduction of confinement.

Furthermore, data on purchases were objective, based on product bar codes, and verified via digital receipts. Given that on-licensed premises were closed for the time period 21st March to 4th July, the analyses will have captured almost all alcohol purchases. Any bar-coded alcohol product brought into the home (including internet-shopping) should have been measured.
By comparison with purchase data from the same calendar days for 2015–2018, we were readily able to estimate excess purchases due to COVID-19 confinement. Controlled interrupted time series analysis provides a strong methodology to evaluate the natural experiment of the introduction of confinement, and we adhered to best practice guidance for undertaking interrupted time series analyses (Bhaskaran et al., 2013; Bernal et al., 2019; Beard et al., 2019).

One key limitation of our study is that we only measure alcohol purchases and not actual consumption data. Households could have been stockpiling and not consuming all the purchased alcohol. However, given that excess purchases maintained at a high level over the full confinement study period, stockpiling seems unlikely. Given that the proportional increases in excess purchases were much higher for younger rather than older shoppers, it is possible that younger people were buying for older people who remained at home, shielding due to greater vulnerability of COVID-19 illness. Nevertheless, there was an increase in excess off-licence purchases for shoppers aged 65 years or more (16%), and such patterns only represent a re-distribution of the excess off-licence purchases overall.

CONCLUSION
Our study has clearly demonstrated that British households did not buy more alcohol during the recent COVID-19 confinement, when accounting for what would normally have purchased from on-licence premises. Our findings are in line with HM Revenue and Customs duty receipts over the same time period. While reassuring from a public health perspective, our results contradict self-reported survey data. This discrepancy needs further investigation, including the extent to which self-reported data might reflect anxiety or dis-orientation during what is an unprecedented change to the normal activities of daily living.

AUTHORS’ CONTRIBUTIONS
P.A. conceptualized the paper and analyses and undertook the analyses. All the authors refined the various versions of the full paper and approved the final manuscript. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. P.A. and A.O.D. are the guarantors.

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E.J.L., A.O./D. and E.K. declare no competing interests and declare no financial relationships with any organizations that might have an interest in the submitted work in the previous three years. Within the previous three years, P.A. has received financial support from AB InBev Foundation outside the submitted work. All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare no support from any organization for the submitted work; all authors declare no other relationships or activities that could appear to have influenced the submitted work.

ETHICAL APPROVAL
Not required.

DATA SHARING
Kantar Worldpanel data cannot be shared due to licensing restrictions.

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