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# Do dual purchasers behave differently? An analysis of purchasing data for households that buy both alcohol and tobacco in the United Kingdom

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## ABSTRACT

**Background and Aims** Dual purchasers of alcohol and tobacco are at increased health risk from the interacting health impacts of alcohol and tobacco use. They are also at financial risk from exposure to the dual financial cost of policies that increase alcohol and tobacco prices. Understanding whose alcohol and tobacco use exposes them to these health and financial risks is important for understanding the inequality impacts of control policies. This study explores the extent to which household spending on alcohol and tobacco combined varies between socio-economic groups and compares this with results for households which purchase only one of the commodities. **Design** Cross-sectional analysis of household-level alcohol and tobacco purchasing data. **Setting** United Kingdom, 2012–17. **Participants/Cases** A total of 26 021 households. **Measurements** We analysed transaction-level data from individual 14-day spending diaries in the Living Cost and Food Survey (LCFS). We used this to calculate expenditure, volumes of alcohol and tobacco purchased, and the price paid per unit of alcohol (1 unit = 8 g) and per stick of tobacco. This was compared with equalized total expenditure and quintiles of equalized household income. Prices were calibrated and pack sizes were imputed using empirical sales data from Nielsen/CGA to correct for reporting bias. **Findings** Dual purchasing households spent [95% confidence interval] more on alcohol and more on tobacco than their single-purchasing counterparts. In general, lower-income households spent less on both alcohol and tobacco than higher-income households. Furthermore, dual purchasing households in the lowest income group were most exposed to potential increases in price than were other income groups, with (CI = 12.41–13.15%) of their total household budget spent on alcohol and tobacco. **Conclusions** Dual purchasers of alcohol and tobacco in the United Kingdom appear to be concentrated evenly among income groups. However, dual purchasers may experience particularly large effects from pricing policies, as they spend a substantially higher proportion of their overall household expenditure on alcohol and tobacco than do households that purchase only one of the commodities.

**Keywords** Alcohol, consumption patterns, dual purchasers, joint household expenditure, socio-economic inequalities, tobacco.

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## INTRODUCTION

The consumption of alcohol and tobacco are both leading risk factors for mortality and morbidity in the United Kingdom and internationally [1,2]. In England, approximately 10 000 deaths each year are attributable to alcohol and 77 900 are attributable to tobacco smoking [3,4]. As a result, various countries world-wide have introduced a range of control-based policies aimed at overall population

consumption as well as prompting individual-level behaviour change.

Increasing the price of alcohol and tobacco through taxation is recommended by the World Health Organization as a 'best buy' policy [5], and a substantial body of research [6–9] has demonstrated its effectiveness at reducing the consumption of alcohol and tobacco and, by extension, their related harms at the population level. A wide range of international evidence has illustrated that the effects of

alcohol and tobacco control policies vary across socio-economic groups [6,10–13]. Evidence from various Organization for Economic Co-operation and Development (OECD) countries has shown that price policies affect the consumption and expenditure of a larger number of high-income households than low-income households, and any resulting price increases tend to be financed disproportionately by high-income households [14]. Understanding this variation is critical to assessing the potential impacts on inequalities of different alcohol and tobacco policy options, both in isolation and in combination. Additionally, evidence has shown that the tobacco and alcohol industries may shift increases onto more expensive products to protect affordability for more price-sensitive consumers [15,16]. Differences in the effect of policies across the socio-economic spectrum can arise from differential rates of participation, levels of consumption, responses to price increases and current health, as well as the extent to which the prices of products purchased by particular groups may be more or less affected [13,17–19].

Existing studies and press releases have tended to focus on the potential inequality impacts of alcohol or tobacco control policies in isolation, rather than considering the joint impact of combined policy action across both products [14]. In addition, there is little evidence in the United Kingdom documenting the prevalence of dual purchasers in the population. Recent analysis conducted in the United Kingdom found that alcohol and tobacco expenditure appears to exacerbate poverty in low-income households [19]. Our study aims to further address this gap by exploring the extent to which household spending on alcohol and tobacco combined varies between socio-economic groups and compares this with results for households which purchase only one of the commodities. Dual purchasing households are of key interest as they are exposed to the negative health impacts of high alcohol and tobacco use as well as the increasing financial costs, from tax rises, associated with both commodities.

## METHODS

This study uses household expenditure data from 2012 to 2017 to investigate spending patterns across the income distribution. We focus predominantly on the household rather than the individual as the unit of analysis, as it is difficult to attribute the consumption of shop-bought alcohol and tobacco to specific individuals within the household. This analysis was not pre-registered, therefore the results found should be considered exploratory.

### Data set

The annual UK Living Costs and Food Survey (LCFS [20]) uses a 14-day diary of all spending by household members

aged 16 years and older. The LCFS is a repeated cross-sectional survey of approximately 12 000 households selected at random from the Royal Mail's Postcode Address File, with interviews being spread evenly over the year to ensure that seasonal effects are covered. For the purpose of this study, we use data from 2012 to 2017 on 26,021 households. During the 14 days, respondents are asked to record daily all commodity-based purchases, such as groceries and clothing, while outgoings such as rent, monthly subscriptions and utility bills are captured in the household characteristics section of the questionnaire. The LCFS therefore collects information on spending patterns and the cost of living that reflect household budgets and are converted into fortnightly outgoings. For more information see the LCFS technical report [20].

### Data cleaning

Each recorded alcohol purchase in the diary is categorized based on whether it took place in the on-trade (pubs, bars and restaurants) or off-trade (at home) and whether the product purchased was beer, cider, wine, spirits or 'ready-to-drink' (RTD)—a pre-mixed, spirit-based, drink or alcopop. Each purchase, whether that be a single standard measure drink in the on-trade or a case/bottle in the off-trade, is recorded as a separate transaction and includes data on the total price paid and the number of drinks purchased (e.g. bottles, cans and glasses). For on-trade transactions, respondents were not required to record the serving size of their purchase in ml. Instead, they reported the type of container, such as glass, bottle or can, as well as whether it was a 'small glass' for wine or 'pint' for beer, for example. Therefore, we use market research data from AC Nielsen and CGA Strategy to impute the serving size of the beverage in ml using the most common serving size for that particular product and container type for each year of our analysis.

Respondents were not asked to record the brand or brand variant, nor were they asked to record the alcohol by volume (ABV) percentage of the product. We therefore estimate this for each product using AC Nielsen and CGA strategy data. The Supporting information provides a breakdown of the estimated ABV by product and purchase location (on- or off-trade) we use for the five different alcohol product types. Finally, we inflate all prices and measures of expenditure to January 2017 prices using the all-items retail price index (RPI), as this is HM Revenue and Customs' (HMRC) preferred inflation measure when calculating the duty payable on tobacco and alcohol. Following the previous literature [21], to correct for potential misreporting of prices we use 'gold-standard' pricing data for all alcohol sales from the market research companies AC Nielsen (off-trade) and CGA Strategy (on-trade) to calibrate the transaction level prices paid to match empirical

sales data. This is to ensure that our record of prices paid matches the true distribution of prices faced by households in the United Kingdom. See the previous research for full details of the calibration methodology [21].

For tobacco purchases, LCFS respondents record whether the product bought was factory-made cigarettes (FM) or roll-your-own tobacco (RYO) as well as the price they paid at the point of sale.<sup>1</sup> Following previous literature [22–24], we define a single RYO cigarette as 0.5 g of tobacco; therefore, a 12.5 g packet of tobacco would refer to 25 cigarettes (sticks). In the LCFS, respondents were not required to record the size of the purchase, i.e. the number of sticks or the weight of the pouch of hand-rolling tobacco. We therefore use market research data from AC Nielsen to impute the number of sticks and the pack weight for each transaction based on the modal pack size at each price point, based on 1p bands. See Supporting information for full details of the imputation process.

## Design

We collapse the transaction level data into the total expenditure across the 2-week diary and calculate the weekly spend for each household on alcohol, tobacco and all other consumption goods (e.g. food and clothing) and all other expenditure (e.g. housing and utility costs). Based on whether the household has any recorded purchases of alcohol and tobacco during the diary week, we classify every household in the LCFS into one of four mutually exclusive groups: alcohol-only (purchased some alcohol but no tobacco), tobacco-only (purchased some tobacco but no alcohol), dual purchasers (purchased both) and neither (purchased neither alcohol or tobacco). Within each group we calculate the average expenditure, expenditure share, volume purchased in units of alcohol<sup>2</sup>/sticks of tobacco and price paid per household on each product type, weighted by household size, and explore how this varies against alcohol-only and tobacco-only households across quintiles of total equivalized income using the OECD equivalence scale [25].

## RESULTS

### Variations by household composition

In order to understand the spending patterns of the various household types, we first present our findings for overall spending on alcohol and tobacco, with respect to each other and the rest of the additional household expenditure. Table 1 illustrates the average weekly expenditure on alcohol and tobacco by household types. Dual purchasers

spend a greater share of their expenditure on alcohol compared to alcohol-only households (6.45% compared to 5.12%,  $P \geq 0.001$ ). While dual purchasers spend more in absolute terms on tobacco [£24.30 compared to tobacco-only households (£22.92) ( $P = 0.0493$ ), as a proportion of total spend, tobacco-only households spend 8.67% of expenditure on tobacco products while dual purchasers spend only 6.33% ( $P \leq 0.001$ ).

In Table 1, panel C, we present the average weekly number of units and cigarettes/sticks purchased by each household. Drinking-only households purchase, on average, 27.68 units a week compared to dual-purchasing households, who bought 34.32 units. Dual purchasers also buy, on average, more cigarettes than tobacco-only households, smoking 74.86 cigarettes compared to 70.44 ( $P = 0.033$ ).

Combining the average weekly expenditure and average weekly quantity allows the calculation of the average spend per unit on alcohol and per stick for tobacco. Dual purchasers spend more, on average, on alcohol compared to alcohol-only households because they purchase 24.0% more units of alcohol even though they pay 6.59% less, on average, per unit at a mean price of 91 p/unit compared to 98 p/unit ( $P \leq 0.001$ ). In contrast, dual purchasing households spend more on tobacco than tobacco-only households because they buy 6.27% more cigarettes, but they pay almost exactly the same price per stick on average.

### Quintile analysis

The total weekly expenditure figures in Table 1 show that tobacco-only households have an average total weekly expenditure, which is substantially lower than either alcohol-only or dual purchasing households. This suggests that the differences between these groups may be driven by systematic differences between groups. In order to explore this further we separate our sample into quintiles using equivalized disposable income. Figure 1 illustrates the breakdown of household type across income quintiles, clearly showing that the income quintiles are not evenly distributed between the household types: 72% of households in the highest income group are alcohol-only compared to 2% that are tobacco-only. Equivalent figures for the lowest income quintile are 31% alcohol-only and 12% tobacco-only. The prevalence of dual purchasers is consistent across the lowest four income quintiles at 13–12% and then falls to 9%. Combining single and dual purchasers, the proportion of households buying alcohol increases with income (from 44% in the lowest quintile to 81% in the highest), while the proportion buying tobacco falls from 25 to 11%.

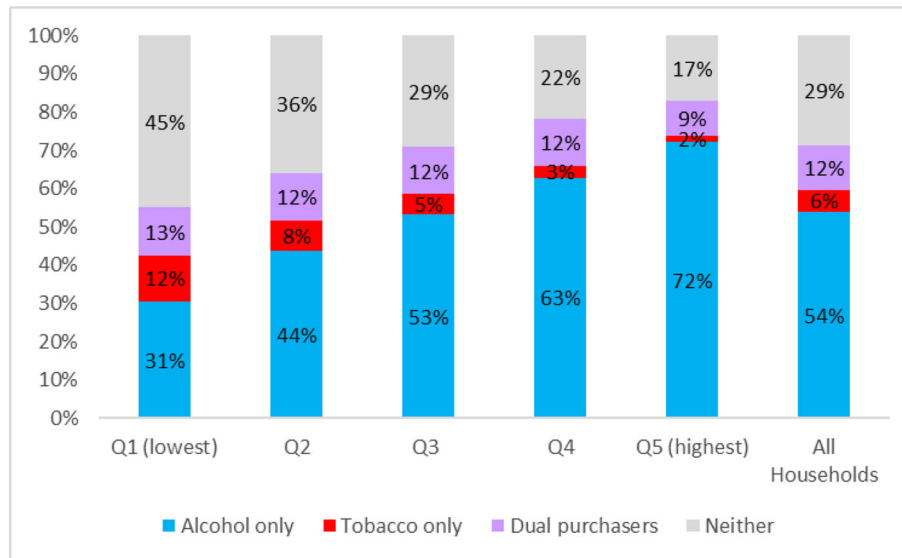
<sup>1</sup>We included make-your-own cigarette packs in the RYO category, and we drop cigars and cigarillos from the analysis due to their small share in the LCFS (0.65%) [33].

<sup>2</sup>A UK unit of alcohol is equivalent to 10 ml or 8 g of pure alcohol. For example, one 4% pint (568 ml) of beer is 2.3 units.

**Table 1** Average weekly spend, volume consumed, price paid by expenditure category and household composition.

		<i>Household type</i>			
		<i>All households</i>	<i>Alcohol only</i>	<i>Tobacco Only</i>	<i>Dual purchasers</i>
<i>n</i> (% of sample)		25 973 (100%)	14 018 (54.0%)	1453 (5.6%)	3014 (11.6%)
Mean total weekly household expenditure <sup>a</sup>		£453.28	£462.11	£264.36	£419.38
Total weekly household spend on goods and services <sup>b</sup>		£74.77	£79.24	£31.47	£54.98
Panel A: Average weekly expenditure and proportion of total spend by expenditure category					
Alcohol	Mean weekly spend	£15.91 (15.61–16.21)	£23.66 (23.22–24.11)		£27.05 (26.04–28.06)
	% of total expenditure	3.51% (3.44–3.58)	5.12% (5.02–5.21)		6.45% (6.21–6.69)
Tobacco	Mean weekly spend	£4.10 (3.94–4.26)		£22.92 (21.72–24.12)	£24.30 (23.49–25.10)
	% of total expenditure	1.22% (1.17–1.27)		8.67% (8.23–9.10)	6.33% (6.10–6.56)
Alcohol and tobacco combined	Mean weekly spend	£20.01 (19.66–20.36)	£23.66 (23.22–24.11)	£22.92 (21.72–24.12)	£51.34 (49.96–52.73)
	% of total expenditure	4.73% (4.64–4.81)	5.12% (5.02–5.21)	8.67% (8.23–9.10)	12.78% (12.41–13.15)
Panel B: Average weekly amount purchased in units for alcohol and sticks for tobacco					
Alcohol	Units of alcohol purchased	18.92 (18.55–19.30)	27.68 (27.13–28.24)		34.32 (33.01–35.64)
	Mean price paid per unit <sup>c</sup>	£0.97 (0.96–0.98)	£0.98 (0.97–1.00)		£0.91 (0.89–0.94)
Tobacco	Stick equivalents purchased	12.63 (12.16–13.10)		70.44 (68.15–72.74)	74.86 (73.54–76.18)
	Mean price paid per stick <sup>c</sup>	£0.32 (0.32–0.32)		£0.33 (0.32–0.33)	£0.32 (0.32–0.32)

95% confidence intervals (CIs) in parentheses. <sup>a</sup>Total weekly household expenditure includes 'running costs' such as mortgage payments and utilities; <sup>b</sup>total weekly household spending only includes spending on goods and services. Both are equivalized using the Organization for Economic Co-operation and Development (OECD) equivalized scale; <sup>c</sup>mean price per unit/stick is conditional on purchasing tobacco.



**Figure 1** Proportion of household purchasing types by quintile

We disaggregate this further in Table 2, presenting the expenditure, volume purchased and the mean price paid per unit/stick across all five income quintiles. Across all income quintiles, dual purchasers spend more in both absolute and relative terms on alcohol than alcohol-only households. However, the same is not true for tobacco. In absolute terms, high-income dual expenditure households spend less than tobacco-only households, while the opposite is true at low incomes. In relative terms, dual purchasers spend a smaller proportion of their total weekly expenditure on tobacco compared to tobacco-only households across all income groups.

Among all income groups, dual purchasers also buy larger volumes of alcohol than alcohol-only households and pay lower prices on average. The difference in both measures is larger in higher-income groups, e.g. dual purchasing households in the highest income quintile pay an average of 13.16% [95% confidence interval (CI) = 10.26–14.55%] less for each unit of alcohol they buy than alcohol-only households in the same income group. At the lowest end of the distribution (Q1), dual purchasers pay approximately the same per unit as alcohol only-households £0.83 (95% CI = £0.78–0.88) compared to £0.83 (95% CI = £0.80–0.86).

This pattern, however, is different for tobacco. Among higher-income households, dual purchasers spend less and buy less tobacco than tobacco-only households, while the reverse is true in low-income households. Among all income groups, dual purchasers pay marginally less per stick than tobacco-only households.

Figure 2 illustrates the expenditure spent on alcohol and tobacco as a proportion of total household expenditure. Among all five income quintiles dual purchasing households are spending a greater proportion of their total

household expenditure on alcohol than their equivalent alcohol-only purchasing household, whereas the opposite is true for tobacco, where tobacco-only households spend a greater proportion relative to dual purchasing households.

## DISCUSSION

Many previous studies have looked at socio-economic patterning in expenditure on, and consumption of, alcohol and tobacco [6–9,14]. However, they provide limited evidence on the jointness of the relationship between tobacco and alcohol throughout the socio-economic distribution. Dual purchasing households are of key interest because of the interactive health risks of both behaviours. Although there exists a large body of research about the impacts of policy on inequalities and on the regressiveness of both alcohol and tobacco pricing policies [9,13,14,26], the socio-economic distribution of both behaviours is very different, as is the extent to which dual purchasers are affected by reductions in health inequalities or concerns about regressiveness.

Our study extends our deeper understanding of dual purchasing and inequalities. Dual purchasing households spend a much greater share of their total expenditure on tobacco or alcohol than households who buy only one of these commodities. Dual purchasers in the lowest income group are particularly exposed to potential increases in price in either product, with 12.78% (95% CI = 12.41–13.15%) of their total household budget being spent on either alcohol or tobacco. When we decompose the spending patterns we find that, across all income levels, the prevalence of dual purchasers remains roughly similar across the income distribution; however, it falls to 9% in Q5.

**Table 2** Weekly household expenditure and proportion, purchase volume and mean price of total by product type, household type and income quintile.

Commodity	Income quintile	All households	Alcohol only	Tobacco only	Dual purchasers
Panel A: Expenditure					
Alcohol	Q5 (highest)	£25.60 (24.78–26.42)	£30.74 (29.77–31.72)		£37.64 (34.61–40.67)
	Q4	£19.38 (18.68–20.08)	£24.60 (23.70–25.50)		£32.31 (30.00–34.61)
	Q3	£14.26 (13.68–14.85)	£20.93 (20.09–21.77)		£25.10 (23.06–27.15)
	Q2	£10.31 (9.82–10.81)	£17.14 (16.34–17.95)		£22.55 (20.67–24.43)
	Q1 (lowest)	£6.98 (6.54–7.43)	£15.47 (14.44–16.50)		£17.93 (16.32–19.54)
Tobacco	Q5 (highest)	£2.72 (2.43–3.01)		£26.13 (21.45–30.81)	£25.68 (23.53–27.83)
	Q4	£3.92 (3.58–4.26)		£27.17 (23.12–31.22)	£25.32 (23.65–26.99)
	Q3	£4.55 (4.17–4.93)		£26.17 (23.14–29.19)	£25.97 (24.12–27.82)
	Q2	£4.97 (4.57–5.38)		£24.79 (22.17–27.41)	£24.27 (22.55–25.99)
	Q1 (lowest)	£4.62 (4.27–4.98)		£17.77 (16.34–19.20)	£19.72 (18.16–21.29)
Panel B: Expenditure (% of total)					
Alcohol	Q5 (highest)	3.83% (3.71–3.95)	4.61% (4.47–4.75)		5.55% (5.12–5.97)
	Q4	3.87% (3.73–4.01)	4.91% (4.74–5.08)		6.47% (5.99–6.95)
	Q3	3.50% (3.35–3.64)	5.19% (4.98–5.41)		5.88% (5.39–6.37)
	Q2	3.14% (2.99–3.29)	5.34% (5.09–5.60)		6.41% (5.88–6.93)
	Q1 (lowest)	3.07% (2.87–3.27)	6.74% (6.29–7.19)		8.02% (7.25–8.78)
Tobacco	Q5 (highest)	0.47% (0.41–0.52)		5.82% (4.66–6.98)	4.16% (3.75–4.56)
	Q4	0.87% (0.79–0.95)		7.09% (6.03–8.14)	5.33% (4.95–5.71)
	Q3	1.19% (1.09–1.29)		7.89% (6.96–8.82)	6.34% (5.86–6.82)
	Q2	1.63% (1.50–1.77)		9.12% (8.23–10.01)	7.34% (6.79–7.90)
	Q1 (lowest)	2.24% (2.07–2.41)		9.76% (8.99–10.53)	8.48% (7.81–9.15)
Panel C: Purchase volume (units/sticks)					
Alcohol	Q5 (highest)	26.74 (25.81–27.68)	31.69 (30.56–32.81)		42.73 (39.14–46.32)
	Q4	23.27 (22.36–24.18)	29.31 (28.12–30.5)		40.00 (36.97–43.04)
	Q3	18.12 (17.35–18.88)	26.36 (25.25–27.47)		32.87 (30.11–35.63)
	Q2	13.73 (13.05–14.41)	22.88 (21.71–24.06)		29.79 (27.40–32.18)
	Q1 (lowest)	9.87 (9.21–10.54)	21.52 (20.00–23.04)		26.22 (23.50–28.93)
Tobacco	Q5 (highest)	7.57 (6.79–8.34)		71.93 (60.09–83.77)	71.54 (65.98–77.10)
	Q4	11.86 (10.85–12.86)		82.61 (71.17–94.05)	76.47 (71.68–81.26)
	Q3	13.69 (12.57–14.82)		75.68 (67.73–83.62)	79.43 (73.92–84.95)
	Q2	15.55 (14.36–16.74)		75.04 (68.15–81.93)	77.44 (72.33–82.55)
	Q1 (lowest)	15.70 (14.54–16.86)		59.78 (55.27–64.29)	67.57 (62.67–72.48)

(Continues)

Table 2. (Continued)

Commodity	Income quintile	All households	Alcohol only	Tobacco only	Dual purchasers
Panel D: Mean price paid per unit/stick	Alcohol				
	Q5 (highest)	£1.12 (1.09–1.15)	£1.14 (1.10–1.17)		£0.99 (0.94–1.05)
	Q4	£0.97 (0.95–0.99)	£0.98 (0.96–1.00)		£0.95 (0.89–1.01)
	Q3	£0.91 (0.89–0.93)	£0.91 (0.89–0.94)		£0.90 (0.85–0.95)
	Q2	£0.89 (0.86–0.91)	£0.89 (0.86–0.92)		£0.88 (0.83–0.94)
Tobacco	Q1 (lowest)	£0.83 (0.80–0.85)	£0.83 (0.80–0.86)		£0.83 (0.78–0.88)
	Q5 (highest)	£0.35 (0.35–0.36)		£0.36 (0.34–0.38)	£0.35 (0.34–0.36)
	Q4	£0.34 (0.33–0.35)		£0.34 (0.32–0.35)	£0.34 (0.33–0.35)
	Q3	£0.34 (0.33–0.34)		£0.35 (0.34–0.36)	£0.34 (0.33–0.34)
	Q2	£0.33 (0.32–0.35)		£0.33 (0.32–0.34)	£0.33 (0.31–0.36)
	Q1 (lowest)	£0.31 (0.29–0.32)		£0.31 (0.29–0.33)	£0.30 (0.29–0.31)

95% confidence intervals (CIs) in parentheses.

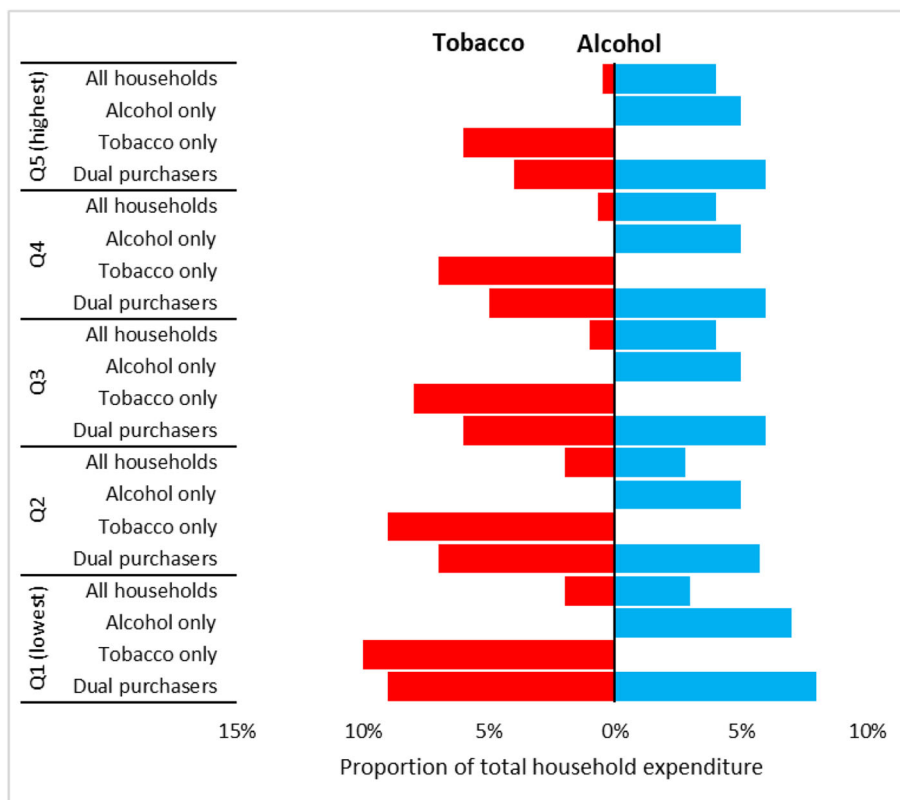
When comparing dual purchasers with alcohol-only purchasers, the dual purchasers spend a greater proportion of their weekly expenditure on alcohol than the alcohol-only households. In contrast, overall, dual purchasers spend a smaller proportion of their weekly expenditure on tobacco than tobacco-only households, but this varies by income group, with the dual purchasers in the lowest income quintile spending more on tobacco than their tobacco-only counterparts.

These results show that increasing the price of alcohol or tobacco will have the biggest absolute impact on the purchasing of higher-income dual purchasers. Those on the lowest income will, however, face a greater proportional increase in their weekly expenditure. Increases in tobacco prices will have the greatest impact on households which purchase only tobacco, which are much more prevalent in lower-income groups. In contrast, increasing alcohol prices will have the greatest effect on dual purchasers, who are relatively evenly spread across all income groups, although these groups would be particularly affected by simultaneous increases in both alcohol and tobacco prices.

Our study relates to the existing evidence in several ways. Our findings show that lower-income households spend a greater proportion of their expenditure on both alcohol and tobacco and suggests that increasing prices on both may be regressive in a narrow economic sense, although this definition ignores the fact that the health benefits arising from reduced consumption may be experienced disproportionately by lower-income groups [13,14]. Recent analysis conducted in the United Kingdom extrapolates expenditure to population data to show that tobacco and alcohol expenditure appear to exacerbate poverty in low-income households in the United Kingdom. We provide a more in-depth analysis of dual purchasing households by calculating the volumes and prices faced by incorporating market research data into the spending diaries. We find that for alcohol, not only do dual purchasing households spend more than alcohol-only households, they also consume more and pay a lower price per unit. For tobacco, tobacco-only households spend more than dual purchasers except for those in the poorest quintile, who not only spend more but also buy more sticks and pay a lower price per stick.

Unfortunately, the LCFS does not collect reliable data on the purchasing of electronic cigarettes (e-cigs). E-cigs are hand-held devices that deliver nicotine to the user through the battery-powered vaporization of a nicotine/propylene-glycol solution. Evidence has shown that these devices can be used as both complements or substitutes to smoking tobacco products [27,28]. In addition, in the United Kingdom, the number people using e-cigs has increased over time [29]. Therefore, one limitation of this study is that we are unable to quantify the expenditure share on e-cigs and how this may affect the purchasing of tobacco





**Figure 2** Proportion of equalized total expenditure spent on alcohol and tobacco by household type

products. However, in order to understand the prevalence of e-cigs we used data from the Smoking Toolkit Study, a representative, monthly, cross-sectional survey of approximately 1700 adults (age 16+) each month in England [30,31]. The survey collects data on current smoking status, including whether the respondent uses an e-cig and has previously been used to assess the prevalence of e-cig usage [32]. Using data from 2014 to February 2020 ( $n = 121\,695$ ), we find very little difference in the prevalence of e-cig users in smoking-only and dual purchasing households (see Supporting information). We find that approximately 20% of smoking households, whether or not they drink, use e-cigs in some capacity. We show that there does not appear to be a substantial socio-economic gradient in the prevalence of e-cigarette use. However, to explore this fully we would need data on spending on e-cigs, which might have more of a socio-economic gradient. Another limitation is that the larger the household, the more likely it is that that household may identify as a dual purchasing household and therefore spend more; we seek to control for this by weighting by household size. Additionally, the LCFS data records expenditure across a wide range of products, but it does not directly capture the consumption of these goods. While on-trade purchases could be reasonably linked to the individual and the time-frame, off-trade alcohol and cigarettes could be consumed by another household member or 'stockpiled'. Furthermore, due to budget

constraints, poorer households may be less likely to purchase large quantities in one transaction. This suggests that our observation of poorer households' expenditure patterns may be more precise than those with higher disposable income.

We identify two important policy messages that are of interest. First, dual purchasing households are particularly exposed to large effects of pricing policies on their purchasing as a large part of their total expenditure is spent on alcohol and tobacco. However, this may lead to larger health gains in this group, as they have reduced capacity to prevent lower consumption by increasing spending. This is particularly true for alcohol, where dual purchasers tend to buy more alcohol, unlike dual tobacco purchasers who buy similar amounts. Secondly, policies targeting cheaper alcohol will affect lower-income dual purchasers more than single purchasers, which is not true for tobacco, where there is no difference in price per stick.

Our findings here highlight the importance of studying household expenditure and spending habits on not only alcohol or tobacco individually, but also to examine the 'jointness' of this relationship in relation to overall household spending and how this may differ across the socio-economic spectrum. There are also implications for further research. Our analysis suggests that price increases in alcohol and tobacco are most likely to be more keenly felt by lower-income consumers, and increases in both would

have a large impact on dual purchasers. Estimates of consumer responsiveness suggest that consumers of both alcohol and tobacco respond to price increases by reducing consumption proportionally less than prices rise, meaning that their net spending increases [14]. At the same time, lower-income consumers are more likely to face greater risks from their drinking and smoking and therefore stand to gain more in terms of health benefits from reducing their consumption. Further research would be useful to perform a full appraisal of the impact of pricing policies on health and health inequalities and to consider the extent to which these health gains are offset by any negative impacts associated with corresponding spending increases, particularly among the lowest-income groups.

## CONCLUSION

Our analysis of household expenditure on alcohol and tobacco has identified that households which purchase both alcohol and tobacco are markedly different to those that purchase either commodity individually, and that these differences cannot be explained by differences in income. Households which consume both alcohol and tobacco consistently spend a smaller proportion of their budget on tobacco than tobacco-only households, but a larger proportion on alcohol compared to alcohol-only households, across all income groups. As a result of their levels of consumption of both products, dual purchasing households, particularly those on low incomes, face significant exposure to price increases on either alcohol or tobacco.

## Declaration of interests

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## Author contributions

**Luke Wilson:** Conceptualization; data curation; formal analysis; investigation; methodology; validation; visualization. **Colin Angus:** Conceptualization; methodology; validation; visualization. **Robert Pryce:** Conceptualization; data curation; formal analysis; investigation; methodology; validation; visualization. **John Holmes:** Conceptualization;

methodology; validation. **Alan Brennan:** Conceptualization; funding acquisition; methodology; project administration; validation. **Duncan Gillespie:** Conceptualization; funding acquisition; methodology; project administration; validation.

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### Supporting Information

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

### Data S1 Supporting Information.