OPEN ACCESS

Purchase price of tobacco in small retailers in Great Britain: the relationships with neighbourhood deprivation and urbanicity between 2016–2021

Helena Tunstall [1], Luke Brian Wilson [2], Roberto Valiente [3], Niamh K Shortt [4], Colin Angus [2], Alan Brennan [2], Duncan Gillespie [2], Jamie Pearce [4]

► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/tc-2025-059286).

[1]School of Social and Political Science, University of Edinburgh, Edinburgh, UK
[2]Sheffield Addictions Research Group (SARG), Sheffield Centre for Health and Related Research (SCHARR), University of Sheffield, Sheffield, UK
[3]Department of Geology, Geography and Environment Science, University of Alcalá, Alcalá de Henares, Spain
[4]Centre for Research on Environment, Society and Health (CRESH), School of Geosciences, University of Edinburgh, Edinburgh, UK

Correspondence to
Dr Helena Tunstall;
helena.tunstall@ed.ac.uk

Received 13 January 2025
Accepted 9 September 2025

To cite: Tunstall H, Wilson LB, Valiente R, *et al*. *Tob Control* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/tc-2025-059286

ABSTRACT

Background Tobacco price is an important determinant of smoking behaviour. Using electronic point-of-sales (EPOS) data, this study assesses purchase price of factory-made cigarettes (FMC) and roll-your-own (RYO) tobacco across neighbourhood deprivation and urban/rural status in Britain. It considers price changes, 2016–2021 and brand price segmentation.

Methods The analysis uses EPOS data describing 10 156 106 tobacco packs sold from 1012 convenience stores, across 24 seasonally-distributed weeks (2016–2021). Gross sales prices were adjusted for inflation and presented per 20 cigarette sticks of FMC and equivalent RYO. Tobacco brand variants were assigned to four price segments (sub value, value, midprice and premium).

Results Between 2016–2021, the sales-weighted price of tobacco (20 sticks or equivalent) reduced from £8.72 to £8.10, reflecting a shift from FMC to RYO (RYO increasing from 32–46% of tobacco sales). The mean price of 20 sticks of FMC in the most deprived neighbourhoods was 5% (£0.51–£0.59) lower compared with the least deprived in all years; for RYO, this price difference grew from 3% to 5% (£0.13–£0.28). The greater likelihood that tobacco was from lower price segments in more deprived areas largely accounted for this price difference.

Conclusions Differences in average price paid for tobacco between more and less deprived neighbourhoods reflect variations in numbers of purchases across price segments. Combined (FMC and RYO) tobacco prices per stick have fallen, reflecting increasing RYO sales. Innovative approaches are required to respond to the tobacco industry's price differentiation by both price segment and product type and the growing importance of lower price RYO products.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The pricing of tobacco products influences tobacco purchasing and consumption with the tobacco industry developing lower cost tobacco brands to support purchasing by lower income smokers.
⇒ Previous work has shown that the price of tobacco varies between neighbourhoods with a tendency for lower prices in more disadvantaged and rural areas.
⇒ However, no previous studies have examined tobacco pricing across Britain, and most studies internationally have focused on a small number of tobacco brands at a single point in time.

WHAT THIS STUDY ADDS

⇒ This longitudinal study (2016–2021) uses electronic point-of-sale (EPOS) data to examine neighbourhood differences (deprivation, urban/rural) in the price paid for purchases of factory-made cigarettes (FMC) and roll-your-own (RYO) tobacco, across the entire product range, in a selection of small convenience stores in Britain.
⇒ Over the study period, the mean, inflation-adjusted, price paid for tobacco reduced, largely as a result of a consumer shift from FMC to RYO tobacco products.
⇒ Across the UK, between 2016–2021, the mean price of tobacco purchases was approximately 5% lower in the most disadvantaged compared with least disadvantaged quintile of neighbourhoods.
⇒ Differences in the price of tobacco purchases by neighbourhood deprivation were largely, but not wholly, accounted for by greater sales of tobacco from lower price segments.
⇒ After adjustment, compared with large urban areas, the mean price of tobacco purchases was slightly lower in other urban, town rural and village rural areas.

INTRODUCTION

Tobacco price is an important influence on tobacco purchasing, and the maintenance of some relatively cheap tobacco products is used by tobacco manufacturers to support tobacco sales in the face of ongoing tobacco tax rises.[1 2] The tobacco industry intends for lower cost tobacco brands to support purchasing by low-income smokers, who are an increasingly large proportion of the tobacco market.[3] Tobacco manufacturers stratify tobacco products by reducing tax 'pass-though' on lower cost brands and raising prices of the most expensive brands.[1 4 5]

A recent systematic review of area-level differences in the price of tobacco[6] found that cigarette shelf prices were lower in more deprived neighbourhoods, although the differences were often modest and not always statistically significant.[6–9] Other studies assessing geographical differences in tobacco price have focused on urbanicity and have generally found prices were higher in urban

HOW THIS STUDY AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The increasing gap between prices of RYO price segments, alongside the rising popularity of RYO products, suggests that tobacco control policy should address the segmentation of tobacco type and the role this plays in smoking behaviours.

⇒ The tobacco industry uses price as a marketing tool because current legislation permits a wide price differentiation between tobacco products.

⇒ In order to maximise the effectiveness of tobacco price rises, policies could be introduced to limit price variation. However, it is important to also support people who find it harder to quit to do so, in order to avoid larger price penalties, particularly among disadvantaged populations.

areas;[10–13] however, one analysis in the USA found higher prices in rural areas.[8]

Among the geographical studies of tobacco prices, few have considered temporal changes,[6] despite this being important for understanding impacts of price-related tobacco control interventions. Most studies rely on data collected through field visits to selected stores or self-reports of purchases by consumers.[6] Due to these data collection constraints, this research has commonly focused on the shelf price of cigarettes for a limited number of brands, sold at a single time point.[6]

This study addresses these concerns by using secondary electronic point-of-sale (EPOS) data to examine price paid for purchases of factory-made cigarettes (FMC) and roll-your-own (RYO) tobacco across the entire product range in a group of convenience stores in Britain. The study considers patterns in tobacco expenditure across all tobacco FMC and RYO purchases, rather than the prices charged by retailers for individual tobacco brands. It also examines temporal variations in price alongside neighbourhood deprivation, urban/rural status and tobacco price segment over a 6-year time period, 2016–2021. Convenience stores in Britain are smaller stores selling groceries, alcohol and lottery tickets[14] and have accounted for 55–60% of total volume of cigarettes sold.[15] It is important to assess tobacco prices in such retailers as they are a convenient, accessible option for purchasing tobacco within local communities.

The study includes the time period of the COVID-19 pandemic, which resulted in significant changes in purchasing patterns with greater sales in local convenience stores during 'lockdown' periods.[16–19] We assess RYO as well as FMC tobacco because of the growing importance of RYO sales, especially as a source of low-priced tobacco.[20] In the UK, the price of RYO has historically always been considerably cheaper than FMC, due in part to the UK Government's past strategy of a higher tax escalator on FMC, although recent RYO tax rises have been larger, in percentage terms, than those on FMC products.[21–25] The study period covers the introduction of UK legislation (May 2017) banning small cigarette packs below 20 sticks and RYO packs below 30 g, alongside plain packaging mandates eliminating price-marked packs.[21]

METHODS

Retail sales data

Retail sales data were provided by The Retail Data Partnership (TRDP) collected from 1012 convenience stores across Britain recorded on their EPOS system, 'Shopmate', during 2016–2021. TRDP data include stores which are independent or members of franchises. TRDP data describe the tobacco product type, name, barcode, pack size (number of sticks or grams), units purchased, gross sales price, date of sale and store neighbourhood.

TRDP EPOS data were selected from 1 week in each quarter of the study years (avoiding school holidays), from the dates 7–13 March, 7–13 June, 7–13 September and 7–13 December in 2016–2021, totalling 24 weeks of sales. The stores included in the study were selected from the 2187 TRDP stores that recorded sales during the first study week. To qualify, stores had to report sales in all 24 weeks of the study (n=1127) and maintain regular sales activity (n=1060) and sales of tobacco products (n=1012) across this time period. Tobacco transactions were excluded if missing data describing price, units or pack size or they had gross sales price outside the expected range (the top and bottom 0.2% of prices across all study weeks for FMC and RYO), 0.7% of transactions were excluded in total. The data set included 10 156 106 tobacco packs sold, 8 369 927 FMC and 1 786 179 RYO, within the study period.

Tobacco purchase price

Tobacco purchase price is defined as the gross sales price paid by customers in stores across all RYO and FMC tobacco products purchased. The distribution of this price measure, therefore, reflects the consumers' selection of FMC and RYO brands. FMC and RYO tobacco products accounted for over 95% of the total tobacco products sold in the study stores. Tobacco purchase price was represented by price paid per 20 cigarette sticks. 20 cigarette sticks were selected as a measure because 20 sticks of FMC was the most popular tobacco pack size purchased during the study time period. Based on the assumption that RYO cigarettes weigh 0.5 g, 10 RYO g were considered equivalent to 20 cigarette sticks. In the UK, an average RYO cigarette weight of 0.5 g has been found in surveys of people who smoke[23 26] and has been used by the National Health Service in the development of smoking cessation policies.[27 28]

Where TRDP data were missing pack size, online searches for information were completed tracing the product barcode using barcode look-up sites and general purpose search engines. Following previous tobacco research, gross sales prices for all data weeks were inflated to December 2021 levels based upon monthly Retail Price Index Cigarettes & Tobacco figures.[29] Prices were not adjusted directly for tobacco tax changes or other government policies affecting tobacco retail during the time period of the study.

FMC brand variants were defined as belonging to one of four price segments: sub value, value, mid-price and premium. RYO brand variants were categorised as value, mid-price and premium. For example, Carlton Red FMC was defined as sub value and B&H Gold FMC as premium. Classification of brands in TRDP data was based upon the brand price segment scheme defined by Hiscock *et al*.[30] We updated this categorisation using the mode gross price of brand variants within TRDP data, tobacco industry and wholesaler descriptions of price categories and recommended sales price and retail industry literature.

In the results, we present the average price paid separately for FMC and RYO and together as a 'combined tobacco' (CT) price. CT was defined to indicate how shifts in the relative popularity of FMC and RYO were affecting the overall price paid for cigarettes of all types.

Geographic variables

The neighbourhoods of stores were defined by their lower super output area (LSOA) (between 1000 and 3000 population) in England and Wales and their data zone (between 500 and 1000

population) in Scotland. The 1012 TRDP stores in our analysis were located across 993 neighbourhood areas.

Measures of neighbourhood deprivation and urban/rural status were linked to stores using their neighbourhood identifiers. Neighbourhood deprivation was based upon the Composite 2020 GB Index of Multiple Deprivation quintiles,[31] which are derived from the English Indices of Deprivation and the Welsh Index of Multiple Deprivation for LSOAs in England and Wales and the Scottish Index of Multiple Deprivation for data zones in Scotland, reweighted to create a Britain-wide deprivation measure.[32] Urban and rural areas were classified using categories from the Office for National Statistics (ONS) Rural Urban Classification (RUC) 2011 for LSOAs in England and Wales[33] and the Scottish Government Urban Rural Classification (SGUR) 2020 for data zones in Scotland[34]. This variable combines RUC 2011/SGUR 2020 categorises to define neighbourhoods within four categories 'large urban' ('conurbation'/'large urban areas'), 'other urban' ('city and town'/'other urban areas'), 'town rural' ('town and fringe'/'small towns') and 'village rural' ('village and dispersed'/'rural areas'). The country of the stores' location was also identified so that national differences could be considered.

Statistical analyses

Linear regression was used to analyse neighbourhood level differences in average price paid for tobacco purchases, how these relationships changed over time and how they were affected by price segmentation of tobacco products. Separate models were used to assess tobacco products by type, FMC and RYO. The dependent variable in the models was the gross sales price per 20 sticks of each tobacco product purchased in stores.

The modelling strategy utilised separate models to explore the two neighbourhood variables, deprivation and urban/rural status. For the analysis of neighbourhood deprivation, models 1a/b show the main effects of deprivation on prices paid, with adjustment for the country in which the store was located. In models 2a/b, year and the two-way interactions between the country and year were also included as a covariate to further account for potential confounding national-level effects. Next, to test whether the relationship between neighbourhood deprivation and prices paid differed significantly between the years of the study, two-way interactions between deprivation and time were included (models 3a/b). In the subsequent models, urban/rural status was included as a covariate (models 4a/b), testing whether it explained variation beyond that explained by deprivation and its interactions with the other covariates. Finally, models adjusting for the price segment of the tobacco products purchased (models 5a/b) and price segment and year interactions (models 6a/b) were examined. These models tested the extent to which the relationship between deprivation and price paid was affected by the selection of brands from different price levels. A similar modelling strategy was then repeated, focused on the effects of neighbourhood urban/rural location on price paid. Statistical significance was defined at the 0.05 level.

The relative fit of each model was assessed using Akaike's Information Criterion (AIC)/R-squared, to determine the degree of statistical support for the model structures. To check

Table 1 Mean price paid for 20 sticks FMC and 20 sticks/10 g RYO by area type, tobacco price segment and year, 2016–2021

		Stores	FMC		RYO			CT (FMC and RYO)		
Area type, tobacco price segment and year		Total stores (n)	Mean price per 20 sticks (£)	Mean sticks per store and week (n)	Mean price per 20 sticks (£)	Mean grams per store and week (n)	Mean sticks per store and week (n)	Mean price per 20 sticks (£)	Mean sticks per store and week (n)	Percentage of CT sticks that were RYO (%)
Total		1012	10.46	6438	4.89	2049	4099	8.29	10 536	38.9
IMD deprivation quintile	1Q most dep.	336	10.31	7842	4.82	2329	4658	8.26	12 501	37.3
	2Q	227	10.42	6669	4.89	2378	4757	8.12	11 426	41.6
	3Q	186	10.54	5645	4.94	1965	3929	8.24	9574	41.0
	4Q	154	10.66	5404	4.97	1529	3057	8.61	8461	36.1
	5Q least dep.	109	10.85	4438	5.04	1383	2765	8.62	7203	38.4
Urban/rural status	Large urban	214	10.46	8032	4.84	1567	3134	8.88	11 165	28.1
	Other urban	538	10.42	6573	4.88	2373	4747	8.10	11 320	41.9
	Town rural	144	10.50	5718	4.95	2107	4214	8.14	9932	42.4
	Village rural	116	10.64	3763	5.00	1365	2731	8.27	6494	42.1
Country	England	742	10.51	6126	4.90	2052	4104	8.26	10 229	40.1
	Scotland	109	10.29	8306	4.82	1465	2931	8.86	11 237	26.1
	Wales	161	10.36	6609	4.90	2434	4868	8.05	11 478	42.4
Price segment	Sub value	–	9.73	3556	–	–	–	–	–	–
	Value	–	10.63	1543	4.39	1815	3629	–	–	–
	Mid-price	–	11.69	910	5.28	1879	3758	–	–	–
	Premium	–	13.28	419	5.37	403	806	–	–	–
	Unclassified	–	10.39	9	4.68	2	4	–	–	–
Year	2016	–	10.53	7899	4.93	1897	3794	8.72	11 693	32.4
	2017	–	10.33	6991	4.87	1852	3704	8.44	10 695	34.6
	2018	–	10.27	6222	4.81	1793	3585	8.27	9807	36.6
	2019	–	10.42	5595	4.76	1809	3618	8.20	9214	39.3
	2020	–	10.53	6011	4.88	2467	4934	7.99	10 945	45.1
	2021	–	10.66	5908	5.04	2479	4957	8.10	10 865	45.6

Full SD and CIs of the price means are presented within online supplemental material table S1.
CT, combined tobacco; FMC, factory-made cigarettes; IMD, Index of Multiple Deprivation; Q, quintile; RYO, roll-your-own.

the robustness of the Britain-wide results and results for years of purchase, additional (online supplemental file 1) regression models were also completed separately for England, Scotland and Wales and for each year. All models were completed using Stata/SE V.14.2 and were adjusted for clustering of prices within stores.

RESULTS

Tobacco price by area type (all years)

Inflation adjusted prices for all years (2016–2021) indicated that the average purchase price for 20 cigarette sticks or equivalent was £10.46 for FMC, £4.89 for RYO and £8.29 for CT (table 1; online supplemental material table S1). For FMC and RYO separately, there was a gradient in average price across the deprivation quintiles with the lowest price in the most deprived quintile 1 (£10.31 for FMC and £4.82 RYO) and a difference between the least and most deprived quintiles of £0.55 and £0.22, respectively. For CT, although the average price was highest in the least deprived quintile 5 (£8.62), there was not a clear gradient with the lowest prices occurring in quintiles 2 and 3 (£8.12 and £8.24). The absence of a gradient for CT is likely due to the lower percentage of CT sticks that were RYO in the most deprived areas (37%) compared with less deprived areas (42% and 41% in the second and third most deprived quintiles, respectively). FMCs are more expensive per stick and, as such, the balance of FMC to RYO shifts the CT price gradient (table 1).

Comparing urban and rural areas over the full study period shows that when considering FMC and RYO separately, the average prices were highest in village rural areas (£10.64 and £5.00, respectively) and lowest in the urban categories (table 1). However, for CT, tobacco prices were highest in large urban areas, reflecting the lower numbers of RYO sticks sold in these areas. The average price of both FMC and RYO sticks was lower in Scotland than in England and Wales, but the CT price was highest in Scotland, again reflecting the lower number of RYO sticks sold (table 1).

When we switched from looking at the average price of all FMC and RYO to looking at the average price in different product segments, there was a large variation in the average price of tobacco purchases from different price segments across 2016–2021. There was a difference of £3.55 between sub value and premium FMC 20 sticks (sub value 27% lower) and £0.99 between value and premium RYO 20 sticks (value 18% lower) (table 1).

The greatest variation in average tobacco price among the categories assessed was between tobacco types, with the average price of 20 sticks of FMC more than double the price of RYO and the lowest priced FMC price segment 81% more expensive than the highest priced RYO segment (table 1).

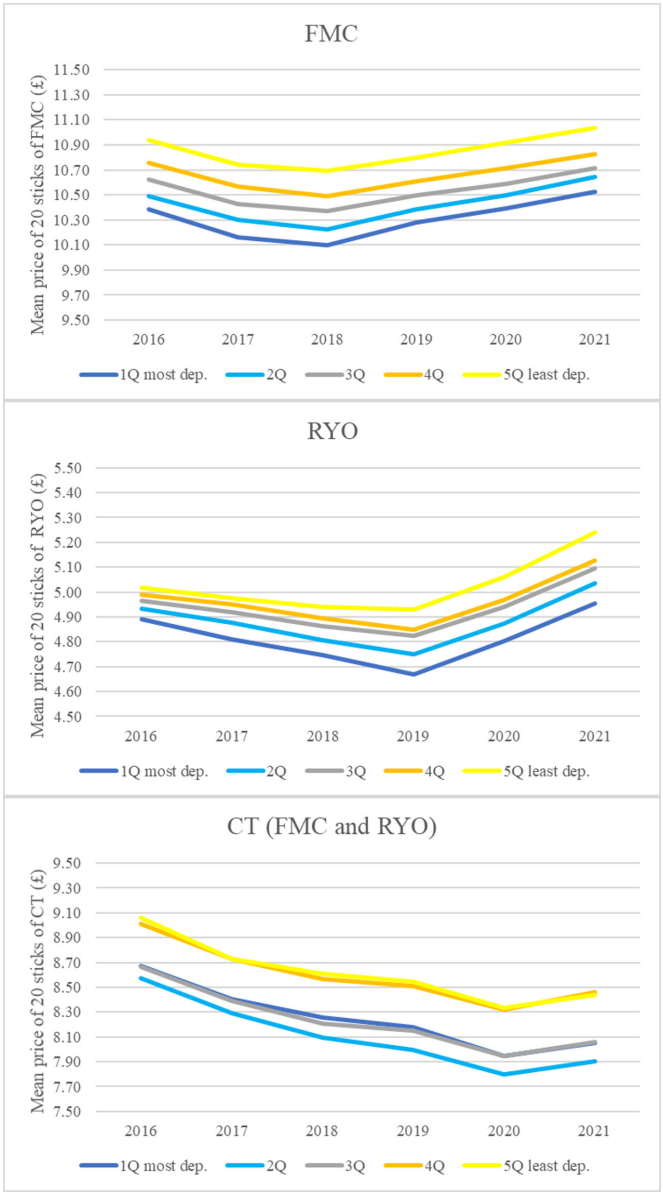


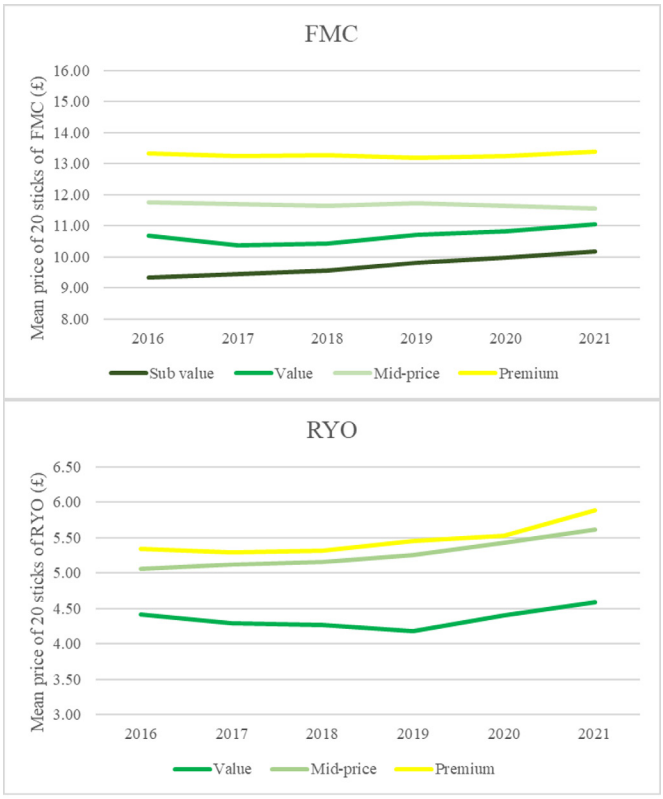
Figure 1 Mean price paid for 20 sticks FMC/RYO/CT by neighbourhood deprivation quintile and year, 2016-2021. CT, combined tobacco; FMC, factory-made cigarettes; Q, quintile; RYO, roll-your-own.

Time trends in tobacco price

There was a consistent gradient in average price paid for FMC across deprivation in all years. The average price paid for FMC in the most deprived quintile of areas was 5% less than in the least deprived areas in each year (figure 1). For RYO, a similar trend was found with a lower average price paid in more deprived areas, with the price difference between the least and most deprived areas widening from 3% in 2016 to 5% in 2021.

Analysis of the average CT price indicates an overall decline in price paid from £8.72 in 2016 to £8.10 in 2021 and a non-linear relationship with neighbourhood deprivation (table 1). The decline in CT price reflects the shift between RYO and FMC over time, rather than prices falling for either FMC or RYO. The proportion of sticks purchased that were RYO across all stores increased from 32% in 2016 to 46% in 2021. The difference in gradient for CT price between areas reflects the balance of sales between RYO and FMC. In both 2016 and 2021, RYO accounted for the greatest proportion of CT sticks sold in the second and third most deprived quintiles of neighbourhoods and the least in the most deprived and fourth most deprived quintiles (online supplemental figure S1). However, the proportion of sticks that were RYO increased substantially over the study period in both the second most deprived quintile (34–49%) and the most deprived quintile (31–44%) (online supplemental figure S1).

Analysis of urbanicity and purchase price over time indicates that differences in price between urban and rural categories narrowed for FMC (from 3% to 1% less in the lowest priced relative to the highest priced area, other urban and village rural, respectively) but widened for RYO (from 3% to 4% less in the lowest priced relative to highest prices areas, large urban and village rural, respectively) between 2016 and 2021 (online



Note: The denominator is the total number of FMC sticks/RYO grams

Figure 2 Mean price paid for 20 sticks FMC/RYO by brand price segment and year, 2016–2021. FMC, factory-made cigarettes; RYO, roll-your-own.

supplemental figure S2). Trends in national prices indicate that average tobacco price for both FMC and RYO became relatively cheaper in Scotland compared with England between 2016–2021 (online supplemental figure S3). The CT price is, however, more expensive in large urban areas and in Scotland across all years, again reflecting the balance of sales between RYO and FMC (table 1; online supplemental figure S4–S5).

Analysis of time trends in tobacco product price segments suggests that differences in average price among FMC segments have decreased between 2016–2021, narrowing between sub value and premium from 30% to 24% less, while differences among RYO segments have widened between value and premium from 17% to 22% less (figure 2). The proportion of purchases from the lowest brand price segments increased notably during the study period in all areas, with sub value sales growing from 41% of all FMC sticks sold in 2016 to 66% in 2021, and value RYO grams increasing from 26% to 56% of all RYO sales (figure 3). Purchases from cheaper price segments grew faster in more deprived areas.

Regression modelling

Models 1–6 show the relationship between deprivation and tobacco purchase price over time (table 2). In models of FMC price, there is a gradient in price differentials across the deprivation quintiles with the average price 55 pence (£0.55) lower in the most deprived relative to the least deprived quintile of neighbourhoods, after adjusting for country, area level deprivation, year, country-year interactions, neighbourhood urban/rural status and deprivation-year interactions (model 4a). When the price segment of FMC tobacco brand was added (model 5a), there was a substantial improvement in model fit, as indicated by AIC and R-squared values, and the coefficient for difference in price between the most and least deprived quintile of neighbourhoods was attenuated to 10 pence. In the final model (model 6a), the inclusion of an interaction variable of price segment and year further reduced the coefficients of price difference between the most deprived relative to the least deprived quintile of neighbourhoods to four pence.

RYO models with the dependent variable as the equivalent price of 20 sticks, adjusted for country, area level deprivation, year and country-year interactions, again indicate a gradient in average price across deprivation quintiles with prices 23 pence lower in the most deprived areas compared with the least deprived areas (table 2; model 2b). However, inclusion of deprivation-year interactions attenuated the size of these differences to a 13 pence difference (models 3b). The deprivation-year interactions were significant for all years for RYO in the most deprived quintile and indicated that between 2016 and 2021 prices had become lower compared with the least deprived areas (online supplemental table S2b; model 3b). The inclusion of the price segment and price segment-year interactions (table 2; models 5b–6b) greatly improved model fit and further reduced almost all differences in price between the most and least deprived quintiles. The variables representing interactions between price segment and year indicated that the prices of mid-price and premium RYO brand increased significantly relative to value RYO between 2016 and 2021 (online supplemental table S2b; model 6b).

Year-specific models, adjusted for week of sale and area characteristics, confirmed that in every study year there was a price gradient across deprivation quintiles, which was substantially attenuated by the further inclusion of price segment in the models (results not shown).

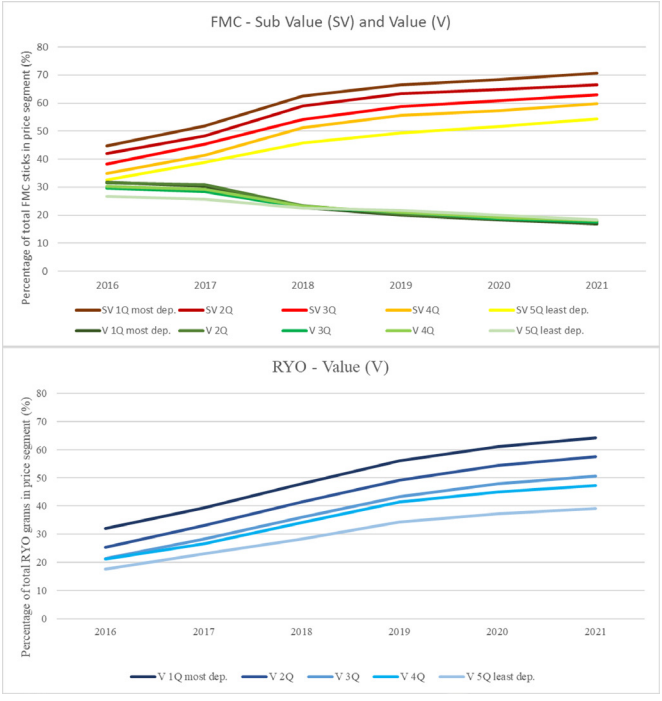


Figure 3 Percentage of FMC sticks and RYO grams purchased in deprivation quintile within sub value and value price segments by year, 2016–2021. FMC, factory-made cigarettes; Q, quintile; RYO, roll-your-own.

Table 2 Models 1–6. Linear regression models: tobacco price and neighbourhood deprivation

Area type, year and tobacco price segment		FMC 20 sticks price						RYO 20 sticks price					
		Coefficients (£)						Coefficients (£)					
		Model 1a	Model 2a	Model 3a	Model 4a	Model 5a	Model 6a	Model 1b	Model 2b	Model 3b	Model 4b	Model 5b	Model 6b
Constant		10.88 *	11.09 *	11.07 *	11.14 *	10.15 *	10.30 *	5.04 *	5.20 *	5.24 *	5.21	4.67 *	4.62 *
Country	England	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Scotland	−0.21 *	−0.13 *	−0.13 *	−0.15 *	−0.10 *	−0.10 *	−0.07 *	−0.06 *	−0.07 *	−0.07 *	0.00	−0.02 *
	Wales	−0.10 *	−0.11 *	−0.10 *	−0.08 *	−0.02	−0.02 *	0.02 *	0.00	−0.01	−0.02 *	−0.03 *	−0.02 *
IMD deprivation quintile	1Q most dep.	−0.53 *	−0.52 *	−0.53 *	−0.55 *	−0.10 *	−0.04 *	−0.22 *	−0.23 *	−0.13 *	−0.11 *	0.03	0.00
	2Q	−0.41 *	−0.41 *	−0.43 *	−0.45 *	−0.07 *	−0.03	−0.16 *	−0.16 *	−0.08 *	−0.07 *	0.01	−0.01
	3Q	−0.30 *	−0.30 *	−0.29 *	−0.31 *	−0.07 *	−0.04 *	−0.10 *	−0.10 *	−0.05 *	−0.05 *	−0.01	−0.02
	4Q	−0.18 *	−0.18 *	−0.16 *	−0.19 *	−0.03	−0.02	−0.07 *	−0.07 *	−0.03	−0.03	0.01	0.00
	5Q least dep.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Urban/rural status	Large urban				Ref.	Ref.	Ref.				Ref.	Ref.	Ref.
	Other urban				−0.07 *	−0.04 *	−0.04 *				0.02	0.01	0.01
	Town rural				−0.12 *	−0.09 *	−0.09 *				0.04 *	−0.01	−0.01
	Village rural				0.06	−0.10 *	−0.09 *				0.10 *	−0.03 *	−0.03 *
Year			Included	Included	Included	Included	Included		Included	Included	Included	Included	Included
Country × Year			Included	Included	Included	Included	Included		Included	Included	Included	Included	Included
Deprivation × Year				Included	Included	Included	Included			Included	Included	Included	Included
Price segment						Included	Included					Included	Included
Price segment × Year							Included						Included
Akaike's Information Criterion†		25 529 428	25 408 760	25 406 833	25 392 539	10 082 697	9 157 067	2 742 695	2 686 478	2 684 741	2 680 965	−366654	−536799
Adjusted R-squared‡		0.026	0.040	0.040	0.042	0.846	0.862	0.019	0.049	0.050	0.052	0.828	0.844

Dependent variable a=price paid for 20 sticks of FMC.
Dependent variable b=price paid for 20 sticks of RYO.
Full coefficients for all variables are presented within online supplemental materail table S2a and S2b.
*p<0.05.
†Smaller values of Akaike's Information Criterion indicate a better model fit to the data.
‡Greater values of Adjusted R-squared indicate a better model fit to the data.
FMC, factory-made cigarette; IMD, Index of Multiple Deprivation; RYO, roll-your-own.

Models 7–12 show the relationship between urban/rural status and tobacco purchase price over time (online supplemental table S3a and S3b). After full adjustment, compared with large urban areas, prices were slightly lower in other urban, town rural and village rural for FMC and RYO products (model 12), ranging from 1 pence to 8 pence.

All models assessing FMC 20 stick price indicate that average price was lower in Scotland relative to England, and while the inclusion of deprivation and price segment attenuated these differences, the prices in Scotland remained 10 pence lower relative to England in the fully adjusted models (table 2; model 6a). Separate models for England, Scotland and Wales are also presented in online supplemental tables S4a and S4b.

DISCUSSION

This national-level analysis used EPOS data to examine differences in price paid for FMC, RYO and CT purchases and assessed how the geographical distribution of these expenditures has changed over time. We find that between 2016–2021, RYO represented an increasing share of the tobacco sales in convenience stores (from 32% to 46% of sticks sold). Further, over the study period, the average price paid for FMC and RYO tobacco products was related to neighbourhood socioeconomic status, with lower prices in more deprived areas. These neighbourhood differences in average expenditure, as in a previous study in Scotland,[13] were found to be largely accounted for by higher purchasing in less expensive price segments.

The findings show that differences in price paid between more and less deprived neighbourhoods remained stable for FMC but widened for RYO tobacco. Sales of the least expensive FMC and RYO products rose across all areas, with the largest increases in more deprived neighbourhoods. While lower-priced FMC brands became more dominant in these areas, the price gap between sub value and higher-priced FMC categories narrowed from 2016 to 2021. Conversely, the gap in purchase price between value and premium RYO products grew. Relative declines in the price of lower-priced RYO brands may have pushed down overall RYO prices in more deprived areas where sales of these products increased substantially. Additionally, deprived areas saw large drops in mid-priced RYO sales, while FMC sales shifted away from fairly low-priced value brands. The growing price stratification in RYO is particularly significant since RYO, priced at half the cost of FMC, accounts for a growing share of tobacco sales.[35]

The relative sales of FMC and RYO products are important when assessing price differentials between areas. In areas where RYO products are more dominant, the average price of CT is driven down. Although people who consume RYO products are more likely to be from lower social grades,[35] we found RYO, as a proportion of overall tobacco sales, was higher in the second and third most deprived quintiles compared with most deprived neighbourhoods across the study period. This relationship between RYO sales and deprivation could reflect the low sales of RYO found in large urban areas compared with other neighbourhoods. Notably, while RYO sales were greatest relative to FMC in the second and third most deprived quintiles, they increased at a high rate in the two most deprived quintiles over time. This rise of RYO sales is concerning as, along with lower price, there is a perception among people who smoke that RYO may be less harmful than FMC.[20]

The finding that differences in the average price paid for FMC in the cheaper price segments relative to more expensive segments narrowed from 2016 to 2021 is perhaps unexpected. Analysis of tobacco prices in the UK, 2013–2015, found price rises were much smaller for sub value FMC and value RYO segments in comparison to higher priced segments, as a result of tobacco industry price strategies.[36] However, more recent work (2013–2017) found that for packs of 20 cigarettes, price increases were greater in the lower price quintiles.[37] Similarly, an analysis of the UK's 20 bestselling FMC brands before and after standardised packaging legislation in May 2017 found the largest increase in price in the value price segment, followed by premium and mid-price.[38]

Policymakers' concerns about the price stratification of tobacco brands by the tobacco industry to maintain tobacco consumption among low-income smokers has led to consideration of minimum unit pricing for tobacco products.[39 40] However, in this study, increasing price stratification between price segments was found for RYO, but not for FMC, suggesting policies targeting lower-priced FMC products could have the unintended effect of further increasing the price of lower-priced FMC relative to lower-priced RYO products and therefore encouraging more people who smoke to switch to cheaper RYO products. Differences in price per stick between FMC and RYO in this study were markedly greater than differences among price segments of either tobacco type. The growing price difference between RYO segments and the increasing popularity of RYO are further evidence of the importance of tobacco control pricing policies that seek to narrow the gap between RYO and FMC. Recent UK Government policy has targeted this price gap between RYO and FMC with a higher tax escalator on RYO. In 2023, the UK Government announced the duty on hand-rolled tobacco escalator would rise by 12% above Retail Prices Index (RPI) inflation, compared with 2% for FMC.[24] Subsequently, in the Autumn Budget 2024, this policy has been continued.[25] Tobacco control policies also need to understand smokers' responses to tobacco costs, consider potential harms of higher tobacco prices, particularly among disadvantaged populations, and support people who find it harder to quit.[41]

The study findings demonstrate that, after adjustment for deprivation and price segment, average cigarette prices were slightly higher in large urban areas, which is consistent with previous research.[13] Higher prices in large urban areas could be due to greater overheads associated with operating retail businesses in premium retail centres,[13] although effects of urban location on price have been found to vary between product types.[7 12] There were also price differences across the countries with lower average prices in Scotland than England and Wales, which persisted for FMC after adjustment for neighbourhood characteristics and tobacco price segment.

Strengths and limitations

Study strengths include national-level analyses, comprehensive EPOS data describing all FMC *and* RYO sales linked to neighbourhood characteristics, and one of the few analyses of areas' differences in price to assess changes in price over time. There were also limitations. Stores are an opportunity sample and may not represent convenience stores across Britain. Sales patterns among the selected stores were affected by the COVID-19 pandemic and government lockdown measures, although TRDP convenience store businesses were relatively resilient during this period.[19] Changes in sales patterns over time may also have been influenced by changes in the characteristics of customers, including movements of customers between retailer types. Estimates from models which include the price segment variable may be biased by endogeneity due to reverse causation in the relationship between price segment and sales price. Finally, the

calculation of RYO cigarette equivalents may not reflect perceptions of equivalence among people who smoke or the volume of tobacco used in their RYO cigarettes. Tobacco weight in RYO cigarettes may vary with product affordability and change over time.[23]

CONCLUSION

This study of 10 156 106 EPOS tobacco transactions in 1012 convenience stores across Britain shows significant geographical variations in the average price paid for FMC and RYO tobacco, with lower prices in more deprived and rural areas and in Scotland. These spatial differences in average price reflect geographically varying purchasing patterns across different tobacco price segments. In addition, during 2016–2021 there has been a large increase in the proportion of cigarettes purchased which are RYO, with considerable growth in more deprived areas. Innovative tobacco control approaches to tobacco pricing are required to respond to the tobacco industry's price differentiation of both tobacco product types and price segments.

Contributors HT is the guarantor. NKS and JP conceived the initial idea for the study. All authors contributed to shape and define the study throughout all the stages. JP, NKS, DG and HT designed the analytic strategy. HT cleaned and prepared data for analyses. HT carried out the analyses with critical feedback from all co-authors. All authors contributed to the interpretation of results. HT wrote the initial draft of the manuscript. NKS, JP, RV and DG contributed substantial edits to the manuscript text. All authors contributed critical review to the preparation of the final manuscript.

Funding This research also benefited from support from the UK Prevention Research Partnership (MR/S037519/1), which is funded by the British Heart Foundation, Cancer Research UK, Chief Scientist Office of the Scottish Government Health and Social Care Directorates, Engineering and Physical Sciences Research Council, Economic and Social Research Council, Health and Social Care Research and Development Division (Welsh Government), Medical Research Council, National Institute for Health Research, Natural Environment Research Council, Public Health Agency (Northern Ireland), The Health Foundation and Wellcome.

Competing interests No, there are no competing interests.

Patient consent for publication Not applicable.

Ethics approval This project received research ethics approval from the University of Edinburgh, School of GeoSciences' Ethics and Integrity Committee in Edinburgh, UK, on 17 November 2021. The reference number for this committee determination is 2021-569.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Data may be obtained from a third party and are not publicly available. The tobacco transactions data must be requested from The Retail Data Partnership. The neighbourhood deprivation index, the Composite GB IMD Index, was produced by Alex Parsons and can be accessed from: https://github.com/mysociety/composite_uk_imd. The Rural-Urban Classification 2011 was produced by the Office for National Statistics and can be accessed from: https://www.ons.gov.uk/methodology/geography/geographicalproducts/ruralurbanclassifications/2011ruralurbanclassification. The Scottish Government Urban Rural Classification 2020 was produced by the Scottish Government and is available from: https://www.data.gov.uk/dataset/f00387c5-7858-4d75-977b-bfdb35300e7f/urban-rural-classification-scotland.

ORCID iDs
Helena Tunstall http://orcid.org/0000-0002-0895-9078
Luke Brian Wilson http://orcid.org/0000-0001-5769-5729
Roberto Valiente http://orcid.org/0000-0002-1016-0548
Niamh K Shortt http://orcid.org/0000-0002-8573-7794
Colin Angus http://orcid.org/0000-0003-0529-4135
Alan Brennan http://orcid.org/0000-0002-1025-312X
Duncan Gillespie http://orcid.org/0000-0003-3450-5747
Jamie Pearce http://orcid.org/0000-0002-0994-7140

REFERENCES

1 Gilmore AB, Tavakoly B, Taylor G, *et al*. Understanding tobacco industry pricing strategy and whether it undermines tobacco tax policy: the example of the UK cigarette market. *Addiction* 2013;108:1317–26.
2 Chaloupka FJ, Yurekli A, Fong GT. Tobacco taxes as a tobacco control strategy. *Tob Control* 2012;21:172–80.
3 Partos TR, Hiscock R, Gilmore AB, *et al*. Chapter 3: tobacco industry pricing strategies and price segmentation of the uk tobacco market. In: *Impact of tobacco tax increases and industry pricing on smoking behaviours and inequalities: a mixed-methods study*. Southampton (UK): NIHR Journals Library, 2020: 25–44.
4 He Y, Ma S, Yang Q, *et al*. How cigarette excise tax pass-through to prices responds to the uptake and evolution of e-cigarettes (ECs). *Tob Control* 2025;34:e058078:85–91:.
5 Wilson LB, Angus C, Brennan A, *et al*. Quantile regression of tobacco tax pass-through in the UK 2017-2021: how have manufacturers passed through tax changes for different tobacco products in small retailers? Analysis at the national level and by neighbourhood of deprivation. *Tob Control* 2025.
6 Guindon GE, Fatima T, Abbat B, *et al*. Area-level differences in the prices of tobacco and electronic nicotine delivery systems — A systematic review. *Health Place* 2020;65:102395.
7 Guindon GE, Montreuil A, Driezen P, *et al*. Do cigarette prices near secondary schools vary by area-level socioeconomic status? Findings from a field study in Ontario and Québec, Canada. *Health Place* 2023;79:102936.
8 Raskind IG, Vishwakarma M, Schleicher NC, *et al*. The changing retail landscape for tobacco: dollar stores and the availability of cheap cigarettes among tobacco-related priority populations. *Tob Control* 2022;31:e140–7.
9 Henriksen L, Schleicher NC, Fortmann SP. Menthol cigarettes in black neighbourhoods: still cheaper after all these years. *Tob Control* 2022;31:e211–2.
10 Burton S, Williams K, Fry R, *et al*. Marketing cigarettes when all else is unavailable: evidence of discounting in price-sensitive neighbourhoods. *Tob Control* 2014;23:e24–9.
11 Golden SD, Kong AY, Ribisl KM. Racial and Ethnic Differences in What Smokers Report Paying for Their Cigarettes. *NICTOB* 2016;18:1649–55.
12 Henriksen L, Schleicher NC, Barker DC, *et al*. Prices for Tobacco and Nontobacco Products in Pharmacies Versus Other Stores: Results From Retail Marketing Surveillance in California and in the United States. *Am J Public Health* 2016;106:1858–64.
13 Shortt NK, Tunstall H, Mitchell R, *et al*. Using point-of-sale data to examine tobacco pricing across neighbourhoods in Scotland. *Tob Control* 2021;30:168–76.
14 Association of Convenience Stores. The local shop report 2022. Farnborough Association of Convenience Stores; 2022.
15 Robinson M, Reid G. Population cigarette consumption in Great Britain: novel insights using retail sales data. *BMC Public Health* 2017;17:941.
16 The Retail Data Partnership Ltd. COVID-19 impact on the UK's independent C-stores. Essendine: The Retail Data Partnership Ltd; 2021.1–5.
17 Thompson C, Hamilton L, Dickinson A, *et al*. Changes to household food shopping practices during the COVID-19 restrictions: Evidence from the East of England. *Health Place* 2022;78:102906.
18 Gordon-Wilson S. Consumption practices during the COVID-19 crisis. *Int J Consum Stud* 2022;46:575–88.
19 Rybaczewska M, Sułkowski Ł, Bilan Y. Covid-19 Pandemic and Independent Convenience Stores in the United Kingdom. *EE* 2021;32:258–65.
20 Moodie C, O'Donnell R. Reasons for Using Roll-Your-Own Tobacco and Perceptions of Health-Promoting Pack Inserts: A Focus Group Study with Roll-Your-Own Tobacco Smokers in Scotland. *Nicotine Tob Res* 2022;24:1937–44.
21 Breton MO, Britton J, Bogdanovica I. Changes in roll-your-own tobacco and cigarette sales volume and prices before, during and after plain packaging legislation in the UK. *Tob Control* 2020;29:263–8.
22 Hiscock R, Augustin NH, Branston JR, *et al*. Standardised packaging, minimum excise tax, and RYO focussed tax rise implications for UK tobacco pricing. *PLoS ONE* 2020;15:e0228069.
23 Branston JR, McNeill A, Gilmore AB, *et al*. Keeping smoking affordable in higher tax environments via smoking thinner roll-your-own cigarettes: Findings from the International Tobacco Control Four Country Survey 2006–15. *Drug Alcohol Depend* 2018;193:110–6.
24 HMRC. Increases to tobacco duty rates from 22 november 2023. 2023.
25 HMRC. Changes to tobacco duty rates from 30 October 2024. 2024.

26 Gallus S, Lugo A, Ghislandi S, *et al*. Roll-your-own cigarettes in Europe: use, weight and implications for fiscal policies. *Eur J Cancer Prev* 2014;23:186–92.
27 NHS Scotland. Scottish community pharmacy smoking cessation programmer: the pharmacy model; module 4: products to support smoking cessation attempts - working out cigarette equivalents. NHS Scotland; 2014.
28 Reilly V, Millar H. Clinical guideline: smoking cessation guidelines for community pharmacy. NHS Greater Glasgow and Clyde; 2020.
29 Wilson LB, Pryce R, Hiscock R, *et al*. Quantile regression of tobacco tax pass-through in the UK 2013-2019. How have manufacturers passed through tax changes for different tobacco products? *Tob Control* 2021;30:e27–32.
30 Hiscock R, Branston JR, McNeill A, *et al*. Tobacco industry strategies undermine government tax policy: evidence from commercial data. *Tob Control* 2018;27:488–97.
31 Parsons A. UK 2020 composite index of multiple deprivation, 2020. Available: https://github.com/mysociety/composite_uk_imd
32 Abel GA, Barclay ME, Payne RA. Adjusted indices of multiple deprivation to enable comparisons within and between constituent countries of the UK including an illustration using mortality rates. *BMJ Open* 2016;6:e012750.
33 Office for National Statistics. ONS rural-urban classification 2011. 2011. Available: https://www.ons.gov.uk/methodology/geography/geographicalproducts/ruralurbanclassifications/2011ruralurbanclassification
34 Scottish Government. Scottish government urban rural classification 2020. 2020. Available: https://www.data.gov.uk/dataset/f00387c5-7858-4d75-977b-bfdb35300e7f/urban-rural-classification-scotland
35 Jackson SE, Shahab L, Garnett C, *et al*. Trends in and Correlates of Use of Roll-Your-Own Cigarettes: A Population Study in England 2008-2017. *Nicotine Tob Res* 2020;22:942–9.
36 Hiscock R, Branston JR, Partos TR, *et al*. UK tobacco price increases: driven by industry or public health? *Tob Control* 2019;28:e148–50.
37 Breton MO, Britton J, Huang Y, *et al*. Cigarette brand diversity and price changes during the implementation of plain packaging in the United Kingdom. *Addiction* 2018;113:1883–94.
38 Critchlow N, Stead M, Moodie C, *et al*. Pricing of tobacco products during, and after, the introduction of standardized packaging: an observational study of retail price data from independent and convenience (small) retailers in the United Kingdom. *Addiction* 2019;114:523–33.
39 Whitehead R, Brown L, Riches E, *et al*. Rapid evidence review: strengths and limitations of tobacco taxation and pricing strategies. Edinburgh NHS Health Scotland; 2018.
40 Gillespie D, Morris D, Angus C, *et al*. Model-based appraisal of the potential effects of minimum pricing for tobacco in Scotland. *Tob Control* 2025.
41 Hoek J, Smith K. A qualitative analysis of low income smokers' responses to tobacco excise tax increases. *Int J Drug Policy* 2016;37:82–9.