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Anticipated responses to a hypothetical minimum price for cigarettes and roll-your-own tobacco: an online cross-sectional survey with cigarette smokers and ex-smokers in the UK

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ABSTRACT

Objectives As tobacco companies can circumvent tax increases, a minimum retail price per-cigarette/per-gram of roll-your-own tobacco presents an additional mechanism for governments to reduce smoking. We examined (1) anticipated responses to a hypothetical minimum price-per-cigarette/per-gram among smokers in the UK; (2) what demographic and smoker characteristics are associated with anticipated responses; and (3) whether minimum pricing may help ex-smokers stay quit.

Design Cross-sectional survey (May–July 2019).

Setting UK.

Participants Adult cigarette smokers (n=2412) and ex-smokers (n=700).

Main outcome measurements Anticipated responses to a hypothetical minimum price of £10.00 for 20 cigarettes (£0.50 per-cigarette) and £13.50 for 30 grams of roll-your-own tobacco (£0.45 per-gram); approximately £0.10 per-cigarette/per-gram increases on the cheapest prices in leading UK supermarkets (January 2019). Smokers were presented with ten options (eg, '*Try to quit*') and asked which they would do (*Yes/No*) and then which they would most likely do. Ex-smokers were asked to what extent the minimum prices would help them stay quit (*A lot vs Lesser agreement*).

Results Among smokers, 55.6% said they would most likely smoke the same amount, 10.7% they would smoke less, 9.5% they would try to quit and 5.8% they would use e-cigarettes more often. Anticipated reactions were associated with demography and smoker characteristics, for example, C2DE (lower social grade) smokers were less likely than ABC1 (higher social grade) smokers to say they would smoke the same as they do now (OR$_{Adj}$=0.74, 95% CI 0.62 to 0.88). Among ex-smokers, 38.5% said the minimum prices would help them stay quit 'A lot', more so among C2DE than ABC1 participants (OR$_{Adj}$=1.80, 95% CI 1.30 to 2.49).

Conclusions In response to a hypothetical minimum price for cigarettes and roll-your-own tobacco, approximately a fifth of smokers in the UK indicated they would smoke less or quit and almost two-fifths of ex-smokers indicated the prices would help them stay quit.

Strengths and limitations of this study

► The study provides important consumer insight concerning how cigarette smokers and ex-smokers in the UK anticipate responding to a minimum retail price for cigarettes and roll-your-own tobacco.

► The study examines the anticipated impact of a minimum retail price on variety of outcomes among consumers in the UK, including smoking (eg, 'smoke less than I do now'), purchasing source (eg, 'buy illicit cigarettes or tobacco') and likelihood of ex-smokers staying quit.

► The large sample supports robust statistical analyses to examine the relationships between demography, smoking behaviour and anticipated reactions among UK consumers.

► The study only examines anticipated consumer reactions to one set of hypothetical minimum retail prices for cigarettes and roll-your-own tobacco in the UK, and the data do not control for the confounding influence of existing price paid for tobacco or granular measurements of disposable income and deprivation.

► The data are cross-sectional and cannot demonstrate causal associations between demography, smoking behaviour and anticipated reactions to the minimum retail prices among consumers in the UK.

INTRODUCTION

Price is an important determinant of smoking.[1–4] While low prices enable more consumers to use tobacco, particularly price-sensitive groups such as young people and those of lower socioeconomic status,[5 6] high prices present a barrier. Reducing affordability, by increasing price, is therefore a cost-effective means of reducing uptake and increasing cessation.[7–10]

Prices for cigarettes and roll-your-own tobacco are typically controlled through taxation. In the UK, taxation for cigarettes comprises a duty per-1000 cigarettes and an

ad valorem duty (16.5% of recommended retail price (RRP)).[11] Taxation for roll-your-own tobacco is a single duty per-kilogram.[11] Duty rates for cigarettes and roll-your-own are subject to frequent escalation above inflation rates[12 13] and sales are subject to 20% Value-Aadded Tax (VAT).[12] On 20 May 2017, the UK also introduced a Minimum Excise Tax (MET) for cigarettes, under which the duty became either the standard duty rates or a minimum duty per-1000 cigarettes, whichever was higher in monetary value.[14] This created a de facto floor price, as selling below this threshold meant that duty would exceed sales revenue. The MET is also subject to escalation above inflation, with the MET in November 2020 £320.90 per-1000 cigarettes; equating to approximately £6.41 per-20 cigarettes (£7.70 including VAT; or approximately £0.39 per-cigarette).[11] In the UK, the price of cigarettes and roll-your-own has also been indirectly influenced by the Tobacco and Related Products Regulations 2016 which, from 20 May 2017, mandated minimum pack sizes of 20 for cigarettes and 30 grams (g) for roll-your-own.[15] Before this, multiple smaller pack sizes were available, many of which sold in high volumes.[16 17] Although these minimum sizes do not directly influence price-per-cigarette or per-gram, they do influence the overall retail price of a pack to the consumer.

Higher prices and reduced affordability are associated with greater motivation to stop smoking and many smokers identify a price-point at which they would seriously consider quitting.[18–21] However, tobacco companies can shift tax increases across brand portfolios to preserve affordability for price-sensitive consumers; for instance, charging extra for more expensive variants (overshifting) and absorbing tax increases for the least expensive variants (undershifting).[22–26] Consequently, there is growing interest in non-taxation mechanisms for price control, including a minimum mark-up on wholesale price, a price cap to limit overshifting duty increases onto premium products and a minimum retail price (hereafter 'minimum pricing').[27 28] Sales modelling data suggest that minimum pricing may reduce smoking prevalence, and the effects may be greater than achieved through taxation alone.[27 28] As tobacco prices are reportedly lower in the most income-deprived areas,[29] minimum pricing may also have a greater relative impact on more economically disadvantaged smokers, thus helping reduce health inequalities.[28–30]

Key to understanding the impact of minimum pricing is exploring how smokers anticipate reacting (eg, attempting to quit) and unintended consequences (eg, purchasing illicit tobacco), factors not readily accounted for in modelling studies.[28] We examine (1) anticipated responses to a hypothetical minimum price-per-cigarette/per-gram among smokers in the UK; (2) what demographic and smoker characteristics are associated with anticipated outcomes; and (3) whether minimum pricing may help ex-smokers in the UK to stay quit.

METHODS
Design and sample
Data come from the Adult Tobacco Policy Survey (ATPS). A cohort of cigarette smokers in the UK were recruited April/May 2016 (n=6233) and followed up September/November 2017 (n=4293) and May/July 2019 (n=3175). This cross-sectional analysis is based on the wave three sample only. The survey was conducted by YouGov, who recruited the sample from their non-probabilistic online panel. All participants who completed wave one were contacted for wave three. Participants received approximately 400 points on their YouGov account (equivalent to £4.00) for participation at wave three. A cross-sectional weight was provided for the third wave, based on age, gender, region and tobacco consumption, to represent the national profile of smokers aged ≥16 years in the UK, based on the Opinions and Lifestyle Survey and Integrated Household Survey (weight *Median*=0.73; IQR=0.57–0.95).

Measures
Demographics
Data were collected on age (coded: 19–34, 35–54, 55–64, ≥65 years), gender, country (coded: England vs Other) and social grade, with participants classified ABC1 (middle and upper classes, hereafter 'higher social grade') or C2DE (working classes, hereafter 'lower social grade') using the National Readership Survey system.[31]

Cigarette smoking status
All participants were cigarette smokers at wave one. To assess smoking behaviour at wave three, participants were asked '*Which of the following best describes your CURRENT smoking status?*': (1) I smoke cigarettes (including hand-rolled) every day; (2) I smoke cigarettes (including hand-rolled), but not every day; (3) I do not smoke cigarettes at all, but I do smoke tobacco of some kind (eg, pipe, cigar or shisha); (4) I have stopped smoking completely in the past year; (5) I stopped smoking completely more than a year ago; or (6) Don't know. Those selecting 'I smoke cigarettes every day' were categorised as 'cigarette smokers'. Those who answered 'I smoke cigarettes, but not every day' were subsequently asked '*Can we just confirm, how often do you **currently** smoke cigarettes (either factory-made or hand-rolled)*' and could indicate: (1) At least once a week; (2) Less than once a week, but at least once a month; (3) Less than once a month, but at least once in the last 3 months; (4) I have not smoked cigarettes in the last 3 months; or (5) Don't Know. Those answering 1–3 were also categorised as 'cigarette smokers' and the remainder excluded. Those who indicated that they had stopped smoking completely in the past year, or more than a year ago, were categorised as 'ex-smokers'.

Heaviness of Smoking Index
To estimate nicotine dependence, cigarette smokers completed the Heaviness of Smoking Index (HSI).[32 33] They were asked the number of cigarettes (including hand-rolled) they typically smoked per-day,

per-week or per-month; the latter two were converted into daily estimates. The daily estimates were coded as: (0) ≤10 cigarettes; (1) 11–20 cigarettes; (2) 21–30 cigarettes; or (3) ≥31 cigarettes. Participants also reported time until first cigarette on days they smoked, with answers: (0) more than 1 hour; (1) 31–60 min; (2) 6–30 min; (3) within 5 min; or 'Don't Know'. Results for both items were summed (range 0–6) and participants coded as light (0–1), moderate (2–3) or heavy smokers (4-6).[34–37] Those not providing valid answers for time to first cigarette were coded 'Not stated' for HSI category.

Cessation intentions

Cigarette smokers were asked '*Are you planning to quit smoking?*' with response options: (1) 'Within the next month'; (2) 'Between one and 6 months from now'; (3) 'Sometime in the future, beyond 6 months'; (4) 'Not planning to quit'; or (5) 'Don't know'. Responses were coded into those who reported some intentions to quit (codes: 1–3), those who did not (code: 4) and 'Don't know'.

Thoughts about the cost of smoking

To measure price sensitivity, cigarette smokers were asked '*In the last 30 days how often, if at all, have you thought about how much money you spend on smoking*'. Responses were provided on a five-point scale (1=Never to 5=Very often; Don't know), which was converted into Very often/Often (codes 4/5, hereafter 'Often') versus Less often/Never (codes: 1–3). 'Don't know' responses were excluded.

Anticipated reactions to a hypothetical minimum price-per-cigarette or per-gram

To establish a minimum price, we identified the cheapest pack of 20 cigarettes and 30 g of roll-your-own in UK supermarkets in the month the third survey wave was developed (January 2019). Data came from an audit which captures monthly information on tobacco products sold online by the four leading tobacco-selling supermarkets (Asda/Tesco/Sainsbury's/Morrisons).[38 39] In January 2019, the cheapest packs of 20 cigarettes were £8.00 (Tesco/Sainsbury's), £8.30 (Morrisons) and £8.35 (Asda), equivalent to approximately £0.40–£0.42 per-cigarette. We set the hypothetical minimum price at £0.50 per-cigarette, an approximate £0.10 increase on the lowest prices. In January 2019, the cheapest pack of 30 g roll-your-own was £9.89 in Asda, £10.00 in Sainsbury's, £10.25 in Tesco and £10.50 in Morrisons; equivalent to £0.33–£0.35 per-gram. We set the hypothetical minimum price at £0.45 per-gram, matching the approximate £0.10 increase applied to cigarettes. Between establishing the minimum prices and the fieldwork, there was no recorded increase in tax duty for cigarettes (overall/MET) or roll-your-own.[11] Prices were checked again during the months that data were collected. In June 2019, across the four supermarkets, the cheapest 20 cigarettes were £0.42–£0.43 per-cigarette (£8.30–£8.69 per 20 cigarettes) and the cheapest 30 g roll-your-own were approximately £0.35 per-gram (range £10.43–£10.50 per 30 g), showing no

substantial change from development and still below the hypothetical minimum prices of £0.50 per-cigarette and £0.45 per-gram.

Cigarette smokers were prompted with the statement '*If the cheapest pack of 20 cigarettes available for sale in the UK was £10, and the cheapest pack of 30 grams of rolling tobacco was £13.50…*' and presented with eight responses concerning smoking behaviour (eg, 'Smoke less than I do now'), purchasing behaviour (eg, 'Use a cheaper tobacco product some of the time or all of the time') and purchasing source (eg, 'Buy illicit cigarettes or tobacco'). These reflect outcomes reported in existing price sensitivity research.[20] The question was presented twice. On first presentation, the prompt statement was suffixed with '*…which, if any, of following do you think you would do?*' and participants were invited to select all that applied. On second presentation, the prompt statement was suffixed with '*…which, if any, of the following do you think you would be MOST likely to do?*' and participants could select only one. For each question, participants could also indicate 'Don't know' or 'Other'.

Ex-smokers were prompted with the same statement, but this time suffixed with '*…to what extent, if at all, do you think the price of cigarettes/rolling tobacco would help you stay quit?*' Responses were provided on a four-point scale (1=Not at all to 4=A lot; Don't know), which was converted into 'A lot' (code: 4) versus a lesser extent (codes 1–3). 'Don't know' responses were excluded.

Ethics

The third wave of the ATPS was approved by the University of Stirling's General University Ethics Panel (GUEP652). Participants provided informed consent to participate.

Patient and public involvement

No specific public and patient involvement activities were conducted. The measures and study design were informed by the two preceding waves of the ATPS.

Analysis

Data were analysed using SPSS V.23. Overall, 3175 participants responded to wave three (50.9% retention to wave one). The wave three sample comprised 2412 cigarette smokers and 700 ex-smokers. The remainder reported only using other forms of tobacco (eg, cigars) (n=44), had not smoked in the past 3 months (n=6) or said 'Don't know' for smoking status (n=13), and were excluded from analyses.

Among cigarette smokers, weighted frequencies are reported for demographics, frequency of thinking about the cost of smoking, what they thought they would do in response to the hypothetical minimum prices (all reactions) and what they would most likely do. Among cigarette smokers, binary logistic regressions examined to what extent demographics or smoking characteristics were associated with thinking about the cost of smoking in the past month (*Often vs Less often/Never*) and which outcome they would *most likely* do in response to the

minimum prices (each: *Yes/No*). In each regression, the covariates were age, gender, country, social grade, HSI category, cessation intentions, and frequency of thinking about the cost of smoking (anticipated reaction models only). For the increased use of e-cigarettes reaction, the model additionally controlled for existing e-cigarette use (codes ranging: *Never user to Daily*). Regressions were unweighted as the variables used to construct the weights were included as covariates. Reference categories and the contrast functions are reported in the Results.

Among ex-smokers, weighted frequencies are reported for demographics and the proportion who said that the minimum prices would help them stay quit (*A lot vs Lower*

agreement). An unweighted binary logistic regression examined to what extent demographics were associated with reporting that the minimum prices would help them to stay quit (*A lot vs Lower agreement*). Covariates included age, gender, country, social grade, and recency of quitting (*In the past year vs More than a year ago*). Reference categories and the contrast functions are reported in the Results.

Table 1 Sample characteristics of current cigarette smokers and ex-smokers in wave three of the Adult Tobacco Policy Survey (ATPS)

	Cigarette smokers				Ex-cigarette smokers			
	Unweighted		Weighted		Unweighted		Weighted	
Variable	%	n	%	n	%	n	%	n
Age								
19–34 years	13.1	317	37.0	880	17.9	125	43.7	317
35–54 years	43.7	1054	37.5	890	43.0	301	34.7	252
55–64 years	22.3	537	14.0	332	18.4	129	11.1	81
≥65 years	20.9	504	11.5	273	20.7	145	10.5	76
Gender								
Male	47.8	1153	53.1	1262	47.4	332	47.2	343
Female	52.2	1259	46.9	1113	52.6	368	52.8	384
Country								
England	82.3	1984	82.4	1957	83.3	583	84.0	610
Other	17.7	428	17.6	419	16.7	117	16.0	116
Social grade								
ABC1 (higher)	57.2	1363	62.2	1464	60.1	412	60.9	435
C2DE (lower)	42.8	1019	37.8	889	39.9	273	39.1	279
Missing/Not stated	–	30	–	23	–	15	–	13
Heaviness of smoking*†								
Light	38.1	903	47.2	1100	–	–	–	–
Moderate	43.8	1036	37.7	879	–	–	–	–
Heavy	18.1	429	15.0	351	–	–	–	–
Missing/Not stated	–	44	–	46	–	–	–	–
Intentions to quit*								
No intention	31.3	754	32.6	774	–	–	–	–
Some intention	53.5	1291	54.2	1288	–	–	–	–
Do not know	15.2	367	13.2	313	–	–	–	–
Recency of cessation‡								
In the past year	–	–	–	–	46.9	328	50.5	367
More than a year ago	–	–	–	–	53.1	372	49.5	360

*Only asked of current cigarette smokers.
†Measured using the Heaviness of Smoking Index (HSI), which accounts for cigarettes typically smoked per day and time to first cigarette in the morning.
‡Only asked of ex-cigarette smokers. Participants were minimum 16 years when recruited at wave one, so minimum age in wave three was 19 years.

RESULTS

Sample characteristics

Cigarette smokers and ex-smokers ranged from 19 to 34 to >65 years old, with a similar proportion of males and females. Most participants were from England (vs Scotland, Wales or Northern Ireland), and more were from the higher social grades (ABC1) than the lower grades (C2DE) (table 1). Around two-fifths of cigarette smokers were either light or moderate smokers and approximately half of cigarette smokers reported some quit intentions. Around half of ex-smokers reported quitting in the year prior and the other half more than a year ago.

Thinking about the cost of smoking

A fifth of cigarette smokers (20.5%, weighted) thought 'Often' about how much money they had spent on smoking, less so among males than females (Adjusted OR (OR_{Adj})=0.74, 95% CI 0.60 to 0.92, p=0. 006) (table 2). There was also an association with HSI, after adjusting for demography, with moderate (OR_{Adj}=1.88, 95% CI 1.47 to 2.41, p<0.001) and heavy smokers (OR_{Adj}=2.84, 95% CI 2.10 to 3.84, p<0.001) more likely to think about the cost 'Often' versus light smokers. Smokers with some quit intentions (OR_{Adj}=5.02, 95% CI 3.73 to 6.77, p<0.001), or who were unsure on their quit intentions (OR_{Adj}=2.61, 95% CI 1.78 to 3.83, p<0.001), were also more likely to think about the cost 'Often' versus those with no quit intentions.

Anticipated reactions to the hypothetical minimum prices among cigarette smokers

When first asked about possible responses to the hypothetical minimum prices, where multiple options could be selected, more than half of cigarette smokers said they

Table 2 Logistic regression exploring the association between demographics, smoking characteristics and thinking about the cost of smoking often among cigarette smokers

| Variable and reference categories | n | Thinking about the cost of smoking often | | |
		OR_{Adj}	95% CI	P value
Age				0.160
19–34 years	304	REF	–	–
35–54 years (*vs younger*)	1016	0.93	0.66 to 1.30	0.667
55–64 years (*vs younger*)	520	0.87	0.65 to 1.16	0.342
>65 years (*vs younger*)	489	1.29	1.00 to 1.68	0.054
Gender				
Female	1218	REF	–	–
Male	1111	0.74	0.60 to 0.92	**0.006**
Country				
England	1925	REF	–	–
Other	404	1.13	0.86 to 1.48	0.373
Social grade				
ABC1 (higher)	1335	REF	–	–
C2DE (lower)	994	1.21	0.97 to 1.49	0.086
Heaviness of smoking				**<0.001**
Light	886	REF	–	–
Moderate (*vs light*)	1019	1.88	1.47 to 2.41	**<0.001**
Heavy (*vs light*)	424	2.84	2.10 to 3.84	**<0.001**
Intentions to quit				**<0.001**
No intention	729	REF	–	–
Some intention (*vs no intention*)	1257	5.02	3.72 to 6.77	**<0.001**
Not stated (*vs no intention*)	343	2.61	1.78 to 3.83	**<0.001**

Unweighted base: Current cigarette smokers (n=2412).
Dependent variable: Thinking about cost of smoking in the past 30 days (Very often/Often vs Less Often/Never).
Data are unweighted.
Data missing on one or more variables (n=83).
Hosmer and Lemeshow: χ^2 (8)=3.29, p=0.915.
χ^2 test of coefficients for model: χ^2 (10)=212.24, p<0.001; Nagelkerke R^2=0.135.
Classification accuracy in final model stage: 78.7%.
OR_{Adj}, adjusted odds ratio.

would 'smoke the same amount as I do now' (58.8%) (table 3). One-in-six stated they would 'smoke less than I do now' (15.9%) or 'try to quit' (14.5%), while less than one-in-ten indicated that they would 'use e-cigarettes some or all the time' (9.7%), 'buy cheap cigarettes or tobacco online/abroad' (7.8%) or 'buy illicit cigarettes or tobacco' (6.8%).

When asked which outcome they would *most likely* do, where only one option could be selected, more than half of cigarette smokers reported they would 'smoke the same amount as I do now' (55.6%) (table 3). Around one-in-ten indicated that they would 'smoke less than I do now' (10.7%) or 'try to quit' (9.5%). A smaller proportion said they would 'use e-cigarettes some or all of time' (5.8%), 'buy cheaper cigarettes or tobacco online/abroad' (5.0%), 'buy illicit cigarettes or tobacco' (2.8%) or 'use a cheaper tobacco product some or all of the time' (1.7%). Only a small number suggested they would 'smoke more than I do now' (1.3%).

Associations between demography, smoking characteristics and anticipated reactions

Logistic regressions identified associations between *most likely* reactions to the minimum prices and demography (tables 4 and 5). Age was associated with reporting 'smoke the same amount as I do now' (p=0.019), with those aged 55–64 years less likely to endorse this versus younger age groups (OR$_{Adj}$=0.74, 95% CI 0.59 to 0.93, p=0.009). There was also an association between age and endorsing 'try to quit' (p<0.001), with those aged 55–64 years (OR$_{Adj}$=1.85, 95% CI 1.28 to 2.67, p=0.001) or ≥65 years (OR$_{Adj}$=1.57, 95% CI 1.11 to 2.21, p=0.010) more likely to endorse this than younger age groups. Men were more likely to endorse 'purchase illicit cigarettes or tobacco' than women (OR$_{Adj}$=1.76, 95% CI 1.06 to 2.95, p=0.031). Lower social grade cigarette smokers (C2DE) were less likely than those in the higher social grades (ABC1) to indicate that they would 'smoke the same amount as I do now' (OR$_{Adj}$=0.74, 95% CI 0.62 to 0.88, p<0.001), but more likely to endorse 'buy illicit cigarettes or tobacco' (OR$_{Adj}$=3.03, 95% CI 1.73 to 5.32, p<0.001) or 'use a cheaper tobacco product some or all of the time' (OR$_{Adj}$=2.18, 95% CI 1.06 to 4.50, p=0.035).

After controlling for demography, the logistic regressions showed associations between most likely anticipated reactions to the minimum prices and HSI category (tables 4 and 5). Specifically, heavy smokers were less likely to endorse 'smoke less than I do now' (OR$_{Adj}$=0.43, 95% CI 0.27 to 0.68, p<0.001) versus light smokers. Conversely, moderate (OR$_{Adj}$=2.37, 95% CI 1.14 to 4.93, p=0.021) and heavy smokers (OR$_{Adj}$=4.10, 95% CI 1.91 to 8.83, p<0.001) were more likely to endorse 'buy illicit cigarettes or tobacco' than light smokers. Moderate smokers (OR$_{Adj}$=2.93, 95% CI 1.14 to 7.56, p=0.026) and heavy smokers (OR$_{Adj}$=3.02, 95% CI 1.02 to 8.99, p=0.047) were also more likely to endorse 'use a cheaper tobacco product some or all of the time' than light smokers.

Table 3 Anticipated reactions to the hypothesised minimum prices for cigarettes and roll-your-own tobacco among cigarette smokers in the UK

| Reaction to hypothesised minimum pricing | If the cheapest pack of 20 cigarettes available for sale in the UK was £10.00, and the cheapest pack of 30 g of rolling tobacco was £13.50… | | | |
| | …which, if any, of the following do you think you would do?* | | …which, if any, of the following do you think you would be MOST likely to do?† | |
	%	n	%	n
Smoke the same amount as I do now	58.8	1397	55.6	1321
Smoke less than I do now	15.9	379	10.7	254
Try to quit	14.5	344	9.5	227
Use e-cigarettes some or all of the time	9.7	231	5.8	137
Buy cheaper cigarettes or tobacco online or abroad	7.8	185	5.0	120
Don'tt know	7.4	177	6.8	162
Buy illicit cigarettes or tobacco	6.8	162	2.8	66
Use a cheaper tobacco product some or all of the time	4.4	104	1.7	40
Other	1.2	28	0.8	18
Smoke more than I do now	1.4	34	1.3	32

Base=All current cigarette smokers.
Data are weighted.
*Participants could select all that applied; % do not sum to 100; it was not possible for participants to select contrasting answers (eg, both 'smoke the same as I do now' and 'smoke less than I do now').
†Participants could only select one option, % do sum to 100.

Table 4 Logistic regression exploring the association between demography, smoking characteristics and most likely anticipated reaction to the minimum tobacco prices

| | Most likely anticipated reaction to the minimum tobacco prices | | | | | | | | | | | |
| | Smoke same amount as now* | | | Smoke less than now† | | | Try to quit‡ | | | Use e-cigarettes more often§ | | |
	OR$_{Adj}$	95% CI	P value	OR$_{Adj}$	95% CI	P value	OR$_{Adj}$	95% CI	P value	OR$_{Adj}$	95% CI	P value
Age			0.019			0.391			<0.001			0.283
19–34 years	REF	–	–	REF	–	–	REF	–	–	REF	–	–
35–54 years (vs younger)	1.10	0.84 to 1.44	0.497	0.84	0.56 to 1.26	0.400	0.78	0.49 to 1.24	0.289	0.91	0.49 to 1.69	0.761
55–64 years (vs younger)	0.74	0.59 to 0.93	0.009	1.19	0.85 to 1.66	0.305	1.85	1.28 to 2.67	0.001	1.30	0.77 to 2.20	0.324
>65 years (vs younger)	0.97	0.78 to 1.20	0.769	1.08	0.78 to 1.49	0.647	1.57	1.11 to 2.21	0.010	1.42	0.88 to 2.29	0.153
Gender												
Female	REF	–	–	REF	–	–	REF	–	–	REF	–	–
Male	1.12	0.94 to 1.33	0.192	0.87	0.67 to 1.13	0.299	0.80	0.60 to 1.07	0.134	0.93	0.62 to 1.39	0.712
Country												
England	REF	–	–	REF	–	–	REF	–	–	REF	–	–
Other	0.92	0.74 to 1.15	0.455	0.93	0.66 to 1.32	0.686	1.08	0.75 to 1.56	0.692	1.39	0.84 to 2.29	0.198
Social grade												
ABC1 (higher)	REF	–	–	REF	–	–	REF	–	–	REF	–	–
C2DE (lower)	0.74	0.62 to 0.88	<0.001	1.21	0.93 to 1.58	0.152	1.13	0.84 to 1.52	0.405	0.94	0.62 to 1.43	0.788
Heaviness of smoking			0.029			<0.001			0.445			0.316
Light	REF	–	–	REF	–	–	REF	–	–	REF	–	–
Moderate (vs light)	0.87	0.72 to 1.05	0.155	1.08	0.81 to 1.43	0.605	1.00	0.72 to 1.38	0.984	0.72	0.46 to 1.13	0.150
Heavy (vs light)	1.19	0.93 to 1.54	0.170	0.43	0.27 to 0.68	<0.001	0.78	0.50 to 1.20	0.254	0.95	0.53 to 1.69	0.857
Intentions to quit			<0.001			<0.001			<0.001			0.076
No intention	REF	–	–	REF	–	–	REF	–	–	REF	–	–
Some intention (vs no intention)	0.48	0.39 to 0.58	<0.001	1.94	1.39 to 2.72	<0.001	10.45	5.59 to 19.52	<0.001	1.73	1.02 to 2.95	0.043
Not stated (vs no intention)	0.53	0.41 to 0.70	<0.001	1.96	1.29 to 3.00	0.002	3.78	1.80 to 7.92	<0.001	1.10	0.52 to 2.33	0.802
Frequency think about cost												
Less often/Never	REF	–	–	REF	–	–	REF	–	–	REF	–	–
Often	0.57	0.46 to 0.70	<0.001	1.23	0.91 to 1.67	0.181	3.30	2.46 to 4.43	<0.001	1.29	0.82 to 2.01	0.268
e-cigarette use¶	–	–	–	–	–	–	–	–	–			<0.001
Never user	–	–	–	–	–	–	–	–	–	REF	–	–
Not current user (vs never)	–	–	–	–	–	–	–	–	–	2.32	0.74–7.24	0.149
Less than monthly (vs less often)	–	–	–	–	–	–	–	–	–	3.82	1.59–9.21	0.003
At least monthly (vs less often)	–	–	–	–	–	–	–	–	–	6.25	2.75–14.20	<0.001

Continued

Table 4 Continued

	Most likely anticipated reaction to the minimum tobacco prices										
	Smoke same amount as now*			Smoke less than now†			Try to quit‡			Use e-cigarettes more often§		
	OR_{Adj}	95% CI	P value	OR_{Adj}	95% CI	P value	OR_{Adj}	95% CI	P value	OR_{Adj}	95% CI	P value
At least weekly (vs less often)	–	–	–	–	–	–	–	–	–	8.97	5.25–15.32	<0.001
Daily (vs less often)	–	–	–	–	–	–	–	–	–	8.63	5.56–13.40	<0.001

Base current cigarette smokers (n=2412). Dependent variable for all models, whether outcome was selected as the most likely in response to the minimum prices (Yes/No; see table 3 for weighted frequencies). Hosmer and Lemeshow for all models p>0.05. Data are unweighted. Data missing on one or more variables on each test (n=83, except e-cigarette use where n=103). χ^2 test of coefficients for final block in all models.

*χ^2=139.24, p<0.001; r^2=0.078.
†χ^2=49.51, p<0.001; r^2=0.041.
‡χ^2=234.30, p<0.001; r^2=0.198.
§χ^2=228.30, p<0.001; r^2=0.278.
¶Existing e-cigarette use only included in the model on e-cigarette outcome.
OR_{Adj}, Adjusted odds ratio.

After controlling for demography, the logistic regressions also showed associations between most likely anticipated reactions to the minimum prices and cessation intentions (tables 4 and 5). Specifically, those with quit intentions were less likely to endorse 'smoke the same amount as I do now' (OR_{Adj}=0.48, 95% CI 0.39 to 0.58, p<0.001) or 'buy cheaper cigarettes or tobacco online/abroad' (OR_{Adj}=0.56, 95% CI 0.36 to 0.86, p=0.008) than those with no quit intentions, but more likely to say they would 'smoke less than I do now' (OR_{Adj}=1.94, 95% CI 1.39 to 2.72, p<0.001) or 'try to quit' (OR_{Adj}=10.45, 95% CI 5.59 to 19.52, p<0.001). Existing use of an e-cigarette (and increased frequency of use) was positively associated with reporting that they would likely 'use e-cigarettes some or all of the time' (p<0.001), as too was reporting existing quit intentions (OR_{Adj}=1.73, 95% CI 1.02 to 2.95, p=0.043).

After controlling for demography and smoking status, the logistic regressions also showed some associations between price sensitivity and most likely reactions to the minimum prices (tables 4 and 5). Specifically, those who had thought about the cost of smoking 'Often' were less likely to endorse 'smoke the same amount as I do now' (OR_{Adj}=0.57, 95% CI 0.46 to 0.70, p<0.001) or 'buy cheaper cigarettes or tobacco online/abroad' (OR_{Adj}=0.50, 95% CI 0.27 to 0.94, p=0.032) compared with those thinking about it less often, but more likely to say they would 'try to quit' (OR_{Adj}=3.30, 95 CI 2.46 to 4.43, p<0.001).

Impact of hypothetical minimum prices on staying quit

Almost two-fifths (38.5%, weighted) of ex-smokers said the minimum prices would help them stay quit 'A lot', while 20.1% said they would 'Not at all' help. A logistic regression found that believing the minimum prices would help 'A lot' with staying quit was greater among participants from the lower social grades (C2DE) compared with higher (ABC1) grades (OR_{Adj}=1.80, 95% CI 1.30 to 2.49, p<0.001) (table 6).

DISCUSSION

The findings are consistent with suggestions that a minimum retail price may be an effective, non-taxation, mechanism for reducing smoking.[27–30] Approximately a fifth of cigarette smokers anticipated they would most likely try to reduce smoking or try to quit in response to the minimum prices, while approximately two-fifths of ex-smokers said the minimum prices would help them stay quit. That anticipation of smoking less or trying to quit was more likely among those already reporting quit intentions, and that increased use of e-cigarettes was more likely among those who already reported using these products (and particularly those using them more frequently), suggests that minimum pricing may provide additional encouragement to those already trying to alter their smoking behaviour.

Table 5 Logistic regression exploring the association between demography, smoking characteristics and most likely anticipated reaction to the minimum tobacco prices

| | Most likely anticipated reaction to the minimum tobacco prices | | | | | | | | |
| | Buy cheaper abroad/online* | | | Buy illicit tobacco† | | | User cheaper product‡ | | |
	OR_Adj	95% CI	P value	OR_Adj	95% CI	P value	OR_Adj	95% CI	P value
Age			0.152			0.058			0.073
19–34 years	REF	–	–	REF	–	–	REF	–	–
35–54 years (*vs younger*)	1.44	0.71 to 2.91	0.306	2.18	0.65 to 7.30	0.207	0.57	0.23 to 1.41	0.222
55–64 years (*vs younger*)	1.43	0.86 to 2.39	0.165	1.84	0.88 to 3.85	0.107	0.34	0.12 to 0.92	**0.034**
>65 years (*vs younger*)	0.67	0.39 to 1.17	0.163	0.54	0.24 to 1.24	0.148	0.53	0.20 to 1.43	0.211
Gender									
Female	REF	–	–	REF	–	–	REF	–	–
Male	1.06	0.72 to 1.58	0.754	1.76	1.06 to 2.95	**0.031**	0.49	0.23 to 1.04	0.064
Country									
England	REF	–	–	REF	–	–	REF	–	–
Other	0.80	0.46 to 1.37	0.413	1.19	0.66 to 2.18	0.561	0.75	0.29 to 1.96	0.559
Social grade									
ABC1 (higher)	REF	–	–	REF	–	–	REF	–	–
C2DE (lower)	0.73	0.48 to 1.10	0.131	3.03	1.73 to 5.32	**<0.001**	2.18	1.06 to 4.50	**0.035**
Heaviness of smoking			0.130			**0.001**			0.070
Light	REF	–	–	REF	–	–	REF	–	–
Moderate (*vs light*)	1.42	0.90 to 2.25	0.134	2.37	1.14 to 4.93	**0.021**	2.93	1.14 to 7.56	**0.026**
Heavy (*vs light*)	1.74	0.99 to 3.03	0.053	4.10	1.91 to 8.83	**<0.001**	3.02	1.02 to 8.99	**0.047**
Intentions to quit			**0.022**			0.224			0.218
No intention	REF	–	–	REF	–	–	REF	–	–
Some intention (*vs no intention*)	0.56	0.36 to 0.86	**0.008**	0.61	0.35 to 1.07	0.085	0.61	0.27 to 1.38	0.235
Not stated (*vs no intention*)	0.61	0.33 to 1.13	0.113	0.76	0.36 to 1.59	0.463	1.30	0.51 to 3.29	0.586
Frequency think about cost									
Less often/Never	REF	–	–	REF	–	–	REF	–	–
Often	0.50	0.27 to 0.94	**0.032**	0.65	0.32 to 1.32	0.234	1.19	0.53 to 2.67	0.674

Base current cigarettes smokers (n=2412). Dependent variable for all models, whether outcome was selected as the most likely in response to the minimum tobacco prices (Yes/No; see table 3 for frequencies). Hosmer and Lemeshow for all models p>0.05. Data are unweighted. Data missing on one or more variables on each test (n=83); χ^2 test of coefficients for all models.
*χ^2=27.75, p=0.004; r^2=0.038.
†χ^2=67.37, p<0.001; r^2=0.123.
‡χ^2=26.56, p=0.005; r^2=0.079.
OR_Adj, Adjusted odds ratio.

Table 6 Logistic regression exploring the association between demographics, recency of quitting, and agreement the minimum prices would help ex-smokers stay quit 'a lot'

Variable and reference categories	n	OR$_{Adj}$	95% CI	P value
Reporting the hypothetical minimum prices would help stay quit 'A lot'				
Age				0.228
19–34 years	110	REF	–	–
35–54 years (*vs younger*)	274	1.33	0.83 to 2.13	0.235
55–64 years (*vs younger*)	119	1.49	0.96 to 2.30	0.074
>65 years (*vs younger*)	138	1.18	0.80 to 1.75	0.411
Gender				
Female	332	REF	–	–
Male	309	0.86	0.62 to 1.19	0.358
Country				
England	533	REF	–	–
Other	108	1.04	0.68 to 1.60	0.844
Social grade				
ABC1 (higher)	384	REF	–	–
C2DE (lower)	257	1.80	1.30 to 2.49	**<0.001**
When stopped smoking				
In the past year	306	REF	–	–
More than a year ago	335	1.26	0.91 to 1.74	0.161

Base: Ex-smokers (n=700).
Dependent variable: Whether the minimum price would help the stay quit (*A lot vs Lower Agreement*).
Data are unweighted.
Data missing on one or more variables (including saying 'not sure' for whether minimum price would help them stay quit) (n=59).
Hosmer and Lemeshow: χ^2 (8)=7.03, p=0.533.
χ^2 test of coefficients for final model stage: χ^2 (7)=22.11, p=0.002; Nagelkerke R^2=0.046.
Classification accuracy for final model stage: 60.1%.
OR$_{Adj}$, Adjusted odds ratio.

The findings suggest that minimum pricing may have a greater impact on price-sensitive consumers. Specifically, smokers from lower social grades were less likely to anticipate maintaining current smoking levels in response to the minimum prices, consistent with suggestions of heightened price sensitivity among this group.[4–6] Ex-smokers from the lower social grades were also more likely to suggest that the minimum prices would help them stay quit. These findings provide precautionary support to the proposition that minimum pricing could have a more pronounced impact in the most deprived areas and help reduce inequalities,[28 29] a key priority for governments in the UK,[30] although further investigation is required, for example through economic modelling (eg, see previous work[40]) or using granular indications of disposable income and deprivation. It is also important to consider unintended consequences. We found that a minority of cigarette smokers, particularly heavy smokers and those from lower social grades, indicated they would most likely purchase illicit products or switch to cheaper products (eg, cigarillos) in response to minimum prices, both of which may confound any positive impact on inequalities.

A minimum retail price is a viable tobacco control option for the UK. After a protracted contest about legality and proportionality,[41] Scotland recently implemented minimum pricing for alcohol, set at £0.50 per unit (ie, per 10 ml of pure alcohol),[42] with the policy introduced on top of UK-wide taxation measures. Minimum unit pricing for alcohol is now also law in Wales[43] and is scheduled for implementation in the Ireland,[44] which provides evidence of reproducibility. While the Scottish Government could introduce minimum pricing for tobacco, a UK-wide policy would eliminate the risk of cross-border sales between Scotland and England. To inform implementation, it is also important to evaluate how a minimum retail price (or the level set) would interact with existing UK-wide taxation, ideally using longitudinal retail data. For example, eventually the price-per-cigarette set under the MET would exceed the minimum retail price due to the escalator, although the MET does not make retailing at this threshold a legal requirement.

Limitations and future directions

The minimum prices were based on the cheapest products in supermarkets during survey development and

may not reflect prices in smaller retailers who account for a substantial proportion of tobacco sales in the UK.[45] Data were also not available to assess what proportion of cigarette sales in the UK would have been below the minimum prices used, although our values exceed the average price-per-cigarette/gram reported in recent UK market data, particularly the subvalue, value and mid-price categories.[45 46] Future data examining how the proportion of smokers who anticipate trying to quit increases in relation to different price thresholds would also be beneficial, as too would research that controls for an objective measure of typical or last price paid (eg, using consumer panel data or retail receipts to segment by price-per-cigarette or gram). For example, research could also ask participants to indicate the highest price they would be willing to pay,[20] and assess how reactions vary at increments leading up to, and exceeding, these values. While social grade was included as a covariate, future research using granular measurements of disposable income, employment status and area deprivation would also provide necessary insight into how the impact of minimum pricing varies among lower income or more deprived groups. Moreover, our analyses only examined reactions among cigarette and roll-your-own tobacco users combined. As UK Government data suggest that illicit market share is greater for roll-your-own than cigarettes,[47] further research examining how anticipated reactions vary among dual users versus exclusive users of roll-your-own or cigarettes would be of value. Put simply, while the current data suggest some utility of minimum tobacco pricing, these are only preliminary steps in understanding the potential impact in the UK. Further examination remains a requirement.

The data are cross-sectional and cannot demonstrate causality. For example, anticipating purchase of illicit tobacco could be a reflection of existing behaviour, a valid hypothesis given that anticipation of increased e-cigarette use was associated with pre-existing uptake. Our data also only relate to UK consumers and the UK market, and come from a non-probability market research panel. Other countries have different pricing and taxation structures, tobacco control policies[48] and different geographical contexts compared with the UK (eg, land borders which may facilitate easier cross-border purchasing). Further research is needed to understand the generalisability of these findings to other jurisdictions. Furthermore, the questions on minimum pricing were only included in the third ATPS wave and we cannot know how the findings would have differed if based on all participants recruited in the first wave (ie, whether certain subpopulations are more likely to be lost to attrition) and cannot know if anticipated reactions have varied over time or as other tobacco control policies were implemented (eg, MET). Finally, the data are based on self-reported anticipated reactions to minimum prices, and responses may be influenced by social desirability, response bias and recall errors. Future research employing discrete choice experimental designs would be beneficial.

CONCLUSION

In response to hypothetical minimum prices for cigarettes and roll-your-own tobacco, approximately a fifth of smokers in the UK indicated that they would smoke less or try to quit and almost two-fifths of ex-smokers that they would stay quit. Only a minority suggested they would purchase illicit tobacco. Minimum pricing may help reduce health inequalities given that smokers and ex-smokers from lower social grades were more likely to anticipate that the minimum prices may help them reduce consumption or stay quit. Minimum pricing may also provide an additional stimulus to those already trying to alter their smoking behaviour by increasing quit attempts or use of e-cigarettes. These are, however, only preliminary findings in relation to the potential efficacy of this policy in the UK. Future research should consider how consumers respond to different minimum price thresholds, examine the impact of base price sensitivity (eg, how reactions vary among those purchasing in the cheaper price segments versus more expensive segments), explore how reactions interact with other factors (eg, disposable income) and use discrete experiments of consumer behaviour.

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