Trends in attempts to quit smoking in England since 2007: A time series analysis of a range of population-level influences

Beard, E., PhD[1*], Jackson, S, E., PhD[1], West, R., PhD[1], Kuipers, M, A, G., PhD[1,2], Brown, J., PhD[1],

[1] Department of Behavioural Science and Health, University College London, WC1E 6BT, UK

[2] Department of Public Health, Amsterdam Public Health research institute, Amsterdam UMC, University of Amsterdam, Amsterdam, P.O. Box 22660, The Netherlands

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Correspondence to: Emma Beard, Cancer Research UK Health Behaviour Research Centre, University College London, WC1E 6BP. Email: e.beard@ucl.ac.uk. Tel: 02031083179

Abstract (n=250; max=250)

Aim: To quantify population-level associations between quit attempts and factors that have varied across 2007-2017 in England.

Methods: Data from 51,867 past-year smokers taking part in the Smoking Toolkit Study (STS) were aggregated monthly over a 10 year period. The STSinvolves repeated, cross-sectional household surveys of individuals aged 16+ in England. Time series analysis was undertaken using ARIMAX modelling. The input series were: 1) prevalence of smoking reduction using a) e-cigarettes and b) nicotine replacement therapy (NRT); 2) prevalence of roll-your-own tobacco; 3) prevalence of a) smoking and b) non-daily smoking; 4) mass media expenditure; 5)expenditure on smoking; 6) characteristics in the form of a) prevalence of high motivation to quit, b) average age, c) proportion from lower social-grades, and d) average number of cigarettes smoked; and 7) implementation of tobacco control policies.

Results: There was a decline in the prevalence of quit attempts from 44.6% to 33.8% over the study period. The partial point-of-sale ban was associated with a temporary increase in quit attempt prevalence ($B_{adjusted}$=0.224%;95%CI 0.061 to 0.388). A positive association was found with the prevalence of high motivation to quit ($B_{adjusted}$=0.165 %;95%CI 0.048 to 0.282). There was a negative association with the mean age of smokers ($B_{adjusted}$=-1.351 %;95%CI -2.168 to -0.534). All other associations were non-significant.

Conclusion: Increases in the prevalence of high motivation to quit was associated with higher prevalence of attempts to quit smoking, while an increase in the mean age of smokers was associated with lower prevalence. The introduction of the partial point-of-sale ban appeared to have a temporary positive impact.

IMPLICATIONS (50-100 WORDS)

This study provides insight into how monthly changes in a wide range of population-level factors are associated with changes in quit attempts over an extended time period in a country with a strong tobacco control climate. The findings suggest a need for intervention or policy to stimulate quit attempts in older smokers. Otherwise, increases in the mean age of a smoking population appear likely to undermine wider efforts to promote quit attempts in a population.

INTRODUCTION

Smoking prevalence in England continues to decline, with official prevalence in 2017 estimated to be 15%, down from 21% in 2007 [1,2]. The Government Tobacco Control Plan for England aims to reduce this further to less than 12% by the end of 2022 [3]. In order to achieve this goal, there is a need to promote smoking cessation. Smoking cessation is a function of two processes: making an attempt to stop and succeeding in that attempt. A number of studies have assessed factors that drive or hinder attempts to stop and their success at an individual level [4]. In order to inform and evaluate policy decisions, it is also important to assess population processes that may lead to an increase in quitting activity. Thus, this paper aimed to assess associations between quit attempts and factors that have varied over time at a population level and are known or hypothesised to influence quit attempts, using population-level time series data on quit attempts among smokers in England between 2007 and 2017.

Prevalence of quit attempts among smokers in England has declined from around 45% at the end of 2006 to 30% during 2018 (www.smokinginengland.info). This decline has not been linear, with substantial variation during this period. The observed population-level variations have not been previously explained. Some have argued that the rise in use of e-cigarettes and decline in use of traditional NRT products may have undermined quitting activities [5-7]. Using time series data we recently showed that at a population level, the increase in e-cigarette use for any purpose in England has been positively associated with the success rates of quit attempts, but found no evidence of a clear association between e-cigarette use and prevalence of quit attempts [8]. The association between the prevalence of quit attempts and prevalence of NRT is currently unclear. Moreover, given that a large number of smokers use e-cigarettes and NRT to support smoking reduction, and not necessarily as an aid to smoking cessation, similar findings may not occur for prevalence of use for harm reduction [9]. There is reason to believe that positive associations may be found, given that randomised controlled trials have shown that use of NRT for smoking reduction aids quitting [10]. Outside of the clinical setting where little behavioural support is provided, the use of NRT during attempts to cut down also appears to increase smokers' propensity to quit [10,11].

The prevalence of roll-your-own tobacco use as a function of all cigarette use may play a role in the decline in attempts to stop smoking. Also referred to as "hand-rolled" cigarettes or "handmade" cigarettes, roll-your-own cigarette consumption is on the increase in many countries. In the UK, it rose from 27% in 2007 to 33% in 2010 [12]. This appears to be in response to greater relative tax increases on factory-made cigarettes, with many smokers switching to cheaper (sometimes smuggled) products to mitigate the increased cost [13]. Roll-your-own smokers have been shown to be significantly less likely

than those who smoke factory-made cigarettes to attempt to quit, with the lower cost of smoking roll-your-own cigarettes a central factor driving this difference [14]. In general, use of roll-your-own tobacco is more common among those of lower socio-economic status and with higher nicotine dependency [12,15,16]; factors associated with a lower odds of making a quit attempt [4].

The overall prevalence of smoking may influence quit attempts – it has been argued that as smoking prevalence declines, the remaining cohort of smokers includes disproportionate representation from groups of people who are less motivated to quit [17,18]. On the other hand, if denormalization is in fact more important, a reduction in smoking prevalence may motivate a greater number of smokers to stop regardless of their background [19]. The proportion of non-daily smokers as a function of all smokers may also have an impact on the rate of quit attempts. Although smoking prevalence has been gradually decreasing in high-income countries, non-daily smoking (also referred to as occasional smoking) appears to be becoming more prevalent. Studies in the US and Europe report a prevalence of non-daily smoking among current smoking populations of up to 16-22% of smokers, with estimates as high as 36% in some communities [20-22]. Studies have shown that non-daily smokers often still struggle to quit smoking and are less likely than daily smokers to seek and receive smoking cessation treatment [23,24]. However, they are also often more likely to report having made a quit attempt in the past year and to report being interested in quitting smoking [22,25]. A major barrier is the erroneous belief that that smoking at a low level does not incur any health disadvantages [26].

Characteristics of smokers have changed since 2007, and this may account for some of the decline in population level quit rates [27]. For example, a study conducted over a ten-year period between 2000 and 2010 found that the proportion of smokers in England with both high nicotine dependency and low motivation to quit had increased [17]. This is in line with the 'hardening hypothesis' which argues that with the decline in prevalence the remaining smokers are less able or unwilling to quit smoking [18]. In contrast, a more recent study found that although motivation to quit appears to have declined among smokers, nicotine dependence is decreasing [27]. Both lower levels of nicotine dependence and higher motivation to quit have been shown to predict greater quit success [4]. Studies have also shown an increase in the age of smokers over time, but little change in the socio-economic characteristics of smokers [27]. This is likely to be partially attributable to reduced uptake in younger age groups and highlights the lack of progress that has been made in reducing social inequalities. Socio-economic status has been shown to be a strong predictor of quitting activity [28].

In England, tobacco mass media campaigns have been run as part of a national tobacco control programme. Spending was almost completely suspended in 2010 and then reintroduced in 2011 at a much lower level. Studies have shown that such cuts on mass media expenditure are associated with a reduction in use of smoking cessation support [29,30] and that higher monthly expenditure on tobacco control mass media campaigns in England is associated with a higher rate of quit success [31]. Tobacco

expenditure as a proportion of total household expenditure has fallen by nearly 2% since 1985 [32]. As significant tax increases over this period have resulted in the rise in cost of smoking [33], this suggests that smokers may be particularly adept at controlling their tobacco expenditure. If smokers are adjusting their smoking behaviours to accommodate tax increases, such as consuming fewer cigarettes per day, this may promote attempts to stop smoking; at the same time, if they are changing the source of purchase or switching to roll-your-own then the effects of tobacco price increases on smoking cessation may be mitigated.

Since the first comprehensive tobacco control plan for Great Britain was published in 1998, a range of policies have been enacted including bans on tobacco marketing, a ban on smoking in indoor public areas, introduction of graphic health warnings on packs, and increasing the legal age of sale [34]. There is substantial evidence for the association between these population-level tobacco control policies and quitting activities. The introduction of a smoking ban in July 2007 was associated with a significant temporary increase in the percentage of smokers attempting to stop [35] and the change in the minimum age of sale of cigarettes in October 2007 resulted in a greater fall in prevalence in 16-17 year olds [36]. Pictorial health warnings on product packaging introduced in October 2008 have been shown to promote smoking cessation [37]. An evaluation of the partial (i.e. supermarket) tobacco point-of-sale display ban introduced in England in April 2012 found evidence for a decline in smoking prevalence [38]. There have also been several other policies including licensing of NRT for harm reduction in December 2009 [11,39], the move in commissioning of stop smoking services to local authorities in April 2013 [40] and the publication of National Institute for Health and Care Excellence (NICE) guidance on harm reduction in June 2013 [41].

In summary, this paper aims to examine the extent to which trends in attempts to quit smoking in England since 2007 can be explained by a range of population-level factors. To provide the most comprehensive assessment, all relevant factors available were selected. These included: 1) prevalence of attempts at smoking reduction using a) e-cigarettes and b) nicotine replacement therapy (NRT); 2) prevalence of use of roll-your-own tobacco; 3) prevalence of a) smoking and b) non-daily smoking; 4) mass media expenditure; 5) expenditure on tobacco; 6) smokers' characteristics in the form of a) prevalence of high motivation to quit smoking, b) the average age of smokers, c) the proportion of smokers from lower socio-economic backgrounds, and d) the average number of cigarettes smoked (as an index of dependence); and 7) population-level tobacco control policies occurring during this period. To our knowledge, this is the first study to assess a wide range of population-level factors associated with quit attempts over an extended time period.

METHODS

Design

Data were used from the Smoking Toolkit Study (STS) (www.smokinginengland.info) between January 2007 and December 2017 (the dates for which information on mass media expenditure was available from Public Health England). The STS is a monthly survey of a representative sample of the population in England aged 16+ [42] which collects data on smoking patterns among smokers and recent ex-smokers. The STS involves monthly household surveys using a random location sampling design, with initial random selection of grouped output areas (containing 300 households), stratified by ACORN (socio-demographic) characteristics (http://www.caci.co.uk/acron/acornmap.asp) and region. Interviewers then choose which houses within these areas are most likely to fulfil their quotas and conduct face-to-face computer-assisted interviews with one member per household. The STS sample appears to be representative of the population in England, having a similar socio-demographic composition to other large national surveys, such as the Health Survey for England [42].

Measures

Data on outcome variable

Past-year smokers were asked: "How many serious attempts to stop smoking have you made in the last 12 months? By serious attempt I mean you decided that you would try to make sure you never smoked again. Please include any attempt that you are currently making and please include any successful attempt made within the last year." The prevalence of quit attempts in each month was calculated as the number of respondents who reported having made one or more quit attempt in the past 12 months divided by the number of past-year smokers.

Data on explanatory variables

Participants were asked: "Which of the following best applies to you? a) I smoke cigarettes (including hand-rolled) every day; b) I smoke cigarettes (including hand-rolled), but not every day; c) I do not smoke cigarettes at all, but I do smoke tobacco of some kind (e.g. pipe or cigar); d) I have stopped smoking completely in the last year; e) I stopped smoking completely more than a year ago; f) I have never been a smoker (i.e. smoked for a year or more)." Smoking prevalence in each month was calculated as the proportion of respondents who reported a), b) or d) i.e. the number of past-year smokers. The prevalence of non-daily smoking in each month was calculated as the proportion of current cigarette smokers who reported that they smoked cigarettes (including hand-rolled) but not every day. Past-year cigarette smokers were also asked how many hand-rolled cigarettes they smoked per day. The prevalence of roll-your-own smoking in each month was calculated as the proportion of

past-year cigarette smokers who reported that at least 50% of the cigarettes they smoked were roll-your-own cigarettes.

Participants who reported that they were currently smoking cigarettes (including hand-rolled) every day or that they smoked cigarettes (including hand-rolled) but not every day, were asked the following question: "Which, if any, of the following are you currently using to help you cut down the amount you smoke?" This question had the following response options: nicotine gum, nicotine replacement lozenges/tablets, nicotine replacement inhaler, nicotine replacement nasal spray, nicotine patch, e-cigarette, nicotine mouth spray, other, none. The prevalence of e-cigarette use for cutting down in each month was calculated as the proportion who reported having used an e-cigarette. The prevalence of NRT use for cutting down in each month was calculated as the proportion who reported having used any form of NRT.

Motivation to quit was assessed using the Motivation to Stop Scale (MTSS) [43]. Current smokers were asked: "Which of the following describes you? (1) I don't want to stop smoking; (2) I think I should stop smoking but don't really want to; (3) I want to stop smoking but haven't thought about when; (4) I REALLY want to stop smoking but I don't know when I will; (5) I want to stop smoking and hope to soon; (6) I REALLY want to stop smoking and intend to in the next 3 months; (7) I REALLY want to stop smoking and intend to in the next month." The prevalence of high motivation to quit in each month was calculated as the proportion of smokers who reported intending to stop smoking within the next three months, i.e. response 6 or 7.

Nicotine dependence was measured by asking past-year smokers "How many cigarettes per day do you usually smoke?". We analysed the mean number reported by respondents in each monthly survey. The STS also records time to the first cigarette of the day over the study period of interest. Together with the number of cigarettes smoked per day this gives the Heaviness of Smoking Index (HSI) [44]. In this study an average HSI score per month of 2.73 (SD 0.22) did not provide enough variability over time for the ARIMAX analysis.

Past-year smokers' socio-economic status was assessed by social grade measured using the British National Readership Survey (NRS) Social Grade Classification Tool (27): AB (higher managerial, administrative or professional), C1 (supervisory or clerical and junior managerial, administrative or professional), C2 (skilled manual workers), D (semi-skilled and unskilled manual workers) and E (casual or lowest grade workers, pensioners, and others who depend on the welfare state for their income). The prevalence of smokers in lower social grades was calculated as the proportion who reported being in C2, D and E. Past-year smokers were also asked for their age, with an average taken each month.

To assess expenditure on smoking, current smokers were asked: "On average about how much per week do you think you spend on cigarettes or tobacco?" and to report the number of cigarettes they

smoke per day. Smokers' average cost of smoking (in £/week) was derived from the following liberal assumptions for upper estimates of plausible levels of consumption and expenditure per week: 1) smokers smoke a maximum of 560 cigarettes per week; 2) spending does not exceed £280 per week, and 3) single cigarettes cost between £0.05 and £1 [45]. The cost of smoking was adjusted for inflation using Consumer Prices Index (CPI) of all items from the Office for National Statistics, with December 2017 as the reference [45].

Quarterly mass media expenditure (in million £) was obtained from PHE.

The following tobacco control policies were assessed using a temporary pulse effect, whereby a dummy variable was coded 0 before and after the policy was introduced and 1 during the month the policy was introduced: 1) the introduction of a smoking ban in July 2007 [35]; 2) change in the minimum age of sale of cigarettes in October 2007 [36]; 3) pictorial health warnings on product packaging introduced in October 2008 [37]; 4) licensing of NRT for harm reduction in December 2009 [11]; 5) point-of-sale ban introduced in England in April 2012 [38]; 6) the move in commissioning of stop smoking services to local authorities in April 2013 [40]; and 7) the publication of NICE guidance on harm reduction in June 2013 [41].

Analysis

The analysis plan and data set were pre-registered on the Open Science Framework (https://osf.io/8nmx9/). All data were analysed in R Studio. Data were aggregated monthly and weighted to match the population in England [42]. Autoregressive Integrated Moving Average with Exogeneous Input (ARIMAX) analysis was used to estimate the effect of the variables of interest on prevalence of quit attempts. Unadjusted models and a fully adjusted model are reported. Both unstandardised and standardised coefficients are given for the continuous covariates. Standard recommended procedures were used to select the ARIMAX models. Bayes factors were derived using an online calculator for the final best fitting adjusted model to help in the interpretation of null findings [46]. Full details of the analysis are given in Supplementary File 1.

RESULTS

Data were collected from 233,379 respondents. Of these, 22.22% (95%CI 22.21 to 22.24; n=51,867) were past year-smokers and 20.19% (95%CI 20.17 to 20.20; n=47,118) were current smokers. Table 1 shows the mean, standard deviation, 95% confidence interval, and start and end dates of the time series for prevalence of quit attempts and the predictor time series of interest. Supplementary Figures 1 to 4 show the plotted time series.

Table 2 presents the unadjusted ARIMAX analyses. Changes in use of NRT for smoking reduction and high motivation to quit were positively associated with the prevalence of quit attempts. There was also a negative association between prevalence of quit attempts and the mean age of smokers. Standardised coefficients indicated that the largest unadjusted associations were with NRT use for smoking reduction. Models with and without seasonal terms showed very similar results. Other variables were not significantly associated with quit attempts.

Table 3 presents the adjusted ARIMAX analyses. The partial point-of-sale ban was found to have a two-month delayed pulse effect on the prevalence of quit attempts, leading to a temporary 0.224% increase in the prevalence of quit attempts from the mean point prevalence. Also, for every 1% increase in the proportion of smokers reporting high motivation to stop smoking from the mean point prevalence, the point prevalence of quit attempts increased by 0.165% from the mean point prevalence. Finally, each 1% increase in the mean age of smokers from the overall mean across the period resulted in a -1.351% decrease in the point prevalence of quit attempts from the mean point prevalence. Standardised coefficients indicated that these significant adjusted associations were of a similar magnitude. Models with and without seasonal terms showed very similar results. Other variables were not significantly associated with quit attempts.

For the non-significant findings, Bayes factors indicated that there was support for the null hypothesis of no impact of prevalence of e-cigarette use for harm reduction (BF 0.3) and mass media expenditure on prevalence of quit attempts (BF 0.2) (see Table 3). There was evidence for the alternative hypothesis of an impact on quit rates of the introduction of NICE guidance on harm reduction (BF 3.1). All other non-significant findings were deemed insensitive (BF 0.3 To 2.8).

DISCUSSION

This paper aimed to identify factors at a population level that are associated with attempts to stop in England in order to give an indication of the population processes that lead to a quit attempt and also the factors that influence quit attempts.

Key findings

An increase in the proportion of smokers with a high motivation to quit was associated with a significantly higher prevalence of attempts to stop smoking in England, while an increase in the mean age of smokers was associated with a significantly lower prevalence of quit attempts. The introduction of the partial point-of-sale ban also appeared to have a significant positive impact on the prevalence of quit attempts among smokers. Bayes factors indicted that there was evidence of no association with prevalence of e-cigarette use for harm reduction and mass media expenditure, but that there

was evidence of a possible positive association with the introduction of NICE guidance on harm reduction. The data were insensitive to detect an association between the other variables and prevalence of quit attempts.

Strengths and limitations

Although previous studies have assessed the individual-level factors associated with attempts to stop smoking [4], this is the first study to our knowledge which has assessed the impact of a wide range of population-level factors. There were several advantages to this study, including the use of ARIMAX modelling which accounts for underlying trends, seasonality and autocorrelation. ARIMAX also has the added value over traditional regression models of using all the information in past data to estimate coefficients. However, this study also has several limitations. First, the Smoking Toolkit Study requires participants to recall certain key smoking-related factors which could have introduced bias. However, this would only have had a significant effect on time series models such as these if there was a change in the rate of under reporting over time. Secondly, the findings might not generalise to other countries. England has a strong tobacco control climate and generally high motivation to quit among smokers, and relatively liberal regulation of e-cigarettes. In countries with weaker tobacco control, or stricter regulation of e-cigarettes, different effects may be observed. Thirdly, although we are unaware of any other major population-level interventions or other events during the study period, we cannot rule out residual confounding. Fourthly, caution should be taken when interpreting the null effects. Although this study was powered to detect relatively small associations, Bayes factors indicated that the presence of a P value greater than 0.05 in a number of instances was because the data were inconclusive as to whether an association exists rather than there being evidence for no effect [46-48]. Fifthly, the failure to find an impact of several population-level polices which have previously been evaluated as successful, may reflect that fact that we only assessed pulse and delayed pulse effects. It is possible that findings might be different if a more comprehensive evaluation had been undertaken, for example, a consideration of step-level changes or permanent changes in quit rates. This was beyond the scope of the current study but does warrant further investigation. Finally, time series type analyses such as these are dependent on data variability. Thus, where there is little fluctuation, as was the case with lower socio-economic status, associations may not be identifiable.

Interpretation of the findings

It is unsurprising that an increase in the proportion of smokers with high motivation to stop was associated with quitting activity. The concept of motivation is a pivotal component of many theories of behaviour change. For example, PRIME theory argues that our wants and needs at any one moment are the main drivers of our behaviour [49]. Studies at the individual level have also consistently shown an association between an individual's motivation to quit and attempts to stop[50].

The introduction of the partial point-of-sale ban also had a positive impact on the prevalence of quit attempts. The point-of-sale ban has already been comprehensively evaluated, with the authors concluding that although its introduction in April 2012 did not lead to an immediate decline in smoking prevalence, it was followed by a decline in the trend of prevalence which could not be accounted for by seasonal factors, e-cigarette use or price changes [38]. One explanation for this finding is that the point-of-sale ban reduced impulse tobacco purchases and therefore promoted quitting activity.

This study also found that an ageing smoking population was associated with reduced prevalence of quit attempts. Associations between age and quitting activity at an individual level are far from consistent. Some studies have reported that younger smokers are more likely to quit, while others have found a reverse association or no association [4]. The negative association at a population level may reflect the fact that older smokers hold more negative beliefs about quitting, consider themselves as survivors or believe that the damage has been done so they see no point in attempting to quit in later life.

Although not statistically significant, Bayes factors found a positive impact for the introduction of NICE guidance on tobacco harm reduction. To our knowledge, this is the first study to evaluate this. The NICE guidance was introduced in 2013 and supported the use of licensed nicotine-containing products to help smokers cut down, for temporary abstinence and as a substitute for smoking [41]. This was following the accumulation of evidence that use of NRT for harm reduction increased smokers' propensity to quit at a population level and in clinical trials [10]. This finding bore out in the unadjusted analyses, where the population level prevalence of NRT use for smoking reduction was associated with the population level prevalence of quit attempts. Bayes factors also provided support for there being no association of e-cigarette use for harm reduction and mass media expenditure with attempts to quit smoking. This is in line with our previous findings [39].

These findings have several policy implications. First, they suggest that population-level campaigns and polices should target smokers' motivation to stop smoking. One may have assumed that mass media campaigns would achieve this objective, however, the lack of an association between expenditure on mass media and attempts to stop means we cannot deduce a mediation effect. Mass media campaigns are, however, positively associated with quit success [8]. The strong tobacco control climate in England has likely played a role in increasing motivation, along with the provision of licensed smoking cessation medication and stop smoking services. Secondly, these findings identify the need to address smoking specifically in older age groups who have not generally been recognised as a priority group. Opportunities to offer cessation advice and support to these individuals is often missed in primary care [51]. Thirdly, these findings do not support the proposal that smokers who currently use, or have used e-cigarettes in the past, are less likely subsequently to quit smoking. We have shown

previously that although e-cigarette prevalence is not associated with quit attempts it is with the success of those attempts [8].

Conclusion

The decline in quit attempts in England since 2007 is associated with a decrease in the population-level prevalence of smokers with a high motivation to quit, while an increase in the mean age of smokers. The introduction of the partial point-of-sale ban appeared to have a positive impact on the prevalence of quit attempts. There was evidence for no association with quit attempts and e-cigarette use for harm reduction or mass media expenditure. There was some evidence for the impact of the NICE guidance on tobacco harm reduction.

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DECLARATION OF INTERESTS

RW undertakes consultancy and research for and receives travel funds and hospitality from manufacturers of smoking cessation medications. EB and JB have received unrestricted research funding from Pfizer. MK and SJ have no interests to declare.

DATA SHARING STATEMENT

For access to the Smoking Toolkit Study please contact Dr Jamie Brown, jamie.brown@ucl.ac.uk.

Supplementary Figure 1: plotted time series of prevalence of attempts to quit smoking and a) prevalence of e-cigarette use for smoking reduction; b) prevalence of NRT use for smoking reduction; c) mass media spend

Supplementary Figure 2: plotted time series of prevalence of attempts to quit smoking and d) cost of smoking; e) prevalence of high motivation to quit; and f) prevalence of lower socio-economic status.

Supplementary Figure 3: plotted time series of prevalence of attempts to quit smoking and a) smoking prevalence; b) non-daily smoking prevalence; c) average cigarette consumption per day

Supplementary Figure 4: plotted time series of prevalence of attempts to quit smoking and d) average age of smokers and e) prevalence of roll-your-own smokers

Table 1: Descriptive statistics of the time series of prevalence of quit attempts over time and the predictor time series of interest

	Mean	SD	95% confidence interval		Start – Jan 07	End – Dec 17
			Lower	Higher		
Quit attempt	36.0	4.57	35.22	36.78	44.6	33.8
E-cigarette use for SR	6.9	6.37	5.81	7.99	0.1	13.6
NRT use for SR	9.9	3.93	9.23	10.57	15.6	5.8
Non-daily smokers	11.4	2.57	10.96	11.84	14.3	13.8
Roll-your-own smokers	39.4	7.24	38.16	40.64	27.9	47.4
Mass media spend	0.5	0.49	0.42	0.58	1.5	0.2
Smokers' expenditure on smoking	25.4	1.77	25.10	25.70	27.6	23.6
Lower social grade	59.4	2.82	58.92	59.88	60.4	56.8
Age	41.3	0.87	41.15	41.45	39.8	40.8
High motivation to quit	18.6	3.96	17.93	19.27	22.8	18.5
Cigarettes per day	12.2	1.01	12.03	12.37	12.9	10.2
Smokers	22.2	2.52	21.77	22.63	26.9	19.8

Note: SR=smoking reduction

Table 2: Results of the unadjusted ARIMAX models assessing the association between the variables of interest and prevalence of attempts to quit smoking

	B No seasonal AR Seasonal AR	Lower CI	Upper CI	P	β No seasonal AR Seasonal AR
Partial point-of-sale ban (2 month lag)	-0.035 -0.054	-0.217 -0.241	0.148 0.132	0.711 0.568	
Smokefree	-0.063 -0.063	-0.245 -0.246	0.120 0.119	0.502 0.496	
Increase in age of sale (1 month lag)	0.039 0.036	-0.144 -0.146	0.222 0.219	0.676 0.696	
Pictorial health warnings	0.035 0.037	-0.147 -0.145	0.218 0.219	0.705 0.689	
Move of Stop Smoking Services to local authority control (2 month lag)	0.167 0.168	-0.014 -0.012	0.349 0.349	0.071 0.067	
Licensing of NRT for harm reduction	-0.120 -0.144	-0.303 -0.297	0.063 0.068	0.198 0.220	
NICE guidance on harm reduction (2 month lag)	-0.025	-0.212	0.161	0.789	

	-0.046	-0.237	0.144	0.633	
E-cigarette use for SR	0.017	-0.010	0.043	0.222	0.222
	0.017	-0.010	0.043	0.216	0.259
Mass media spend	0.004	-0.017	0.025	0.699	0.047
	0.006	-0.015	0.028	0.575	0.063
NRT use for SR	**0.097**	**0.025**	**0.169**	**0.009**	**0.362**
	0.096	**0.024**	**0.167**	**0.009**	**0.357**
Roll-your-own smokers	-0.059	-0.268	0.150	0.581	-0.079
	-0.062	-0.270	0.146	0.560	-0.086
Non-daily smokers	0.018	-0.057	0.094	0.630	0.049
	0.019	-0.056	0.094	0.619	0.051
Smokers' expenditure on smoking	-0.084	-0.391	0.223	0.592	-0.060
	-0.085	-0.388	0.218	0.584	-0.061
Cigarettes per day	-0.039	-0.401	0.323	0.831	-0.051
	-0.020	-0.386	0.345	0.913	-0.036
Smokers	0.156	-0.102	0.414	0.237	0.158
	0.155	-0.106	0.416	0.244	0.156
High motivation to quit	**0.151**	**0.041**	**0.261**	**0.007**	**0.226**
	0.173	**0.063**	**0.283**	**0.002**	**0.272**
Age	**-1.015**	**-1.866**	**-0.163**	**0.020**	**-0.159**
	-1.003	**-1.845**	**-0.160**	**0.020**	**-0.156**
Lower social grade	-0.211	-0.594	0.171	0.279	-0.077
	-0.201	-0.585	0.183	0.304	-0.074

Note: SR=smoking reduction

Table 3: Results of the adjusted ARIMAX models assessing the association between the variables of interest and prevalence of attempts to quit smoking

	B No seasonal AR Seasonal AR	Lower CI	Upper CI	P	β No seasonal AR Seasonal AR	Bayes factors
Partial point-of-sale ban (2 month lag)	**0.236**	**0.073**	**0.399**	**0.005**		
	0.224	**0.061**	**0.388**	**0.007**		10.8
Smokefree	-0.058	-0.219	0.104	0.485		
	-0.062	-0.223	0.098	0.446		1.1
Increase in age of sale (1 month lag)	-0.140	-0.307	0.026	0.099		
	-0.148	-0.314	0.019	0.082		2.8
Pictorial health warnings	0.039	-0.121	0.199	0.633		
	0.046	-0.111	0.204	0.564		0.9
Move of Stop Smoking Services to local authority control (2 month lag)	-0.052	-0.229	0.125	0.564		
	-0.071	-0.249	0.107	0.433		1.1
Licensing of NRT for harm reduction	-0.114	-0.279	0.050	0.173		
	-0.105	-0.249	0.107	0.433		1.7
NICE guidance on harm reduction (2 month lag)	0.164	-0.003	0.330	0.054		
	0.153	-0.013	0.318	0.070		3.1
E-cigarette use for SR	0.013	-0.011	0.037	0.282	0.112	
	0.012	-0.011	0.035	0.319	0.114	0.3
Mass media spend	-0.011	-0.030	0.008	0.263	-0.088	
	-0.009	-0.029	0.011	0.319	-0.077	0.2
NRT use for SR	0.055	-0.019	0.129	0.144	0.255	
	0.044	-0.031	0.119	0.250	0.201	1.1
Roll-your-own smokers	-0.119	-0.308	0.070	0.217	-0.173	
	-0.130	-0.318	0.058	0.176	-0.192	1.9
Non-daily smokers	0.001	-0.075	0.077	0.980	-0.007	
	0.004	-0.070	0.079	0.908	0.060	0.4
Smokers' expenditure on smoking	0.101	-0.276	0.477	0.601	0.038	
	0.072	-0.296	0.441	0.700	0.025	1.0
Cigarettes per day	0.003	-0.419	0.426	0.989	-0.025	
	0.056	-0.370	0.483	0.796	0.014	1.0
Smokers	0.138	-0.092	0.368	0.240	0.177	1.7

	0.147	-0.086	0.380	0.217	0.183	
High motivation to quit	**0.144** **0.165**	**0.030** **0.048**	**0.259** **0.282**	**0.013** **0.006**	**0.212** **0.259**	16.4
Age	**-1.439** **-1.351**	**-2.261** **-2.168**	**-0.616** **-0.534**	**0.001** **0.001**	**-0.237** **-0.223**	2.0
Lower social grade	-0.213 -0.217	-0.559 -0.563	0.133 0.129	0.227 0.218	-0.073 -0.075	1.5

Note: SR=smoking reduction

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