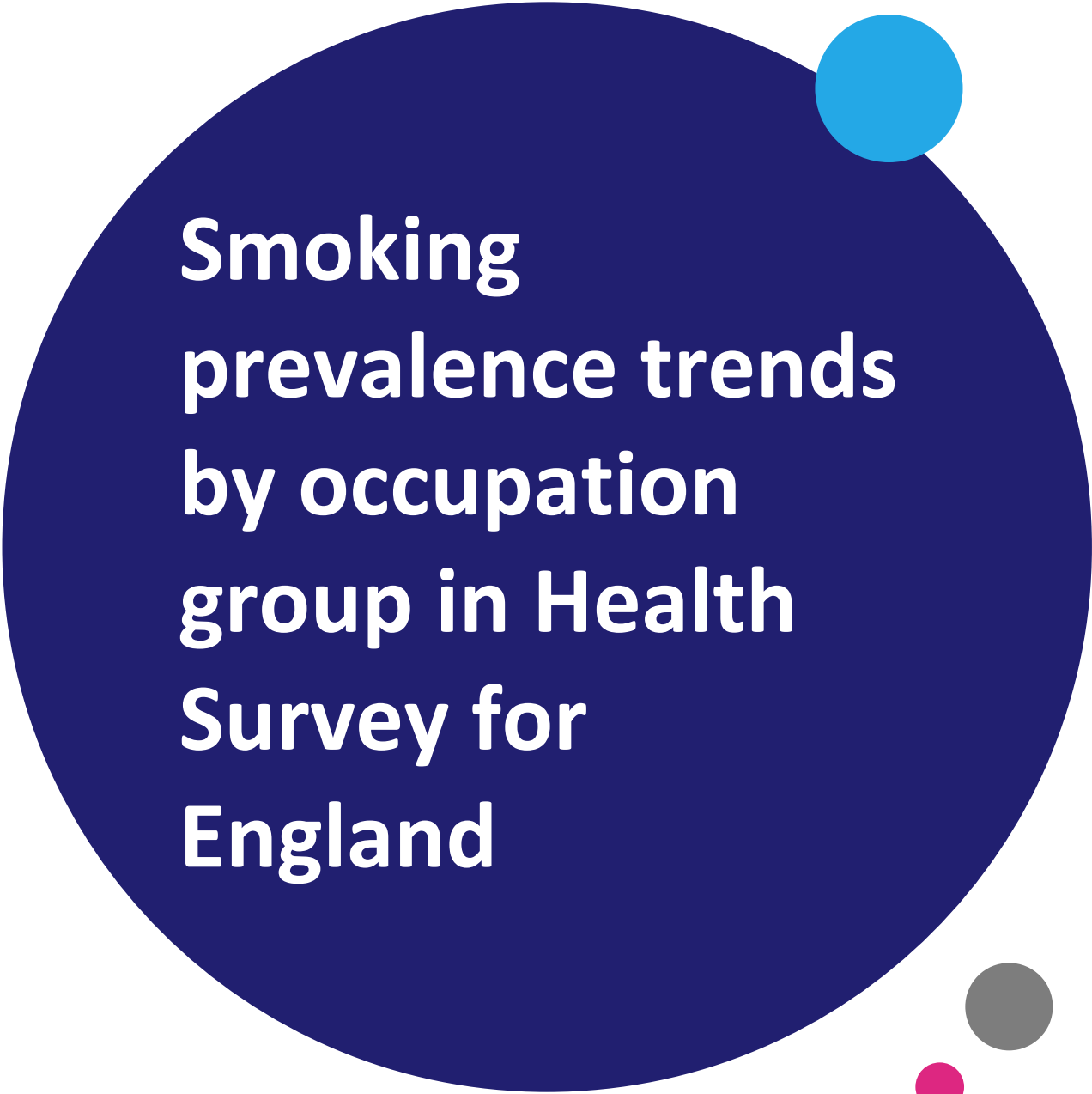
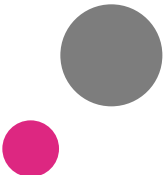




Smoking prevalence trends by occupation group in Health Survey for England



October 2019

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About Cancer Research UK

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Executive summary

Purpose

Smoking prevalence is declining however the rate of decline may not be equal across occupational groups. This report compares the pace of change in smoking prevalence from 2001 to 2015, between routine and manual (R&M) versus managerial and professional (M&P) workers, and the economic impact of smoking in both groups. Health Survey for England data were used and obtained from the UK Data Archive.

Key Findings

Our analysis shows that R&M workers in England have experienced relatively slower progress in the decline of smoking prevalence compared to M&P workers. This inequality has both an economic and health impact on the population. Key findings are summarised below.

1. More than half of England's smokers are R&M workers

R&M workers account for over 50% of England's current smokers. This proportion has remained stable between 2001-2003 and 2013-2015. R&M workers are over-represented in the smoking population, because they account for only 42% of the total population in England.

2. Likelihood of being a smoker decreased at half the rate in R&M workers compared to M&P workers

In the past 15 years, the likelihood of being a smoker has fallen by only 16% (from 31.6% to 26.6%; 5 percentage points) in R&M workers, whereas M&P workers have seen a reduction of 31% (from 19.1% to 13.1%; 6 percentage points). As a result, the smoking prevalence gap between R&M and M&P workers has widened: in 2001-2003, smoking prevalence was around 65% higher (13 percentage points) in R&M workers than in M&P workers, now it is twice (14 percentage points) as high.

3. The difference in smoking prevalence rates may be driven by higher rates of smoking uptake and lower than necessary quitting (given their higher smoking prevalence) in R&M workers

The proportion of ex- smokers did not differ between R&M and M&P workers, effectively reflecting lower quitting prevalence in R&M workers given their higher proportion of current smokers). R&M workers have a lower proportion of never-smokers versus M&P workers: R&M workers are more likely to take up smoking. Both smoking uptake and quitting are drivers of the occupation-related inequality in smoking prevalence.

4. Occupation group is independently linked to smoking behaviour

The influence of occupation group on smoking prevalence trends over time is separate from the effect of age, sex, region, education, marital status, ethnicity, alcohol consumption and general perceived health. Occupation group and smoking behaviour are intrinsically linked regardless of our other demographic factors or behavioural characteristics.

5. Without the difference in smoking prevalence rates between M&P and R&M workers, England could have almost a million fewer R&M worker smokers

In 2013-2015 there were around 4.6 million R&M worker smokers in England. There would have been only around 3.7 million if the likelihood of being a smoker had decreased for R&M workers as much as it did for M&P workers over the study period.

6. R&M workers in England take 12.3 million days smoking-related sick leave each year

Smoking-related sick leave claims around 6.6 million more days of routine and manual work than of managerial and professional work. This difference is due to the larger number of R&M worker smokers compared with M&P worker smokers.

Policy Implications

This analysis clearly demonstrates the inequality between R&M and M&P workers in terms of smoking prevalence and quantifies the impact of that inequality on the economy. There is a clear economic and health case for improving access to the best smoking cessation services for our routine and manual workforce.

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Introduction

Smoking is the leading cause of death worldwide¹. In the UK alone, smoking causes 115,000 deaths per year². Smoking accounts for more than a quarter (27%) of all cancer deaths in the UK². This is not surprising as smoking is the largest preventable risk factor for cancer in the UK, causing lung, larynx, oral cavity and pharynx, bladder, pancreas, kidney, liver, stomach, bowel, cervix, leukaemia and ovarian cancers³. In England, individuals with lower socioeconomic status (SES) have higher cancer incidence and mortality, and smoking is central to this variation⁴. Reduction of smoking prevalence is therefore vital to reduce overall cancer incidence and mortality, and to tackle health inequalities between socioeconomic groups.

Adult smoking prevalence in England has declined in recent decades and is currently 14.9%, the lowest-ever figure⁵. A clear social gradient in smoking prevalence has existed for decades: more deprived people are more likely to smoke, compared with those less deprived^{5,6,7,8}.

The smoking epidemic model suggests that smoking first emerges within the 'upper class' then spreads to the 'lower class', and becomes concentrated in the latter group because the former has lower initiation and higher cessation levels⁹. This theory is borne out in England, where deprivation is associated with higher levels of smoking initiation and lower levels of successful smoking cessation relative to baseline smoking population size^{5,6,7,10}.

Given these socioeconomic differences in smoking initiation and cessation, smoking prevalence trends in England differ by SES: the overall population decline in smoking prevalence between 2001 and 2008 was not observed among the most disadvantaged¹¹.

Defining deprivation using multi-component SES measures – such as educational level, occupational class, accumulated wealth, housing tenure, economic activity status, and household income – is common in the smoking literature¹². However this hinders understanding of the independent influence of each SES component, which in turn limits the opportunity to use these results to drive effective interventions. Using occupation alone as the SES measure offers a practical solution for targeting smoking cessation services, e.g. through workplace interventions. This approach can be further refined by examining whether the association of occupation with smoking status is independent from other demographic factors; this type of analysis has not been included in previous comparable work with England data¹¹.

Smoking prevalence percentages and statistical comparisons between groups have appeal for policymakers, however this is emphasised by extrapolating these percentages and comparisons to quantifying the number of smokers and the economic effect. This offers powerful results for communicating to policymakers and therefore driving change.

Purpose

This study explores:

1. How England's smoking population is distributed across occupation groups
2. How smoking prevalence trends have differed between occupation groups

3. How rates of smoking initiation and cessation contribute to these trends
4. Whether occupation group is linked with smoking status independently of other factors
5. How occupation group inequalities impact on the current size of the smoking population
6. How many days are lost to sick leave in the routine and manual workforce

Methods

Data Sources

This study used data for 2001-2015 from the Health Survey for England (HSE). HSE is a nationally representative annual survey of adults (aged 16+) which captures information on health, health-related behaviours and lifestyle. Sample sizes per year from the 15-year study period ranged from around 9,000 to around 23,000. Anonymised participant-level HSE data was obtained from the UK Data Archive. HSE 2016 data were not available on UK Data Archive when the analysis was conducted. Data were analysed in discrete three-year cohorts (e.g. 2001-2003, 2004-2006) to reduce the impact of year-on-year fluctuations ¹¹.

Measures

Outcome measure/dependent variable: Smoking status categorised as “current cigarette smoker”, “ex-regular cigarette smoker” or “never regular cigarette smoker”.

Main predictor/independent variable: Occupation group categorised using the National Statistics Socio-Economic Classification (NS-SEC) as “managerial and professional”, “intermediate” (defined as ‘not involving general planning or supervisory powers’) or “routine and manual”.

Covariates: Selected correlates of smoking based on literature review and chi-square analysis of the HSE data. Included demographic covariates (Table 1): general perceived health categorised as “very good/good”, “fair” or “bad/very bad”; self-reported alcohol drinking frequency in the past 12 months categorised as “almost every day”, “five or six days a week”, “three or four days a week”, “once or twice a week”, “once or twice a month”, “once every couple of months”, “once or twice a year” or “not at all in the last 12 months/non-drinker”

Data Analysis

Analyses were conducted using R and SPSS version 24.0.

As per the HSE guide, the SPSS complex sample module and cross tabulation test was used to obtain proportions and 95% confidence intervals whilst taking into account the sampling frame and the weighting of the analysis. For differences between occupation groups, and changes over time within occupation groups, significance was assessed using confidence intervals. Relative and absolute differences and changes were calculated. Relative difference and change is influenced by baseline levels: in two time periods both with the same absolute difference between groups, the relative difference will be larger in the time period with the lower baseline levels; and in two groups both with the same absolute change, the relative change will be larger in the group with the lower baseline level. However relative difference and change can be interpreted as the likelihood of an individual in the group being a smoker at the end versus the start of the time period. In the absence of inequality between groups, this likelihood should be similar, regardless of difference in the overall group baseline level.

A mixed effects logistic regression was carried out in R using the nlme package to assess whether the association between smoking status and occupation group was independent of covariates. The outcome variable was recoded into smoking (“current cigarette smoker”) and non-smoking (“ex-regular cigarette smoker” or “never regular cigarette smoker”). Mixed effects modelling was chosen, to allow exploration of clustered data such as changes over

time, and to allow inclusion of both fixed effect variables (such as demographic variables) and random effect variables (those that are assumed to vary between different groups). Three models were tested to establish which model was the most appropriate for the data: i) year as independent variable and demographics as covariates, both specified to have fixed effects; ii) as above but with occupation group as an additional independent variable, specified to have a random intercept; iii) as above but with occupation group specified to have both a random intercept and a random slope (meaning different occupation groups are expected to show different smoking prevalence at the start of the analysis period, and different smoking prevalence trends during the analysis period). Likelihood ratio tests were used to assess whether the models were significantly different from one another, and which model best explained the data; here significance was accepted at $p < 0.05$.

To extrapolate the results to number of smokers and their sick days, the average population size for 2013-2015 was used ¹³. Smokers were assumed to take 2.7 days smoking-related sick leave per year ¹⁴.

Results

Sample Characteristics

216,876 participants provided a response to at least one of the variables included in the analysis across the 15-year study period. Participants with missing data on any variable were excluded, leaving 147,791 participants in the analysis. Smoking status was associated with age group, sex, marital status, equivalised household income, highest educational qualification, and region (Table 1).

Table 1. Sample Characteristics

Characteristic	Number of participants (% within each group)			Chi-square test for association
	Current smokers	Ex-smokers	Never-smokers	
Total participants	32021	37708	78062	
Age group				p<0.001
16-24	5108 (16.0%)	1077 (2.9%)	11444 (14.7%)	
25-34	6451 (20.2%)	3357 (8.9%)	12083 (15.5%)	
35-44	6776 (21.2%)	5147 (13.6%)	14578 (18.7%)	
45-54	5634 (17.6%)	5859 (15.5%)	12743 (16.3%)	
55-64	4267 (13.3%)	7637 (20.3%)	10355 (13.3%)	
65-74	2627 (8.2%)	7924 (21.0%)	9140 (11.7%)	
75+	1158 (3.6%)	6707 (17.8%)	7719 (9.9%)	
Sex				p<0.001
Male	15167 (47.4%)	19787 (52.5%)	30812 (39.5%)	
Female	16854 (52.6%)	17921 (47.5%)	47250 (60.5%)	
Marital status				p<0.001
Single	8942 (27.9%)	3304 (8.8%)	17043 (22.3%)	
Married	12103 (37.8%)	22395 (62.0%)	42639(54.6%)	
Separated	1085 (3.4%)	760 (2.0%)	1649(2.1%)	
Divorced	2979 (9.3%)	2545 (6.7%)	3724(4.8%)	
Widowed	1678 (5.2%)	4305 (11.4%)	6005 (7.7%)	
Cohabiting	5226 (16.3%)	3388 (9.0%)	6615 (8.5%)	
Equivalised household income				p<0.001
Quintile 1 (lowest)	7375 (28.1%)	5263 (17.2%)	10702 (17.3%)	
Quintile 2	5692 (21.7%)	6638 (21.6%)	10666 (17.2%)	
Quintile 3	4943 (18.8%)	6597 (21.5%)	12219 (19.7%)	
Quintile 4	4561 (17.4%)	6182 (20.1%)	13566 (21.9%)	
Quintile 5 (highest)	3689 (14.0%)	6006 (19.6%)	14772 (23.9%)	

Characteristic	Number of participants (% within each group)			Chi-square test for association
	Current smokers	Ex-smokers	Never-smokers	
Total participants	32021	37708	78062	p<0.001
NVQ1/CSE other grade	2210 (6.9%)	2084 (5.5%)	2848 (3.7%)	
NVQ2/GCE O level	8493 (26.6%)	7511 (20.0%)	16293 (20.9%)	
NVQ3/GCE A level	4543 (14.2%)	3961 (10.5%)	11787 (15.1%)	
Higher ed. below degree	2811 (8.8%)	4225 (11.2%)	8760 (11.2%)	
NVQ4/NVQ5/Degree	3664 (11.5%)	6388 (17.0%)	19262 (24.7%)	
Region				
North East	2485 (7.8%)	2619 (6.9%)	4783 (6.1%)	
North West	4786 (14.9%)	5171 (13.7%)	10442 (13.4%)	
Yorkshire & Humber	3476 (10.9%)	3781 (10.0%)	7458 (9.6%)	
East Midlands	3014 (9.4%)	3549 (9.4%)	7147 (9.2%)	
West Midlands	3250 (10.1%)	3932 (10.4%)	8193 (10.5%)	
East of England	3432 (10.7%)	4446 (11.8%)	8568 (11.0%)	
London	4199 (13.1%)	3615 (9.6%)	11973 (15.3%)	
South East	4234 (13.2%)	6046 (16.0%)	11305 (14.5%)	
South West	3145 (9.8%)	4546 (12.1%)	8183 (10.5%)	

More than half of England’s smokers are routine and manual workers

During the entire study period 2001-2015, the highest smoking prevalence was in routine and manual workers (29%), followed by intermediate workers (20%), and the lowest was in managerial and professional workers (15%). Accordingly 54-55% of the smoking population were R&M workers, and only 25% were M&P workers; this was consistent between 2001 and 2015 (Figure 1).

Figure 1. Smokers and non-smokers by occupation



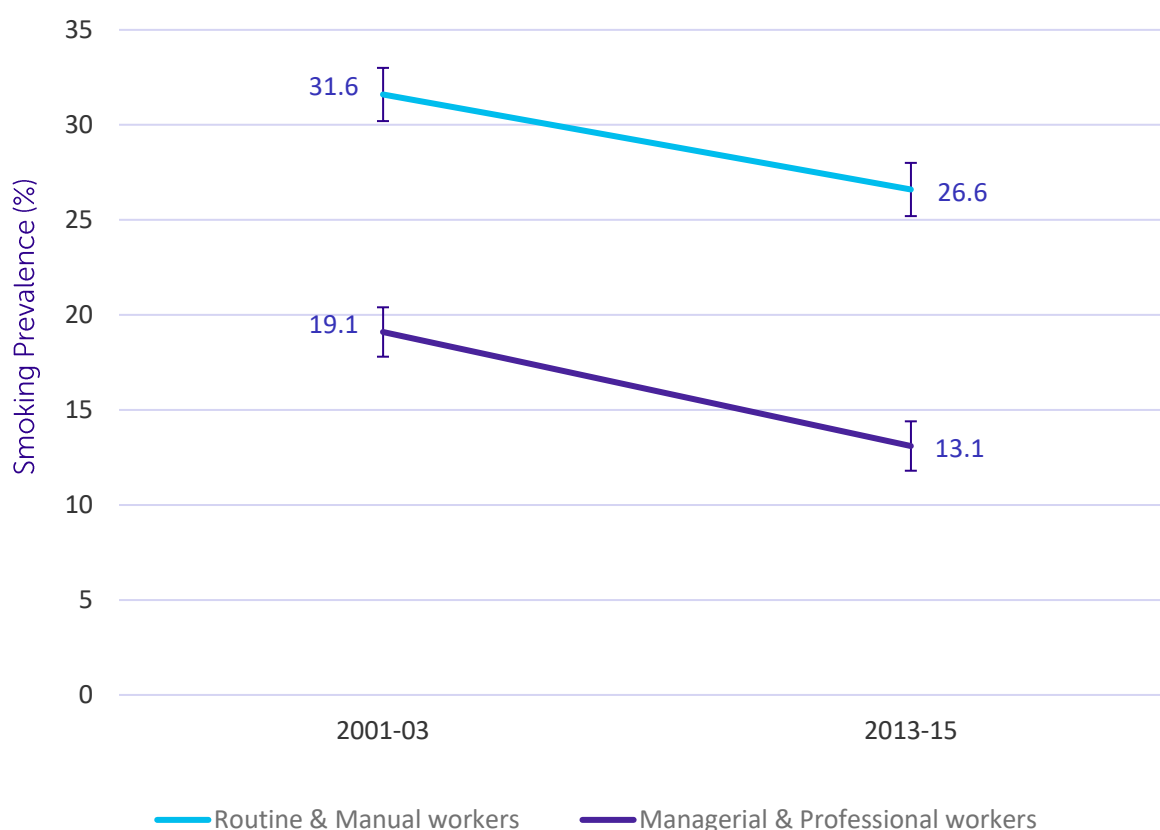
Likelihood of being a smoker decreased at half the rate in R&M workers compared to M&P workers

Smoking prevalence in M&P workers fell by 6 percentage points, from 19.1% (95% CI 17.8-20.5%) to 13.1% (95% CI 12.2-14.0%), between 2001-2003 and 2013-2015 (Figure 2). The relative change shows the likelihood of an M&P worker being a smoker decreased by 31.4% over this period.

Smoking prevalence in R&M workers fell by 5 percentage points; from 31.6% (95% CI 30.2-33.1%) to 26.6% (95% CI 25.5-27.9%), between 2001-2003 and 2013-2015. The relative change shows the likelihood of an R&M workers being a smoker decreased by 15.8% over this period.

Whilst the absolute change in smoking prevalence was similar between the two groups, the relative change was half the rate in R&M workers compared to M&P workers. Due to the difference in relative rate of change, the gap between R&M and M&P workers has widened. Smoking prevalence was 65% (12.5 percentage points) higher in R&M than in M&P workers in 2001-2003, and the gap widened to 103.5% (13.5 percentage points) higher in 2013-2015.

Figure 2. Smoking prevalence trends by occupation group

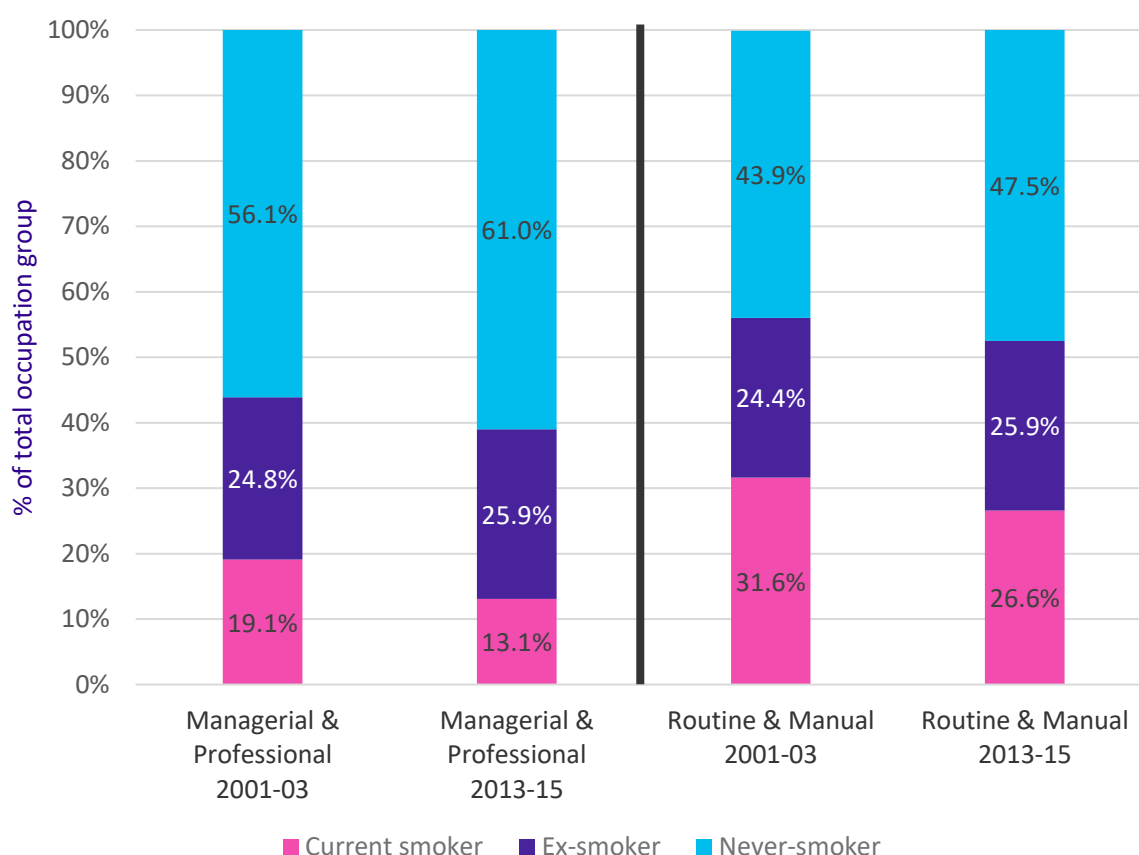


The difference in smoking prevalence rates may be driven by higher rates of smoking uptake and lower relative rates of quitting in routine and manual workers

Though R&M workers have a larger proportion of ever-smokers (52.5% in 2013-15) compared with M&P workers (39% in 2013-15), they do not have a correspondingly larger proportion of ex-smokers compared with M&P workers (both 25.9 in 2013-15). The proportion of ex-smokers was similar between occupation groups throughout the study period (Figure 3). However, the absolute increase in ex-smokers as proportion of ever-smokers was smaller for R&M workers (43.6% of ever-smokers were ex-smokers in 2001-03 vs 49.3% in 2013-15; 5.7 percentage points) than for M&P workers (56.5% of ever-smokers were ex-smokers in 2001-03 vs 66.4% in 2013-15; 9.9 percentage points). Accordingly, the relative change shows the likelihood of an ever-smoker being an ex-smoker increased by 17.6% for M&P workers and by 13.2% for R&M workers over this period.

Throughout the study period, R&M workers have had a significantly lower proportion of never-smokers compared with M&P workers: in 2013-15, 47.5% of M&P workers were never-smokers, versus 61% of R&M workers. For both occupation groups the relative change shows the likelihood of being a never-smoker increased over this period; by 8.7% for M&P workers and 8.2% for R&M workers. This suggests higher smoking uptake within R&M workers compared to M&P workers.

Figure 3. Occupation by smoking status



Occupation group is independently linked to smoking behaviour

In mixed effects logistic regression, the model including occupation group with random intercept and slope was a significantly better predictor of change in smoking status over time, compared with the model only including other demographic variables (likelihood ratio chi-square = 37.45, $p < 0.001$).

This means that occupation explained changes in smoking status over time which is separate from that explained by the demographic variables (such as age, education, income etc). Furthermore, smoking status at the first-time point (2001) and the change of smoking status over time differed by occupation. This supports the finding that the pace of change in smoking prevalence trends differs by occupation.

Without the difference in smoking prevalence rates between M&P and R&M workers, England could have almost a million fewer R&M worker smokers

If the likelihood of being a smoker had decreased for R&M workers at the same rate as it did for M&P workers over the study period, smoking prevalence in R&M workers for 2013-2015 would have been 21.7%, rather than the observed 26.6%. This would have translated to 0.8 million fewer smokers in 2013-2015: 3.7 million rather than 4.6 million R&M smokers (Table 2).

R&M workers in England take 12.3 million days smoking-related sick leave each year

Based on the assumption that smokers take an extra 2.7 sick days per year, the 4.6 million R&M workers who smoke take an extra 12.3 million smoking-related sick days per year (Table 2). The 2.1 million M&P workers who smoke take an extra 5.6 million smoking-related sick days per year. If the likelihood of being a smoker had decreased for R&M workers as much as it did for M&P workers over the study period, there would have been 2.3 million fewer days lost to smoking-related sickness per year in 2013-2015.

Table 2. Impacts of occupation-related inequalities in smoking prevalence trends, 2013-2015.

	Smokers	Smoking-related sick days per year
Managerial & Professional workers	2.1 million	5.6 million
Routine & Manual workers	4.6 million	12.3 million
Routine & Manual workers if likelihood of being a smoker had decreased as much as for M&P workers	3.7 million	10 million
'Avoidable' impacts of inequality	0.8 million	2.3 million

Discussion

Main Findings

Smoking prevalence declined during the study period for both R&M and M&P workers, but not at the same rate relative to baseline: the likelihood of being a smoker decreased by half as much in R&M workers as it did in M&P workers. This difference in pace of relative change has widened the smoking prevalence gap between R&M workers and M&P workers. This reflects both smoking initiation and cessation. The association between occupation group and smoking prevalence trend is independent of differing demographics of the occupation groups. Failure to make the same reductions in R&M workers' smoking prevalence as have been achieved in M&P workers' smoking prevalence has manifested in an 'extra' 0.8 million smokers and an 'extra' 2.3 million worker sick days per year in 2013-2015 for R&M workers.

Though overall smoking prevalence is declining ^{5,6,7}, there are clear and persistent socio-economic inequalities in smoking prevalence, initiation rates and successful quit rates ^{5, 6, 7, 10}. This study builds on existing evidence by analysing the most recent available data and using statistical modelling to confirm the independent association between occupation group and smoking prevalence trends. The study adds further value for policymakers by quantifying the economic impact of failure to match M&P workers' smoking reduction progress among R&M workers.

Strengths and limitations

HSE is a cross-sectional survey meaning causality (e.g. occupation group causes smoking status) cannot be ascertained ¹⁵. Indeed, reverse causality is possible, with smoking affecting progress through socioeconomic and occupational strata due to tobacco expenditure ¹⁶, and poorer health and less productive time at work hindering career development. Longitudinal studies are necessary to ascertain causality ¹². However, such studies rarely achieve the large, representative samples found in national health surveys like HSE, so a mix of approaches is arguably beneficial.

Some potential covariates were omitted from the mixed effects logistic regression because appropriate data were not available in HSE. For example, mental health is a strong predictor of smoking behaviour ⁶, but the assessment of mental health in HSE was inconsistent over time meaning it could not be included in the model. It is possible that other factors may contribute to the association between occupation group and smoking trends but could not be tested using HSE data.

The large number of covariates in the analysis meant that 32% of participants in the full data set were excluded from the mixed effects logistic regression due to missing data on one or more variables. The majority of excluded participants were R&M workers, though the R&M worker group was still larger than the M&P worker group in the final analysis. It is possible that the participants excluded from the analysis were qualitatively different from those included in the analysis, and if these differences were unequal between occupation groups, the results would be affected.

Policy Implications

Occupation group is independently associated with smoking prevalence trends and is therefore a viable option for targeting smoking cessation efforts.

Smoking has a clear impact on our essential workforce. The progress achieved in M&P workers, and the finding that demographics do not explain the occupation group inequality, demonstrates what is possible for R&M workers.

Conclusions

Occupation group-related inequality in smoking prevalence has increased over time. There is little evidence to indicate the inequality will be resolved without targeted action on smoking initiation and cessation in R&M workers. There are clear health and economic consequences of the failure thus far to match M&P workers smoking reduction progress across all occupation groups.

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