Title	The effect of smoking on individual well-being: a propensity score matching analysis based on nationwide surveys in Japan
Author(s)	Oshio, Takashi; Kobayashi, Miki
Citation	
Issue Date	2009-08
Type	Technical Report
Text Version	publisher
URL	http://hdl.handle.net/10086/17554
Right	

The effect of smoking on individual well-being:

a propensity score matching analysis based on nationwide surveys in Japan

Takashi Oshio[1] and Miki Kobayashi[2]

[1]Institute of Economic Research, Hitotsubashi University, Tokyo, Japan

[2]Graduate School of Economics, Kobe University, Kobe, Japan

Key words:

Smoking, Happiness, Job satisfaction, Self-rated Health, Propensity score matching

─────────────────────────────────

Correspondence to: Takashi Oshio, Institute of Economic Research, Hitotsubashi University, 2-1 Naka, Kunitachi, Tokyo 186-8603, Japan
Email: oshio@ier.hit-u.ac.jp
Tel/fax +81-42-580-8658

ABSTRACT

Background: It is widely known that smokers tend to feel less satisfied than non-smokers with their jobs and life more generally. However, it is not easy to establish a causal relationship between smoking and individual well-being, because of shared associations with socioeconomic or demographic factors. This issue was largely avoided in the present study, which used propensity score matching methods to investigate whether smoking affects the extent to which individuals are satisfied with their job and other aspects of their life.

Methods: Using a large-scale Japanese dataset, we first estimated propensity scores for smoking as a function of numerous socioeconomic and demographic factors. We then matched smokers to non-smokers on the basis of these. We subsequently estimated the average treatment effect, considering smoking as a treatment and smokers as the treated group. We used different matching methods to ascertain the robustness of any effects.

Results: We found that smoking made both males and females unhappy, and that it reduced both the extent to which they were satisfied with multiple aspects of their lives (including their job, non-working activities, household's financial conditions, family life, friendships, residential area, health and physical conditions) and their level of self-rated health. Some of these effects differed between males and females.

Conclusions: Our propensity score matching analyses identified smoking as having direct adverse effects on individual well-being.

INTRODUCTION

Several studies have investigated associations between smoking and each of work stress, job satisfaction, and happiness. [1-5] A negative correlation between smoking and individual well-being has been observed, but this is not necessarily a causal relationship. For example, while it is reasonable to think that work stress and frustration may make people more inclined to smoke, it is equally reasonable to think that smoking may increase feelings of frustration, irritation, and unhappiness. [6]

Furthermore, it must be considered that any correlation between smoking and individual well-being might be spurious, given that both of these factors are likely to be affected by common socioeconomic or demographic variables. Indeed, many previous studies have found lower levels of educational attainment and household income to be associated positively with smoking [7-14] and negatively with individual well-being. [15-17] Such associations could lead to findings of a negative correlation between smoking and well-being irrespective of any causal relationship between them.

It is not easy to determine the extent to which smoking directly affects individual well-being, because at any single point of time an individual cannot be observed as both a smoker and a non-smoker. The use of instrumental variable methods could potentially resolve this issue. However, it is difficult to identify instrumental variables that affect smoking behaviour but do not directly affect individual well-being.

The aim of the present study was to examine the extent to which smoking affects an individual's assessment of their own well-being. To achieve this we used propensity

score matching methods, [18, 19] which are widely employed in clinical medicine, epidemiology, health economics and other fields to identify causal effects of treatments when random assignment is difficult to implement. We accessed a large-scale dataset derived from nationwide surveys in Japan that contained information permitting relationships between smoking, socioeconomic status and individual well-being to be analysed and compared against other advanced countries. The impact of smoking on individual well-being remains yet to be explored in Japan, although some studies have examined the association between smoking and socioeconomic factors in the Japanese population. [20, 21]

In employing a propensity score matching method, we effectively considered smoking as a treatment, and smokers and non-smokers as treated and control groups, respectively. We also interpreted self-reported assessments of individual well-being such as job satisfaction and happiness as potential outcomes of the treatment (i.e., smoking). We assumed that individuals were randomly assigned to the smoking and non-smoking groups given all observed socioeconomic and demographic characteristics. From this position, for each individual we calculated a propensity score, i.e., the probability of being assigned to the smoking group on the basis of the observed socioeconomic and demographic characteristics. We subsequently matched non-smokers to smokers, and calculated the average treatment effect on the treated, which was defined here as the difference between a smoker's average outcome and the average outcome of a matched individual. This procedure enabled us to capture the causal effect of smoking on individual well-being. Though yielding little information

4

concerning any reverse causal relationship (from individual well-being to smoking behaviour), we believe our approach capable of providing new insights into the association between smoking and individual well-being.

METHODS

Data

Our analyses were based on data pooled across six Japanese General Social Surveys (JGSSs) conducted in each of the years 2000–2003 and 2005–2006 (a survey was not conducted in 2004). The surveys were conducted and compiled by the Institute of Regional Studies, Osaka University of Commerce, in collaboration with the Institute of Social Science, University of Tokyo.

Sampling for each JGSS began by dividing Japan into six geographical blocks, which were subdivided according to population size into either three (in 2000–2005) or four (in 2006) sub-blocks. Between 300 and 526 locations (different each survey year) were then selected from each sub-block using the Population Census divisions. From each of these locations, 12 to 16 individuals aged between 20 and 89 years old were randomly selected. Data was collected from these individuals through a combination of interviews and self-administered questionnaires. Across the six surveys, the number of respondents ranged between 1,957 (in 2003) and 2,953 (in 2002); the response rate

ranged between 50.5 per cent (in 2005) and 64.9 per cent (in 2000). The total sample size for the six surveys was 14,750.

Our analysis focused on survey respondents who were both employed and aged less than 60 years old. This was because the impact of smoking on job satisfaction was to be one of the main issues addressed in our analysis, and a substantial portion of respondents aged 60 or more years had already retired (most private firms and public-sector institutions in Japan have a mandatory retirement age of 60 years, or slightly older than this). We were also interested in the impact of educational attainment on smoking, and most of the respondents aged 60 or more years had received their education under a system different from that currently in place (established in 1947). We also did not analyse any data of respondents missing information for key variables. Our final dataset had a sample size of 6,109 (2,940 males and 3,169 females), 41 per cent of the original sample.

We obtained from our dataset information on smoking, individual well-being, socioeconomic status, and demographics. The proportion of current smokers was 52.1 per cent and 17.7 per cent for males and females, respectively. There were nine individual well-being outcomes included in our analyses. Seven of these were based on JGSS questions that asked respondents how satisfied they were with their job, non-work activities, household's financial conditions, family life, friendships, residential area, and health and physical condition. Responses were made on a five-point scale, where 1 = satisfied and 5 = dissatisfied. We categorised responses of either 1 or 2 as 'satisfied'.

Two further items addressed aspects of subjective well-being: happiness and self-rated health. Responses were made by choosing one of five options in relation to the questions 'How happy are you?' and 'How would you rate your health condition?', and for which we categorised each of the top two options as 'happy' and 'excellent' respectively.

A number of socioeconomic variables were extracted from the dataset, with these relating to educational attainment, family types at age 15, household income, occupational status, and housing tenure. Educational attainment was categorised into three groups: graduated from college or higher establishment, from high school, or from junior high school. With regards to family types at age 15, we focused on whether respondents lived in a double-parent or single-parent family when they were at that age. The JGSS asked respondents to choose their pre-tax annual household income for the previous year from one of 19 possible categories. We equivalised the median value of each category by dividing by the square root of the number of household members, and evaluated the outcome in terms of consumer prices in 2005. The sample was then divided into four income classes. Occupational status was categorised as management, regular employee, non-regular employee, or self-employed. We had five categories for housing tenure: owner, renter from the free market, renter from employer, renter of public housing, and other. Housing tenure is an indicator of cumulative property ownership and wealth, rather than of flow-based income. [12, 22] With regards to demographics, we divided the respondents into four age groups (aged in their 20s, 30s, 40s, or 50s), considered marital status as married, never married, or divorced/widowed,

and having children in terms of either none or one or more. Table 1 provides summary statistics of all socioeconomic and demographic variables.

Table 1. Numbers and characteristics of respondents

	Males	Females	Total
Survey year	Number of observations		
2000	632	688	1,320
2001	566	612	1,178
2002	623	628	1,251
2003	346	415	761
2005	329	380	709
2006	444	446	890
Total	2,940	3,169	6,109
	Percentage (pooled across six surveys)		
Current smoking behaviour			
Smoker	52.1	17.7	34.2
Non-smoker	47.9	82.3	65.8
Educational attainment			
College or higher	42.6	38.0	40.2
High school	46.7	53.2	50.1
Junior high school	10.6	8.8	9.7
Family type at age 15			
Double-parent family	91.6	91.6	91.6
Single-parent family	8.4	8.4	8.4
Household income (equivalised)			
Highest quartile	21.8	27.8	24.9
Third quartile	26.4	23.1	24.7
Second quartile	27.4	23.4	25.4
Lowest quartile	24.4	25.6	25.0
Occupational status			
Management	13.9	37.1	25.9
Regular employee	70.0	25.6	46.9
Non-regular employee	4.4	33.5	19.5
Self-employed	11.7	3.9	7.6
Housing tenure			
Owner	73.0	72.7	72.8
Renter (free market)	17.9	16.9	17.4
Renter (from employer)	3.8	3.8	3.8
Renter (public housing)	4.7	6.1	5.4
Other	0.5	0.4	0.5
Age (years)			
20s	14.2	13.1	13.6
30s	22.4	25.6	24.1
40s	27.0	27.4	27.2
50s	36.3	33.9	35.0
Marital status			
Married	77.3	80.5	79.0
Never married	18.9	11.6	15.1
Divorced/widowed	3.7	8.0	5.9
Children			
None	27.3	19.7	23.4
One or more	72.7	80.3	76.6

Statistical analysis

It is well-known that there are substantial differences in smoking behaviour between the genders, [23] and thus all of our analyses were conducted separately for males and females.

We initially conducted logistic regression analyses to determine how smoking was related to each of the socioeconomic and demographic variables, the results of which were used to estimate propensity scores. In all of our estimations we included survey years as dummy variables, to control for any factors specific to these, used sampling weights provided by the JGSS organisers, and computed robust standard errors to correct for potential heteroscedasticity.

In estimating propensity scores, we repeatedly split the sample into a greater number of equally spaced intervals until the average propensity score of smokers and non-smokers did not differ. We confirmed that the balancing property was satisfied by testing that the mean for each characteristic did not differ between smokers and non-smokers. We employed three different widely used matching methods by which to estimate the average treatment effect of smoking from estimated propensity scores. These were nearest neighbourhood, radius, and kernel-based matching. We performed radius matching with radius sizes of both 0.01 and 0.001. For kernel-based matching we bootstrapped the standard error of the average treatment effect with 1,000 replications. For all of our estimations we used the econometric procedures of the Stata statistical software package. [24]

RESULTS

Data for individual well-being is shown in Table 2; also presented are results for comparisons of the proportion of smokers and non-smokers reporting favourable assessments (not controlling for covariates). For many of the nine variables by which it was evaluated, self-reported well-being was significantly lower for smokers than for non-smokers, with the largest of these differences being for happiness. It should also be noted that smoking was associated with a more substantial reduction in job satisfaction for males than for females. However, the results of the comparisons presented in this table must be interpreted cautiously, because covariates were not controlled for. Indeed, if smoking behaviour and individual well-being are strongly associated with common covariates it is likely that the magnitude and statistical significance of differences between means were both overestimated.

Table 3 summarises the estimated odds ratios (and 95 per cent confidence intervals) for the key covariates in our analysis of a relationship between smoking and individual well-being. Educational attainment had a strong association with smoking behaviour, a result that is consistent with many previous studies. A lower level of educational attainment was associated with a greater risk of smoking for both males and females. Living in a single parent family at age 15 was also associated with a greater risk of smoking for females, but not for males.

Table 2. Distribution of individual well-being by smoking status (before controlling for covariates)

	Males			Females			Total		
	Smokers (A)	Non-smokers (B)	(A) - (B)	Smokers (A)	Non-smokers (B)	(A) - (B)	Smokers (A)	Non-smokers (B)	(A) - (B)
Satisfied with the job	0.559	0.638	-0.079 ***	0.421	0.451	-0.030 *	0.522	0.517	0.005
with non-work activities	0.379	0.448	-0.069 ***	0.380	0.414	-0.034 *	0.379	0.426	-0.047 ***
with the household's financial conditions	0.242	0.287	-0.045 ***	0.232	0.289	-0.057 ***	0.239	0.288	-0.049 ***
with family life	0.511	0.564	-0.053 ***	0.449	0.515	-0.065 ***	0.495	0.532	-0.037 ***
with friendships	0.470	0.466	0.003	0.553	0.562	-0.010	0.492	0.529	-0.037 ***
with the residential area	0.533	0.591	-0.058 ***	0.496	0.534	-0.039 **	0.523	0.554	-0.031 **
with health and physical conditions	0.442	0.466	-0.024	0.456	0.492	-0.036 *	0.446	0.483	-0.037 ***
Happiness (happy)	0.598	0.678	-0.081 ***	0.579	0.684	-0.105 ***	0.593	0.682	-0.089 ***
Self-rated health (excellent)	0.480	0.524	-0.044 **	0.501	0.552	-0.051 ***	0.486	0.542	-0.057 ***

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

11

Table 3. Estimated associations between smoking and socioeconomic/demographic factors in logistic regression models: Odds ratios (OR) and their 95% confidence intervals (CI)
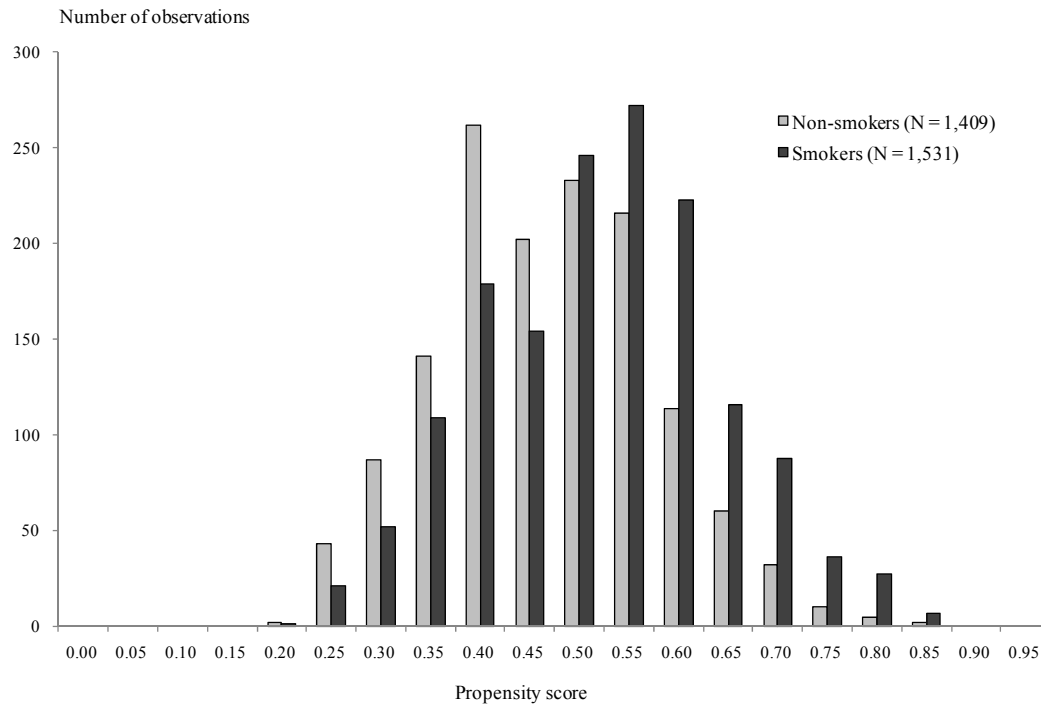
	Males		Females	
	OR	CI	OR	CI
Educational attainment				
College or higher	1.00		1.00	
High school	1.71 ***	[1.43-2.03]	1.98 ***	[1.54-2.55]
Junior high school	2.16 ***	[1.61-2.91]	3.11 ***	[2.07-4.68]
Family type at age 15				
Double-parent family	1.00		1.00	
Single-parent family	1.17	[0.87-1.56]	1.59 ***	[1.16-2.19]
Household income				
Highest quartile	1.00		1.00	
Third quartile	0.95	[0.76-1.19]	0.70 **	[0.51-0.97]
Second quartile	1.02	[0.81-1.29]	0.78	[0.56-1.08]
Lowest quartile	1.23	[0.95-1.59]	0.85	[0.62-1.18]
Occupational status				
Management	1.00		1.00	
Regular employee	1.01	[0.79-1.30]	1.15	[0.86-1.55]
Non-regular employee	0.93	[0.60-1.46]	1.20	[0.93-1.53]
Self-employed	1.08	[0.78-1.49]	1.76 **	[1.07-2.90]
Housing tenure				
Owner	1.00		1.00	
Renter (free market)	1.36 ***	[1.09-1.70]	2.04 ***	[1.56-2.66]
Renter (from employer)	0.93	[0.61-1.42]	0.57	[0.27-1.19]
Renter (public housing)	1.27	[0.86-1.87]	1.56 **	[1.07-2.27]
Other	1.55	[0.47-5.15]		
Age (years)				
20s	1.00		1.00	
30s	0.90	[0.68-1.19]	0.99	[0.71-1.39]
40s	0.73 **	[0.55-0.98]	0.59 ***	[0.40-0.86]
50s	0.66 ***	[0.49-0.89]	0.36 ***	[0.24-0.54]
Marital status				
Married	1.00		1.00	
Never married	0.77	[0.55-1.09]	1.19	[0.73-1.94]
Divorced/widowed	2.59 ***	[1.61-4.15]	1.97 ***	[1.37-2.84]
Children				
None	1.00		1.00	
One or more	0.98	[0.72-1.33]	1.05	[0.70-1.57]
Number of observations	2,940		3,155	
Log pseudo likelihood	-1951.7179		-1415.3451	
Pseudo R^2	0.0403		0.0738	

Survey year was included as a dummy variable in all analyses. *** $p < 0.01$, ** $p < 0.05$.

Household income and occupational status were not significantly associated with smoking, a result that is inconsistent with many previous studies. However, this changed when educational attainment was excluded from being an explanatory variable. Under these circumstances, we found odds ratios significantly greater than unity for males who were in the lowest income quartile, non-regular employees, or self-employed (results not presented). This suggests that educational attainment is associated with smoking in part via shared associations with household income and occupational status. With regards to housing tenure, only renters from the free market were found to have a greater risk of being smokers. From the results of these analyses, we can conclude that educational attainment is the strongest determinant of smoking status for both males and females in Japan.

The distribution of estimated propensity scores is shown for males and females in Figures 1 and 2, respectively. For males, the distribution for both smokers and non-smokers was bell-shaped, though skewed somewhat towards lower values for the latter. There was also a high degree of overlap between the distributions for smokers and non-smokers, meaning that matching could be reliably performed. In contrast, for females the distributions for smokers and non-smokers differed substantially, reflecting a low proportion of female smokers (17.7 per cent). Nevertheless, there was sufficient overlap between the distributions for matching to be performed. For both males and females, we confirmed that the balancing property was satisfied at the 1 per cent significance level.

Figure 1. Distribution of estimated propensity scores (males)

Number of observations

Propensity score

Figure 2. Distribution of estimated propensity scores (females)

Number of observations

Propensity score

14
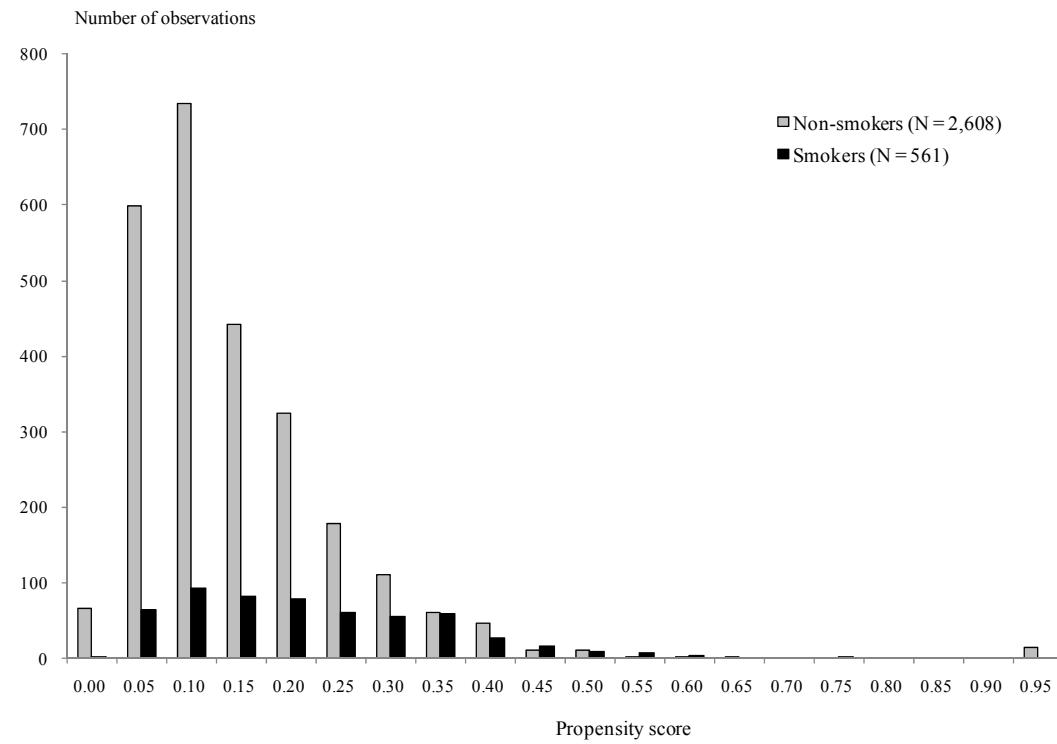
The key results of our matching analyses for investigating the estimated effect of smoking on individual well-being are shown in Table 4. The average treatment effect on the treated represents the difference in the probability of smokers and non-smokers reporting satisfaction or favourable assessments: a negative value indicates a lower probability for smokers. The matching analysis results differ from those for the comparisons reported Table 2, in which covariates were not controlled for, and are noteworthy for two reasons. The first of these was a substantial difference between males and females in the extent to which smoking had an impact. For males, smoking was associated with a significant reduction in satisfaction with their job and non-work activities (the latter of which could arise from an unsatisfactory work situation). For females, it was satisfaction with their family life and household's financial conditions that were adversely associated with smoking. In addition, smoking was associated with more substantial reductions for females than for males in both satisfaction with health and physical condition and self-rated health. These results suggest that any true understanding of smoking behaviour requires males and females to be considered separately. [20] The second and most important result to emerge from our matching analysis was that smoking had a significantly negative impact on happiness, the most comprehensive measure of individual well-being. Unlike more particular measures of individual well-being, the effect on happiness was found for both males and females and with all of the matching methods used.

Table 4. Estimated effects of smoking on individual well-being

Outcome per matching method	Males		Females	
	ATT	S.E.	ATT	S.E.
Satisfied with the job				
Nearest neighbourhood	-0.068	(0.025) ***	-0.037	(0.032)
Kernel	-0.055	(0.019) ***	-0.033	(0.025)
Radius (0.01)	-0.069	(0.019) ***	-0.040	(0.023) *
Radius (0.001)	-0.076	(0.020) ***	-0.041	(0.025)
Satisfied with non-work activities				
Nearest neighbourhood	-0.074	(0.025) ***	-0.033	(0.032)
Kernel	-0.060	(0.018) ***	-0.035	(0.023)
Radius (0.01)	-0.056	(0.019) ***	-0.034	(0.023)
Radius (0.001)	-0.063	(0.020) ***	-0.042	(0.024) *
Satisfied with the household's financial conditions				
Nearest neighbourhood	-0.014	(0.023)	-0.049	(0.028) *
Kernel	-0.021	(0.017)	-0.037	(0.020) *
Radius (0.01)	-0.026	(0.017)	-0.058	(0.020) ***
Radius (0.001)	-0.025	(0.018)	-0.059	(0.022) ***
Satisfied with family life				
Nearest neighbourhood	-0.011	(0.026)	-0.027	(0.032)
Kernel	-0.031	(0.019)	-0.053	(0.024) **
Radius (0.01)	-0.043	(0.019) **	-0.068	(0.023) ***
Radius (0.001)	-0.045	(0.020) **	-0.067	(0.025) ***
Satisfied with friendships				
Nearest neighbourhood	0.014	(0.026)	-0.022	(0.032)
Kernel	0.022	(0.019)	-0.006	(0.024)
Radius (0.01)	0.013	(0.019)	-0.012	(0.023)
Radius (0.001)	-0.001	(0.020)	-0.025	(0.025)
Satisfied with the residential area				
Nearest neighbourhood	-0.019	(0.025)	-0.023	(0.032)
Kernel	-0.046	(0.019)	-0.035	(0.024)
Radius (0.01)	-0.044	(0.019) **	-0.040	(0.024) *
Radius (0.001)	-0.043	(0.020) **	-0.057	(0.025) **
Satisfied with health and physical conditions				
Nearest neighbourhood	0.011	(0.026)	-0.039	(0.032)
Kernel	-0.015	(0.019)	-0.042	(0.024) *
Radius (0.01)	-0.020	(0.019)	-0.044	(0.024) *
Radius (0.001)	-0.017	(0.020)	-0.050	(0.025) **
Happiness (happy)				
Nearest neighbourhood	-0.058	(0.024) **	-0.094	(0.031) ***
Kernel	-0.067	(0.018) ***	-0.087	(0.024) ***
Radius (0.01)	-0.074	(0.018) ***	-0.111	(0.023) ***
Radius (0.001)	-0.085	(0.020) ***	-0.118	(0.024) ***
Self-rated health (excellent)				
Nearest neighbourhood	-0.017	(0.026)	-0.060	(0.032) *
Kernel	-0.034	(0.019) *	-0.058	(0.024) **
Radius (0.01)	-0.037	(0.019) *	-0.060	(0.024) **
Radius (0.001)	-0.032	(0.021)	-0.061	(0.024) **
Number of observations	Treated	Controls	Treated	Controls
	(Smokers)	(Non-smokers)	(Smokers)	(Non-smokers)
Nearest neighbourhood	1,531	1,049	561	919
Kernel	1,531	1,409	561	2,608
Radius (0.01)	1,528	1,409	557	2,591
Radius (0.001)	1,424	1,373	519	2,297

ATT (the average treatment effect on the treated) represents the difference in the probability of smokers and non-smokers reporting satisfaction or favourable assessments: a negative value indicates a lower probability for smokers. Standard errors for radius matching models are bootstrapped with 1,000 replications. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

DISCUSSION

It is not easy to identify the causal effect of smoking on individual well-being, as smoking is not a randomly assigned behaviour within the general population. This problem is further complicated by being unable to exclude the possibility that people smoke because they are unhappy. Indeed, as outlined above, many studies have found high levels of work stress and strain to place individuals at greater risk of smoking. Furthermore, it is also the case that any observed association between smoking and individual well-being may be at least partially spurious if common covariates are not adequately controlled for.

In the present study, we used propensity score matching methods to estimate the average effect of smoking on smokers. These methods assumed that individuals were randomly assigned to smoking and non-smoking groups given all observed socioeconomic and demographic characteristics. This approach is a reasonable alternative to instrumental variable methods for identifying direct causal effects of smoking, particularly if there are few reliable instrumental variables available.

The logistic regression models we used to estimate propensity scores revealed current smoking status to be strongly determined by educational attainment for both males and females, and by experiences in living in a single-parent family at age 15 for females. Current household income and occupational status bore little association with smoking when educational attainment was controlled for. These findings are consistent with a view that smoking tends to begin in adolescence, before the labour market has

been fully entered into. They also thus suggest that it is important to further investigate the individual-specific and social environmental influences on smoking in children and adolescents. [25, 26]

The key message to emerge from our study is that smoking makes people unhappy. This causal effect of smoking on individual well-being was identified with suitably appropriate propensity score matching methods, and was found to be highly significant for both males and females and with different matching methods. With regards to more particular measures, smoking tended to reduce the extent to which males were satisfied with their job and non-work activities. For females, it was satisfaction with each of family life, the household's financial conditions, and health and physical condition, and self-rated health that were adversely affected by smoking.

Our findings of adverse effects of smoking on individual well-being provide a clear rationale for smoking cessation policies. It should be noted however that our analyses do not completely exclude the possibility that lower levels of current well-being make individuals more inclined to smoke. In this context our results support a vicious cycle between individual well-being and smoking.

There are limitations of the present study that must be considered. Firstly, the reliability of propensity score matching methods depends heavily on assignment into treated and control groups being determined on the basis of observed covariates. However, the number of covariates for which we had data was limited, with potentially important factors not considered including personality traits, [27] peer and

neighbourhood effects, [28, 29] perceived income inequality, [30] social capital, [30, 31] and macroeconomic factors. [32] Secondly, relationships between smoking and socioeconomic status are more likely to be dynamic rather than static. Therefore, it will be of interest to investigate the extent to which it changes over time in association with changes in socioeconomic status. [33] This is an issue for future research that uses panel data and considers smoking as a dynamic behaviour.

ACKNOWLEDGEMENTS

COMPETING INTERESTS

None.

FUNDING

None.

REFERENCES

1 Becker GS, Murphy K. A theory of rational addiction. *J Polit Econ* 1988;**96**:675-700.

2 Johansson G, Johnson JV, Hall EM. Smoking and sedentary behavior as related to work organization. *Soc Sci Med* 1991;**32**:837-46.

3 Hellerstedt WL, Jeffery RW. The association of job strain and health behaviours in men and women. *Int J Epidemiol* 1997;**26**:575-83.

4 Albertsen K, Hannerz H, Borg V, et al. The effect of work environment and heavy smoking on the social inequalities in smoking cessation. *Public Health* 2003;**117**:383-8.

5 Kouvonen A, Kivimäki M, Virtanen M, et al. Work stress, smoking status, and smoking intensity: an observational study of 46,190 employees. *J Epidemiol Community Health* 2005;**59**:63-9.

6 Lang I, Gardener E, Huppert FA, et al. Was John Reid right? Smoking, class, and pleasure: a population-based cohort study in England. *Public Health* 2007;**121**:518-24.

7 Winkleby MA, Jatulis DE, Frank E, et al. Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health* 1992;**82**:816-20.

8 Adler N, Boyce T, Chesney MA, et al. Socioeconomic inequalities in health: no easy solution. *J Am Med Assoc* 1993;**269**:3140-5.

9 Stronks K, van de Mheen D, Looman CWN, et al. Cultural, material, and

psychosocial correlates of the socioeconomic gradient in smoking behavior among adults. *Prev Med* 1997;**26**:754-66.

10 Cavelaars AEJM, Kunst AE, Geurts JJM, et al. Educational differences in smoking: international comparison. *BMJ* 2000;**320**:1102-7.

11 Laaksonen M, Prättälä R, Helasoja V, et al. Income and health behaviours: evidence from monitoring surveys among Finnish adults. *J Epidemiol Community Health* 2003;**57**:711-7.

12 Laaksonen M, Rahkonen O, Karvonen S, et al. Socioeconomic status and smoking: analysing inequalities with multiple indicators. *Eur J Public Health* 2005;**15**:262-9.

13 Huisman M, Kunst AE, Mackenbach JP. Inequalities in the prevalence of smoking in the European Union: Comparing education and income *Prev Med* 2005;**40**:756-64.

14 Alexander JC. The relationship between education and health behavior: Some empirical evidence. *Health Econ* 2006;**15**:125-46.

15 Easterlin RA. Income and happiness: Towards a unified theory. *Econ J* 2001; **111**:465-84.

16 Frey BS, Stutter A. What can economists learn from happiness research? *J Econ Lit* 2002;**40**:402-35.

17 Blanchflower, DG, Oswald, AJ. Well-being over time in Britain and the USA. *J Public Econ* 2004;**88**:1359-86.

18 Rosenbaum PR, Rubin, DB. The central role of the propensity score in observational studies for causal effects. *Biometrika* 1983;**70**:41-55.

19 Rosenbaum PR. Observational studies (2nd ed.). New York: Springer-Verlag 2002.

20 Nakamura Y, Sakata K, Kubo N, et al. Smoking habits and socioeconomic factors in Japan. *J Epidemiol* 1994;**4**:157-61.

21 Fukuda Y, Nakamura K, Takano T. Socioeconomic pattern of smoking in Japan: income inequality and gender and age differences. *Ann Epidemiol* 2005;**15**:365-72.

22 Macintyre S, Ellaway A, Hiscock R, et al. What features of the home and the area might help to explain observed relationships between housing tenure and health? Evidence from the west of Scotland, *Health Place* 2003;**9**:207-18.

23 Bauer Th, Göhlmann S, Sinning M. Gender differences in smoking behavior. *Health Econ* 2007;**16:**895-909.

24 Becker SO, Ichino A. Estimation of average treatment effects based on propensity scores. *The Stata J* 2002;**2**:358-77.

25 Pust S, Mohnen SM, Schneider S. Individual and social environment influences on smoking in children and adolescents. *Public Health* 2008;**122**:1324-30.

26 Finkelstein DM, Kubzansky LD, Goodman E. Social status, stress, and adolescent smoking, *J Adolesc Health* 2006;**39**:678-85.

27 Khwaja A, Silverman D, Sloan F. Time preference, time discounting, and smoking decisions. *J Health Econ* 2007;**26**:927-49.

28 Shohaimi S, Luben R, Wareham N, et al. Residential area deprivation predicts smoking habit independently of individual educational level and occupational social class: a cross sectional study in the Norfolk cohort of the European Investigation into Cancer (EPIC-Norfolk). *J Epidemiol Community Health* 2003;**57**:270-6.

29 Harris JE, López-Valćarcel BG. Asymmetric peer effects in the analysis of cigarette

smoking among young people in the United States, 1992–1999. *J Health Econ* 2008;**27**:249-64.

30 Siahpush M, Borlanda R, Taylorb J, et al. The association of smoking with perception of income inequality, relative material well-being, and social capital. *Soc Sci Med* 2006;**63**:2801-12.

31 Lindström M. Social capital, political trust and daily smoking and smoking cessation: a population-based study in southern Sweden. *Public Health* 2009;**123**:496-501.

32 Novo M, Hammarström A, Janlert U. Smoking habits—a question of trend or unemployment? A comparison of young men and women between boom and recession. *Public Health* 2000;**114**:460-3.

33 Siahpusha M, Hellerb G, Singh G. Lower levels of occupation, income and education are strongly associated with a longer smoking duration: multivariate results from the 2001 Australian National Drug Strategy Survey. *Public Health* 2005;**119**:1105-10.