

# Smoke intake among smokers is higher in lower socioeconomic groups

Martin Bobak, Martin J Jarvis, Zdenka Skodova, Michael Marmot

## Abstract

**Objective**—To analyse socioeconomic differences in serum thiocyanate concentrations among current smokers, and whether such differences persist after adjustment for the number of cigarettes smoked.

**Setting**—General population of six districts of the Czech Republic in 1992.

**Participants**—451 male and 282 female current smokers.

**Main outcome measure**—Serum concentration of thiocyanate.

**Results**—There was a clear educational gradient in serum thiocyanate among male smokers; car ownership and crowding were not related to thiocyanate. Age adjusted mean concentrations in men with primary, vocational, secondary, and university education were 168.6, 158.2, 148.2, and 141.8  $\mu\text{mol/l}$ , respectively ( $p$  for trend 0.032). Adjustment for the average daily number of cigarettes explained a part of this gradient. Socioeconomic differences in serum thiocyanate were not seen in women.

**Conclusion**—The strong gradient in men suggests that smokers from lower socioeconomic groups have a preference for higher smoke intake and so may be more nicotine dependent. This finding, if confirmed, would have important implications for anti-smoking programmes.

(*Tobacco Control* 2000;9:310-312)

Keywords: socioeconomic groups; serum thiocyanate; smoke intake

It is well known that the prevalence of smoking is higher in lower socioeconomic groups,<sup>1</sup> but socioeconomic differences in biochemical measures of smoke intake among smokers have been studied less. In the USA, higher concentrations of cotinine for a given level of cigarette consumption have been reported among black compared with white smokers.<sup>2-4</sup> Data from the Health Survey for England revealed a strong social gradient in plasma cotinine among smokers, and controlling for the number of cigarettes per day did not remove this gradient.<sup>5</sup>

Such differences are potentially important, as they may indicate higher levels of nicotine dependence among smokers with low socioeconomic status which, in turn, may result in a differing impact of anti-smoking interventions in different socioeconomic groups. We have analysed plasma levels of thiocyanate among smokers in the Czech Republic

to examine whether these observations can be replicated in other populations.

## Methods

We used data from the Czech 1992 MONICA (monitoring trends and determinants in cardiovascular disease) survey, a cross sectional study in a random sample of men and women aged 25-64 years, resident in six participating districts. Of 3200 invited, 2353 subjects took part in the study (response rate 75%).<sup>6</sup> Smoking status was established by the question: "Do you currently smoke more than one cigarette a day?" Information on the average daily number of cigarettes was also collected. All 451 men and 282 women who smoked at least one cigarette a day constituted the sample for the present analyses. Serum thiocyanate was measured by the Butts method<sup>7</sup> following the WHO MONICA project protocol.<sup>8</sup>

Participants were classified into four groups of educational attainment: primary, apprenticeship, secondary, and university. Education, previously found to be the most useful indicator of socioeconomic status in this population,<sup>6</sup> was used as the primary socioeconomic indicator, but data on car ownership and crowding were also collected.

Linear regression was used to adjust the sex specific means of thiocyanate by socioeconomic category among smokers, first for age group and then for age and the average number of cigarettes smoked per day. Because the association of thiocyanate with age was not linear, 10 year age groups were used in the analyses.

## Results

The mean levels of serum thiocyanate were 157.2  $\mu\text{mol/l}$  in men and 152.5  $\mu\text{mol/l}$  in women. As in other studies, the relation between serum thiocyanate and cigarette consumption was curvilinear, tending to asymptote at about 15-20 cigarettes per day, reflecting smokers tendency to titrate their intake at higher consumption level (data not shown).

There was a clear educational gradient in cigarettes per day and in serum thiocyanate among men but not among women (table 1). Men in the lowest educational category smoked, on average, six cigarettes per day more, and their plasma thiocyanate was 26.8  $\mu\text{mol/l}$  higher than that of those in the highest category. Controlling for the average number of cigarettes per day reduced the social gradient in thiocyanate (the difference between the highest and lowest category was reduced to

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Received 23 July 1999 and in revised form  
25 November 1999.  
Accepted 6 March 1999

Table 1 Numbers of smokers (at least one cigarette a day), average number of cigarettes per day among smokers, and mean serum thiocyanate by education.

	Number of subjects	Mean age (years)	Mean number of cigarettes per day	Mean (95% CI) serum thiocyanate adjusted for age ( $\mu\text{mol/l}$ )	Mean (95% CI) serum thiocyanate adjusted for age and cigs/day ( $\mu\text{mol/l}$ )
<b>Men</b>					
Education					
Primary	66	45.6	18.4	168.6 (156.2 to 181.0)	164.1 (152.0 to 176.2)
Apprenticeship	249	41.4	15.5	158.2 (151.2 to 165.3)	158.8 (152.0 to 165.7)
Secondary	110	42.6	14.6	148.2 (139.1 to 157.4)	150.3 (141.1 to 159.2)
University	26	45.3	12.5	141.8 (120.7 to 162.9)	147.6 (127.1 to 168.2)
p for linear trend	—	—	—	0.032	0.195
<b>Women</b>					
Education					
Primary	93	41.7	10.1	152.9 (140.1 to 165.8)	153.2 (141.3 to 165.1)
Apprenticeship	96	40.3	11.0	152.9 (139.0 to 165.8)	152.0 (139.1 to 164.9)
Secondary	85	40.9	9.5	144.7 (133.0 to 156.4)	147.1 (136.3 to 158.0)
University	8	43.8	10.4	149.4 (104.2 to 194.5)	146.4 (104.5 to 188.2)
p for linear trend	—	—	—	0.51	0.851

16.5  $\mu\text{mol/l}$ ), and the trend became non-significant. Educational differences among women were smaller. Neither car ownership nor crowding were associated with serum thiocyanate in men or women.

### Discussion

We found that serum thiocyanate concentrations were inversely associated with education among men. The absence of this association among women may partly be caused by the small number of women with university education, but it is also consistent with relatively small social differences in smoking in Czech women.<sup>6</sup> There seems to be a cohort effect among women; the gradient has the “western” direction (higher prevalence of smoking in women with lower education) among younger women (< 35 years old) but the opposite among older women. The absence of an association between serum thiocyanate and car ownership and crowding is consistent with previous studies of socioeconomic differences in health in the Czech population; education appears to be the most important social indicator while factors reflecting material conditions are less important.<sup>6-9</sup>

Although thiocyanate is a less accurate indicator of smoke intake than cotinine, the results clearly demonstrated that among men in this population, the educational gradient was not limited to the prevalence of smoking, but was also pronounced among smokers. Higher intakes can be achieved by different ways, including smoking more cigarettes or inhaling more smoke from each cigarette. In either case, the smokers choose the level of intake they prefer. In our data, the educational differences in serum thiocyanate were only partly attributable to differences in the average number of cigarettes per day. This suggests that smokers with lower socioeconomic status also inhaled the cigarettes they smoked more intensively. Socioeconomic differences may thus have contributed to the racial differences in plasma cotinine observed in the USA.<sup>2-4</sup>

There are two main potential confounders: diet and passive smoking. The contribution of diet, particularly beer and some foodstuffs, to thiocyanate concentrations is well known. Information on beer consumption was available in our dataset, but controlling for this

variable made no difference to our finding. We were not able to adjust for consumption of vegetables such as brassicas, but it is unlikely that this could account for our findings. In this population, we have previously found no socioeconomic differences in consumption of different types of vegetables (M Bobak, unpublished data). It could be argued that smokers from lower socioeconomic groups would also be more heavily exposed to other people’s tobacco smoke, and that passive smoking could therefore be a confounder. Again, this is unlikely. Previous work has shown that thiocyanate is not sensitive to passive smoking exposure.<sup>10</sup> Data on self reported passive smoking were available, but adjustment for this again made no difference to our results.

The data support the hypothesis that nicotine addiction may be stronger among smokers in lower socioeconomic groups. This may contribute to the lower effectiveness of anti-smoking interventions among smokers in lower social strata. Nicotine addiction may also help to explain the observation that most of the current social gradient in smoking is caused by low cessation rates in lower social groups although they seem to be similarly motivated to quit.<sup>5,11</sup> If this hypothesis proves to be true, policies to reduce the socioeconomic gradient in smoking may need to be social group specific and take into account the higher levels of nicotine dependence in lower social groups.

The study was funded by the Czech Ministry of Health. MB was supported by a Wellcome Trust Training Fellowship in Clinical Epidemiology. MM is the recipient of a Medical Research Council Research Professorship.

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*Tob Control* 2000 9: 310-312

doi: 10.1136/tc.9.3.310

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