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Short report

Does the association between smoking and mortality differ by educational level?

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ABSTRACT

Some researchers suggest that the effect of smoking on health depends on socioeconomic status; while others purport that the effect of smoking on health is similar across all social groups. This question of the interaction between smoking and socioeconomic status is important to an improved understanding of the role of smoking in the social gradient in mortality and morbidity. For this purpose, we examined whether educational level modifies the association between smoking and mortality. Information on smoking by age, gender and educational level was extracted from the Belgian Health Interview Surveys of 1997 and 2001. The mortality follow up of the survey respondents was reported until December 2010. A Poisson regression was used to estimate the hazard ratio of mortality for heavy smokers, light smokers, and former smokers compared with never smokers by educational level controlling for age and other confounders. Among men, we found lower hazard ratios in the lowest educational category compared with the intermediate and high-educated categories. For instance, for heavy smokers, the hazard ratios were 2.59 (1.18–5.70) for those with low levels of education, 4.03 (2.59–6.26) for those with intermediate levels of education and 3.78 (1.52–9.43) for the highly educated. However, the interaction between smoking and education was not statistically significant. For women, the hazard ratios were not significant for any educational category except for heavy smokers with intermediate levels of education. Also here the interaction was not statistically significant. Our results support the hypothesis that educational attainment does not substantially influence the association between smoking and mortality.

Introduction

The joint influence of smoking and socioeconomic status (SES) on health and mortality has received little attention in the literature; and the few published studies reported inconsistent findings and supported contradictory arguments (Pampel & Rogers, 2004; Thrane, 2006; Williamson, 2000).

One set of studies purports that the impact of harmful lifestyle factors such as smoking is conditional upon SES. This argument has been championed by Mildred Blaxter who studied a large sample of adults in Britain using a composite measure of physiological indices and found that smoking had a greater impact on the health of the non-manual social classes compared with the manual social classes. The author concluded that due to the existence of a wide range of competing risk factors in manual social classes, smoking makes little difference, while the high potential of the non-manual social classes for good health makes them more vulnerable to the damaging effect of tobacco smoking (Blaxter, 1990). This argument implies that there are few benefits in changing lifestyle factors such as tobacco smoking without improving the social conditions of the disadvantaged social groups (Pampel & Rogers, 2004). However, Blaxter's results have been criticized for not presenting statistical significance tests (Marang-van de Mheen, Davey Smith, & Hart, 1999). Using Canadian data, a study examined the presence of interactions between smoking and socioeconomic status on general self assessed health status (Birch, Jerrett, & Eyles, 2000). The authors found significant variations by income, employment and education in the association between smoking and health. They found that those who are employed or have a high income are less prone to the adverse health effects of smoking compared with those who are unemployed or have a low income. This association is reversed for education, implying that as the level of education increases the adverse effect of smoking on health increases. The authors concluded that even if lower SES groups reduced their smoking rates to the levels of higher social groups, this would not eliminate the excess of smoking related diseases experienced by lower SES groups.

Another set of studies suggests that both socioeconomic status and lifestyle factors affect health, but the combination of both brings no additional effect. This means that the effect of harmful health behaviour is similar across all socioeconomic categories. For instance, Marang-van de Mheen and colleagues tested the Blaxter hypothesis and found in a prospective study of mortality in West Scotland that the association between tobacco and mortality is not

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statistically different between occupational classes (Marang-van de Mheen et al., 1999). The question of whether the association between smoking and mortality differed by educational level was also examined in a prospective population study from Copenhagen (Schnohr et al., 2004). The authors found that the association between smoking and mortality was the same for all educational levels. A similar finding of no interaction between smoking and SES was reported by authors studying self-reported health outcomes in the Denmark, the Netherlands and Canada (Christiansen & Kooiker, 1999; Kooiker & Christiansen, 1995; Williamson, 2000). These arguments in favour of the lack of interaction suggest that improving the social conditions and reducing smoking are both important to reduce health inequalities.

In conclusion, the studies examining the interaction between socioeconomic status and lifestyle factors are rare and are characterized by inconsistent findings. In this context, the purpose of the current study is to use Belgian data to explore further whether educational level modifies the association between smoking and mortality.

Methods

Study population

Data for smoking behaviour by age, sex and socioeconomic status were extracted from two national cross sectional studies: the Health Interview Surveys of 1997 and 2001. The participants were selected from the National Register through a multistage stratified sample of the non-institutionalized Belgian population aged 15 years and over. The National Register is a public register with details of all registered residents living in Belgium. The participation rate in the HIS surveys was 58.5% in 1997 and 61.4% in 2001 (Bayingana et al., 2006). The detailed methodology of the survey is described elsewhere (Van Oyen et al., 1997). The data about socioeconomic status were collected through face-to-face interviews, while data related to smoking were collected via self-administered written questionnaires.

For the purpose of this study, the National Institute of Statistics (NIS) provided us with a list of those who participated in the HIS 1997 and HIS 2001 and who had died by December 31st, 2010. We merged the list provided by the NIS with the database of the surveys of 1997 and 2001 to create a final database that included all the participants in these surveys with their characteristics and their vital status at the end of the follow up period.

Measures

Smoking

Smoking status is self-reported. Daily and occasional smokers were considered as smokers. A four-category variable was used to differentiate between never smokers, former smokers, light smokers (smoking less than 20 cigarette per day), and heavy smokers (20 cigarette or more per day).

Educational attainment

Socioeconomic position was based on the highest level of education achieved in the household. We recoded the original education variable into three educational categories: low (primary education or less), intermediate (lower secondary education and higher secondary education), and high (higher education).

Data analyses

The ages of the subjects belonging to a cohort study change during the follow up time, and the longer the follow up period, the larger will be the difference between the ages of entry and the ages attained during the follow up. To account for this, we used Lexis expansions of the original data. We divided the follow up period of each subject into 5-year age bands. The assumption was made that the true rate for the cohort is constant within each age band, but then changes to a different constant level for the next band and so on (Kirkwood & Sterne, 2003a). As mortality information is for all causes, we restricted our final database to include only those older than 40 years because death at younger ages is not likely to be related to smoking. The restriction on age was applied for age during follow up.

The age standardized mortality rates by educational level and smoking were estimated by direct standardization, using the Belgian population of 2001 as a standard population. This standardization was weighted to account for the complex study design of the survey. A Poisson regression was used to estimate the hazard ratio of mortality for heavy smokers, light smokers, and former smokers compared with never smokers by educational level. The regression models were weighted to be representative of the Belgian population. In the first model, we adjusted only for age that was categorized into 5-years age groups (40/45, 50/55, 60/65, 70/75, 80/85). In the second model, we adjusted for age and other covariates that are: obesity, alcohol consumption, and employment of the head of the household. In accordance with the WHO criteria, subjects with a body mass index greater than or equal to 30 were considered obese (WHO, 1995). The professional status was categorized into 9 groups with senior officials and managers as reference category. Heavy alcohol consumption was accounted for using 3 categories: Abstainers or no heavy drinking in the past 12 months; occasional heavy drinking (less than once per month in the past 12 months); regular, frequent or chronic heavy drinking (once per month or more in the past 12 month).

To assess the interaction between educational level and smoking, we introduced in the regression interaction terms between smoking categories and educational categories and used the Wald test to evaluate difference in the fit of the models with and without these interaction terms. A significant interaction would suggest that the effect of smoking is statistically different by educational level (Kirkwood & Sterne, 2003b). Additionally, we stratified our analysis by educational level and estimated three Poisson regressions, one for each educational level.

All analyses were undertaken separately for males and females. Confidence intervals were calculated at the 95% level. The analyses were performed using STATA 10.

Results

We had a total of 13,410 respondents and 1970 deaths (approximately 15%) by the date of 31/12/2010. Table 1 shows age adjusted mortality rates by educational level and by smoking category. The figures show that the higher the level of education the lower the mortality rate. For instance, the mortality rate among men with a low educational level was 2977 per 100,000 person years (PY) while this figure was 1519 per 100,000 PY for men with a high educational level. Concerning smoking, we found increasing mortality rates with increasing smoking intensity.

Table 2 shows age standardized mortality rates stratified simultaneously by educational level and smoking category, as well as the age adjusted rate difference (RD) and rate ratio (RR) between never smokers and the other categories of smokers. As a general pattern, the RD between the never smokers and the other smoking categories was less pronounced in the high educational category. The intermediate educational level showed elevated RD that were in many cases higher than the RD for the low education level. The RD became more important as smoking intensified. For instance, the RD between heavy smokers and never smokers among men