BRIEF REPORT

Smokers living in deprived areas are less likely to quit: a longitudinal follow-up

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Objective: To follow up smokers to examine whether the likelihood of quitting smoking varied by area deprivation, and whether smoking history, health status, personality characteristics, social support and stressful situations contributed to differences in area deprivation in quit rates.

Design: Longitudinal data with a 6-year follow-up period were analysed using multilevel logistic regression. Area-level deprivation was characterised by a composite measure that was the sum of the proportion of unemployed residents, the percentage of residents in blue-collar occupations and the proportion with only elementary-level education. Previously established predictors of smoking cessation, including education, age at smoking initiation, self-assessed health, chronic illness, locus of control, neuroticism, negative life events, longlasting relationship difficulties, emotional social support and negative neighbourhood conditions were examined separately and in a combined model to assess whether they contributed to neighbourhood deprivation differences in quitting.

Participants: 404 participants (residing in 83 areas) identified as smokers at baseline and who did not change their residential address over the follow-up period.

Main outcome: Being a non-smoker at follow-up.

Results: Odds ratios of quitting decreased with greater area-level deprivation, but differences reached significance only between the most and least deprived quartiles. Smoking history, health status, personality characteristics, social support and stressful situations did not contribute to the lower quitting rates seen among smokers in deprived areas.

Conclusions: Living in a deprived area seems to reduce the likelihood of quitting smoking; hence individual-level tobacco control efforts should be complemented with area-based interventions. However, we need to identify and understand the underlying factors associated with living in a deprived area that contributes to lower quitting rates.

Extensive research has examined the socioeconomic influences on smoking. Most of this work has focused on socioeconomic determinants at the individual level, such as how smoking varies by education, occupational class and income.[1][2] Recent work has shown that deprivation characteristics of residential areas are associated with residents' smoking, independent of their demographic and socioeconomic characteristics, and that smoking prevalence increases with area deprivation.[1–4] However, one of these studies showed that the relationship between smoking prevalence and area deprivation did not hold for all measures of area deprivation.[3] A US study found no relationship between the degree of income inequality in states and smoking behaviour.[5] These studies have hypothesised that area inequalities in smoking may be the consequence of a spatial patterning in smoking history, health status, personality characteristics, support and stressful situations that predisposes people in disadvantaged areas to smoke.

The relationship between area deprivation and smoking has been examined only in cross-sectional studies. There has been no longitudinal follow-up of changes in smoking status of adults living in areas with different deprivation characteristics. Such an examination would help elucidate whether area of residence is likely to have a causal relationship on smoking, and whether any of the established individual-level factors contribute to changes in smoking status.

This study followed a group of smokers over 6 years to examine whether the likelihood of quitting varied between residents of areas differing in their deprivation characteristics. Furthermore, it investigated whether smoking history, health status, personality characteristics, coping, social support and stressful situations contributed to area deprivation inequalities in quitting.

MATERIALS AND METHODS

Longitudinal data were used from the GLOBE study conducted in The Netherlands. The aim of GLOBE is to examine the socioeconomic inequalities in health and determinants of these inequalities. The study population slightly over-represents people with chronic illnesses (ie, cardiovascular diseases, lung diseases, type 2 diabetes and arthritis) relative to the general population. Detailed information about its design and sampling is provided elsewhere.[6]

Self-reported smoking status data were collected by baseline postal questionnaires in 1991 (response rate 70.1%) and follow-up postal questionnaires in 1997 (response rate 85.8%). Reminder postcards and replacement questionnaires were sent to non-respondents of each postal questionnaire to enhance response rates. Respondents' addresses in 1997 were obtained from the municipality population register to decrease loss of follow-up owing to change in address. Attrition between the two data collection time points was due to death (5.8%), moving abroad (0.7%), active refusal of participation (5.6%) or because participants' addresses could not be traced (0.7%). Attrition, loss to follow-up and non-response occurred more among participants in deprived areas, the low educated and smokers. The current study focused on participants who reported being current smokers at baseline, lived in an urbanised area and did not change their residential address over the period (n = 404 participants living in 83 areas).

We used several factors collected by postal questionnaires at baseline (1991) as potential predictors of area deprivation differences in quitting smoking. Their selection was based on previous analyses of a larger number of predictors of quitting among smokers in the GLOBE study.[7] Only factors significantly associated with quitting were selected—namely, socioeconomic and demographic characteristics (education, sex and age), age at smoking initiation, perceived health, chronic illness, locus of control, neuroticism, life events,

relationship difficulties, emotional social support and negative neighbourhood conditions. Their measurement and categorisation are detailed elsewhere.[7]

Measures
Smoking status was measured in the 1991 and 1997 postal questionnaires. All remaining measures were obtained from the baseline (1991) postal questionnaire.

Smoking status
In the baseline and follow-up questionnaires, participants were asked, ''Do you smoke?'' Answering options were ''yes'', ''no'' or ''no, but I used to smoke''. The next question to all smokers and ex-smokers was how many cigarettes they smoked per day. Those reporting smoking $\geqslant 1$ cigarettes per day were considered smokers. The outcome of interest was being a non-smoker at follow-up (n = 85, 21%).

Neighbourhood deprivation
City administrative units, which have an average population of 2000 inhabitants, were the area-level units used in the current study. An area deprivation indicator was developed from three socioeconomic and deprivation items: percentage of residents with primary school as their highest attained educational level; percentage who were employed in unskilled manual occupations; and percentage who were unemployed. These percentages were summed and the measure was categorised into quartiles. This measure has been used elsewhere with other health-related outcomes.[8 9]

Education
Participants were asked about their highest attained level of education. Responses were coded into four categories based on years of education: elementary ($\leqslant 6$ years), lower secondary (9–11 years), higher secondary (12–13 years) and tertiary ($\geqslant 14$ years).

Self-assessed health
Self-assessed health was assessed by the question: ''How do you rate your health in general?''.[7] Answers were dichotomised into ''very good'' and ''less than good''.

Chronic illness
Participants were considered to have a chronic illness if they reported having at least one of 23 chronic conditions presented in a checklist, some were severe illnesses (ie, cancer and heart disease) and others were less severe (ie, migraines and varicose veins).[7]

Locus of control and neuroticism
Rotter's Locus of Control scale was used to measure the locus of control,[10] and a Dutch translation of the Eysenck Personality questionnaire was used to measure neuroticism.[11] Both these measures were summarised as variables of four categories, ranging from internal to external locus of control, and from no or slight neuroticism to high neuroticism.

Negative life events
Similar to previous studies,[7 12] nine negative life events in the preceding 12 months (eg, serious illness, death of loved ones, divorce, substantial drop in income or victim of crime) were used to assess negative life events. Participants were coded as experiencing none, one, two or three or more negative life events.

Longlasting difficulties in relationship
Long-term difficulties in relationship were assessed with a modified version of the Dutch longlasting difficulties list.[7] Eight items dealt with conflicts or difficulties with a partner, family members or friends. Each item had a five-category response option ranging from 0 (no problem or not applicable) to 4 (serious problem), and were summed to form a total score and categorised into five groups ranging from no difficulties in any relationship to difficulties in most relationships.

Emotional social support
Emotional social support was measured by a shortened version of a Dutch questionnaire.[7] Respondents stated the three most important people in their lives and subsequently indicated how often these people provided several examples of emotional support (eg, feeling free to go to this person when upset, being able to share thoughts with this person and being able to rely on the person). Scores were divided into quartiles that ranged from a high level of emotional social support to hardly any emotional social support.

Negative neighbourhood conditions
Four items used in previous research[7] were used to assess negative neighbourhood conditions. These items measured participants' perceptions of the presence of stench or fumes, noise from neighbours, noise from traffic and criminality in their neighbourhood.

Analyses
Weights were assigned to all analyses to adjust for the over-representation of chronically ill participants in the sample. The effect of area deprivation on quitting smoking was assessed using multilevel logistic regression, comprising of people clustered in residential areas (model A). Each predictor was added separately to this model, and its contribution was expressed by the reduction in inequality of the odds ratio (OR; only significant ORs were examined). The final model included all predictors simultaneously. The least deprived quartile of areas was used as the reference category in all analyses. The combined Wald test was used to assess the contribution of neighbourhood deprivation to explaining variation in quitting behaviour. The Wald test is considered more reliable than the likelihood ratio test for logistic models.[13]

Area heterogeneity for quitting smoking was analysed as a two-level multilevel logistic regression model using MlwiN V.1.10.0007. Specifically, we fitted a multilevel binomial logit-link model with the predictive-penalised quasi-likelihood procedure and second-order linearisation using the iterative generalised least squares algorithm. Tests for extrabinomial variation at level 1 (individuals) showed no evidence of underdispersion or overdispersion.

RESULTS
Table 1 summarises the odds of quitting by area deprivation, and the contribution of individual and other factors to explaining area deprivation gradients. Model A showed that participants were less likely to quit with increasing area deprivation; however, differences reached significance only between the highest and lowest deprivation categories. Those living in the most advantaged quartile were about four times more likely to quit than participants in deprived areas.

Overall, none of the predictors made a substantial contribution to explaining the lower odds of quitting among participants living in deprived areas. Educational level contributed the most; self-assessed health and emotional social support explained a very small amount. Chronic illness, locus of control and negative life events had a negligible role in explaining the inequalities.

Age at smoking initiation, neuroticism, longlasting relationship difficulties and perceived negative neighbourhood conditions did not have a role in the lower quitting rates seen

Table 1 Odds ratios of quitting smoking by area deprivation and potential explanatory factors (n = 404, n = 85 quitters)

Model	Neighbourhood deprivation quartiles ORs of quitting (95% CI)†			
	Most deprived	2	3	Least deprived
Area deprivation effects				
Model A	0.22* (0.09 to 0.54)	0.54 (0.24 to 1.23)	0.87 (0.35 to 2.18)	1.00
Predictor variables				
Model A and education	0.28* (0.11 to 0.72)	0.66 (0.26 to 1.65)	0.96 (0.39 to 2.37)	1.00
%‡	7.5			
Model A and age at smoking initiation	0.22* (0.09 to 0.54)	0.53 (0.23 to 1.24)	0.86 (0.34 to 2.21)	1.00
%	0			
Model A and self-assessed health	0.25* (0.10 to 0.64)	0.59 (0.25 to 1.41)	0.94 (0.36 to 2.46)	1.00
%	3.8			
Model A and chronic illness	0.23* (0.09 to 0.57)	0.55 (0.23 to 1.31)	0.88 (0.34 to 2.25)	1.00
%	1.3			
Model A and locus of control	0.23* (0.10 to 0.54)	0.54 (0.24 to 1.24)	0.87 (0.35 to 2.14)	1.00
%	1.3			
Model A and neuroticism	0.22* (0.09 to 0.54)	0.51 (0.21 to 1.20)	0.92 (0.35 to 2.41)	1.00
%	0			
Model A and negative life events	0.23* (0.10 to 0.54)	0.54 (0.24 to 1.24)	0.84 (0.34 to 2.08)	1.00
%	1.3			
Model A and longlasting relationship difficulties	0.22* (0.09 to 0.54)	0.54 (0.24 to 1.23)	0.88 (0.35 to 2.21)	1.00
%	0			
Model A and emotional social support	0.25* (0.10 to 0.61)	0.57 (0.24 to 1.34)	0.94 (0.37 to 2.37)	1.00
%	3.8			
Model A and negative neighbourhood conditions	0.22* (0.09 to 0.53)	0.54 (0.24 to 1.23)	0.85 (0.35 to 2.10)	1.00
%	0			
All predictors				
Model A and all predictors	0.30* (0.11 to 0.79)	0.64 (0.25 to 1.68)	1.07 (0.44 to 2.59)	1.00
%	10.0			

Model A consists of area deprivation, gender and age as independent variables.
*p<0.05.
†Odds ratios determined by multilevel logistic regression.
‡% Reduction in inequality compared with base model = (OR model A−OR model A+predictor)/(OR model A−1).

among smokers in deprived areas. Entering all predictors in the model simultaneously only made a small contribution to understanding why smokers in the most deprived areas were less likely to quit. The combined Wald test for area deprivation was significant (p<0.05) for all models. Analyses for each of the dummy variables separately showed that this significance was primarily a result of the most deprived quartile.

DISCUSSION

Our findings suggest that the socioeconomic characteristics of areas in which smokers reside influence their quitting behaviour, and raise the possibility of a causal relationship between neighbourhood deprivation and smoking status. None of the individual-level predictors explained these area deprivation inequalities substantially.

Selection bias or residual confounding may have contributed to our findings. Attrition, loss to follow-up and non-response occurred more among participants in deprived areas, the low-educated and smokers.[7] Other analyses show greater follow-up losses among participants who had higher scores for some of the predictors of quitting.[7] This group could be expected to have lower odds of quitting; therefore, our current study may underestimate the magnitude of the inequalities. In studies such as the current study, it can be asserted that independent contextual effects are simply an artefact caused by individual-level factors that are not accounted for in the models. To reduce all potential sources of residual confounding, the analyses were repeated, simultaneously adjusting for education, occupation, employment status, income, single parenthood and housing tenure (analyses not shown); however, this did not change the results markedly. Therefore, residual confounding may not probably contribute to the lower odds of quitting among residents of deprived areas in our study.

Our longitudinal results suggest something unique about living in a deprived area that was not measured in our study that contributes to lower odds of quitting. Other studies based on cross-sectional data have also shown that area deprivation reduces the likelihood of quitting after adjustment for demographic and socioeconomic factors and housing deprivation.[4] A greater availability of cigarettes and the worse provision of preventive health services may contribute to our findings.[3] Social contagion may also have a role. It may be more difficult for smokers in deprived areas to quit because a higher proportion of people in their neighbourhood smoke. Qualitative studies in deprived areas also point to the overwhelming influence of factors in the social rather than physical environment. In deprived areas, smoking is described as a socially and culturally ingrained behaviour, a consequence of a poorly resourced and stressful environment, strong community norms and social reinforcement for smoking, social isolation and limited opportunity for other forms of respite.[14–16] These were not measured in the current study.

The findings confirm that the traditional individual-based approach to tobacco control needs to be complemented with interventions targeted towards areas or communities. However, for such interventions to be effective, we need to identify the area-level and individual-level factors that contribute to differences in quitting rates between advantaged and disadvantaged areas. Subsequent studies need to focus on the characteristics of the social environment, as these may be more promising intervention points. Area deprivation characteristics should be considered along with individual-level factors when examining the determinants of smoking behaviour among populations. Further longitudinal research on smoking will provide stronger evidence of a causal role of area deprivation on smoking.

What this paper adds

- Numerous cross-sectional studies have shown that the socioeconomic characteristics of residential areas are independently associated with residents' smoking, and that smoking prevalence increases with area deprivation.
- This longitudinal examination of smokers who lived at the same address between 1991 and 1997 suggests that deprivation characteristics of areas may influence smoking behaviour.
- The findings imply that some (currently unknown) attribute of living in a deprived area may contribute to its residents' worse smoking profiles and lower prevalence of quitting.

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CORRECTION

In the October editorial, How much of the decrease in cancer death rates in the United States is attributable to reductions in tobacco smoking? (*Tobacco Control* 2006;**15**:345–7) an error has occurred in the table. The observed death rate from all cancers combined among women in 1991 was 175.3 per 100 000 (not 17303). The percentage decrease in the death rate from 1991 to 2003 was -8.4% (not -8.5%). The journal apologises for this error.