The impact of individual and area characteristics on urban socioeconomic differences in health and smoking

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Background
In general, poor health and lifestyles occur more frequently among individuals of low socioeconomic status (SES) and in deprived areas. An explanation for the latter may simply be the on average lower SES of residents of these areas. It is possible, however, that living in a deprived area contributes to poor health and lifestyles. This study examines whether such an area-contribution exists in urban settings.

Methods
Data on health, smoking, and individual SES were collected on 5121 residents of Amsterdam, the Netherlands, by face-to-face interviews (response: 61.4%). Area deprivation was measured by indicators used previously, on 22 areas. Odds ratios (OR) for poor health (poor self-rated health, long-term limitations, health complaints and obesity) and smoking were computed comparing tertiles of area deprivation. All analyses employed multilevel techniques, with residents hierarchically nested within areas.

Results
The age- and gender-adjusted prevalences of poor health and smoking are higher in deprived urban areas. Most of the differences in poor health can be explained by the on average lower SES of residents of deprived areas. Only for long-term limitations and obesity, some statistically significant area-differences remain. The higher prevalence of smoking in deprived areas can only partially be explained by the SES of residents.

Conclusions
Adverse health status in deprived areas is mainly due to a lower individual SES and not to contextual factors. For smoking, living in a deprived area contributes to a higher prevalence. This shows the necessity of community-based preventive interventions in deprived areas.

Keywords
Socioeconomic status, multilevel, urban health, deprivation

Accepted 28 May 1997

Socioeconomic (SE) differentials in health among human populations have been recognized for a long time, both at the individual and at the area level.1 At the individual level, SE differentials have been reported with regard to mortality2–8 and morbidity9 in various countries. At the area level, differences between areas of varying SE deprivation have been found in ecological studies on mortality at the level of urban areas,10–20 and of larger, urban and rural regions,21–35 as well as in ecological studies on poor health10,36–40 and on lifestyles.34,41

Two explanations have been proposed for the higher prevalence of poor health and lifestyles in deprived areas. Firstly, individual SE health differences may explain this because of the on average lower socioeconomic status (SES) of residents of deprived areas. Secondly, the social and physical context of these areas may have a detrimental effect on the health and lifestyles of their residents, in addition to individual SES.42–44 Practically, such a contextual effect provides reasons for community-based interventions, like improving the availability of healthy food or reducing the number of tobacco selling-points in deprived areas instead of measures which (only) aim at individuals and their behaviour.45–49

This study aims to determine the effect of living in a deprived area on poor health and lifestyles, over and above the effect of individual SES. It focuses on an urban setting because health differences resulting from deprivation are especially pronounced there.33,50 The study employs multilevel techniques to take the hierarchical nature of the data into account, individuals being nested within urban areas.
Methods

Data on individual characteristics and area deprivation were collected for Amsterdam, the Dutch capital which has about 700,000 residents. Amsterdam is a highly urbanized city.

Individual data

Data on health, lifestyles, and SES were collected by trained interviewers on 5121 residents during the second half of 1992 and the first half of 1993. Respondents came from a random sample of the Amsterdam municipal population register (N = 8335; response 61.4%), restricted to people living outside care-institutions, and stratified by age (16–34, 35–64 and 65+ years) and borough. Registration of residents in the population register is obligatory. Details of the survey have been reported elsewhere.51–53

Poor health was measured by four indicators which were all dichotomized (cutoff point: prevalence of the adverse outcome). These were: self-rated health ([very] good/fair or worse: 29.8%),54 physical complaints (0–4/5–20: 36.3%),55 long-term physical limitations (0/1–7: 23.0%),56,57 and body mass index (BMI) (<27/≥27 kg/m²: 19.6%).55 Poor lifestyle was indicated by cigarette smoking (<1/≥1 daily: 35.7%).55 Obesity (i.e., a high BMI) is the health outcome which reflects unhealthy eating behaviour and lack of exercise. Although BMI is strongly related to unhealthy behaviours, it is not a lifestyle itself. Strong individual SE differences were found for all these indicators of poor health and lifestyle, regarding all indicators of indi-vidual SES. Population attributable risks,58 compared to the most favourable SES category, varied from 34% to 57% for the morbidity outcomes and from 8% to 22% for smoking, after adjustment for differences in age and gender between SES categories.

Individual SES was measured by its traditional indicators: income, occupational status and educational level.55,59 Income was measured as household income in five levels, adjusted for the number of people who depended on it (one or more). Occupational status concerned the present occupation of people in five levels,60,61 or, if none, their main activity as measure of economic position.55 Educational level concerned the highest degree earned, in four levels.9,55

Area data

Measures of area deprivation were selected on the basis of two criteria. Firstly, they had to cover income and unemployment, because out of all aspects of area deprivation, these material aspects probably have the relatively largest impact on a community. These aspects had to be measured in a similar way to the measures of individual SES to prevent effects of area deprivation being found only because the measures of area deprivation and individual SES referred to different concepts. Secondly, they had to have been used previously as a measure of deprivation in studies on area health differences. No measure of area deprivation meets this last criterion for the entire Netherlands, but some do for specific cities like Amsterdam.

The selected measures were: mean registered income,14,20 household income below minimum,20 and unemployment rate.14,20 Registered income is the mean income after taxation in 1989, for people aged 25–64 years.62 Household income below minimum concerns the proportion of residents reporting an income at the Dutch social minimum or below. This indicator has previously been shown to represent the principal component from a factor analysis on a number of measures of area deprivation in Amsterdam.20 Employment concerns the proportion of residents aged 16–64 years and available for work, who were looking for work.32 The last two indicators are aggregate measures from the survey mentioned above. In theory, this could lead to a spurious correlation between area deprivation and individual SES. In practice, the SES of one individual respondent hardly affected the area mean because each area comprised on average 235 respondents. Furthermore, the standardized mortality ratio (SMR) for areas was used as a general measure of the health consequences of area deprivation. This SMR concerned the overall mortality among residents aged 1–64 years, in the period 1986–1991.14,19 All indicators were collected for 22 SE homogeneous parts (boroughs) of the city of Amsterdam and standardized for age and gender, to obtain unbiased estimates.19,63

Analysis

We analysed whether the prevalence of poor health and smoking were higher in deprived areas and whether this higher prevalence could be explained by individual SES or if area deprivation had an additional impact on health status. Firstly, we computed ratios of the age/gender adjusted odds of poor health and smoking for three categories of increasing deprivation and mortality (7/8/7 boroughs), using the most affluent or lowest mortality category (hereinafter called: least deprived category) as reference. Next, we assessed whether individual SES explained the differences between deprived and less deprived areas. Therefore, all OR for area deprivation were again estimated after adjustment for individual SES, i.e. income, occupational status and educational level, both separately and all three combined.

Multilevel aspects: analysis of hierarchical data

The adverse health effects of area deprivation, over and above the effect due to individual SES, can only be analysed properly if the hierarchical nature of the effects is accounted for. Characteristics of areas and communities have a potential impact on all residents, whereas the individual characteristics of residents which were included only affect those individuals. This implies that the individual responses cluster by area, i.e. their variability due to area characteristics may be smaller than their variability due to individual characteristics. Random variables at both levels were modelled to take this into account. The use of random variables at two (or more) levels of aggregation is specific for multilevel models.64

The probability of the response of the i-th individual in the j-th area was modelled as follows:

$$\log(\pi_{ij}/(1-\pi_{ij})) = \alpha + \beta_1 x_{1ij} + \ldots + \beta_p x_{piij} + \gamma_1 z_{1j} + \gamma_2 z_{2j} + (e_{ij} + e^*_{ij})$$

where $\alpha$ represents the constant term; $\beta_1, \ldots, \beta_p$ represent the regression coefficients of the individual explanatory variables $x_1, \ldots, x_p$; $\gamma_1$ and $\gamma_2$ represent the regression coefficients of the area explanatory variables $z_1$ and $z_2$; $e_{ij}$ represents the individual level residuals, and $e^*_{ij}$ represents the area level residuals. These residuals are also denoted as random variables, with a zero expectation, and $\sigma^2_{e_{ij}}$ and $\sigma^2_{e^*_{ij}}$ as respective variances.
The size of the area level random variance was expressed relative to the overall random variance, as is necessary in such models. Random variation at individual level was assumed to be approximately binomially distributed; deviations were assessed separately.

We further assessed whether the variability by area deprivation in health and lifestyles differed from average for the lowest SES category, by introduction into the model of a covariance term between this variable and the area level random variance (\(q^2\)). Models were fitted using the most accurate procedure available, i.e. a predictive quasi-likelihood procedure in combination with a second order Taylor expansion series. The improvement of the fit of each model was determined by the reduction of the area level random variation, and by the degree to which OR for area deprivation approached the null-value of one. This procedure differs from the usual one in ordinary logistic models, which is based on the change in deviance. In multilevel logistic models, however, this statistic is unreliable. All analyses with OR of \(\geq 1.2\), or statistically significant OR (\(P < 0.05\)) after adjustment for individual SES were repeated excluding those born outside The Netherlands (987 respondents; mainly Surinamese, 23.2%; Moroccans, 18.3%; and Turks, 12.0%) to control for potential bias by country of birth.

**Results**

The age- and gender-adjusted prevalences of poor health and smoking are higher in deprived areas and in areas with higher SMR, and vary considerably between areas (Table 1). Prevalences in the least and most deprived categories all differ with statistical significance, except for physical complaints and obesity in areas with high SMR. Area differences are especially large for long-term physical limitations and for poor self-rated health. For these two outcomes, the average OR for the least favourable category, compared to the most favourable one, are 1.7 and 1.5, respectively.

The area effect on the occurrence of poor health is small, despite the strong association of poor health with area deprivation: in the intercept only model, on average only 3.7% of all random variation occurs at area level (range 2.9–5.0%). This concerns the area level variance in the bottom part of Table 1, divided by the summation of the individual and the area level variances). Introduction of measures of area deprivation into the models reduces this share of the area level by about 50%. It then ranges from 0.6% to 2.9% (mean 1.9%; upper parts of Table 1). For smoking, an even smaller part of the random variation occurs at area level, and is almost eliminated after the introduction of area deprivation.

Individual SES explains much of the differences by area deprivation regarding all measures of poor health, but not regarding smoking. Table 2 shows that regarding poor health, most OR decrease sufficiently to lose statistical significance, after adjustment for income, educational status and employment status combined. Remaining statistically significant differences concern long-term physical limitations in areas with a high mortality and an intermediate registered income, and obesity in areas with high rates of below minimum household incomes. Adjustment for income yields a slightly smaller decrease of the differences by area deprivation than all three measures of individual SES combined. Adjustment for the other two SES measures yields more limited decreases; the smallest for educational level (results not shown). Analyses which yielded OR of \(\geq 1.2\), or statistically significant OR were repeated excluding those born outside The Netherlands. The OR hardly changed after this restriction, except for smoking. For smoking, differences by area deprivation after adjustment for individual SES became larger for all measures of area deprivation; for instance mean OR for the most deprived category increased from 1.21 to 1.42.

The area effect on the occurrence of poor health (all indicators) is further reduced by the introduction of measures of individual SES into the models which already contained indicators of area deprivation. After this, the area level comprises on average only 0.8% of all random variation (0.9% if smoking is excluded), which is in no case statistically significant.

The analyses on covariances show that the smoking habits of residents with low educational status vary less by area than average with statistical significance regarding all indicators of area deprivation (results not shown). The same holds for long-term physical limitations regarding low income and unemployed residents, if area deprivation is measured by SMR and registered income, respectively. The prevalence of a poor self-rated health varies more for the unemployed in areas with a higher SMR. None of these covariances for the lowest SES category is statistically significant any more if the analyses are restricted to those born in The Netherlands.

All models for long-term physical limitations show a smaller than binomial random variation at individual level (Table 2). Restriction of the analyses to those born in The Netherlands removes this extrabinomial random variation, except when individual SES is (partially) measured by educational level. The latter might be due to the strong cohort effect in educational achievement, which causes age to modify the effect of low education on the prevalence of long-term physical limitations. Inclusion of an interaction term between age and educational level removed the extrabinomial random variation at individual level completely (individual level variances varying from 0.991 to 0.997).

**Discussion**

This study shows that the age- and gender-adjusted prevalences of four indicators of poor health and of smoking are higher in deprived urban areas, but that living in the context of a deprived area or community has a consistent effect on smoking behaviour only. Most of the additional poor health in deprived areas is due to the lower SES of the residents concerned; it is only with regard to long-term physical limitations and obesity, that some statistically significant differences by area deprivation remain. In contrast, with regard to smoking, living in the context of a deprived area consistently gives a higher risk of smoking, irrespective of individual SES. Furthermore, for some outcomes the variation by area is smaller for low SES groups; this is entirely due to foreign born people. In all analyses, only a small part of the random variation occurs at area level, which implies that most variation can be explained by the characteristics measured.

Selection bias due to a differential non-response by area deprivation might explain our results. Analysis of additional registration data which were available on both respondents and non-respondents makes this explanation unlikely. Differences by response status were small for gender, age, country of birth,
### Table 1 Multilevel logistic models: Mean and standard deviation (s.d.) of the prevalences in the 22 boroughs; odds ratios and 95% confidence intervals (OR, CI) comparing the prevalence of poor health and smoking by increasing area deprivation, and the random variation at area and individual (ind.) level: all models include age and gender

<table>
<thead>
<tr>
<th>Prevalence in boroughs (mean, SD)</th>
<th>Self rated health (poor)</th>
<th>Physical complaints (&gt;5)</th>
<th>Long-term physical limitations (&gt;1)</th>
<th>Obese (BMI &gt;27)c</th>
<th>Cigarette smoking (&gt;1 daily)c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registered income (OR, CI)</td>
<td>30.1% (4.5%)</td>
<td>36.0% (4.8%)</td>
<td>22.9% (3.8%)</td>
<td>20.0% (4.2%)</td>
<td>36.1% (5.0%)</td>
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<tr>
<td>least deprived (1.14)d</td>
<td></td>
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<tr>
<td>intermediate (0.99)d</td>
<td>1.24 (0.98, 1.58)</td>
<td>1.06 (0.87, 1.29)</td>
<td>1.50 (1.21, 1.86)</td>
<td>1.19 (0.95, 1.49)</td>
<td>1.10 (0.94, 1.28)</td>
</tr>
<tr>
<td>most deprived (0.91)d</td>
<td>1.51 (1.18, 1.91)</td>
<td>1.35 (1.11, 1.65)</td>
<td>1.78 (1.44, 2.21)</td>
<td>1.90 (1.20, 1.88)</td>
<td>1.36 (1.17, 1.59)</td>
</tr>
<tr>
<td>Area level random variance (CI)</td>
<td>0.026 (-0.004, 0.056)</td>
<td>0.013 (-0.006, 0.035)</td>
<td>0.008 (-0.014, 0.029)</td>
<td>0.012 (-0.013, 0.038)</td>
<td>0.000 (0.000, 0.000)</td>
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<tr>
<td>Ind. level random variance (CI)e</td>
<td>0.999 (0.959, 1.038)</td>
<td>0.997 (0.959, 1.036)</td>
<td>0.976 (0.938, 1.015)</td>
<td>0.995 (0.954, 1.036)</td>
<td>1.002 (0.962, 1.042)</td>
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<td>Household income below minimum (OR, CI)</td>
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<tr>
<td>least deprived (0.61)d</td>
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<tr>
<td>intermediate (0.98)d</td>
<td>1.13 (0.88, 1.45)</td>
<td>1.07 (0.87, 1.32)</td>
<td>1.05 (0.81, 1.37)</td>
<td>1.00 (0.79, 1.27)</td>
<td>1.25 (1.07, 1.47)</td>
</tr>
<tr>
<td>most deprived (1.40)d</td>
<td>1.44 (1.14, 1.84)</td>
<td>1.29 (1.05, 1.58)</td>
<td>1.48 (1.16, 1.90)</td>
<td>1.38 (1.11, 1.71)</td>
<td>1.35 (1.17, 1.55)</td>
</tr>
<tr>
<td>Area level random variance (CI)</td>
<td>0.029 (-0.003, 0.062)</td>
<td>0.019 (-0.004, 0.043)</td>
<td>0.029 (-0.007, 0.064)</td>
<td>0.015 (-0.012, 0.042)</td>
<td>0.000 (0.000, 0.000)</td>
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<tr>
<td>Ind. level random variance (CI)e</td>
<td>0.998 (0.958, 1.037)</td>
<td>0.997 (0.958, 1.036)</td>
<td>0.975 (0.936, 1.013)</td>
<td>0.995 (0.954, 1.035)</td>
<td>1.000 (0.960, 1.040)</td>
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<td>Unemployment rate (OR, CI)</td>
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<tr>
<td>least deprived (0.45)d</td>
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<tr>
<td>intermediate (0.73)d</td>
<td>1.14 (0.89, 1.46)</td>
<td>1.03 (0.83, 1.27)</td>
<td>1.33 (1.06, 1.67)</td>
<td>1.09 (0.87, 1.37)</td>
<td>1.18 (1.01, 1.39)</td>
</tr>
<tr>
<td>most deprived (1.67)d</td>
<td>1.47 (1.15, 1.87)</td>
<td>1.27 (1.03, 1.56)</td>
<td>1.69 (1.35, 2.12)</td>
<td>1.44 (1.15, 1.80)</td>
<td>1.34 (1.15, 1.57)</td>
</tr>
<tr>
<td>Area level random variance (CI)</td>
<td>0.028 (-0.003, 0.060)</td>
<td>0.020 (-0.004, 0.044)</td>
<td>0.015 (-0.012, 0.041)</td>
<td>0.014 (-0.013, 0.040)</td>
<td>0.002 (-0.011, 0.014)</td>
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<tr>
<td>Ind. level random variance (CI)e</td>
<td>0.998 (0.958, 1.037)</td>
<td>0.997 (0.958, 1.036)</td>
<td>0.976 (0.937, 1.014)</td>
<td>0.996 (0.955, 1.036)</td>
<td>1.001 (0.961, 1.041)</td>
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<tr>
<td>Standardized mortality (OR, CI)</td>
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<tr>
<td>least deprived (0.82)d</td>
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</tr>
<tr>
<td>intermediate (1.01)d</td>
<td>1.30 (1.03, 1.64)</td>
<td>1.25 (1.02, 1.54)</td>
<td>1.51 (1.25, 1.83)</td>
<td>1.20 (0.94, 1.53)</td>
<td>1.31 (1.13, 1.51)</td>
</tr>
<tr>
<td>most deprived (1.21)d</td>
<td>1.46 (1.14, 1.89)</td>
<td>1.06 (0.85, 1.33)</td>
<td>1.70 (1.38, 2.11)</td>
<td>1.28 (0.98, 1.66)</td>
<td>1.36 (1.16, 1.60)</td>
</tr>
<tr>
<td>Area level random variance (CI)</td>
<td>0.029 (-0.003, 0.061)</td>
<td>0.022 (-0.003, 0.047)</td>
<td>0.006 (-0.015, 0.028)</td>
<td>0.026 (-0.008, 0.060)</td>
<td>0.001 (-0.011, 0.013)</td>
</tr>
<tr>
<td>Ind. level random variance (CI)e</td>
<td>0.998 (0.959, 1.038)</td>
<td>0.997 (0.958, 1.036)</td>
<td>0.981 (0.942, 1.019)</td>
<td>0.997 (0.956, 1.038)</td>
<td>1.000 (0.960, 1.040)</td>
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<tr>
<td>Without area deprivation</td>
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</tr>
<tr>
<td>Area level random variance (CI)</td>
<td>0.052 (0.006, 0.099)</td>
<td>0.033 (0.001, 0.064)</td>
<td>0.029 (-0.007, 0.064)</td>
<td>0.038 (-0.003, 0.080)</td>
<td>0.019 (-0.005, 0.042)</td>
</tr>
<tr>
<td>Ind. level random variance (CI)e</td>
<td>0.997 (0.958, 1.036)</td>
<td>0.997 (0.958, 1.035)</td>
<td>0.975 (0.936, 1.013)</td>
<td>0.993 (0.953, 1.034)</td>
<td>0.998 (0.959, 1.038)</td>
</tr>
</tbody>
</table>

a These means differ slightly from the prevalences mentioned in the text, because they concern the mean of the prevalences of 22 boroughs.
b Age in 10-year categories (16–24, 25–34, ..., 75+), gender, and their interactions.
c Part of a questionnaire which the respondent filled out in the presence of the interviewer, if possible (n = 4959), and limited to people aged >20 years regarding obesity.
d Ratio of the mean level of the area deprivation in this deprivation category, compared to the entire city mean.
e By definition, individual level random variance is one if the binomial distribution holds.
Table 2  Multilevel logistic models: Odds ratios and 95% confidence intervals (OR, CI) comparing the prevalence of poor health and smoking by area deprivation, and random variation at area and individual (ind.) level after adjustment for age/gender and SES; all models include age and gender, income, occupational status and educational level

<table>
<thead>
<tr>
<th>Registered income (OR, CI)</th>
<th>Self rated health (poor)</th>
<th>Physical complaints (&gt;5)</th>
<th>Long-term physical limitations (&gt;1)</th>
<th>Obese (BMI &gt;27)</th>
<th>Cigarette smoking (&gt;1 daily)</th>
</tr>
</thead>
<tbody>
<tr>
<td>least deprived</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>intermediate</td>
<td>1.12 (0.90, 1.40)</td>
<td>0.93 (0.77, 1.14)</td>
<td>1.32 (1.06, 1.63)</td>
<td>1.04 (0.85, 1.26)</td>
<td>1.02 (0.86, 1.21)</td>
</tr>
<tr>
<td>most deprived</td>
<td>1.11 (0.88, 1.39)</td>
<td>1.00 (0.82, 1.22)</td>
<td>1.23 (0.99, 1.54)</td>
<td>1.15 (0.94, 1.41)</td>
<td>1.19 (1.01, 1.42)</td>
</tr>
<tr>
<td>Area level random variance (CI)</td>
<td>0.015 (-0.009, 0.038)</td>
<td>0.012 (-0.007, 0.032)</td>
<td>0.006 (-0.015, 0.027)</td>
<td>0.000 (0.000, 0.000)</td>
<td>0.002 (-0.011, 0.015)</td>
</tr>
<tr>
<td>Ind. level random variance (CI)</td>
<td>0.990 (0.950, 1.029)</td>
<td>0.992 (0.953, 1.030)</td>
<td>0.949 (0.912, 0.986)</td>
<td>0.988 (0.948, 1.029)</td>
<td>1.006 (0.966, 1.046)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household income below minimum (OR, CI)</th>
<th>Self rated health (poor)</th>
<th>Physical complaints (&gt;5)</th>
<th>Long-term physical limitations (&gt;1)</th>
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<tr>
<td>least deprived</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>intermediate</td>
<td>1.04 (0.83, 1.30)</td>
<td>1.00 (0.82, 1.22)</td>
<td>0.92 (0.72, 1.17)</td>
<td>1.03 (0.84, 1.26)</td>
<td>1.24 (1.05, 1.45)</td>
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<td>most deprived</td>
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<td>1.00 (0.83, 1.21)</td>
<td>1.07 (0.85, 1.35)</td>
<td>1.20 (1.00, 1.44)</td>
<td>1.23 (1.06, 1.43)</td>
</tr>
<tr>
<td>Area level random variance (CI)</td>
<td>0.016 (-0.009, 0.041)</td>
<td>0.013 (-0.007, 0.032)</td>
<td>0.018 (-0.011, 0.047)</td>
<td>0.000 (0.000, 0.000)</td>
<td>0.000 (-0.012, 0.012)</td>
</tr>
<tr>
<td>Ind. level random variance (CI)</td>
<td>0.989 (0.950, 1.028)</td>
<td>0.992 (0.953, 1.030)</td>
<td>0.944 (0.907, 0.981)</td>
<td>0.986 (0.946, 1.026)</td>
<td>1.005 (0.965, 1.045)</td>
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</tbody>
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<thead>
<tr>
<th>Unemployment rate (OR, CI)</th>
<th>Self rated health (poor)</th>
<th>Physical complaints (&gt;5)</th>
<th>Long-term physical limitations (&gt;1)</th>
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<td>least deprived</td>
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<tr>
<td>intermediate</td>
<td>1.02 (0.81, 1.27)</td>
<td>0.90 (0.74, 1.10)</td>
<td>1.14 (0.90, 1.44)</td>
<td>0.96 (0.79, 1.17)</td>
<td>1.10 (0.92, 1.32)</td>
</tr>
<tr>
<td>most deprived</td>
<td>1.09 (0.87, 1.37)</td>
<td>0.94 (0.77, 1.15)</td>
<td>1.20 (0.95, 1.52)</td>
<td>1.16 (0.95, 1.41)</td>
<td>1.17 (0.97, 1.40)</td>
</tr>
<tr>
<td>Area level random variance (CI)</td>
<td>0.016 (-0.009, 0.041)</td>
<td>0.012 (-0.007, 0.031)</td>
<td>0.013 (-0.013, 0.039)</td>
<td>0.000 (0.000, 0.000)</td>
<td>0.007 (-0.010, 0.023)</td>
</tr>
<tr>
<td>Ind. level random variance (CI)</td>
<td>0.989 (0.950, 1.029)</td>
<td>0.992 (0.953, 1.030)</td>
<td>0.945 (0.908, 0.982)</td>
<td>0.986 (0.946, 1.026)</td>
<td>1.005 (0.965, 1.045)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standardized mortality (OR, CI)</th>
<th>Self rated health (poor)</th>
<th>Physical complaints (&gt;5)</th>
<th>Long-term physical limitations (&gt;1)</th>
<th>Obese (BMI &gt;27)</th>
<th>Cigarette smoking (&gt;1 daily)</th>
</tr>
</thead>
<tbody>
<tr>
<td>least deprived</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>intermediate</td>
<td>1.09 (0.89, 1.33)</td>
<td>1.04 (0.88, 1.23)</td>
<td>1.22 (1.01, 1.47)</td>
<td>1.03 (0.86, 1.23)</td>
<td>1.23 (1.06, 1.44)</td>
</tr>
<tr>
<td>most deprived</td>
<td>1.23 (0.99, 1.54)</td>
<td>0.87 (0.72, 1.05)</td>
<td>1.35 (1.09, 1.68)</td>
<td>1.18 (0.96, 1.45)</td>
<td>1.25 (1.05, 1.49)</td>
</tr>
<tr>
<td>Area level random variance (CI)</td>
<td>0.011 (-0.010, 0.033)</td>
<td>0.007 (-0.009, 0.023)</td>
<td>0.003 (-0.016, 0.023)</td>
<td>0.000 (0.000, 0.000)</td>
<td>0.002 (-0.011, 0.015)</td>
</tr>
<tr>
<td>Ind. level random variance (CI)</td>
<td>0.991 (0.951, 1.030)</td>
<td>0.992 (0.953, 1.030)</td>
<td>0.946 (0.909, 0.983)</td>
<td>0.987 (0.947, 1.028)</td>
<td>1.005 (0.965, 1.045)</td>
</tr>
</tbody>
</table>

a Age in 10-year categories (16–24, 25–34, …, 75+), gender, and their interactions.
b Income in five levels, adapted for the number of people which depend on it (one or more).
c Present occupation in five levels: if no job: unemployed and looking for work, student, long-term disabled, housekeeping, and retired.
d Highest degree earned in four levels: primary school, lower secondary school, higher secondary school, post-secondary education.
e By definition, individual level random variance is one if the binomial distribution holds.
year of settlement in Amsterdam, marital status, family type, and month of interview. Results of these additional analyses have been reported elsewhere.32,33

For poor health, our findings regarding contextual effects are mainly negative. An explanation might be that there are simply no differences between Amsterdam boroughs, either regarding deprivation and health status, or regarding the mechanisms which lead to contextually determined health differences. However, regarding deprivation and health status, the differences between areas are rather large (Table 1). Regarding relevant explanatory mechanisms, considerable differences also exist between Amsterdam boroughs. Macintyre et al. divides these into five broad groups: physical features, quality of the domestic and working environment, the provision of various services, sociocultural features, and the reputation of areas.43 Studies have shown that Amsterdam’s deprived areas have poorer air quality and housing67 primary schools68 and public safety.69 With regard to sociocultural features, culturally determined contextual effects might be expected as many Amsterdam residents are of non-Dutch origin, especially in deprived areas.70 However, among immigrants the differences by area deprivation are even smaller than among Dutch born residents. No information was available on the other mechanisms. The lack of an overall association between deprivation and poor health, after rigorous adjustment for individual SES, indicates that probably none of the explanatory mechanisms for this association will apply, however.

For smoking, substantial differences by area deprivation remain after adjustment for individual SES, age and gender. The large impact of the social environment on smoking behaviour46,47,50 offers one explanation for this finding. Other factors in deprived areas which might contribute are larger availability of cigarettes and worse provision of preventive services.42,71 No data on these aspects are available for Amsterdam, however. Furthermore, differences by area deprivation regarding smoking do not seem to yield corresponding differences regarding poor health. An explanation may be the long delay in the health effects of smoking,72 combined with high migration rates. This explanation could not be studied because information on length of stay was not available.

The results of some previous studies indicate that differences by area deprivation are larger in cities;33,51 this first multilevel study in a completely urban setting shows that larger contextual effects offer no explanation for this finding. After adjustment for age and gender, poor health and lifestyles do not cluster more heavily in our study than in comparable studies on mixed, urban and rural areas. Many of these previous studies were based on data from the British Health and Lifestyle Survey (HALS).38 regarding self-rated health,73,74 long-standing illness and disability,74 health complaints,74 and the crude prevalence of smoking.41 Data from the West of Scotland Twenty-07 Study on poor self-rated health and limiting long-standing illness,75 and data from the 1991 British census on long-term limiting illness45 do not show a larger share of the area level in the random variation either.

Our study further shows that measures of individual SES vary with regard to their explanatory power for differences in health status by area deprivation. Income explains much of the area-differences, both for men and women, but a combination of measures of individual SES does so even better. In most previous studies, occupational status has been used as measure of individual SES while income has never been used as such.45,74–76 Furthermore, most measures of individual SES and area deprivation are more closely correlated in this study than in previous studies. The use of similar measures at two levels in this study enables the estimation of the additional, detrimental, effect of area deprivation on health status, over and above individual SES.

In conclusion, this study shows that the average health and smoking status of urban residents is worse if they live in a deprived area. Most of the area-differences can be explained by the SE composition of the population of these areas, except for smoking. This implies that for smoking, preventive interventions need to be at least partially area- or community-based in order to be effective.46–50 The existence of contextual effects implies that to reach their aim, interventions should also improve the context in which people live. With regard to poor health, we found no contextual effects which make community-based interventions a sine qua non. In this case, however, a targeting of preventive interventions at deprived areas via community-based activities might still be most efficient;46 our study shows that the prevalence of all measures of poor health is indeed higher in deprived areas, albeit mainly attributable to individual SES. Furthermore, factors in the community may be mediating factors in the association between individual SES and poor health,76 even if they do not have effects independent of individual SES. In either case, the differences by area deprivation observed show a large potential to improve the health of urban residents in this way.

References

4 Pappas G, Queen S, Hadden W, Fisher G. The increasing disparity in poverty and area deprivation are more closely correlated in this study than in previous studies. The use of similar measures at two levels in this study enables the estimation of the additional, detrimental, effect of area deprivation on health status, over and above individual SES.

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