Neighborhood Environment and Self-Reported Health Status: A Multilevel Analysis

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ABSTRACT

Objectives. This study examined whether neighborhood socioeconomic environment helps to explain the proportion of community members with self-reported poor health status.

Methods. A random sample of 9240 persons aged 25 to 74 years were interviewed during 1988 and 1989. The socioeconomic environment of each respondent's neighborhood was measured with the Care Need Index (CNI) and the Townsend score. The data were analyzed with a multilevel model adjusted for the independent variables. The second-level variables were the 2 neighborhood scores.

Results. There was a clear gradient for poor health and education within every CNI interval so that with an increasing CNI (indicating more deprivation), the prevalence of poor health increased in all 3 education groups ($P = .001$). In the full model, decreasing educational level, obesity, length and frequency of smoking, physical inactivity, and increasing CNI were associated with poor health. Persons living in the most deprived neighborhoods had a prevalence ratio of 1.69 (95% confidence interval = 1.44, 1.98) for poor health compared with those living in the most affluent areas.

Conclusions. Both neighborhood socioeconomic environment and individual educational status are associated with self-reported poor health. (*Am J Public Health.* 1999;89:1181–1186)

Although the associations between individual socioeconomic status (SES), lifestyle, and self-reported health status are well known, the influence of neighborhood SES, adjusted for individual SES and lifestyle, is still unclear, and few studies have focused on this issue. This article addresses the additional influence of neighborhood socioeconomic environment on self-reported health status.

Individual-level data have demonstrated a strong inverse relationship between SES and poor self-rated health,[1–3] poor physical functioning,[4] and cardiovascular disease risk factors.[5] Studies on an ecological level have shown an association between poor neighborhood environments and increased admission rates to psychiatric departments,[6,7] high emergency department and primary health care consultation rates,[8,9] and high prevalences of self-reported poor health status and self-reported illness.[10] However, these ecological studies have serious limitations because of the ecological fallacy.

The ecological fallacy stems from a cross-sectional bias that occurs from an individual perspective when inferences are drawn from aggregate data to the individual level. However, there is increasing support for the use of population determinants in studies on improving the health of the individual.[11,12] Marmot stipulated that "ecological analyses are not second rate but are the most useful way to examine the effect of social environment on health."[12(p57)]

There is an increased need to analyze both individual- and macro-level risk factors and outcomes and to clarify their independent and combined effects by using multilevel analysis.[13] Susser clarified and enhanced our understanding of the associations between, and dimensions within, ecological and individual levels.[14] In addition, according to Macintyre et al.[15] and Duncan et al.,[16] it is important to distinguish between compositional and contextual differences. By an area's compositional effects on health, we mean the aggregate of all individual characteristics in a neighborhood, that is, similar types of persons will have similar illness experiences no matter where they live. By an area's contextual effects on health, we mean the aggregate effect of social, cultural, and environmental characteristics of the neighborhood, that is, similar types of individuals will have different self-reported health status in different types of neighborhoods.

A multilevel analysis demonstrated that there were neighborhoods where high prevalences of illness were clustered and that this situation was not fully explained by the individual characteristics of the people living in the area.[17] On the other hand, Duncan et al.[16] showed in a multilevel analysis that smoking and drinking behaviors were less influenced by neighborhood environments, expressed as regional differences, than expected. In contrast, data from the baseline examination of the Arteriosclerosis Risk in Communities Study showed that living in more deprived neighborhoods was related to an increased risk for smoking, increased serum cholesterol, and increased systolic blood pressure after adjustment for individual-level indicators.[18] It was suggested that both neighborhood-level and individual-level social class indicators influenced cardiovascular risk factors.

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Self-reported health status is strongly associated with the occurrence of chronic diseases and physicians' ratings of self-reported health status,[19–21] health care utilization,[22,23] and mortality,[24–26] even though there is a distinct difference between self-reported health status and objectively diagnosed disease. Moreover, it is important to adjust for lifestyle factors—smoking and physical activity in particular—because they are confounders associated with self-reported health and SES.[21,27–29]

In the present study we used 2 composite indices as proxies for neighborhood SES: the Care Need Index (CNI),[30] which is similar to the British Underprivileged Area score,[31] and the Townsend score.[32] CNI is a social deprivation index, intended to be used for distribution of extra-economic resources to primary health care located in the most deprived neighborhoods in Sweden. We hypothesized that people living in socially disadvantaged residential areas with a high CNI would have worse self-reported health than those living in more affluent residential areas, even after adjustments for educational status and lifestyle factors. We tested the hypothesis by analyzing the association between the CNI score, the Townsend score, and self-reported health status (adjusted for age, sex, educational status, body mass index [BMI], smoking, and physical inactivity, all of which have been shown to be related to poor health[33–35]).

Methods

Data on individuals from the Swedish Annual Level of Living Survey were matched with the social rank of the areas in which they lived, measured by the CNI and the Townsend score. The Swedish Annual Level of Living Survey is based on face-to-face interviews with a nationwide random sample of about 8000 individuals per year in the age range of 16 through 84 years.[36] The interviews generally take place in the respondents' homes. The response rate was about 80% in 1988 and 1989. For this study, we used data from 9240 interviews with respondents aged 25 through 74 years conducted in 1988 and 1989, when the interviews contained additional questions on health and lifestyle.

Small-area market statistics (SAMS) apply to the smallest-area units in a system of geographical coordinates for the whole of Sweden. The average population of SAMS areas was about 2000 residents in Stockholm and about 1000 residents in the rest of Sweden. SAMS areas with fewer than 50 inhabitants were excluded because of the instability of proportions based on small numbers, leaving 837 SAMS areas.

Outcome Variable

Information on the dependent variable, self-reported health, was given by the respondents in answer to the question "How would you describe your general health?" There were 3 possible responses: good, bad, or anywhere between good and bad. Those who answered that their health status was bad or anywhere between good and bad were considered to have poor self-reported health.

Independent Variables

Sex and age were analyzed in terms of the age groups 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 to 74 years.

The SES of the respondent's neighborhood was defined in terms of 2 widely used composite indices using area-level macro sociodemographic and economic variables, the CNI and the Townsend score.[30,32] The score on the CNI, adapted to Swedish conditions, is highly correlated with the British Underprivileged Area score ($r = 0.98$).[30]

The CNI was calculated for all SAMS areas in Sweden in 1990–92.[30] The mean value of the CNI is 0, which corresponds to the average value for Sweden as a whole. The values range between –76 (most affluent areas) and +53 (most deprived areas). It was possible to match the respondents' home addresses (taken from the 1988–89 survey) of all but 655 respondents (7%) with CNI for SAMS areas in 1990–92. The respondents were divided into 6 approximately equal-sized groups on the basis of the CNI, with an average of 1400 people in each group. Those for whom the SAMS area CNI was missing constituted a last level ("Missing" in the tables) and were included in all analyses as a separate group.

The Townsend index, a purely material index, was calculated for the same SAMS areas as was the CNI. The mean Townsend score for the whole of Sweden is 0 (range, –8.9 to +8.6). In the main analysis, however, we focused on the CNI.

The respondents were classified into 3 groups according to their educational attainment: (1) elementary school (≤9 years); (2) completed up to 2 years of high school (10–11 years); (3) completed more than 2 years of high school or university studies (>11 years).

Lifestyle factors included BMI, smoking habits, and physical activity. BMI was calculated as weight in kilograms divided by height in meters squared and comprised 3 categories: normal weight (BMI < 23.8 for women and < 25 for men), overweight (23.8 ≤ BMI < 28.6 for women and 25.0 ≤ BMI < 30.0 for men), and obesity (BMI ≥ 28.6 for women and ≥ 30.0 for men).[37] Three categories were used in the analysis of smoking habits: never smokers, former smokers, and current smokers. There were 5 categories of physical activity, which we dichotomized into physical inactivity and regular physical activity at least once a week.

Statistical Methods

Differences between distributions (Table 1) were tested by the likelihood ratio χ^2 test. The data were analyzed with a multilevel modeling strategy. A hierarchical logistic regression model proposed by Wong and Mason was applied.[38] The models were fitted by means of the SAS macro GLIMMIX.[39] The method of estimation was a restricted maximum likelihood procedure. The inclusion of a macro error term makes the model mixed, with the CNI (or Townsend score) as a random effect. Interactions with the CNI were treated as random effects and the individual factors as fixed effects. The fit of the model was judged by an overdispersion parameter, which ideally should be approximately 1. The fitted models met this demand. There were no interactions between the CNI and the variables in the model. The final model included categorical variables that were analyzed as multiple dummy variables, excluding the reference group. Individuals with missing data in the CNI constituted a group of their own in all analyses.

The results are shown as odds ratios (ORs) with 95% confidence intervals (CIs). Because the studied outcome factor (poor self-reported health) occurs frequently, which might result in high odds ratios, prevalence ratios were also calculated for comparison with the odds ratios. Thus, the prevalence of poor self-reported health status by CNI level was adjusted by the direct method for the individual variables and then prevalence ratios with 95% approximate confidence intervals[40–42] were computed for the different levels of CNI.

The prevalences of poor self-reported health status by education and CNI (Table 2) were directly standardized (for sex and age) with Sweden as the standard, according to the method of Breslow and Day.[43] The reliability of the dependent variable and of the majority of the other variables was analyzed by means of reinterviews (test–retest method), which resulted in κ coefficients between 0.7 and 0.9.[44]

Results

Table 1 shows the distribution of the variables and the respondents within different CNI

TABLE 1—Percentage Distribution of Variables Among Respondents to the Swedish Annual Level of Living Survey,[a] by Care Need Index (CNI) Interval: 1988–1989

	CNI Interval							
	<–8.37	–8.37 to <–0.92	–0.92 to <4.09	4.09 to <8.77	8.77 to <16.28	≥16.28	Missing	All
Poor health	16.4	21.2	24.1	25.6	26.8	29.3	21.8	23.8
Sex								
Male	51.4	51.1	50.3	50.1	47.2	47.9	50.8	49.8
Female	48.6	48.9	49.7	49.9	52.8	52.1	49.2	50.2
Age, y								
25–34	16.0	19.3	20.5	21.8	23.7	28.5	28.9	22.1
35–44	30.2	25.8	24.3	22.4	21.7	22.8	23.8	24.5
45–54	25.4	19.9	19.7	17.1	18.5	19.0	17.9	19.8
55–64	15.9	17.6	16.0	16.4	16.0	13.8	14.1	15.8
65–74	12.5	17.4	19.5	22.3	19.8	15.9	15.4	17.7
Education, y								
≤9	25.9	33.1	35.5	37.4	36.1	34.9	31.2	33.6
10–11	38.8	44.0	42.4	41.7	42.8	45.2	42.8	42.5
>11	35.2	22.9	22.2	20.9	21.1	19.9	26.1	23.9
BMI								
Normal	59.1	56.2	56.2	55.9	58.5	56.1	59.2	57.2
Overweight	33.6	35.8	36.6	36.0	32.3	34.1	33.6	34.7
Obese	7.0	8.0	7.2	8.2	9.2	9.9	7.2	8.1
Smoking								
Never	44.7	44.4	43.7	46.4	43.6	37.1	44.7	43.4
Early	31.0	30.5	29.6	26.4	25.9	25.6	27.2	28.1
Daily	24.2	25.1	26.7	27.2	30.5	37.4	28.1	28.5
Physical inactivity	47.1	50.0	52.3	52.5	51.8	54.4	48.4	51.1
n	1424	1418	1467	1432	1435	1409	655	9240
Estimated total population (×1000)	794	755	782	765	778	788	357	5019

Note. The CNI[30] measures the socioeconomic status (SES) of the respondent's neighborhood; a higher score means lower SES. BMI = body mass index.

[a]The survey collects data from persons aged 16 to 84 years; for this study, only data for respondents aged 25 to 74 years were used.

intervals. There were differences in age distribution ($P = .001$); for example, the most affluent areas (those with a CNI<–8.37) had higher proportions of middle-aged people (35 to 54 years) than of younger and older people. There was a gradient, so that as the CNI increased, the proportion of persons with poor self-reported health status increased ($P = .001$). In the deprived areas, there were also higher proportions of respondents with low educational attainment ($P = .001$), obesity ($P = .05$), current smoking ($P = .001$), and physical inactivity ($P = .003$). The estimated population sizes (persons aged 25–74 years) within the different CNI intervals ranged between 755 000 and 794 000 (Table 1). The most deprived areas (CNI ≥ 16.28) had a risk for poor self-reported health status nearly twice as high as that of the most affluent areas (CNI<–8.37).

The sex- and age-standardized prevalence of poor self-reported health status by CNI and educational attainment is shown in Table 2. Interestingly, the proportion of those with poor health in every educational group increased with every increase in the CNI. The proportion of those with a poor self-reported health status increased with lower education and a higher CNI. Furthermore, 11.9% of the highly educated individuals living in the most affluent areas reported a poor health status, compared with 23.1% of similarly educated persons in the most deprived areas.

The odds ratios for the different CNI intervals in a crude model and in a sex- and age-adjusted model were similar (Table 3). Persons living in the most deprived neighborhoods had the highest odds ratios for poor self-reported health status. The risk of poor self-reported health status decreased with every decrement in the CNI.

The final model, adjusted for sex, age, education, and lifestyle factors, is shown in Table 4. The odds ratios for poor self-reported health status for the different CNI intervals decreased, on the average, by about 10% compared with the models shown in Table 3. All CNI levels except the second were still significant. Educational level, increased BMI, physical inactivity, and smoking were all significantly associated with poor self-reported health status. Because the outcome variable (self-reported poor health) is rather frequent (above 20%), the adjusted prevalences and prevalence ratios for the CNI intervals were also calculated. The prevalence ratios were quite similar to the odds ratios shown in Table 4, differing at most by about 7% (data not shown).

The final model for associations between the Townsend score, used as a proxy for neighborhood environments, and poor self-reported health status, adjusted for all individual background variables (not shown), showed only small differences compared with the model for the CNI. However, the 2 most deprived groups as defined by the Townsend score (Townsend score > 1.71) had slightly lower odds ratios (OR = 1.40, CI = 1.16, 1.69 and OR = 1.56, CI = 1.32, 1.85) for poor self-reported health status than did the 2 most deprived groups as defined by the CNI (OR = 1.54, CI = 1.27, 1.85 and OR = 1.89, CI = 1.52, 2.22).

Discussion

This is one of the first studies based on a large national sample to examine the influence of neighborhood environment on self-reported health status (adjusted for individual SES and lifestyle factors such as BMI, smoking, and physical activity). Consistent with our expectations, we found that low

TABLE 2—Sex- and Age-Adjusted Prevalence (%) of Poor Self-Reported Health Status Among Respondents to the Swedish Annual Level of Living Survey,[a] by Care Need Index (CNI) Interval and Educational Level: 1988–1989 (n = 9240)

	CNI Interval							
Education, y	<–8.37	–8.37 to <–0.92	–0.92 to <4.09	4.09 to <8.77	8.77 to <16.28	≥16.28	Missing	All
≤9	25.3	27.4	30.1	29.5	32.4	32.4	29.1	29.6
10–11	14.8	21.3	23.9	23.6	25.1	31.0	22.9	23.1
>11	11.9	10.0	12.0	15.8	16.5	23.1	17.5	14.6
All	16.9	20.3	23.1	24.1	25.9	30.2	23.4	23.4

Note. The CNI[30] measures the socioeconomic status (SES) of the respondent's neighborhood; a higher score means lower SES.
[a]The survey collects data from persons aged 16 to 84 years; for this study, only data for respondents aged 25 to 74 years were used.

TABLE 3—Odds Ratios (ORs) for Poor Self-Reported Health Status Among Respondents to the Swedish Annual Level of Living Survey,[a] by Care Need Index (CNI) Interval: 1988–1989

	Crude Model		Sex- and Age-Adjusted Model	
CNI Interval	OR	(95% CI)	OR	(95% CI)
<–8.37 (Reference)	1.00	...	1.00	...
–8.37 to <–0.92	1.33	(1.08, 1.64)	1.28	(1.03, 1.60)
–0.92 to <4.09	1.56	(1.27, 1.91)	1.50	(1.32, 1.87)
4.09 to <8.77	1.67	(1.36, 2.05)	1.58	(1.27, 1.96)
8.77 to <16.28	1.77	(1.44, 2.17)	1.74	(1.40, 2.16)
≥16.28	2.00	(1.63, 2.45)	2.18	(1.76, 2.71)
Missing	1.39	(1.10, 1.75)	1.48	(1.16, 1.89)

Note. The CNI[30] measures the socioeconomic status (SES) of the respondent's neighborhood; a higher score means lower SES. CI = confidence interval.
[a]The survey collects data from persons aged 16 to 84 years; for this study, only data for respondents aged 25 to 74 years were used.

socioeconomic position for neighborhood environment, high CNI and high Townsend score, were independent risk factors for poor self-reported health status as analyzed in separate models.

A major concern in the present study is the significance and interpretation of the outcome factor. Although self-reported health status, widely used in European[2,45–47] and more and more in American[25,26,48,49] studies, is a useful indicator of the health conditions of a population, it is a subjective and imprecise measure of health, and it could reflect a person's general perception about the quality of life. Qualms about the significance of self-rated health status have been suggested by an Australian study that revealed unexpected differences between men and women in health ratings and survival.[50] Furthermore, the reference point for assessment of self-rated health is not absolute and varies with age, sex, and social context.[50] However, a Finnish longitudinal survey demonstrated the stability over time of self-reported health status and showed that such a subjective health assessment was a valid indicator of health in middle-aged populations and could be used in cohort studies.[21] Moreover, the test–retest reliability of self-rated health status was good; a random subsample of 410 respondents who participated in 1989 were reinterviewed about 4 weeks after the main interview.[51]

The main finding of this study, that the CNI score of an area was significantly related to poor health among area residents, agreed with a British study that found that all individuals living in areas with high levels of illness (which tends to occur more frequently in deprived areas) showed higher levels of illness even after adjustment for individual characteristics.[17] However, in affluent areas, where morbidity was generally lower, the inequality of health (health gradient) between rich and poor individuals was particularly strong. In the present study, there was a clear gradient for poor self-reported health status and educational attainment in every CNI interval, so that with an increasing CNI (more deprivation), the prevalence of poor health increased in all 3 educational level groups.

There is a growing body of literature suggesting that the socioenvironmental properties of the neighborhoods in which people live may, in and of themselves, exert an important influence on disease risks.[15,52,53] The individual characteristics of biological and behavioral factors do not completely explain the difference in morbidity.[11,12,54] Macintyre et al.[15] concluded that over and above the individual-level attributes of deprivation, people of low SES may have poorer health because they tend to live in areas that, in one way or another, have a detrimental effect on health. Another interpretation is that living in a deprived neighborhood may make people feel bad in general and therefore more likely to feel in poor health whatever their physical state. On the other hand, it is possible that sick people migrate to deprived areas.

The mechanism behind the association between neighborhood environment and self-reported health status is not clear, although Macintyre et al. suggested that the association could be mediated in different ways.[15] The possible counterinfluence of healthy environments at home, at work, and during leisure-time activities should be considered. Community services and sociocultural features of a neighborhood may have an impact, and the reputation of an area may influence the self-esteem and morale of the residents.[15] Such suggested mechanisms are still speculative and further analyses must be conducted. Diez-Roux et al.[18] investigated neighborhood characteristics related to prevalence of coronary heart disease and found that the associations persisted after adjustment for individual-level variables. In contrast, a Finnish study showed that smoking and physical activity were determined more by individual characteristics than by the socioregional context.[55]

In addition to the subjective outcome factor, our study has other limitations. First, the cross-sectional design of the Swedish Annual Level of Living Survey makes it difficult to draw inferences about causal pathways. Second, it is possible that the CNI underestimated neighborhood effects in this study. A composite index such as the CNI or the Townsend score does not directly measure the neighborhood characteristics that are potentially related to poor health status.

These limitations are balanced by the strengths of the Swedish Annual Level of

TABLE 4—Odds Ratios for Poor Self-Reported Health Status by Different Care Need Index (CNI) Intervals, Sex, Age, Education, Body Mass Index (BMI), Smoking, and Physical Activity (Hierarchical Logistic Regression): Respondents to the Swedish Annual Level of Living Survey,[a] 1988–1989 (n = 9240)

	Odds Ratio	95% Confidence Interval
Sex		
Male	0.82	(0.73, 0.92)
Female (Reference)	1.00	...
Age, y		
25–34	0.46	(0.38, 0.56)
35–44	0.70	(0.59, 0.83)
45–54 (Reference)	1.00	...
55–64	1.97	(1.66, 2.34)
65–74	2.13	(1.80, 2.52)
Education, y		
≤9	1.89	(1.60, 2.24)
10–11	1.48	(1.25, 1.74)
>11 (Reference)	1.00	...
BMI		
Normal (Reference)	1.00	...
Overweight	1.02	(0.90, 1.15)
Obese	1.62	(1.35, 1.95)
Smoking		
Never (Reference)	1.00	...
Early	1.24	(1.08, 1.42)
Daily	1.48	(1.29, 1.69)
Physical activity ≥1 time/wk		
Yes (Reference)	1.00	...
No	2.15	(1.92, 2.41)
CNI interval		
<–8.37 (Reference)	1.00	...
–8.37 to <–0.92	1.19	(0.98, 1.66)
–0.92 to <4.09	1.38	(1.14, 1.66)
4.09 to <8.77	1.42	(1.17, 1.71)
8.77 to <16.28	1.54	(1.27, 1.85)
≥16.28	1.84	(1.52, 2.22)
Missing	1.37	(1.10, 1.71)

Note. The CNI[30] measures the socioeconomic status (SES) of the respondent's neighborhood; a higher score means lower SES. CI = confidence interval.
[a]The survey collects data from persons aged 16 to 84 years; for this study, only data for respondents aged 25 to 74 years were used.

Living Survey, which is the most comprehensive national survey providing data on self-reported health status and cardiovascular disease risk factors for Swedish men and women. The use of SAMS areas, which are based on homogeneity of housing type, instead of more conventional administrative geographical areas may be regarded as another strength. Therefore, the CNI score is an adequate proxy of a person's neighborhood environment.

In countries where absolute poverty is rare, relative deprivation becomes more important.[56] In 1998, the government of the United Kingdom used a measure similar to the CNI, the Underprivileged Area score, to identify the United Kingdom's most deprived communities, called "health action zones." These communities will be given strong economic support to enable organizations, individuals, and public and private health care services at the local level to enter into a partnership to reduce inequalities in health.[57] However, our findings need to be further analyzed with other outcome measures before we can recommend neighborhood area intervention programs such as those planned for the United Kingdom. □

Contributors

M. Malmström planned the study, analyzed the data, and was the principal writer of this article. J. Sundquist assisted with the study design and contributed to the interpretation of the data and to the writing. S.-E. Johansson contributed to the study design, statistical analysis, and editing of the manuscript.

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