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A prospective investigation of neighborhood socioeconomic deprivation and self-rated health in a large US cohort

Qian Xiao^{1,*}, David Berrigan², and Charles E Matthews³

¹Department of Health and Human Physiology, University of Iowa, Iowa City, IA, USA

²Division of Cancer Control and Population Sciences, National Cancer Institute, USA

³Division of Cancer Epidemiology and Genetics, National Cancer Institute, USA

Abstract

Background—Neighborhood characteristics play a critical role in health. Self-rated health (SRH) is an important indicator of quality of life and a strong predictor of premature death. Prospective study on neighborhood deprivation and SRH is limited.

Methods—We examined neighborhood socioeconomic deprivation with reporting fair/poor SRH at follow-up (2004–2006) in 249,265 men and women (age 50–71) who reported SRH as good or better at baseline (1995–1996) in the NIH-AARP Health and Diet Study. Baseline addresses were geocoded and linked to 2000 Census. Census tract level variables were used to generate a socioeconomic deprivation index by principle component analysis.

Results—Residents of more deprived neighborhoods had a higher risk of developing poor/fair SRH at follow-up, even after adjusting for individual-level factors (Odds ratio (95% confidence interval) Q₅ vs Q₁: 1.26 (1.20, 1.32), *p*-trend: <.0001). The results were largely consistent across subgroups with different demographics, health behaviors, and disease conditions and after excluding participants who moved away from their baseline address.

Conclusion—Neighborhood disadvantage predicts SRH over 10 years.

Keywords

neighborhood; socioeconomic deprivation; self-rated health

Correspondence: Qian Xiao, PhD, Department of Health and Human Physiology, University of Iowa, Iowa City, IA 52242, USA (qian-xiao@uiowa.edu; phone: 319-335-9348).

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Ethics Statement

Participants provided written consent. The study protocol and consent procedure was approved by the IRB at the National Cancer Institute.

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Introduction

Macroevironmental factors have been increasingly recognized as important determinants of health (Ham, 2012). A growing body of literature has shown that people living in more deprived neighborhoods have higher risks for a variety of adverse health conditions, including diabetes (Ludwig et al., 2011), cardiovascular diseases (Diez Roux et al., 2001), cancer (Doubeni et al., 2012a, Palmer et al., 2012), and premature death (Major et al., 2010). Understanding the influence of social and environmental characteristics on people's health has become an important objective of public health research.

Self-rated health (SRH) is a commonly used, single-item subjective measure of health. It is considered an important indicator of quality of life (Alonso et al., 2004) and is a strong predictor of mortality (DeSalvo et al., 2006), especially in the older population (Lyyra et al., 2009, Lee, 2000, Mossey and Shapiro, 1982). As such, SRH is tracked by the U.S. Department of Health and Human Services in Healthy People 2020 as an indicator of the general health of the US population. SRH is a unique measure of overall health status as it integrates multiple aspects of health and provides insight on individual's perception of their health conditions, which cannot be fully captured by medical conditions alone (Jylha, 2009). It has been theorized that neighborhood environment can shape multiple aspects of health, including health behaviors and psychological state, which not only influence specific disease risk but can also affect overall health appraisal (Chen and Miller, 2013). Therefore, neighborhood conditions may have a particularly strong effect on SRH.

More than 40 studies have investigated the cross-sectional association of neighborhood socioeconomic status with SRH, and the majority of these studies showed lower SRH among residents of neighborhoods with more severe deprivation (Riva et al., 2007). There has been few prospective studies on neighborhood socioeconomic deprivation and SRH and their findings were mixed (Glymour et al., 2010) (Jokela, 2014, Jokela, 2015), making it a high priority for researchers to exploit longitudinal data to investigate the health effects of neighborhood characteristics. Another gap in literature is lack of investigation on what individual-level factors may influence the neighborhood effects on SRH. Understanding this may help elucidating the mechanisms that link neighborhood environment to health outcomes, and identifying vulnerable population that is most at risk for the adverse effects of neighborhood socioeconomic deprivation.

In a large cohort of middle-to-old aged men and women with over 10 years of follow-up, we examined the association between neighborhood socioeconomic deprivation and the risk of developing fair or poor SRH among those who reported good or better SRH at baseline. Additionally, we further evaluated the influence of individual-level factors, including individual socioeconomic status, health-related behaviors, and chronic disease status, on the neighborhood effect on SRH.

Methods

Study population

Details of the NIH-AARP Diet and Health study were reported previously (Schatzkin et al., 2001). Briefly, the study was established in 1995–1996 by mailing the baseline questionnaire to AARP members (age 50–71) in six US states (California, Florida, Louisiana, New Jersey, North Carolina, and Pennsylvania) and two metropolitan areas (Atlanta, Georgia, and Detroit, Michigan). In total, 566,399 people satisfactorily completed the questionnaire. In 2004–2006, a follow-up questionnaire was mailed to baseline participants. SRH was reported in both baseline questionnaire and follow-up questionnaire. Of the 318,713 participants who completed both questionnaires, we excluded those who had no information on neighborhood socioeconomic deprivation ($N=327$), and those who had missing baseline ($N=3,683$) and follow-up SRH ($N=38,860$). To assess the risk of developing poor or fair SRH over follow-up, we further excluded those who reported poor or fair SRH at baseline ($N=26,578$) for the main analysis. The final analytic cohort included 249,265 men and women.

Area-level socioeconomic deprivation

The baseline (1995–1996) addresses were geocoded into geographical coordinates and linked to the 2000 US Census at the tract level. We adopted the method developed by Messer et al. (Messer et al., 2006) to generate an empirical neighborhood socioeconomic deprivation index (Doubeni et al., 2012b). In brief, we selected 19 census tract-variables that were related to seven components of the neighborhood environment (housing characteristics, residential stability, poverty, employment, occupation, racial composition, and education). We performed principal component analysis (PCA) on these 19 variables in each state and evaluated consistency across states for high-loading variables in the first principle component. Eventually, we retained ten variables with high loadings. The neighborhood socioeconomic deprivation index was constructed for each census tract by summarizing the PCA scores of these ten variables. The list of ten census variables and their loadings and distribution across quintiles of neighborhood socioeconomic deprivation index are presented in Table 1.

SRH and covariates

Participants were asked “would you say your overall health is...” and were instructed to choose one response from five categories (excellent, very good, good, fair, poor). This question was asked in both baseline and follow-up questionnaires. The baseline questionnaire also ascertained information on a broad range of covariates, including demographic characteristics; lifestyle factors, including smoking history, and physical activity; height and weight; medical history including cancer, cardiovascular disease, renal disease, emphysema, and diabetes; and the use of dietary supplements, non-steroidal anti-inflammatory drugs, and menopausal hormone therapy in women. Diet was measured using a 124-item food-frequency questionnaire, and we calculated the Healthy Eating Index–2005 (HEI-2005) as a measure of overall diet quality (Guenther et al., 2008). Incident cancer cases were identified through linkage to state cancer registry databases. In the follow-up questionnaire, participants reported again on medical conditions.

Statistical analysis

Socioeconomic deprivation was categorized into quintiles, and the first quintile representing the least deprived census tract served as the reference. We used multivariate logistic regression to estimate the odds ratio and 95% confidence interval for reporting poor or fair health at follow-up, comparing participants living in more deprived neighborhood (2nd through 5th quintile) at baseline with the reference group (1st quintile). We took a stepwise approach to evaluate the impact of multiple covariates. The base model included age, sex and baseline SRH health. In the second model, we adjusted for individual-level SES indicators (race/ethnicity and education), which are potential confounders of the association between neighborhood SES and SRH. Because lifestyle may play an important role in mediating the effects of neighborhood deprivation on SRH, we introduced several important lifestyle factors (smoking, BMI, physical activity, alcohol and diet) separately in our model to examine their potential mediating effects. Our final model included all aforementioned variables. We also conducted stratified analysis by baseline SRH, age, sex, education, race, smoking, BMI, physical activity and status of chronic conditions.

We conducted a series of sensitivity analysis. To examine the influence of baseline chronic conditions (diabetes, cancer, cardiovascular disease, emphysema, renal disease, hypertension, and hypercholesterolemia), we ran our analysis by additionally adjusting for these conditions and by excluding participants who had these conditions at baseline. We also performed analysis by restricting to participants who did not move from their neighborhood between baseline and follow-up (defined as <1 kilometer in distance between the follow-up address and baseline address). Finally, we used a propensity score method to account for the potential impact of the large proportion (44%) of baseline participants who did not complete the follow-up questionnaire (Austin, 2011). We calculated the propensity score as the probability of completing the follow-up questionnaire by a multivariate logistic regression model that included neighborhood socioeconomic deprivation index and all the covariates in the full model of our main analysis. We then added the propensity score into our full model as a covariate, or used the reciprocal of the score as the weight, to assess its impact on the relationship between neighborhood socioeconomic deprivation and reporting poor or fair health.

Results

Neighborhoods with higher socioeconomic deprivation had higher percent of the total population that were black and unemployed, while they had a lower percent of men and women who held management occupations. More households in the more deprived areas had an annual income of 30k or less, or below the federal poverty level (1999), and they were also more likely to have no car, live on public assistance and had a female head of the family with dependent children (Table 1).

Study characteristics of participants across quintiles of neighborhood socioeconomic deprivation are presented in Table 2. Compared to participants who lived in the least deprived neighborhoods, those living in more deprived neighborhoods had higher BMI and were more likely to be men, currently smoke, and have a history of diabetes, heart disease, stroke, emphysema, and end-stage renal disease at baseline; while they were less likely to be

white, have college education, or engage in vigorous physical activity for 5+ times/week. Participants living in more deprived neighborhoods also on average had a lower HEI-2005 score, suggesting a less healthy diet.

At baseline, 9.6% of the participants reported poor or fair SRH. We first examined the cross-sectional association between neighborhood socioeconomic deprivation and reporting poor or fair health at baseline and observed a linear trend of higher odds of reporting poor or fair health with more severe neighborhood socioeconomic deprivation (Supplementary table 1). Compared to the reference group, participants who lived in the most deprived neighborhood had 66% higher odds of reporting poor or fair health at baseline, after accounting for multiple individual-level factors. Further adjusting for chronic conditions, or removing participants who reported these conditions at baseline, had little impact on the results.

In prospective analyses of those reporting excellent, very good or good SRH at baseline, we found that living in more deprived neighborhood was associated with significantly higher odds of developing poor or fair health over 10 years of follow-up (table 3). Adjusting for individual socioeconomic status, multiple individual health behaviors (smoking, physical activity, alcohol consumption and diet), and BMI attenuated the results, but the association remained. After accounting for all the individual-level factors, participants who lived in the most deprived neighborhood had a 26% increase in odds of reporting poor or fair health comparing with those who lived in the least deprived neighborhood at baseline. About 53% participants reported living in the same neighborhood in the follow-up questionnaire (defined as <1 kilometer in distance between the follow-up address and baseline address). When we restricted our analysis to these participants, the prospective association between neighborhood deprivation and SRH remained unchanged ($OR_{Q5 \text{ vs } Q1}$ (95% CI), 1.23 (1.15, 1.31)) (supplementary table 2). Additionally adjusted for the propensity score for completion of the follow-up questionnaire (supplementary table 3) also had little impact on the results. Finally, we examined individual census variables in relation to SRH, and found that all variables were significantly associated with reporting poor or fair SRH at follow-up (supplementary table 4). Judged by the magnitude of the effect estimation, the top three census variables with the strongest associations were % total with less than high school, % households with income (1999) below poverty and % households with income <30 k.

We performed subgroup analysis on the prospective relationship between neighborhood socioeconomic deprivation and reporting poor or fair health, stratified by age, sex, baseline SRH, education, race, smoking, BMI, vigorous physical activity, and status of chronic conditions (Figure 1 and supplementary Table 5). Overall, in all subgroups, we found higher odds of reporting poor or fair health among participants living in more deprived neighborhood. However, the association appeared to be weaker and not statistically significant among people who reported excellent health at baseline, blacks, and those who had less than 12 years of education, possibly due to small sample size and insufficient power. We also detected a highly statistically significant interaction with age, BMI, and vigorous physical activity, and although all associations remained positive in each group, the associations appeared smaller in magnitude among those who were 65 years or older, had a BMI of over 30, and reported never or rarely engaging in physical activity.

Discussion

In this group of middle-to-old aged American men and women, we found that living in more deprived neighborhood is a strong predictor of developing poor/fair SRH over 10 years of follow-up. Moreover, this association was only partially explained by individual-level factors such as socioeconomic status, health behaviors, and disease conditions.

Our cross-sectional finding is consistent with the widely reported association between neighborhood characteristics and SRH. A systematic review by Riva et al. examined papers published between 1998 and 2005 that focused on small area effects on health, and found 39 studies, all cross-sectional, that examined area level associations with SRH. The authors concluded that the evidence support an association between less favorable neighborhood socioeconomic conditions and poorer SRH (Riva et al., 2007). Several additional studies published after 2005 also confirmed the cross-sectional relationship in neighborhood features and SRH in the US population (Tomey et al., 2013, Meyer et al., 2014). Our findings, together with previous literature, support a higher prevalence of poor or fair health among residents in deprived neighborhood. It is noteworthy that in general our cohort members were from a relatively high socioeconomic background. For example, 38% of the participants were college graduates; while in 1995, less than 20% of the general population 25 years or older had a bachelor's degree or more (Ryan and Siebens, 2012). Moreover, our cohort were predominately white, with <10% from other race and ethnicity. Yet in this relatively homogeneous group, the age- and sex-adjusted prevalence of poor or fair health in the highest quintile of neighborhood deprivation was twice as high as that in the lowest quintile, suggesting that the disparity among the whole US population could be even larger.

A major limitation of the current literature is lack of prospective investigations. As noted before, only three studies utilized longitudinal data to examine neighborhood conditions and SRH (Glymour et al., 2010, Jokela, 2014, Jokela, 2015). Among them, the study by Glymour et al is most comparable to ours. The authors evaluated the relationship between socioeconomic disadvantage at census tract level and repeated measures of SRH over 10 years in ~4000 men and women (mean age 58) (Glymour et al., 2010), and reported that compared to other participants, those living in neighborhoods in the lowest quartile of socioeconomic status had a 30% increase in odds of reporting poor/fair health during follow-up (OR (95% CI), 1.36 (1.15, 1.59)), an estimate comparable to ours. Due to limited prospective evidence, more such studies are needed to clarify this association. Moreover, although longitudinal observational studies offer substantial advantage over cross-sectional studies, they are susceptible to residual confounding and usually cannot be used to determine a causal effect. Other study designs, such as experiments and quasi-experiments, are advantageous because they minimize the effect of confounding.

Several studies took advantage of social experiments that focused on moving people out of disadvantaged neighborhoods or improving neighborhood conditions, however, such investigations are also scarce and their results are mixed (Oakes et al., 2015). In summary, the field needs more studies with longitudinal data and careful design to elucidate the health effects of neighborhood environment and identify areas for policy and public health interventions.

Several mechanisms have been proposed to explain the association between neighborhood deprivation and poor health. Some suggest that neighborhood environment influences people's health behaviors, which lead to different health outcomes. For example, it has been argued that neighborhoods with low socioeconomic status have less favorable physical activity environments, such as poor walkability and limited recreational facilities (Gordon-Larsen et al., 2006), which may lead to physical inactivity. Similarly, dietary behavior may be affected by availability of local grocery stores, supermarkets, restaurants and other food outlets and services (Hilmers et al., 2012). Low-income and minority communities tend to have limited access to healthy foods and have a higher density of fast-food outlets and convenience stores, which may contribute to the unhealthy diet (Beaulac et al., 2009). A combination of sedentary lifestyle and poor diet increases risk of obesity and related health conditions. Consistent with this hypothesis, several longitudinal studies have shown that neighborhood socioeconomic disadvantage predicted higher weight gain and poor cardiometabolic health (Powell-Wiley et al., 2014, Ludwig et al., 2011, Diez Roux et al., 2001, Coogan et al., 2010). In our study, the association between neighborhood socioeconomic deprivation and poor SRH was substantially attenuated after adjusting for individual-level variables, including smoking, diet, physical activity, and obesity, supporting a role of these factors in mediating the neighborhood effect on health. However, our findings also show that the association between neighborhood deprivation and SRH remained after controlling for individual behaviors and among people who were never smokers, had a normal BMI or engaged in a higher level of physical activity, suggesting that other mechanisms may be in play.

Another hypothesis suggests disadvantaged neighborhoods, with their high crime rates, poor housing quality, infrastructure deprivation, and impaired social interactions, create a stressful environment (Chen and Miller, 2013). Growing evidence has shown that exposure to chronic stress not only alters health behaviors, but may also exert lasting impact on health by promoting inflammation and causing metabolic and hormonal dysregulation (Miller et al., 2011). This hypothesis may be particularly relevant for understanding the neighborhood effects on SRH, because it has been argued that subjectively evaluating one's own health status involves integrating information from biological, emotional and social dimensions, and psychoendocrinological and psychoneuroimmunological pathways play an important role in this process (Jylha, 2009). According to this hypothesis, impairment in endocrine and immune systems caused by stressful neighborhood may directly influence people's interoceptive sensations and affect SRH. Future studies are needed to elucidate mechanisms that are responsible for the link, and even more importantly, identify potential targets for public health interventions. Moreover, as Chen and Miller suggested, social support, particularly positive family dynamics, may buffer the adverse effects of low SES neighborhood (Chen and Miller, 2013). Therefore, more studies are needed to gather evidence for development of effective intervention strategies that aim at reducing health disparities across socioeconomic strata.

We found that neighborhood deprivation was prospectively associated with poor SRH even among participants who were free of major chronic conditions such as cancer, cardiovascular disease and diabetes. This finding is similar to that from an earlier study conducted in Los Angeles, which reported that living in very deprived neighborhoods is

associated with higher odds of reporting poor health among study subjects who reported no chronic obstructive pulmonary disease, hypertension, arthritis, diabetes and asthma (Brown et al., 2007). SRH has long been regarded as a measure of health that is different from objective clinical ratings, because it integrates bodily sensations that cannot be captured by medical examinations (Jylha, 2009). An earlier study showed that over 10% of elders who were considered to be healthy by clinical assessments reported poor SRH (Blazer and Houpt, 1979). Additionally, not only do clinically healthy elders report poor SRH, poor SRH can also serve as a good predictor of higher mortality among those elders who exhibited good physical and cognitive health in objective evaluations (Schoenfeld et al., 1994). Therefore our finding suggests that neighborhood socioeconomic deprivation may have a detrimental effect on health even when there are no or few obvious clinical symptoms. On the other hand, we observed that among people who had chronic conditions, living in more deprived neighborhood was also associated with developing poor SRH. It has been reported that poor SRH is more strongly linked with mortality among people with chronic illness than those without (Burstrom and Fredlund, 2001). Therefore, neighborhood deprivation may play an even more harmful role in mortality for those who are already in challenging health conditions due to diseases.

One of the major strengths of our study is its prospective design, which allowed us to ascertain the temporal sequence of neighborhood exposure and developing poor/fair SRH. This could reduce the likelihood of reversal causation, a major problem for cross-sectional studies. Additionally, previous study has suggested that there might be a long latency period for neighborhood environment to take its effect (Powell-Wiley et al., 2014), and our relatively long follow-up period makes it more likely to detect changes in SRH in relation to neighborhood deprivation. Moreover, information on chronic conditions was collected both at both baseline and follow-up, and therefore we could evaluate the effects of not only baseline conditions but also incident diseases. Additionally, our study has a large sample size, and we were able to perform subgroup analyses to examine whether and how the association between neighborhood deprivation and SRH was modified by multiple factors, such as individual socioeconomic status and health behavior. We were also able to conduct sensitivity analysis to evaluate the potential impact of moving out of the neighborhood and loss of follow-up on our findings.

Our study also has several limitations. First, we only had a one-time measure of neighborhood conditions, and could not evaluate changes in neighborhood that may also contribute to changes in SRH. Second, although we conducted sensitivity analysis by excluding participants whose follow-up address was at least 1 km or more away from the baseline address, we did not have information on their complete residential history during the follow-up and therefore we did not know if they lived in the same area throughout follow-up, or moved out and back during this period. Third, in our study, we used 2000 census variables to characterize neighborhood socioeconomic condition at baseline (1995–1996) and it requires that the baseline neighborhood condition remained stable between baseline and 2000. As a result, neighborhood SES could be misclassified if the neighborhood experienced substantial changes between baseline and 2000. Fourth, we had a large number (44%) of participants who did not complete the follow-up questionnaire due to death or loss of follow up, which limits the generalization of our findings, although using

propensity scores of completing the follow-up questionnaire as weights in regression analysis had minimal impact on the results, suggesting the impact of missingness is likely to be small to the overall findings. Finally, we did not account for spatial autocorrelation, which may have an effect on the validity of the results (Waller and Gotway, 2004) (Berrigan et al., 2014).

In conclusion, our study contributes to the expanding literature of the health effects of neighborhood conditions. Given that SRH is an important indicator of quality of life and established predictor of mortality, particularly in the older population, the association between neighborhood deprivation and SRH highlights the disproportionately high burden of poor health among residence of disadvantaged neighborhoods. Between 2000 and 2010, the percentage of US population living in poverty areas grew from 18.1% to 25.7%, and it is estimated that over 77 million people lived in poverty areas in 2010. Moreover, in the general population, over 20% of those who are 60 years or older report poor SRH. This suggests that an even larger proportion of those who live in poverty areas suffer from poor health, presenting a severe challenge for public health. Future studies should focus on identifying the key elements in the disadvantaged neighborhood that may exert adverse health effects, elucidating the potential mechanisms linking neighborhood deprivation with poor health, and providing critical evidence for designing effective intervention programs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Prospective associations between baseline neighborhood socioeconomic deprivation index and reporting poor/fair health during follow-up, by sex, age, education, race, smoking, BMI, physical activity, and status of chronic conditions ^a, National Institutes of Health-AARP Diet and Health Study, 1995–1996. The odds ratios and 95% confidence intervals were calculated comparing the 5th quintile of neighborhood socioeconomic deprivation index with the 1st quintile, adjusted for age (continuous), sex (male, female) and baseline self-reported health (good, very good, or excellent), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and Asian, Pacific Islander, American Indian/Alaskan Native, or other) and education (less than 12 years, 12 years, post high school, some college or college/post graduate), smoking status (never, former and current smoker), smoking dose (0, 1–10, 11–20, 21–30, 31–40, 41–50, 51–60, or >60 cigarettes per day), time since quitting (never quit, >10, 5–9, 1–4, or <1 years), BMI (<18.5, 18.5–<25, 25–<30, 30–<35, or 35+), vigorous physical activity (never/rarely, 1–3 times/month, 1–2 times/week, 3–4 times/week, or 5+ times/week), alcohol intake (continuous), health eating index (continuous). Covariate that was stratified by was not adjusted in the respective analysis.

^arefers to any of the following conditions: diabetes, cancer, cardiovascular diseases, emphysema, and renal disease. *P-for-interaction*: 0.75 for sex, <.0001 for age, 0.02 for baseline SRH, 0.54 for education, 0.91 for race, 0.08 for smoking, 0.004 for BMI, <.0001 for physical activities, and 0.01 for chronic conditions.

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Neighborhood characteristics according to quintiles of deprivation index among 17,969 census tracts, National Institutes of Health-AARP Diet and Health Study, 1995–1996

Table 1

Neighborhood characteristics ^a , mean (SD)	Neighborhood socioeconomic deprivation index					Loading
	Q1 (high SES)	Q2	Q3	Q4	Q5 (low SES)	
Unemployed, % total population	2.8 (1.8)	3.6 (2.1)	4.4 (2.6)	5.4 (3.1)	10.3 (6.0)	0.30
Less than high school, % total population	4.9 (2.6)	9.1 (3.4)	13.6 (4.3)	19.6 (6.2)	34.4 (13.2)	0.33
Management occupations, % male	60.7 (9.4)	45.2 (8.9)	34.8 (8.7)	26.5 (8.3)	17.4 (8.3)	0.30
management occupations, % female	56.9 (8.0)	46.3 (7.3)	39.2 (7.0)	33.1 (7.4)	25.0 (8.2)	0.30
Income<30k\$, % total households	12.1 (5.3)	19.0 (6.6)	26.0 (7.3)	34.3 (8.2)	50.1 (12.9)	0.35
Income below poverty, % total households	3.2 (2.1)	4.8 (2.8)	6.5 (3.3)	9.4 (3.8)	21.0 (10.2)	0.36
No car, % total households	2.9 (3.1)	4.5 (4.5)	5.8 (4.7)	7.7 (5.8)	18.2 (13.6)	0.30
Living on public assistance, % total households	0.8 (0.8)	1.3 (1.1)	1.8 (1.3)	2.8 (2.0)	7.2 (5.2)	0.33
Female headed with dependent children, % total households	3.0 (1.6)	4.0 (2.1)	4.8 (2.3)	6.0 (2.9)	11.5 (6.6)	0.32
Non-Hispanic blacks, % total population	2.4 (3.3)	3.9 (5.6)	5.2 (8.2)	8.0 (12.4)	28.5 (31.0)	0.24

^a assessed by variables from Census 2000

Study characteristics according to quintiles of deprivation index among 249,265 participants who reported good health or better at baseline, National Institutes of Health-AARP Diet and Health Study, 1995–1996

Table 2

	Neighborhood socioeconomic deprivation index				
	Q1 (high SES)	Q2	Q3	Q4	Q5 (low SES)
Age at baseline, mean (SD)	61.2 (5.4)	61.8 (5.4)	62.0 (5.3)	62.3 (5.3)	62.0 (5.3)
Female, %	34.8	38.1	40.6	42.9	48.2
White, non-Hispanic, %	95.5	95.1	95.2	94.2	83.2
College and postcollege, %	64.6	49.5	39.2	32.2	27.7
Married, %	77.2	72.6	70.8	68.8	61.3
Current smoker, %	6.9	8.6	9.9	10.8	12.6
Former smoker, %	49.8	50.5	50.4	49.4	46.5
Body mass index, kg/m ² , mean (SD)	26.2 (4.4)	26.7 (4.7)	27.1 (5.0)	27.3 (5.1)	27.7 (5.5)
Vigorous physical activity $\geq$ 5 times/wk, %	21.9	20.4	19.7	19.7	18.3
alcohol consumption, g/d, mean (SD)	14.3 (30.1)	13.5 (32.9)	12.9 (35.6)	12.2 (36.2)	11.0 (37.6)
Fruits and vegetables, servings per 1000 kcal, mean (SD)	4.1 (1.8)	4.0 (1.8)	3.9 (1.8)	3.9 (1.8)	3.9 (1.9)
whole grains, servings per 1000 kcal, mean (SD)	0.71 (0.45)	0.69 (0.45)	0.69 (0.46)	0.68 (0.46)	0.67 (0.48)
total fat, % of energy, mean (SD)	0.29 (0.07)	0.30 (0.08)	0.30 (0.08)	0.30 (0.08)	0.31 (0.08)
Red meat, g/1000 kcal, mean (SD)	31.7 (20.6)	33.4 (20.7)	34.6 (21.1)	35.2 (21.3)	34.8 (21.7)
total energy, kcal/d, mean (SD)	1798 (756)	1830 (853)	1851 (875)	1862 (919)	1917 (1103)
HEI-2005 total score	68.5 (10.5)	67.7 (11.0)	67.2 (11.1)	66.7 (11.4)	66.2 (11.5)
Self-reported chronic conditions at baseline, %					
Hypertension	23.3	24.7	26.4	27.1	27.7
Hypercholesterolemia	32.0	31.1	31.0	30.7	29.1
Diabetes	5.2	6.3	7.3	8.2	9.8
Heart Disease	10.8	11.6	12.4	12.8	12.7
Stroke	1.1	1.2	1.5	1.8	2.1
Cancer	8.0	7.7	7.8	7.8	7.7
Emphysema	1.0	1.6	1.9	2.3	2.5
End-stage renal disease	0.08	0.08	0.11	0.11	0.12

Abbreviations: HEI, health eating index; SD, standard deviation

Table 3

Prospective associations between baseline neighborhood socioeconomic deprivation index and reporting poor/fair health during follow-up among people reporting good health or better at baseline (N=249,265), National Institutes of Health-AARP Diet and Health Study, 1995–1996

	Neighborhood socioeconomic deprivation index				
	Q1 (high SES)	Q2	Q3	Q4	Q5 (low SES)
No. of participants reporting poor/fair health at follow-up (%)	3729 (7.2)	4436 (8.7)	5052 (10.1)	5765 (11.8)	6190 (13.1)
Multivariate OR (95% CI)					
Base model ^a	ref	1.12 (1.07, 1.18)	1.23 (1.18, 1.29)	1.39 (1.33, 1.45)	1.51 (1.45, 1.58)
Base model ^a + individual SES ^b	ref	1.08 (1.03, 1.14)	1.16 (1.11, 1.22)	1.29 (1.23, 1.35)	1.36 (1.30, 1.43)
Base model ^a + smoking ^c	ref	1.07 (1.02, 1.12)	1.14 (1.09, 1.20)	1.26 (1.20, 1.32)	1.32 (1.26, 1.38)
Base model ^a + BMI ^d	ref	1.07 (1.02, 1.12)	1.13 (1.08, 1.19)	1.25 (1.20, 1.31)	1.32 (1.26, 1.38)
Base model ^a + physical activity ^e	ref	1.08 (1.03, 1.13)	1.16 (1.10, 1.21)	1.28 (1.22, 1.34)	1.35 (1.28, 1.41)
Base model ^a + alcohol and diet ^f	ref	1.08 (1.03, 1.13)	1.15 (1.10, 1.21)	1.28 (1.22, 1.34)	1.34 (1.28, 1.41)
Full model ^g	ref	1.05 (1.00, 1.10)	1.11 (1.06, 1.16)	1.22 (1.16, 1.28)	1.26 (1.20, 1.32)

^a adjusted for age (continuous), sex (male, female) and baseline self-reported health (good, very good, or excellent)

^b race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and Asian, Pacific Islander, American Indian/Alaskan Native, or other) and education (less than 12 years, 12 years, post high school, some college or college/post graduate)

^c smoking status (never, former and current smoker), smoking dose (0, 1–10, 11–20, 21–30, 31–40, 41–50, 51–60, or >60 cigarettes per day), time since quitting (never quit, >10, 5–9, 1–4, or <1 years)

^d BMI (<18.5, 18.5–<25, 25–<30, 30–<35, or 35+)

^e rigorous physical activity (never/rarely, 1–3 times/month, 1–2 times/week, 3–4 times/week, or 5+ times/week)

^f alcohol intake (continuous), health eating index (continuous)

^g adjusted for all variables ^a through ^f

Abbreviations: BMI, body mass index; HEI, health eating index; SD, standard deviation; SES, socioeconomic status