



Published in final edited form as:

J Epidemiol Community Health. 2011 March ; 65(3): 254–259. doi:10.1136/jech.2008.084723.

A two-county comparison of the HOUSES index on predicting self-rated health

Michael C Butterfield¹, Arthur R Williams², Tim Beebe³, Dawn Finnie³, Heshan Liu³, Juliette Liesinger³, Jeff Sloan³, Philip H Wheeler⁴, Barbara Yawn⁵, and Young J Juhn⁶

¹UC Berkeley-UC San Francisco Joint Medical Program, Berkeley, California, USA

²Center for Health Outcomes and Health Services Research, Children's Mercy Hospitals and Clinics and Office of the Mayor, City of Kansas City, Missouri, USA

³Department of Health Sciences Research, Mayo Clinic, Rochester, Minnesota, USA

⁴Rochester-Olmsted County Planning Department, Minnesota, USA

⁵Olmsted Medical Center, Department of Research, Rochester, Minnesota, USA

⁶Department of Pediatric and Adolescent Medicine, Mayo Clinic, Rochester, Minnesota, USA

Abstract

Background—Mortality, incidence of most diseases, and prevalence of adverse health behaviours follow an inverse gradient with social class. Many proxies for socioeconomic status (SES) exist; however, each bears a different relation to health outcomes, probably following a different aetiological pathway. Additionally, data on SES can be quite difficult to gather. Five measures of SES were compared, including a novel measure, the HOUSES index, in the prediction of self-rated health (SRH) in two Midwestern settings, Olmsted County, Minnesota, and Jackson County, Missouri.

Methods—Using a probability sampling design, a cross-sectional telephone survey was administered to a randomised sample of households. The questionnaire collected a variety of sociodemographic and personal health information. The dependent variable, SRH, was dichotomised into excellent/very good/good versus fair/poor health. Information for the HOUSES index was collected through public property records and corroborated through the telephone questionnaire. Participants were parents/guardians of children aged 1–17 residing in Olmsted County (n=746) and Jackson County (n=704).

Results—The HOUSES index was associated with adverse SRH in Jackson County adults. All five SES measures were significant predictors in this group. Composite SES indices showed significant associations with SRH in Olmsted County adults.

Conclusions—The HOUSES index makes a unique contribution to the measurement of SES and prediction of health outcomes. Its utility is qualified by specific social contexts, and it should be used in concert with other SES indices.

Correspondence to: Young J Juhn, Division of Community Pediatric and Adolescent Medicine, Department of Pediatric and Adolescent Medicine, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA; juhn.young@mayo.edu.

Competing interests None.

Ethics approval This study was conducted with the approval of the Mayo Clinic Institutional Review Board.

Provenance and peer review Not commissioned; externally peer reviewed.

INTRODUCTION

Over the last 25 years, socioeconomic status (SES) has emerged as a critical concept in the assessment and prediction of health outcomes in the industrialised world. The notion that relative social position, rather than absolute poverty, predisposed one to negative health outcomes was demonstrated in the hallmark Whitehall studies of British social servants.¹ The subsequent Whitehall II study of male and female civil servants revealed a similar gradient effect between social class, health behaviours, psychosocial characteristics and the prevalence of a number of chronic diseases.² Similar findings have been replicated in the USA.³⁻⁶ Regarding overall morbidity, decreasing SES correlates with the increasing prevalence of most major chronic diseases, including cardiovascular, respiratory, and gastrointestinal diseases, arthritis, diabetes, and many cancers for which detection and treatment affect survival.^{2-4,6-8}

However, despite the importance of SES measures in studying the roles of SES in health outcomes, measures are often not available in commonly used large datasets such as medical records, administrative data and others.⁸⁻¹¹ This is a significant impediment to research on the role of SES in health. To overcome the absence of measures of SES, a measure was developed derived from housing characteristics, that is, real property data, for which the methodology and findings were reported previously.¹²

In the present study, in an attempt to further study the nature of the HOUSES index (ie, *HOU*sing-based *SES* measure), the relationship between the HOUSES index and self-reported health status was assessed in two counties: Olmsted County, Minnesota, and Jackson County, Missouri. Self-reported health status was employed as a health outcome because it has been widely used in large surveys such as the National Health Interview Survey (NHIS), National Health and Nutrition Examination Survey (NHANES) and its follow-up study (NHEFS), and the Rand Health Insurance Experiment, among others.¹³⁻¹⁵

In addition to the primary aim of assessing the role of the HOUSES index in self-reported health outcomes, relatively few studies have *compared* associations between comprehensive measures of SES and health outcomes, and fewer have compared these associations simultaneously in multiple locales.¹⁰ To address this aim, four standard measures of SES were used in both counties: two individual measurements (income, education) and two composite indexes (Hollingshead and Nakao-Treas). Therefore, in this study, the relationship was assessed between the newly developed HOUSES index derived from housing characteristics along with other SES measures and self-reported health of subjects in Olmsted County, Minnesota, and Jackson County, Missouri.

METHODS

This study was reviewed and approved by the Mayo Clinic Institutional Review Board. Cross-sectional data were obtained from a household telephone survey conducted between August and October 2006 in Olmsted County, Minnesota (n=746) and Jackson County, Missouri (n=704) by the Center for Social Science and Behavioural Research (CSBR) at the University of Northern Iowa. The response rate was 62% for residents of Olmsted County and 50% for Jackson County. Olmsted County is located 90 miles southeast of Minneapolis and in 2000 had a population of 124 277, 69% of whom resided within the city of Rochester. Jackson County includes part of the Kansas City metropolitan area, and in 2000 had a population of 654 880. In 2000, mean household income in Olmsted County was \$51 316, 6.4% of the population lived below the 1999 poverty line and 90.3% of residents were ethnically 'white'; in the same year, median household income was \$39 227 in Jackson County, 11.9% lived below the 1999 poverty line and 70.1% were white.

Participants were a randomised sample of non-institutionalised parents/guardians of children 1–17 years of age residing in the aforementioned counties, stratified by zip code to ensure for geographical coverage. Due to the necessity of linking survey data with property data via address, the sampling frame utilised a list-appended random digit dial (RDD) sample purchased from Survey Sampling, Inc. (SSI, <http://www.surveysampling.com/en>), whereby postal addresses were appended to the RDD telephone numbers if they were found in listed directories. Additional inclusion criteria were the availability of real household property data and completion of the survey in English. The main independent variables were socioeconomic measures, which include two single measures of SES (eg, educational levels of parents and annual family income), two widely used composite measures of SES (eg, Hollingshead and Nakao-Treas indices), and the HOUSES index derived from real property data. Educational levels of parents/guardians were measured by response to the question ‘What is the highest grade or year of school that has been completed by a parent or primary care giver in your household?’ Annual family income was measured using a response to stepwise questions for income category. The first question was ‘Would you say it was more than \$25 000 a year or less than \$25 000 a year?’ Subsequent questions were repeated for increments of income in a stepwise manner. Both questions were adopted from a standard questionnaire for telephone surveys.

Composite SES scores (Nakao-Treas and Hollingshead) were also constructed. The Hollingshead Four-Factor Index uses education, occupation, sex and marital status to determine a family’s composite social status.¹⁶ The Nakao-Treas index is derived from both educational attainment and income of job incumbents corresponding to the 1980 census.¹⁷ The HOUSES index was constructed using seven different real property data and six different neighbourhood characteristics collected twice, once through the survey questionnaire and a second time with publicly available records of housing characteristics.

Study subjects were asked about various health behaviours and outcomes, including self-rated health (SRH). SRH is a global assessment of an individual’s perceived health in response to the question ‘Would you say your health is excellent, very good, good, fair or poor?’ SRH is recognised as an economical, succinct and holistic description of a person’s physical, psychological and social well-being; longitudinally, it is highly predictive of mortality, morbidity, healthcare utilisation and onset of disability, even after controlling for demographic factors and other health status indicators.^{1318–21} Although it is likely that the referents and ‘normative categories’ for assessing SRH may vary according to variables such as age, ethnicity or gender,¹³¹⁴¹⁹ discrepancies in the formation of health perceptions do not appear to diminish its general utility. Furthermore, McGee and colleagues have argued that strong associations remain between SRH and mortality regardless of ethnicity (black, white, Hispanic, Native American, Asian/Pacific Islander) or gender and after controlling for age.²¹

Data analysis

To initially establish the criterion validity of the HOUSES index, Pearson’s correlations between all five SES measures were assessed. Second, ORs were estimated, their corresponding 95% CI and p values between strata of each SES measure and a dichotomised variable of SRH (excellent/very good/good vs fair/poor health). Subjects in each county from the sample were stratified into SES quartiles, except in the case of household income (quintiles). A full methodological discussion is provided in Juhn *et al*, 2008.¹²

RESULTS

The sociodemographic profile of the study populations is provided in tables 1 and 2. The survey response rate was 62% in Olmsted County (750/1209) and 50% in Jackson County

(781/1562); in both counties, more than three-quarters of the adult respondents were women. In the Olmsted County, 91% of subjects were white with a median age of 41 years. In the Jackson County set, 81% were white with a median age of 39 years.

For criterion validity, Pearson's correlation coefficients were assessed between all five SES measures. The results, in brief, indicate moderate to good correlations between the variables among the study populations in both counties. In particular, the HOUSES index correlates most strongly with income in both counties. Full results on the Pearson's coefficients are available in Juhn *et al*, 2008.¹²

Results on the associations between stratified SES indices and risk of fair/poor (adverse) SRH are presented in table 3. The denominator for each test may have varied slightly due to differences in reporting SES data. Significant associations between SES and SRH are present for every SES measure among Jackson County adults. In all four SES measures stratified into quartiles, significant reductions in risk are evident in the highest two strata, and many of the correlations among the second-lowest strata appear to be approaching statistical significance. ORs for adverse SRH among members of the highest SES subgroups ranged from 0.15 on the Hollingshead index (95% CI 0.05 to 0.45) to 0.27 on the Nakao-Treas index (95% CI 0.12 to 0.65). Notably, the HOUSES index appeared to readily predict significant reductions in risk of adverse SRH among the higher two strata. However, HOUSES did not correlate significantly with SRH in Olmsted County; only the Hollingshead and Nakao-Treas composite indices showed significant associations with SRH in this population.

DISCUSSION

In this multi-sited study, the HOUSES index of socioeconomic status was predictive of adverse SRH among adults in Jackson County, but not in Olmsted County. All five individual measures of SES significantly correlated with health in Jackson County adults, but only the Nakao-Treas (NT) and Hollingshead (HH) indices were significant in the Olmsted County sample.

The HOUSES index, therefore, is associated with SRH in certain settings. Beyond SRH, in another study utilising the same dataset,¹² higher scores on the HOUSES index were significantly associated with reduced risk of low birth weight in Jackson County children, as well as lower odds of overweight and exposure to smoking in children in both Jackson and Olmsted counties. HOUSES also significantly predicted low health-related quality of life (QOL) scores in the same sample of Jackson County, whereas results for the other individual and composite SES measures followed a pattern similar to that of SRH (data available upon request). In Olmsted County, HOUSES nearly approached $p < 0.05$ significance in predicting decreased odds of low QOL in the highest stratum. Furthermore, in contrast to the results for SRH, all other measures of SES produced significant associations with QOL in the Olmsted County cohort.

Housing and neighbourhood environments have been an area of concern from the very beginnings of the public health movement.²² The household is a central place of daily activity and interpersonal interaction where health can be affected in myriad ways. Housing has material as well as symbolic dimensions that impinge upon health²³ and exhibit a considerable degree of overlap.²⁴ The structural and spatial aspects of the home may directly affect health through exposures to temperature, infectious agents, pollutants or injury.²⁵ Indirectly, material circumstances at home may serve as indicators of personal or social resource availability^{25,26}; housing tenure in the UK, for example, significantly predicts the level of SRH, among many other health indicators.²⁷ In addition, housing exists as a

category of meaning around which people forge a sense of identity, social status and 'ontological security.'¹²²⁴²⁵ Demands, discord and felt loss of control in the home environment can cause stresses, which adversely affect health through alterations in neuroendocrine and immunological functioning.³²³²⁸

Given the recognised relationships between housing circumstances and health, the absence of a significant association between the HOUSES index and SRH in Olmsted County adults was unexpected. It is noteworthy, however, that *none* of the individual SES indicators significantly correlated with SRH in this population, exactly the opposite of the case in Jackson County.

This lack of association between the HOUSES index and self-reported general health status may be due to four reasons: 1) relatively, Olmsted County, Minnesota, is ethnically and socioeconomically homogeneous; 2) fewer persons are denied access to quality medical services in Olmsted County; 3) Olmsted County is less segregated than Jackson County, Missouri, which has one of the higher levels of measured racial segregation in the USA, whereas Olmsted County is relatively integrated; and 4) the Olmsted County, Minnesota, population had a much lower prevalence of poor SRH (3.5%) than that for Jackson County, Missouri, population (8%).

Almost half (45%) of the Olmsted County population completed college education or professional degrees, as compared to about one-quarter (29%) of the Jackson County population. This trend is also true for income. Caucasians represented 90% of the Olmsted County population versus 69% of the Jackson County population. In addition, Olmsted County is much less racially and economically segregated than Jackson County (ie, relatively wealthy individuals live in modest housing units). The average of the dissimilarity indices calculated by race for white versus other minority groups in the Rochester MSA (including all of, and only, Olmsted County in 2000) was 36.8, ranking 265th out of 331 metropolitan areas, whereas for the Kansas City MSA, of which Jackson County is a part, it was 59.8, the 52nd highest in the USA.²⁹ It is likely that economic segregation is also more prevalent in Jackson County than in Olmsted County (ie, relatively wealthy households in Olmsted County live in relatively modest housing units, or in mixed income neighbourhoods, to a greater extent than in Jackson County). The authors suggest that for all these reasons income and education fail to be more strongly associated with SRH in Olmsted County, which runs counter to a considerable literature showing that measured SES has a dose-response pattern with SRH.^{1820212430–32} Thus, research studies using measures of SES in a community with high socioeconomic and ethnic homogeneity and high levels of integration, such as Olmsted County, may need to utilise more than one socioeconomic index, preferably a more finely graded socioeconomic index such as a composite index.

For example, the two composite measures of SES—Hollings-head and Nakao-Treas—did exhibit significant associations with SRH in Olmsted County adults. The combined findings of the study and literature on SES and SRH suggest, therefore, that the failure of HOUSES, education or income to predict SRH in this group derives from the uniqueness of the socioeconomic structure of Olmsted County. As described above, Olmsted County is a solidly middle-class community where median income, average educational attainment, rate of impoverishment and a host of other socioeconomic indicators strongly diverge from the nation as a whole. Reflecting the community at large, the present sample was predominantly comprised of white women from SES strata that are expected to have a low incidence of adverse SRH; indeed, prevalence of adverse SRH was less than 3.6% in this cohort. Above and beyond individual characteristics, it is likely that contextual factors also attenuated the link between SES and SRH. Ethnically white respondents could be presumed to be less affected by racial prejudice and discrimination in their daily lives, which in turn contributes

to disparities in health, including SRH, among ethnic groups.²¹³³³⁴ Perceptions of relative socioeconomic status might also be particularly relevant to this ethnically and economically homogenous sample. As Ostrove and colleagues (2000) have argued, white women's perceptions of their place on the social 'ladder' are significantly related to self-reported health after controlling for objective measures of income and education.³⁵ Finally, beyond perceptions, a lessened degree objective inequality has been shown to have beneficial effects on SRH above and beyond individual SES characteristics, both at the level of the city and the sub-national state.²⁰³¹

Regarding the 'success' of the composite SES measures in predicting SRH in Olmsted County, it follows that in a context of *relative* affluence and social equity, multiple measures of SES might be required to elucidate distinctions between socioeconomic strata and health outcomes. Composite measures of SES have been criticised for obscuring the contributions through which each individual indicator influences health.⁵ Alternatively, the combinatorial aspect of composite indices may bestow multidimensionality to the SES construct, which corrects for known shortcomings inherent to individual indices, as when income fluctuates from year to year. Few studies have compared composite indices with individual indicators of SES, and one conducted by Abramson and colleagues in Israel did not find a composite SES scale to be more powerfully predictive of SRH.³⁶ The present findings of differences in the association of HOUSES with other SES measures and SRH are plausible, and, importantly, are consistent with the recent emphasis on multidimensional measurement of SES.^{36–38}

A major strength of this study is its comparative design. First, a novel measure of socioeconomic status, the HOUSES index, was compared to both individual and composite SES measures in predicting SRH. The HOUSES index, although no substitute for a more comprehensive construct, provides an easily obtainable and dynamic instrument for capturing socioeconomic information about subjects that often are difficult to obtain. Second, the selection of subjects from two study settings emphasised local differences in the associations between SES and SRH that are potentially obscured in analyses that take large political units like the nation or province as their unit of analysis. Comparative studies of small-scale locales are seemingly better suited to capture effects on SRH exerted by specific socioeconomic contexts and locales *in which people actually live*, though these now appear to be few in number.²¹³¹³⁹⁴⁰ A final strength of the present study is that subjects were obtained from a representative sample of the general population in both counties.

A limitation of the present study is the relatively modest sample sizes collected in both counties; a larger number of subjects would most likely strengthen the significance of our findings. Also, as both Olmsted and Jackson counties are located in the Midwestern USA, further research is needed to examine how the HOUSES index works in different regions. Another limitation is a relatively low response rate to the survey in either county. However, similar telephone surveys rarely attain response rates higher than 60–70% and participation has been declining in recent years.^{41–44} The participation rate in Olmsted County (62%), is higher than other survey-based studies previously conducted in this county. Respondents in our study were primarily women, and this might result in a potential response bias. However, gender was not associated with self-reported general health status in both counties (data not shown) and, thus, the higher proportion of women in the present study is unlikely to cause a significant confounding effect (or effect modification) on the association between SES measures and general health status as well as systematic bias to the main study outcomes. In Jackson County, surveys confront the reluctance of minorities to answer surveys that is often found throughout the USA. Yet, under-representation of African-Americans in Jackson County was small, 19% in our study sample versus 22% in the 2000 US Census.

In summary, this study has shown the unique contribution that the HOUSES index can make in the assessment of health outcomes, and its potential usefulness in the timely and appropriate planning and allocation of health resources in communities.

Acknowledgments

We are indebted to staff in the Rochester-Olmsted County Planning Department, Minnesota and in the Assessor's Office of Kansas City, Missouri.

Funding NIH grant (R21 HD51902) from the National Institute of Child Health and Human Development.

References

1. Marmot MG, Shipley MJ, Rose G. Inequalities in death-specific explanations of a general pattern? *Lancet*. 1984; 1:1003–6. [PubMed: 6143919]
2. Marmot MG, Davey Smith G, Stansfeld S, et al. Health inequalities among British civil servants: the Whitehall II Study. *Lancet*. 1991; 337:1387–93. [PubMed: 1674771]
3. Adler NE, Newman K. Socioeconomic disparities in health: pathways and policies. *Health Aff*. 2002; 21:60–76.
4. Winkleby MA, Jatulis DE, Frank E, et al. Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health*. 1992; 82:816–20. [PubMed: 1585961]
5. Pappas G, Queen S, Hadden W, et al. The increasing disparity in mortality between socioeconomic groups in the United States, 1960 and 1986. *N Engl J Med*. 1993; 329:103–9. [PubMed: 8510686]
6. Navarro V. Race or class versus race and class: mortality differentials in the United States. *Lancet*. 1990; 336:1238–40. [PubMed: 1978083]
7. Adler NE, Ostrove JM. Socioeconomic status and health: what we know and what we don't. *Ann N Y Acad Sci*. 1999; 896:3–15. [PubMed: 10681884]
8. Isaacs SL, Schroeder SA. Class -the ignored determinant of the nation's health. *N Engl J Med*. 2004; 351:1137–42. [PubMed: 15356313]
9. Krieger N, Chen JT, Ebel G. Can we monitor socioeconomic inequalities in health? A survey of US Health Departments' data collection and reporting practices. *Public Health Rep*. 1997; 112:481–91. [PubMed: 10822475]
10. Liberatos P, Link BG, Kelsey JL. The measurement of social class in epidemiology. *Epidemiol Rev*. 1988; 10:87–121. [PubMed: 3066632]
11. Williams DR. Missed opportunities in monitoring socioeconomic status. *Public Health Rep*. 1997; 112:492–4. [PubMed: 10822476]
12. Juhn, YJ.; Beebe, T.; Finnie, D., et al. Individual housing data and socioeconomic status in epidemiologic research. Paper Presented at the 2008 Annual Pediatric Academic Society meeting; Honolulu, Hawaii. May 4, 2008;
13. Idler EL, Angel RJ. Self-rated health and mortality in the NHANES-I epidemiologic follow-up study. *Am J Public Health*. 1990; 80:446–52. [PubMed: 2316767]
14. Krause NM, Jay GM. What do global self-rated health items measure? *Med Care*. 1994; 32:930–42. [PubMed: 8090045]
15. Waidman T, Bound J, Schoenbaum M. The illusion of failure: trends in the self-reported health of the U.S. elderly. *Milbank Q*. 1995; 72:253–87.
16. Hollingshead, A. Four factor index of social status. New Haven, CT: Yale University Department of Psychology; 1975.
17. Nakao, K.; Treas, J. General Social Survey Methodological Report No 74. Chicago: University of Chicago, National Opinion Research Center; 1992. The 1989 socioeconomic index of occupations: construction from the 1989 occupational prestige scores.
18. Gold M, Franks P, Erickson P. Assessing the health of the nation: the predictive validity of a preference-based measure and self-rated health. *Med Care*. 1996; 34:163–77. [PubMed: 8632690]

19. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav.* 1997; 38:21–37. [PubMed: 9097506]
20. Kennedy B, Kawachi I, Glass R, et al. Income distribution, socioeconomic status, and self rated health in the United States: multilevel analysis. *BMJ.* 1998; 317:917–21. [PubMed: 9756809]
21. McGee DL, Liao Y, Cao G, et al. Self-reported health status and mortality in a multiethnic US Cohort. *Am J Epidemiol.* 1999; 149:41–6. [PubMed: 9883792]
22. Engels, F. *The condition of the working class in England.* New York: Oxford University Press; 1993 [1845].
23. Dunn JR, Hayes MV. Social inequality, population health, and housing: a study of two Vancouver neighborhoods. *Soc Sci Med.* 2000; 51:563–87. [PubMed: 10868671]
24. Dunn JR. Housing and inequalities in health: a study of socioeconomic dimensions of housing and self reported health from a survey of Vancouver residents. *J Epidemiol Community Health.* 2002; 56:671–81. [PubMed: 12177083]
25. Shaw M. Housing and public health. *Annu Rev Public Health.* 2004; 25:397–418. [PubMed: 15015927]
26. Klinenberg, E. *Heat wave: a social autopsy of disaster in Chicago.* Chicago: University of Chicago Press; 2002.
27. Macintyre S, Hiscock R, Kearns A, et al. Housing tenure and car access: further exploration of the nature of their relations with health in a UK setting. *J Epidemiol Community Health.* 2001; 55:330–1. [PubMed: 11297651]
28. Adler NE, Boyce T, Chesney MA, et al. Socioeconomic status and health: the challenge of the gradient. *Am Psychol.* 1994; 49:15–24. [PubMed: 8122813]
29. Lewis Mumford Center for Comparative Urban and Regional Research the University at Albany SUNY. *Metropolitan racial and ethnic change-census 2000: segregation of whole population.* New York: The University at Albany SUNY; 2009.
30. Laaksonen M, Rahkonen O, Martikainen P, et al. Socioeconomic position and self-rated health: the contribution of childhood socioeconomic circumstances, adult socioeconomic status, and material resources. *Am J Public Health.* 2005; 95:1403–9. [PubMed: 16006419]
31. Stafford M, Martikainen P, Lahelma E, et al. Neighbourhoods and self rated health: a comparison of public sector employees in London and Helsinki. *J Epidemiol Community Health.* 2004; 58:772–8. [PubMed: 15310804]
32. Zunzunegui MV, Koné A, Johri M, et al. Social networks and self-rated health in two French-speaking Canadian community dwelling populations over 65. *Soc Sci Med.* 2004; 58:2069–81. [PubMed: 15020020]
33. Bolen JC, Rhodes L, Powell-Griner EE, et al. State-specific prevalence of selected health behaviors, by race and ethnicity—Behavioral Risk Factor Surveillance System, 1997. *MMWR CDC Surveill Summ.* 2000; 49:1–60.
34. Williams DR, Neighbors HW, Jackson JS. Racial/ethnic discrimination and health: findings from community studies. *Am J Public Health.* 2003; 93:200–8. [PubMed: 12554570]
35. Ostrove J, Adler NE, Kuppermann M, et al. Objective and subjective assessments of socioeconomic status and their relationship to self-rated health in an ethnically diverse sample of pregnant women. *Health Psychol.* 2000; 19:613–8. [PubMed: 11129365]
36. Abramson JH, Gofin R, Habib J, et al. A comparative appraisal of measures for use in epidemiological studies. *Soc Sci Med.* 1982; 16:1739–46. [PubMed: 7178920]
37. Braveman PA, Cubbin C, Egerter S, et al. Socioeconomic status in health research: one size does not fit all. *JAMA.* 2005; 294:2879–88. [PubMed: 16352796]
38. Krieger N, Williams DR, Moss NE. Measuring social class in US public health research: concepts, methodologies, and guidelines. *Annu Rev Public Health.* 1997; 18:341–78. [PubMed: 9143723]
39. Brown WL, Young AF, Byles JE. Tyranny of distance? The health of mid-age women living in five geographical areas in Australia. *Aust J Rural Health.* 1999; 7:148–54. [PubMed: 10745728]
40. Idler EL, Kasl SV, Lemke JH. Self-evaluated health and mortality among the elderly in New Haven, Connecticut, and Iowa and Washington counties, Iowa, 1982–1986. *Am J Epidemiol.* 1990; 131:91–103. [PubMed: 2293757]

41. Curtin R, Presser S, Snger E. Changes in telephone survey non-response over the past quarter century. *Public Opin Q.* 2005; 69:87–98.
42. Groves, RM.; Fowler, FJ.; Couper, JM., et al. *Survey Methodology*. New York: Wiley; 2004.
43. Brehm, J. *The Phantom respondents: opinion surveys and political representation*. Ann Arbor: University of Michigan Press; 1993.
44. Center for Disease Control and Prevention. *2005 Behavioral risk factor surveillance system data quality report handbook*. Atlanta, GA: Centers for Disease Control and Prevention; 2006.

What is already known on this subject

- Socioeconomic status correlates inversely with many health indices including self-rated health.
- However, in the USA, even typically used measures of socioeconomic status (education, income, occupation) are often difficult to obtain.

What this study adds

- Housing-based indices of socioeconomic status (SES), derived from publicly available data, may provide valuable and accessible information for studies on the relationships between SES and health. In the present study, a novel housing-based SES (HOUSES) index was validated.
- The relationship between social class and health are complex and context-dependent. Research studies using measures of SES in a community with socioeconomic and ethnic homogeneity may need to utilise more than one socioeconomic index, preferably a more finely graded socioeconomic index such as a composite index.

Table 1

Sociodemographic characteristics of the study subjects and the population of Olmsted County, Minnesota

	Study subjects (%)	Olmsted county population per 2000 census (%)
Survey respondents		(Population 18–64)
Gender		
Men	24.53% (183/746)	48.34% (38381/77353)
Women	75.47% (563/746)	51.66% (38972/77353)
Age (years)		
Mean (STD), median, IQR	44.20 (61.21), 41.00, 34.00–46.00	—
Ethnicity		
Hispanic or Latino:	2.68% (20/746)	2.44% (1889/77353)
Not Hispanic or Latino:	97.32% (726/746)	97.56% (75464/77353)
White alone	90.88% (678/746)	89.48% (69217/77353)
Black or African-American alone	0.94% (7/746)	2.55% (1969/77353)
American Indian and Alaska native alone	0.13% (1/746)	0.27% (209/77353)
Asian alone	4.56% (34/746)	4.24% (3281/77353)
Native Hawaiian and other Pacific Islander alone	0.13% (1/746)	0.0003% (21/77353)
Some other race alone	0.54% (4/746)	0.0006% (48/77353)
Two or more races	0.13% (1/746)	0.93% (719/77353)
Education		
Less than 9th grade	0.13% (1/746)	3.78% (1405/77353)
9th to 12th grade, no diploma	0.40% (3/746)	5.11% (4747/77353)
High school graduate	6.17% (46/746)	23.98% (17426/77353)
Some college, no degree	19.57% (146/746)	22.37% (18434/77353)
Associate/college degree	39.28% (293/746)	31.28% (25582/77353)
Graduate or professional degree	34.45% (257/746)	13.48% (9759/77353)
Income (household)		
Less than \$10000	0.27% (2/734)	3.97% (1563/39355)
\$10000–\$14999	0.27% (2/734)	3.30% (1300/39355)
\$15000–\$24999	1.23% (9/734)	7.99% (3144/39355)
\$25000–\$34999	4.36% (32/734)	10.47% (4119/39355)
\$35000–\$49999	8.58% (63/734)	16.55% (6514/39355)
\$50000–\$74999	19.89% (146/734)	25.88% (10185/39355)
\$75000–\$99999	22.07% (162/734)	15.05% (5922/39355)
\$100000–\$149999	23.16% (170/734)	10.42% (4102/39355)
Over \$150000	20.16% (148/734)	6.37% (2506/39355)
Hollingshead index		
8–19	0.27% (2/746)	Not available
20–29	1.74% (13/746)	
30–39	8.45% (63/746)	
40–54	34.85% (260/746)	
55–66	54.69% (408/746)	

	Study subjects (%)	Olmsted county population per 2000 census (%)
Nakao-Treas index		
0–12.5	0% (0/746)	Not available
12.6–25.1	0.27% (2/746)	
25.2–37.7	7.51% (56/746)	
37.8–50.3	11.66% (87/746)	
50.4–62.9	14.88% (111/746)	
63.0–75.5	25.20% (188/746)	
75.6–88.1	30.97% (231/746)	
88.2–100	9.52% (71/746)	

Table 2

Sociodemographic characteristics of the study subjects and population of Jackson County, Missouri

	Study subjects (%)	Jackson county population per 2000 census (%)
Respondents		(Population 18–64)
Gender		
Men	22.16% (156/704)	48.71% (196845/404133)
Women	77.84% (548/704)	51.29% (207288/404133)
Age (years)		
Mean (SD), Median, IQR	39.72 (9.31), 39.00, 34.00–46.00	—
Ethnicity		
Hispanic or Latino	3.41% (24/703)	5.21% (21069/404133)
Not Hispanic or Latino	96.59% (679/703)	94.79% (383064/404133)
White alone	81.25% (571/703)	69.32% (280146/404133)
Black or African-American alone	12.36% (87/703)	21.82% (88164/404133)
American Indian and Alaska native alone	0.14% (1/703)	0.47% (1908/404133)
Asian alone	0.57% (4/703)	1.47% (5924/404133)
Native Hawaiian and other Pacific Islander alone	0.57% (4/703)	0.16% (656/404133)
Some other race alone	0.43% (3/703)	0.001% (404/404133)
Two or more races	1.28% (9/703)	1.45% (5862/404133)
Education		
Less than 9th grade	0.14% (1/704)	2.69% (10891/404316)
9th to 12th grade, no diploma	2.56% (18/704)	12.83% (51866/404316)
High school graduate	14.77% (104/704)	28.89% (116815/404316)
Some college, no degree	24.57% (173/704)	26.20% (105946/404316)
Associate/college degree	32.67% (230/704)	22.11% (89382/404316)
Graduate or professional degree	25.28% (178/704)	7.28% (29416/404316)
Income (household)		
Less than \$10000	1.52% (10/657)	3.97% (26898/266501)
\$10000–\$14999	1.67% (11/657)	3.30% (16763/266501)
\$15000–\$24999	4.57% (30/657)	7.99% (36389/266501)
\$25000–\$34999	7.61% (50/657)	10.47% (38429/266501)
\$35000–\$49999	13.70% (90/657)	16.55% (46656/266501)
\$50000–\$74999	23.44% (154/657)	25.88% (52160/266501)
\$75000–\$99999	20.70% (136/657)	15.05% (25667/266501)
\$100000–\$149999	17.66% (116/657)	10.42% (16122/266501)
Over \$150000	9.13% (60/657)	6.37% (7417/266501)
Hollingshead index		
8–19	0.28% (2/704)	Not available
20–29	4.97% (35/704)	
30–39	15.63% (110/704)	
40–54	38.35% (270/704)	
55–66	40.77% (287/704)	

	Study subjects (%)	Jackson county population per 2000 census (%)
Nakao-Treas index		
0–12.5	0% (0/704)	Not available
12.6–25.1	0.71% (5/704)	
25.2–37.7	14.49% (102/704)	
37.8–50.3	15.06% (106/704)	
50.4–62.9	14.91% (105/704)	
63.0–75.5	27.41% (193/704)	
75.6–88.1	22.16% (156/704)	
88.2–100	5.26% (37/704)	

Table 3
The association between socioeconomic status (SES) indices, self-rated health and self-reported quality of life

Health outcomes	Socioeconomic measures	Jackson county, Missouri			Olmsted county, Minnesota		
		OR	95% CI	p Value	OR	95% CI	p Value
Self-rated health	Income	—	—	—	—	—	—
	less than \$50000 (ref ^{a,b})	—	—	—	—	—	—
	\$50000–\$74999	0.32	0.15 to 0.70	0.004	0.73	0.25 to 2.14	0.562
	\$75000–\$99999	0.24	0.10 to 0.59	0.002	0.37	0.10 to 1.28	0.115
	\$100000–\$149999	0.18	0.06 to 0.54	0.002	0.35	0.10 to 1.22	0.098
	\$150000 and above	<0.001	<0.001 to >999	0.965	0.40	0.11 to 1.41	0.153
	Education	—	—	—	—	—	—
	High school grad or below (ref)	—	—	—	—	—	—
	Some college, no degree	0.84	0.44 to 1.62	0.601	1.15	0.30 to 4.37	0.835
	Associate/college degree	0.20	0.08 to 0.47	0.001	0.44	0.11 to 1.72	0.237
Graduate/Professional degree	0.19	0.07 to 0.050	0.001	0.31	0.07 to 1.35	0.118	
Self-assessed quality of life	Hollingshead index	—	—	—	—	—	—
	0–48 (ref)	—	—	—	—	—	—
	48–56	0.59	0.30 to 1.16	0.128	0.42	0.16 to 1.05	0.064
	57–63	0.33	0.16 to 0.70	0.003	0.25	0.079 to 0.759	0.015
	Greater than 63	0.15	0.05 to 0.45	0.000	0.10	0.01 to 0.76	0.026
	Nakao–Treas index	—	—	—	—	—	—
	0–51.86 (ref)	—	—	—	—	—	—
	51.87–72.23	0.66	0.33 to 1.29	0.223	0.36	0.14 to 0.96	0.041
	72.24–83.66	0.36	0.16 to 0.80	0.012	0.34	0.11 to 1.04	0.059
	Greater than 83.66	0.27	0.12 to 0.65	0.003	0.15	0.03 to 0.65	0.012
HOUSES index	Group1 (lowest SES)	—	—	—	—	—	—
	Group 2	0.54	0.28 to 1.06	0.074	2.29	0.69 to 7.57	0.175
	Group3	0.32	0.14 to 0.69	0.004	1.52	0.42 to 5.47	0.524
	Group4 (highest SES)	0.21	0.08 to 0.51	0.000	0.99	0.25 to 4.04	0.994
	HOUSES index	—	—	—	—	—	—

Health outcomes	Socioeconomic measures	Jackson county, Missouri			Olmsted county, Minnesota		
		OR	95% CI	p Value	OR	95% CI	p Value
	Group1 (lowest SES) (ref)	—	—	—	—	—	—
	Group 2	0.85	0.05 to 1.32	0.473	1.68	0.99 to 2.85	0.055
	Group3	0.30	0.18 to 0.51	<0.001	0.84	0.46 to 1.51	0.549
	Group4 (highest SES)	0.29	0.17 to 0.49	<0.001	0.53	0.27 to 1.01	0.054

* Ref: reference group for comparison.