Measurement of Socioeconomic Status in Health Disparities Research

Vickie L. Shavers, PhD

Socioeconomic status (SES) is frequently implicated as a contributor to the disparate health observed among racial/ethnic minorities, women and elderly populations. Findings from studies that examine the role of SES and health disparities, however, have provided inconsistent results. This is due in part to the: 1) lack of precision and reliability of measures; 2) difficulty with the collection of individual SES data; 3) the dynamic nature of SES over a lifetime; 4) the classification of women, children, retired and unemployed persons; 5) lack of or poor correlation between individual SES measures; and 6) and inaccurate or misleading interpretation of study results. Choosing the best variable or approach for measuring SES is dependent in part on its relevance to the population and outcomes under study. Many of the commonly used compositional and contextual SES measures are limited in terms of their usefulness for examining the effect of SES on outcomes in analyses of data that include population subgroups known to experience health disparities. This article describes SES measures, strengths and limitations of specific approaches and methodological issues related to the analysis and interpretation of studies that examine SES and health disparities.

Key words: socioeconomic status ■ health disparities ■ minorities ■ race/ethnicity

 From Applied Research Program, National Cancer Institute, Bethesda, MD. Send correspondence and reprint requests for *J Natl Med Assoc.* 2007;99:1013–1020 to: Dr. Vickie L. Shavers, National Cancer Institute, Division of Cancer Control and Population Science, Applied Research Program, Health Service and Economics Branch, 6130 Executive Blvd, MSC-7344, EPN Room 4005, Bethesda, MD 20892-7344; phone: (301) 594-1725; fax: (301) 435-3710; e-mail: shaversv@mail.nih.gov

BACKGROUND

Populations that suffer health disparities are defined in The Health Care Fairness Act of 2000 House Resolution #3250 as those "with a significant disparity in the overall rate of disease incidence, morbidity, mortality and survival rates in the population as compared to the health of the general population."[1] Several factors interact to influence health and health status among populations and, as a consequence, health disparities. Among these, socioeconomic status (SES) is among those most frequently implicated as a contributor to the disparities in health observed among U.S. populations.[2] Other factors include lifestyle, the cultural and physical environment, living and working conditions, and social and community networks.

SES was defined by Mueller and Parcel in 1981 as "the relative position of a family or individual on a hierarchical social structure, based on their access to or control over wealth, prestige and power.[3] More recently, SES has been defined as "a broad concept that refers to the placement of persons, families, households and census tracts or other aggregates with respect to the capacity to create or consume goods that are valued in our society."[4] No matter how it is defined, it appears that SES, as it relates to health status/healthcare, is an attempt to capture an individual's or group's access to the basic resources required to achieve and maintain good health. Adler et al. present three pathways through which SES impacts health, which include its association with healthcare, environmental exposure, and health behavior and lifestyle. Together, these pathways are estimated to account for up to 80% of premature mortality.[5]

Although analysis of data on socioeconomic status is nearly always included in epidemiologic research, its specific use is often dependent on data availability. Furthermore, the interpretation of related findings has varied among studies and health outcomes. It is often concluded that differences in SES are the cause of differences in health status and outcomes between population groups. However, there is often little, if any, discussion of the specific manner in which SES might have exerted its influence within the context of the study outcomes. The elimination of health disparities requires an understanding of the specific impact and manner in which various factors influence differences in health among population groups. This article discusses the measurement of SES in health disparities research and suggests approaches that might provide more meaningful information for interventions designed to eliminate health disparities.

METHODOLOGICAL ISSUES

In addition to the overall paucity of data available on SES and measures of inequality in public health and other databases,[6] there are several methodological and analytical issues related to the study of SES and health. These include the 1) lack of precision and reliability of measures, 2) difficulty with the collection of individu-

al SES data (e.g., high rates of nonresponse for income variables), 3) measurement of the effects of SES over the lifetime, 4) the classification of women, children, retired and unemployed persons, 5) poor correlation between

Table 1. Strengths and limitations of selected SES measures

Measure	Strengths	Limitations
Current Income	Allows access to material goods and services that may influence health.	Age dependent More unstable measure than education or occupation Higher nonresponse rate than other SES measures Does not include all assets such as wealth, health insurance coverage, disability benefits and so forth Quality of goods and services available to African Americans and residents of low-income neighborhoods is often poorer, while the price is often higher than that for whites and residents of higher-income neighborhoods. Often not available in administrative data sets.
Wealth	More strongly linked to social class than income Assets are an indication of the ability to meet emergencies or to absorb economic shock.	Difficult to calculate because of the multiple factors that contribute to its assessment Higher error rates because of sensitivity in reporting
Education	Easy to measure Excludes few members of the population Less likely to be influenced by disease in adulthood than income and occupation Higher levels of education are usually predictive of better jobs, housing, neighborhoods, working conditions and higher incomes. Education is fairly stable beyond early adulthood Its measurement is practical and convenient in many contexts. It is one of the socioeconomic indicators especially likely to capture aspects of lifestyle and behavior.	Has different social meanings and consequences in different periods and cultures Economic returns may differ significantly across racial/ethnic and gender groups (i.e., minorities and women realized lower returns than white men with the same investment in education). SES does not rise consistently with increases in years of education. Lack of knowledge of cognitive, material, social and psychological resources gained through education over the life course makes it difficult to understand the educational link to health and to effectively design appropriate interventions Difficult to ascertain in administrative data
Occupation	Major structural link between education and income Less volatile than income Provides a measure of environmental and working conditions, latitude in decision-making, and psychological demands of the job.	Occupational classes are comprised of heterogeneous occupations with substantial variation in education, income and prestige. Lack of precision in measurement Difficulty with the classification of homemakers and retirees Does not account for racial/ethnic and gender differences in benefits arising from employment in the same occupation Most measured were developed and validated on working men.
Composite Indices	May be useful for area-wide planning The integration of individual-level measures of SES with area level measures can provide additional insight.	Aggregating SES may result in confounding when the index does not prove a measure of area level SES that can be easily interpreted.

individual SES measures among some groups (i.e., income, education and occupation)[7] and 6) the inaccurate or misleading interpretation of study results.

Two basic approaches to the study of the influence of SES on health are described by Kaplan:[8] the compositional approach and the contextual approach. Compositional measures of SES refer to characteristics of the individual, while contextual measures of SES refer to characteristics of the individual's environment. Both have inherent strengths and limitations which are somewhat dependent upon the research question and the populations under study (Table 1).

Compositional SES Measures and Health

A compositional approach to the measurement of SES primarily focuses on the socioeconomic and behavioral characteristics of individuals and their associated health outcomes.[9] Traditional SES measures included occupation, education and income. Each of these measures captures a distinct aspect of SES, may be correlated with other measures but are not interchangeable.[10] Examples of compositional SES measures include:

Occupation
- Employment status (e.g., employed/unemployed/retired)
- Specific occupational group
- Aggregate occupation groups
    - Blue-/white-collar workers
    - Employment status

Education
- Years of education completed (continuous)
- Highest educational level completed (categorical)
- Credentials earned (e.g., high-school diploma, Bachelors degree, graduate degrees)

Income
- Individual annual income
- Annual household income
- Family income

Occupation. Occupational status is used to examine the effects of SES on health because of its role in positioning individuals within the social structure, thus; defining access to resources, exposure to psychological risks and physical hazards and through the influence of the occupation on lifestyle (e.g., smoking, alcohol consumption).[11] Therefore, approaches to assessing the influence of occupation on health generally focus on the social class of the occupation, prestige of the occupation and the role of the physical work environment.

Employment status is also used in research studies. Studies using employment status as a SES measure often compare the health status, outcomes or behaviors of unemployed persons to employed persons. Two basic hypotheses form the basis for studies on the role of employment and health. The first is the social causation hypothesis, which is based on the belief that employment improves the health of individuals. The second is the selection hypothesis, which is based on the idea that healthy people are more able to obtain and retain employment.[12] As Rodriguez notes, however, entitlement programs may reduce the negative health impact of unemployment.[13] The use and/or eligibility for these programs, therefore, might be relevant for assessing the contribution of SES to certain health outcomes.

Education. Educational attainment is perhaps the most widely used indicator of SES. This is likely due to the ability to characterize the educational achievement level of most individuals. Education has been called the most basic component of SES because of its influence on future occupational opportunities and earning potential.[5] There are several possible mechanisms through which education might influence health status. For example, persons with higher education may have developed better information processing and critical thinking skills, skills in navigating bureaucracies and institutions, and abilities required to interact effectively with healthcare providers. Individuals with higher education may also be more likely to be socialized to health-promoting behavior and lifestyles, and have better work and economic conditions and psychological resources.[12,14] An advantage of using education as a measure of SES for adults is that the likelihood of reverse causation (e.g., which came first, poor health or low SES)—which can be a problem with other standard SES measures—is reduced, as education is usually complete before detrimental health effects occur.[10]

Income. Income represents the flow of economic resources over a period of time. Persons with higher incomes are more likely to have the means to pay for healthcare and to afford better nutrition (e.g., better quality and variety of fresh fruits and vegetables), housing, schools and recreation.[5]

Two schools of thought exist with regard to the relationship of income and health. One is that income has a linear relationship with health and the other is that the relationship is monotonic but not linear. The former relationship is characterized by better health status among those with better incomes irrespective of the income level (e.g., low income versus high income). In the latter relationship, while better health status is also associated with higher incomes, small differences in income are associated with greater differences in health status among those in the lower-income groups compared to those in higher-income groups.[15]

The Use of Compositional SES Measures in Health Disparities Research

Several limitations exist with the use of compositional SES measures in health disparities research.[16] In an analysis of data from two statewide surveys conducted in California during 1994 and 1999, the correlations between

income and education were found to be low and to vary by race/ethnicity.[17] In a review of the literature on SES measures and of mortality, Daly[18] provided several examples of groups for which commonly used compositional SES measures can be problematic. For example, occupation may not be a useful measure for teen mothers, adolescents, late-career changers and those with little experience in the labor market.[18,19] A number of problems with the use of occupation in studies involving women have been detailed.[20] These include problems with the use of standard occupational classification systems which are based on occupations that more commonly employ men and gender-based occupational segregation and discrimination. The variable used to assess education in many studies is designed to capture formal education only. As a consequence, other types of training which could potentially impact SES may be ignored. Examples include training received on the job, apprenticeships and vocational/technical training. The relative importance of education may be dependent on levels of other SES measures. For example, Krieger et al. found that education was less important to health status among individuals who reside in households below the poverty thresholds.[21] Use of aggregate measures of SES such as household income can also prove to be problematic particularly for women or other family members who may have unequal access to or knowledge of the household income.[18]

SES is a sensitive area of inquiry for research studies. Although item nonresponse tends to be high for some demographic variables, nonresponse for income is often higher than nonresponse rates for other variables.[22] Data from the 1996 American Community Survey show a fairly consistent pattern of higher levels of nonresponse for income-related questions. The nonresponse rates for questions regarding wages and salary, income from Social Security and income from public assistance were 26.1%, 24.2% and 22.9%, respectively.[23] More recently, the nonresponse to income questions on the 2002 National Survey of America's Families was 20%, while the weighted nonresponse to family income on the 2002 National Health Interview Survey was 31.9%.[24]

Factors that influence item nonresponse differ by demographic groups defined by race/ethnicity, gender, age and education achievement level.[25,26] The effect of item nonresponse depends on whether nonresponders differ from responders in ways that are relevant to the research question. For example, bias could be introduced in a study that examined racial/ethnic differences in a health outcome if members of one racial/ethnic group were less likely than members of another racial/ethnic group to answer questions on income or education. Although, several methods have been developed to impute missing data, bias could still be introduced if the responders from whom data are imputed differ substantially in terms of the actual characteristics of the nonresponders for whom data are being imputed. A number of factors can contribute to nonresponse to questions regarding SES. For example, individuals who do not work outside of the home (e.g., women who are homemakers, adolescents, elderly parents) may not be privy to information regarding the household income. Even in the analysis of national data sets, which are frequently used for health disparities research, little attention is often given to item nonresponse by demographic or other groups for whom the presence of health disparities is being investigated.

Nonetheless, these data can still be useful if a better job can be done of collecting and using them. In its 2004 report, *Eliminating Health Disparities: Measurement and Data Needs*, the Committee on National Statistics recognized the continued importance of collecting individual-level data on socioeconomic position, race/ethnicity, acculturation and language for documenting the nature of disparities in healthcare and for developing strategies to eliminate disparities.[27]

Contextual SES Measures

Researchers and public health officials have acknowledged that the context in which one lives also contributes to health.[28,29] Contextual approaches typically involve ecologic area measures and may also involve multilevel analyses. Contextual approaches to SES examine the social and economic conditions that affect all individuals who share a particular social environment.[8] Access to goods and services, the built environment, and social norms and other factors relevant to health are often determined by the community.[30] Examples of commonly used area measures include:

- Neighborhoods: variously described as ZIP codes, census tracts, census block groups and census blocks
- Other geographic areas: examples include counties, regions and states.

The accuracy of these measures in terms of SES within the census tract, ZIP code, county or other community areas can vary widely depending upon the amount of time that has passed since these data were collected and the dynamic nature of the geographic area of interest (e.g., patterns of movement into and out of the area, gentrification, changes in the industry, unemployment rates and so forth). In addition, racial/ethnic differences in underreporting in census data[31] suggest that the reliability of these data may differ among racial/ethnic groups.

Contextual variables often do not correlate well with individual measures.[32,33] In one study, the correlation between imputed and individual-level data was 0.22–0.33 for income, 0.28–0.40 for education and 0.53–0.67 for race.[33] In an analysis of U.S. Census data, Geronimus et al. also noted a stronger association between individual-level SES data and health outcomes compared with

aggregate data.[34] The validity of an area-based measure from a methodological standpoint is more dependent upon whether the geographic unit is meaningful rather than whether or not it serves as an adequate proxy for individual-level measures,[6] which is more a question of reliability. One of the most frequently studied contexts in terms of health is the economic context, including the concentration of poverty and the degree of income inequality. Examples of commonly used contextual SES measures include:

- Average house value
- Median monthly rental value of housing
- Percentage of single-parent families
- Percentage of unemployed persons
- Per capita income

The U.S. Bureau of the Census has also defined several contextual measures that are frequently used by government agencies. These include:

- Social class: percent of persons employed in eight of the 13 census-defined occupational groups (e.g., service, transportation, laborers, etc.)
- Poverty area: area where ≥20% persons are below the poverty level
- Working-class neighborhood: neighborhood where ≥66% of employed persons work in working-class occupations
- Wealth: percent of households owning home, percent of households owning ≥1 car, percent of households with incomes of $50,000

Many contextual analyses focus on examining the effects of living in an economically disadvantaged area independent of the specific economic characteristics of the individual using census-based economic measures.[35] Duncan et al., however, warn that there are two possible interpretations of findings based on geographically defined contexts.[36] One is that the living environment (context) influences individual health susceptibility and, alternatively, people who have individual characteristics that make them more susceptible to poor health are more commonly found in particular places.

As Hillemeir et al. suggest, the focus on disadvantage over other aspects of the contextual environment is

Table 2. Socioeconomic characteristics for selected race/ethnic groups, annual demographic supplement to the march 2003 current population survey

	African Americans (%)	Asians (%)	Hispanics (%)	Non-Hispanic Whites (%)
Educational Attainment 2003 (Age ≥25)				
Less than high-school education	20.0	12.4	43.0	10.6
High-school graduate or more	80.0	87.6	57.0	88.7
Some college or more	44.7	67.4	29.6	52.9
Bachelor's degree or more	17.3	49.8	11.4	27.6
Income				
Median household income in 2003	$30,442	$57,196	$33,184	$49,061
Median household income in 2004	$30,134	$57,518	$34,241	$48,977
Percent change in median household income (2004–2003)	-1.0	0.6	1.1	-0.2
Occupation in 2000				
Management, professional and related occupations service	25.2	44.6	18.1	36.6
Sales and office	22.0	14.1	21.8	12.8
Farming, fishing and forestry	27.3	24.0	23.1	27.2
Construction, extraction and maintenance	0.4	0.3	2.7	0.5
Production, transportation and material moving	6.5	3.6	13.1	9.6
	18.6	13.4	21.2	13.2
Average Earnings in 2002 by Educational Attainment				
Not a high-school graduate	$16,516	$16,746	$18,981	$19,264
High-school graduate	$22,823	$24,900	$24,163	$28,145
Some college or associate's degree	$27,626	$27,340	$27,757	$31,878
Bachelor's degree	$42,285	$46,628	$40,949	$52,479
Advanced degree	$59,944	$72,852	$67,679	$73,870

Source: Stoops N. Educational Attainment in the United States, 2003. Population Characteristics. Current Population Reports. U.S. Census Bureau, June 2004; U.S. Census Bureau. Income, Poverty and Health Insurance Coverage in the United States, 2004; U.S. Census Bureau, Occupation, 2000

likely due to the lack of appropriate data and alternative models regarding the effect of contextual characteristics on health. Nonetheless, it might be more informative for the purpose of designing interventions to know the specific characteristics associated with living in an economically disadvantaged area that might underlie disparities in health outcomes. This will require more careful consideration of the mechanisms by which contextual characteristics are linked to specific health outcomes.[35] Other potentially important contextual dimensions include employment, education (e.g., educational attainment, school characteristics and curriculum quality), political (e.g., civic participation, political structure, power groups), environment (e.g., air and water quality, environmental hazards, physical safety, land use), housing (e.g., housing stock, residential patterns, regulation, financial issues), medical (e.g., primary care, specialty care, emergency services, access to/utilization of services), governmental (e.g., funding, policy/legislation, services), public health (e.g., programs, regulations/enforcement, funding), behavioral (e.g., tobacco use, physical activity, diet/obesity) and transportation (e.g. safety, infrastructure, traffic patterns, vehicles, public transportation).[35]

Composite SES Measures

Composite SES measures are constructed by combining information about several SES measures (e.g., income, employment, education, communications, transportation, home ownership, etc.). Composite SES measures can be divided into two basic categories: those that measure material and social deprivation such as the Townsend Index[37] and Carstairs Index,[38] and those that measure social standing or prestige (e.g., social class) such as the Hollingshead Index of Social Prestige or Position[39] and Duncan's Socioeconomic Index (SEI).[40] Material deprivation has been defined as the lack of goods and conveniences such as a car or television, resources and amenities that are customary in a particular society.[41] Material deprivation is distinctly different from poverty, which is defined as the lack of financial resources required to obtain goods and commodities.[42]

Indices such as the Townsend and Carstairs, which were developed in the United Kingdom, are more frequently used in the United Kingdom than in the United States. Composite SES measures used with U.S. populations tend to focus on social class rather than measurements of material and social deprivation. There appears to be no one composite measure that is overwhelmingly used in the United States to measure SES, although by one report[11] the SEI dominates the U.S. research literature. The SEI, however, does not directly measure access to resources, as it is an occupation prestige-based measure dependent upon the level of education and income associated with an occupation.[43] The Socio-Economic Risk Index which has been used with Canadian populations (SERI) is a composite index of six measures of socioeconomic status that mark environmental, household and individual preconditions that place people at risk of poor health.[44] An internet search of U.S. studies that employed composite SES measures also revealed several investigator-created composite variables.

SES and the Life Course

SES is dynamic and cross-sectional. SES measurements do not take into account the effect of SES over the life course. As several others have noted, the effects of social economic disadvantage may begin in childhood.[45,46] The effects may be cumulative and may interfere with the future ability to gain social and economic advantage[47] and, as a consequence, good health. Pollitt's[48] four conceptual models of the manner in which SES is hypothesized to increase cardiovascular disease (CVD) risk over the life course may be applicable to other chronic disease conditions. These include: 1) the latent effects model in which early experiences increase the risk of CVD in later life independent of intervening SES, lifestyle or traditional risk factors; 2) the pathway model in which early experiences influence later life experiences, opportunities and health risk factors; 3) the social mobility model for which SES mobility across the life course is hypothesized to influence health in adulthood; and 4) the cumulative model for which psychosocial, physiological and environmental exposures are believed to accumulate to influence adult health risk.

While in theory, the life course approach may provide a more comprehensive measure of the effect of a particular SES variable over time, it is often assessed retrospectively. There is seldom control for the amount of time exposed to particular levels of SES, which might have different levels of influence on specific health outcomes. Retrospective life course studies are also prone to selection bias as a consequence of loss to follow-up or differential survival among study groups. Furthermore, racial/ethnic minorities are often underrepresented in these studies.[48]

ANALYTICAL ISSUES

Data Analyses

The most common use of SES in health disparities research has been as a variable which explains differences in outcomes among racial/ethnic and other population subgroups.[47] Research has shown that groups who experience some of the greatest disparities in health (e.g., racial/ethnic minorities, elderly persons, rural populations) tend to experience the greatest socioeconomic disparities. Research studies also show variation in the health impact of specific SES measures among groups commonly examined in health disparities research.[18, 49-51] For example, mortality rates were shown to decrease with lower levels of neighborhood poverty in a recent analysis; however, the amount of decrease varied by race/

ethnicity and gender. The mortality rates in the highest-poverty neighborhoods compared to the lowest-poverty-level neighborhoods were 63% higher for Non Hispanic white men, 58% higher for non-Hispanic white women, 45% higher for African-American men but only 27% higher for African-American women.[52]

SES variables should represent levels that have meaning for the groups or outcomes under study. For example, a dichotomous education measure [such as college graduate (yes/no)] may be less informative for populations with low college graduation rates than other categorical or continuous measures of educational achievement. If the goal is to ascertain the effect of specific levels of a SES measure on outcomes across population groups, it is important that the measure be constructed so that the study groups are distributed among the different levels of the variable.

Race/ethnicity and SES. Data from the Annual Demographic Supplement to the March 2002 Current Population Survey show large disparities in education, income and employment for African Americans and Hispanics compared to whites[53,54] (Table 2). Furthermore, persistent racial/ethnic discrimination in American society modifies the usual influence of specific levels of SES such that racial/ethnic variations still exist within the same occupation, income and educational levels. There are two basic hypotheses commonly used to explain the interactive effect of race and SES.[55] The first is the minority poverty hypothesis, which centers on the belief of a unique disadvantage experienced by racial/ethnic minorities living in poverty. The second is the diminishing returns hypothesis, which centers on the belief that racial/ethnic minorities do not experience the same returns as whites for higher levels of SES achievement. In an analysis of data from the National Health Interview Survey, Braveman[56] showed consistently lower mean family incomes for African Americans and Mexican Americans compared to whites for five different levels of educational attainment.

Both Daly[18] and Braveman[57] have noted that occupation and education may not be adequate measures of income and wealth among racially/ethnically diverse populations. Krieger et al. noted the need to examine the manner in which class-related racial/ethnic and gender discrimination influence health.[58] Racial/ethnic disparities in health outcomes have persisted after controlling for SES in some studies, which suggests that SES and race might also be independently associated with some

Table 3. Race/ethnicity–stratified multivariate logistic regression analysis of the prevalence of occasional smoking among the civilian US population, TUS–CPS 1998–1999

Variable	African Americans	American Indian/ Alaska Native	Asian American/ Pacific Islander	Hispanics	Non–Hispanic Whites
Gender					
Male	1.30 (0.99–1.70)	0.48 (0.19–1.23)	0.93 (0.51–1.69)	0.95 (0.72–1.26)	1.03 (0.93–1.14)
Female	1.0	1.0	1.0	1.0	1.0
Age Group					
18–24	1.23 (0.72–2.10)	1.80 (0.39–8.26)	**3.47 (1.48–8.16)**	**2.18 (1.43–3.32)**	**2.19 (1.91–2.50)**
25–44	1.05 (0.77–1.44)	1.87 (0.66–5.28)	1.07 (0.55–2.10)	**1.60 (1.16–2.19)**	**1.41 (1.29–1.55)**
45–64	1.0	1.0	1.0	1.0	1.0
Education (Years)					
<12	0.72 (0.43–1.19)	16.41 (0.80–334.9)	0.72 (0.21–2.48)	0.73 (0.41–1.27)	0.23 (0.18–0.28)
12	0.77 (0.48–1.24)	**24.79 (1.62–378.5)**	0.51 (0.25–1.03)	0.69 (0.41–1.15)	0.37 (0.32–0.43)
13–15	0.91 (0.59–1.41)	14.46 (0.92–228.4)	0.89 (0.46–1.73)	0.75 (0.43–1.33)	0.53 (0.48–0.60)
≥16	1.0	1.0	1.0	1.0	1.0
Income					
<$25,000	1.13 (0.79–1.62)	1.42 (0.42–4.83)	**0.45 (0.25–0.83)**	0.98 (0.63–1.52)	**0.78 (0.70–0.86)**
$25,000–$49,999	1.04 (0.76–1.43)	0.76 (0.24–2.41)	0.81 (0.46–1.41)	0.91 (0.61–1.34)	**0.83 (0.75–0.91)**
≥$50,000	1.0	1.0	1.0	1.0	1.0
Refused/unknown	1.37 (0.85–2.22)	1.78 (0.24–13.28)	1.09 (0.41–2.92))	1.51 (0.80–2.85)	**0.75 (0.63–0.88)**
Occupation					
Professional/ managerial	1.0	1.0	1.0	1.0	1.0
Sales and administrative support	0.82 (0.56–1.21)	0.87 (0.29–2.68)	0.79 (0.41–1.53)	0.67 (0.41–1.10)	0.96 (0.84–1.11)
Laborers	**0.56 (0.39–0.82)**	0.41 (0.13–1.29)	0.53 (0.20–1.40)	**0.61 (0.39–0.95)**	0.87 (0.75–1.00)
Service	**0.57 (0.37–0.87)**	0.84 (0.23–3.04)	1.23 (0.55–2.72)	0.82 (0.53–1.27)	**0.77 (0.67–0.90)**

Excerpted from: Shavers VL, Fagan P, Lawrence D. Racial/ethnic variation in cigarette smoking among the civilian U.S. population by occupation and employment status, CPS–TUS, 1998–1999. *Prev Med.* 2005;41:597–606.

health outcomes.[47] For example, Greenwald[59] found that race and SES have independent effects on cancer mortality. Similarly, Cella[60] found that SES has a small but significant independent effect on cancer survival. Gornick[61] found that both lower income and African-American race were independently associated with the pattern of medical services received by Medicare beneficiaries in 1993. African Americans were less likely than whites to receive routine office visits and preventive services and more likely to experience emergency room visits, after adjusting for income level.

Multilevel Analyses

An increasing amount of attention is being paid to multilevel analyses because of the limitations of traditional SES measures and the belief that the context in which one lives is as important as the influence of individual SES factors. Multilevel approaches combine compositional and contextual measures each which measure a different aspect of SES. Winkleby et al.[62] found that living in a low-SES neighborhood was independently associated with higher mortality for African-American and white men and women after adjustment for individual income, education and occupation/employment status. Individual SES characteristics, however, were found to have a stronger association with mortality than the neighborhood SES measures. Hadden et al.[63] caution that despite improved statistical methods, race and SES are confounded in multilevel analyses that examine racial differences in health. The authors state that the segregation of American society forms the empirical basis for the confounding of contextual SES measures and race found in the National Health and Nutrition Examination Survey (NHANES) and National Health Interview Survey (NHIS).

Interpretation of SES Analyses

Two common practices influence the interpretation of data analyses involving socioeconomic status, particularly in health disparities research. The first involves the practice of measuring SES as a covariate in multivariate analyses, which also include as covariates race/ethnicity or other variables for which SES is known to vary. Although this can be a useful approach for the initial examination of the association of covariates with study outcomes, it is based on the basic assumption that SES measures have the same relative meaning across race/ethnic, gender and age groups. Several studies have shown differences in the influence of specific SES measures on health outcomes among these groups.[16,63,64]

Arbes[65] argues against the use of SES as a covariate in models with race. The premise is that race represents a social construct, and SES is a consequence of race. Therefore, the authors state that SES should not be modeled as a confounder, as it would bias the hazard ratio for race towards the null. The problem with the interaction between race/ethnicity and SES was also noted by Shavers and Brown, who state in the case of cancer treatment that, "the complexity of the interaction between race/ethnicity and SES makes it difficult to disentangle the independent effects of these two variables … ."[66]

Perhaps, a more useful approach is to also include multivariate analyses stratified by race/ethnicity, gender, age or other group as appropriate. The advantage of this second approach is the ability to examine the effect of specific SES measures across as well as within groups

Table 4. Race-stratified multivariate logistic regression of the receipt among watchful waiting, SEER–Medicare, 1994–1996

	Model 1	Model 2	Model 3
Variable	**African Americans**	**Hispanics**	**Whites**
Marital Status			
Single	1.4 (1.1–1.9)	1.1 (0.6–1.9)	1.6 (1.4–1.8)
Married	1.0	1.0	1.0
Divorced	1.9 (1.4–2.7)	0.7 (0.3–1.5)	1.6 (1.4–2.0)
Separated	0.7 (0.3–1.8)	2.3 (0.6–9.1)	1.5 (0.7–3.6)
Widowed	1.5 (1.1–1.9)	0.9 (0.5–1.4)	1.1 (1.0–1.3)
Unknown	0.9 (0.7–1.3)	2.2 (1.3–4.0)	1.7 (1.5–1.9)
Income			
<$30,000	1.4 (1.0–2.0)	1.7 (0.9–3.1)	1.1 (1.0–1.2)
$30,000–$39,999	1.2 (0.9–2.1)	0.7 (0.3–1.6)	1.1 (1.0–1.3)
≥$40,000	1.0	1.0	1.0
Education			
<20%	1.0	1.0	1.0
20–29.99%	1.6 (1.1–2.3)	2.6 (1.5–4.4)	1.1 (1.0–1.2)
≥30%	1.3 (1.0–1.7)	2.1 (1.5–3.0)	1.2 (1.1–1.3)

Excerpted from: Shavers VL, Brown ML, Klabunde C, et al. Race/ethnicity and the receipt of watchful waiting for the initial management of prostate cancer. *J Genn Intern Med.* 2004;19:146-155.

by examining the magnitude of the odds ratios produced from stratified multivariate analyses, thus allowing for the assessment of interactive effects between SES and the stratification variable. An example of this approach is provided in Table 3, which shows that both the magnitude and direction of the association between education and income with current smoking varies among the five race/ethnic groups in race-/ethnicity-stratified analyses. A second example, provided in Table 4, shows that although the direction of the association is the same for the three race/ethnic groups, having a higher education was more strongly associated with the receipt of the watchful-waiting approach for managing prostate cancer among Hispanics than either African Americans or whites. It is worth noting that large sample sizes such as those contained in many national data sets are needed for this approach, as the stratification reduces sample size and, as a consequence, the power of the analyses.

Alternatively, Hadden et al. propose two other strategies.[63] The more conservative approach would entail modeling race/ethnicity separately from SES and context and then comparing the two models. A second approach involves defining and modeling a variable that represents race with the effect of SES removed.

Even when properly analyzed, the interpretation of multivariate analyses can lead to different conclusions, particularly in studies involving racial/ethnic minorities for whom disparities in health and socioeconomic disadvantage are often the greatest. For example, it is often concluded that no racial/ethnic differences exist in study outcomes after adjustment for SES in multivariate analyses, although the unadjusted analyses show the reverse to be true. This is analogous to concluding that there are no significant differences in deaths between two groups for whom unadjusted death rates differ after adjusting for the prevalence of potentially life-threatening illnesses. A more accurate and meaningful interpretation would be that the variables found to be significantly associated with the outcome variables in multivariate analysis contribute to the differences seen between the race/ethnic groups in the unadjusted analyses. The danger in the former approach is that readers may erroneously conclude that there are no real differences between the groups, while the latter approach affirms the differences and provides further information on the potential sources of the differences. As Braveman et al. suggest, researchers should also acknowledge the limitations of their SES measures, especially since it is neither practical nor possible to measure all dimensions of SES that might be relevant to outcomes in a single research study.[68]

There is also some question about the usefulness of traditional SES measures, such as occupation, income and education, for informing the design of interventions to improve the health status of disadvantaged populations. There is ample evidence that lower SES is associated with poorer health status and health outcomes, so what really is gained by continuing to solely measure SES in this manner? Perhaps a more useful approach to measuring SES, particularly for the purpose of informing intervention research, would involve considering (during the design phase of the study) the specific manner in which low SES might potentially impact study outcomes. For example, data on specific factors likely influenced by SES such as transportation to medical appointments, type of health insurance, type of healthcare facility and provider, copayment amounts, availability for care (i.e., the ability to take time off work, availability of child care), support systems, knowledge of appropriate care, and attitudes toward health are likely to be more useful in the development of interventions designed to reduce health disparities. For example, what might having a low formal educational attainment level mean in terms of compliance with physician recommendations and instructions in the healthcare setting? It could be hypothesized that low educational attainment means low literacy, which might have an impact on the patient's ability to read and comprehend written instructions. How might low educational attainment/low literacy affect compliance when healthcare instructions are delivered verbally? Is the level of educational attainment still important given this context? These questions can be directly answered in properly designed studies, thus forming a basis for more tailored and useful interventions in specific population groups.

CONCLUSION

Choosing the best variables or approach for measuring SES should be dependent on consideration of the likely causal pathways and relevance of the indicator for the populations and outcomes under study.[57] For example, a study of four measures of SES and racial/ethnic differences in low-birthweight babies, delayed prenatal care, unintended pregnancy and intention to breastfeed demonstrated that conclusions regarding the role of SES in racial/ethnic disparities could vary depending upon the SES measure used.[17]

While research studies have established that socioeconomic status influences disease incidence, severity and access to healthcare, there has been relatively less study of the specific manner in which low SES influences receipt of quality care and consequent morbidity and mortality among patients with similar disease characteristics, particularly among those who have gained access to the healthcare system. It is unlikely that education, occupation and income disparities will be eliminated in the near future; in fact, there is some evidence that U.S. economic inequalities are increasing.[69-71] As Duncan et al. note: although, "policies are designed to improve aspects of 'socioeconomic status' (for example, income, education, family structure), no policy improves 'socioeconomic status' directly."[69] In other words, while some barriers faced by populations disproportionately repre-

sented among lower SES levels might be removed, disparities in actual SES levels are likely to remain.

Therefore, the current research challenge is to go beyond attributing well-documented variations in socioeconomic status, as measured by income, education or occupation to examining more proximal ways in which low SES influences health status and health outcomes. More-detailed, better-specified and properly conceptualized studies of the manner in which SES influences health can inform social policy and program design to effectively reduce health disparities in a socially and economically diverse society.

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