

# Socioeconomic Status and Health: How Education, Income, and Occupation Contribute to Risk Factors for Cardiovascular Disease

## ABSTRACT

**Background.** Socioeconomic status (SES) is usually measured by determining education, income, occupation, or a composite of these dimensions. Although education is the most commonly used measure of SES in epidemiological studies, no investigators in the United States have conducted an empirical analysis quantifying the relative impact of each separate dimension of SES on risk factors for disease.

**Methods.** Using data on 2380 participants from the Stanford Five-City Project (85% White, non-Hispanic), we examined the independent contribution of education, income, and occupation to a set of cardiovascular disease risk factors (cigarette smoking, systolic and diastolic blood pressure, and total and high-density lipoprotein cholesterol).

**Results.** The relationship between these SES measures and risk factors was strongest and most consistent for education, showing higher risk associated with lower levels of education. Using a forward selection model that allowed for inclusion of all three SES measures after adjustment for age and time of survey, education was the only measure that was significantly associated with the risk factors ( $P < .05$ ).

**Conclusion.** If economics or time dictate that a single parameter of SES be chosen and if the research hypothesis does not dictate otherwise, higher education may be the best SES predictor of good health. (*Am J Public Health*. 1992;82:816-820)

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### Introduction

One of the strongest and most consistent predictors of a person's morbidity and mortality experience is that person's socioeconomic status (SES).<sup>1-5</sup> This finding persists across all diseases with few exceptions, continues throughout the entire life span,<sup>5</sup> and extends across numerous risk factors for disease.<sup>6-9</sup>

The significant impact of SES on disease makes its definition and measurement of critical importance. SES is a complex phenomenon predicted by a broad spectrum of variables that is often conceptualized as a combination of financial, occupational, and educational influences.<sup>10-13</sup> Although these dimensions of SES are interrelated, it has been proposed that each reflects somewhat different individual and societal forces associated with health and disease. For example, income reflects spending power, housing, diet, and medical care; occupation measures prestige, responsibility, physical activity, and work exposures; and education indicates skills requisite for acquiring positive social, psychological, and economic resources.<sup>9,14</sup>

Much has been written about the underlying mechanisms through which SES may operate to affect disease. Many authors have suggested that certain dimensions of SES are more predictive of health than others;<sup>1,14-16</sup> however, such proposals tend to be theoretically based, without substantiating data. Over time, education has become the most commonly used measure of SES in epidemiological studies,<sup>17</sup> yet no investigators in the United States have conducted an empirical analysis quantifying the relative contributions of different measures of SES to risk factors or disease outcomes. (This paper does

not suggest which component of SES may be the most reliable and valid measure because this question has been examined, with a variety of conclusions, in previously published reports.)<sup>10-13, 17-18</sup>

The present study examines the association between income, education, occupation, and a set of risk factors for cardiovascular disease—namely, cigarette smoking, systolic and diastolic blood pressure, and total and high-density lipoprotein (HDL) cholesterol. Our study objectives are to (1) examine the impact of each separate dimension of SES on cardiovascular risk factors, (2) use a forward stepwise selection model to evaluate if one measure of SES is the strongest predictor of risk factors, and (3) offer guidance to researchers about selection of SES measures. This guidance is critical because nearly all epidemiological studies use SES as an explanatory or a control variable, or for the selection of subjects or matching criteria.

### Methods

Subjects aged 25 to 64 were drawn from the two control cities of the Stanford Five-City Project,<sup>19</sup> a communitywide cardiovascular disease intervention study that contains data from four separate

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cross-sectional surveys, conducted from 1979 to 1986. Participants who were unemployed ( $n = 98$ ), students ( $n = 130$ ), or retirees ( $n = 146$ ) were excluded because they had no occupation that could be ranked. Data from the four cross-sectional surveys were pooled because demographic characteristics, including measures of SES, showed no significant interactions over time.<sup>7</sup> As previously reported,<sup>20</sup> the educational attainment of respondents from the control cities were well matched to those from the treatment cities. A nonrespondent questionnaire indicated that participants were generally more educated than those in both treatment and control communities who refused to participate.<sup>20</sup>

Information on education, income, and occupation was ascertained through questionnaires. Education was recorded as the highest number of years of schooling completed. It was used as a continuous variable in regression analyses and was divided into the following four categories in stratified analyses: less than 12 years, 12 years, 13 to 15 years, and 16 years or more.

Income information, defined as gross annual household income, was collected in intervals of \$5000. For multivariate analyses, the midpoint of the income categories was used; for the remaining analyses, income was divided into five categories ranging from less than \$10 000 to \$40 000 or more per year.

Current occupation was collected as an open-ended variable and coded using the 1980 US Bureau of the Census occupational scaling system, which creates a hierarchy of occupations ordered on the basis of education and income.<sup>21</sup> To examine associations between separate occupations and risk factors, we coded each occupation, including homemaker, as an indicator variable, with executives as the reference category. In multivariate models, we excluded homemakers and used occupation as a ranked variable ranging from executives to unskilled workers.

Participants were considered cigarette smokers if they reported ever smoking on a daily basis and had smoked one or more cigarettes in the last week. Participants whose plasma thiocyanate exceeded 100  $\mu\text{mol/L}$  and whose expired-air carbon monoxide level exceeded 8 ppm were classified as smokers regardless of their self-reported responses.<sup>22</sup> Total and HDL plasma cholesterol were derived from non-fasting venous samples, analyzed fresh by standard methods established by the Lipid Research Clinics Program.<sup>23</sup> Three blood pressure measurements were taken on the

right arm using a semiautomatic recorder, and the average of the second and third readings were used for analyses.<sup>24</sup>

## Results

An overall response rate of 69% was achieved. Approximately 600 individuals participated in each survey, resulting in a total of 2380 participants for all surveys combined. Because the study population was predominantly White, non-Hispanic (85%), findings are not generalizable to populations representing a broad spectrum of racial groups.

All pairwise correlations between education, income, and occupation were positive and were stronger for men than for women (Table 1). The lowest correlation was between education and income, indicating that education is not a primary determinant of wage. Higher correlations were shown for education and occupation, suggesting that skills acquired during education may help determine occupation. Although correlations ranged from .23 to .67, their relatively low magnitude (highest adjusted  $R^2 = 45\%$ ) indicates that the three dimensions are not redundant measures of SES.

Although the study population had relatively high educational and financial levels, individuals from all education, income, and occupation categories were well-represented (Table 2). However, while men were represented fairly evenly across occupations, approximately 75% of women employed outside the home

TABLE 1—Correlation Coefficients for Education, Income, and Occupation

	Men	Women
Education/income	+ .32	+ .23
Income/occupation	+ .41	+ .30
Education/occupation	+ .67	+ .66

Note. Table excludes homemakers. All correlations are significant at  $P \leq .0001$ .

held nonprofessional white-collar jobs. Men tended to have more years of education than women and to be from higher-income households.

In general, those with the lowest educational attainment exhibited the highest prevalence of risk factors (Table 3). Clear gradients were seen between educational level and smoking for both sexes, and between education and total and HDL cholesterol for women. Across all risk factors, men consistently exhibited higher risk than did women.

Income and occupation were less consistent risk predictors. Higher risk was associated with lower incomes for smoking and HDL cholesterol in both sexes but with higher incomes for total cholesterol in men. Within occupations, men and women white-collar executives and managers exhibited the lowest levels of smoking. Among men, executives and managers showed the lowest mean levels of blood pressure.

TABLE 2—Distribution of Study Population by Education, Income, and Occupation

	Men, % (n = 1108)	Women, % (n = 1272)
Education, y		
<12	9.7	13.1
12	23.9	31.8
13–15	24.9	27.8
$\geq 16$	41.5	27.4
Household income		
<\$10 000	6.2	13.3
\$10 000–\$19 999	21.1	25.6
\$20 000–\$29 999	26.6	25.6
\$30 000–\$39 999	20.6	17.8
$\geq$ \$40 000	25.5	17.8
Occupation		
Unskilled	6.1	5.4
Semiskilled	10.7	6.8
Skilled	17.3	3.5
Clerical	13.4	25.1
Administrators	19.9	9.3
Managers	17.8	12.7
Executives	14.7	1.7
Homemakers	0.0	35.7

Note. Table includes homemakers, all of whom were women.

TABLE 3—Prevalence of Risk Factors by Education, Income, and Occupation, Adjusted for Age and Time of Survey

	% Cigarette Smokers		Mean Systolic Blood Pressure		Mean Diastolic Blood Pressure		Mean Total Cholesterol		Mean HDL Cholesterol	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Education, y										
<12	47	41	126	117	76	73	198	201	44	52
12	41	34	127	118	77	74	198	194	44	55
13–15	31	23	126	116	77	73	203	192	44	58
≥16	18	14	125	114	76	71	196	190	46	61
Household income										
<\$10 000	50	32	124	116	77	72	190	192	43	54
\$10 000–\$19 999	30	31	126	117	76	72	193	197	45	57
\$20 000–\$29 999	31	25	126	115	75	73	200	195	45	55
\$30 000–\$39 999	26	24	126	118	76	74	200	193	46	59
≥\$40 000	25	19	126	116	77	72	202	187	46	59
Occupation										
Unskilled	36	33	128	115	78	72	191	199	46	50
Semiskilled	39	22	126	117	76	74	198	187	44	56
Skilled	37	44	127	117	77	71	195	195	46	58
Clerical	41	31	126	117	77	74	206	194	42	57
Administrators	27	25	126	115	77	72	201	190	44	58
Managers	21	18	125	114	76	70	195	190	45	61
Executives	16	20	124	115	75	74	200	192	48	58
Homemakers	n/a	25	n/a	117	n/a	73	n/a	195	n/a	56

Note. Tables includes homemakers. A logistic regression model was used for smoking; a multiple regression model was used for blood pressure, total cholesterol, and HDL cholesterol. Lower mean levels of HDL cholesterol indicate higher risk.

TABLE 4—Partial Correlations and P Values from Univariate and Forward Selection Regression Models for Three Dimensions of SES and Disease Risk Factors

	Cigarette smoking		Systolic Blood Pressure		Diastolic Blood Pressure		Total Cholesterol		HDL Cholesterol	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Univariate Model <sup>a</sup>										
Education	-.23***	-.18***	-.05	-.08*	-.06	-.12***	-.02	-.07*	+.11***	+.21***
Income	-.08**	-.11**	-.00	-.03	+.02	+.02	+.05	-.04	+.06*	+.08*
Occupation	-.18***	-.08*	-.06	-.05	+.05	+.06	+.02	-.03	+.04	+.16***
Forward Selection Model <sup>b</sup>										
Education	-.23***	-.18***	...	-.08*	...	-.12***	...	-.07*	+.11***	+.21***
Income	...	...	...	...	...	...	...	...	...	...
Occupation	...	...	...	...	...	...	...	...	...	...

Note. Table excludes homemakers. Two-tailed significance values are coded as \* $P < .05$ , \*\* $P < .01$ , and \*\*\* $P < .001$ .

<sup>a</sup>Adjusted for age and time of survey.

<sup>b</sup>Model allowed for inclusion of education, income, and occupation after adjusting for age and time of survey. Ellipses indicate not selected for inclusion in model at  $P < .05$ .

To compare the strength of the interrelationships between the three dimensions of SES, we conducted regression analyses (Table 4), adjusted for age and time of survey. Partial correlations are presented with two-tailed  $P$  values, with significance defined as  $P < .05$ . The univariate relationship between SES and risk factors was strongest and most consistent for education, showing higher risk associated with lower levels of education. Using a forward selection model that allowed for inclusion of all three measures of SES after adjustment for age and time of survey, education was the

only measure of SES that was significantly associated with the risk factors. This finding is consistent with a previously conducted multivariate analysis, which showed that the strength and significance of the associations between education and a set of disease risk factors remained virtually unchanged after adjustment for income and occupation.<sup>7</sup>

When stratified by White, non-Hispanic and Hispanic ethnicities (not shown), education remained the strongest SES predictor but became nonsignificant for smoking, possibly because of the small sample of Hispanics.

## Discussion

### Strengths and Limitations of Using Education as the Marker for SES

We caution that, in some studies, using only one indicator of SES may yield misleading results or provide less information than using multiple measures. However, using multiple or composite measures<sup>10–14</sup> requires the cost and time of collecting data on several SES parameters and may not significantly explain more about a population than would a single, well-chosen parameter. As noted by a re-

cent working group of the National Heart, Lung, and Blood Institute, use of composite measures may obscure important differences in associations.<sup>25</sup>

Based on our findings, education may be the most judicious SES measure for use in epidemiological studies (unless the study hypothesis dictates which dimension of SES is to be chosen). In studies that have a cost or time restraint but need a measure of SES as a potential confounding variable, education is an expeditious choice. In addition, education is available for all individuals regardless of employment status, has high reliability and validity,<sup>17</sup> is generally stable after early adulthood, is easily reported, and can be collected as a continuous variable. Furthermore, because education is often available in epidemiological studies,<sup>17</sup> it also permits opportunities for meta-analyses and interstudy comparisons.

However, there are potential limitations to using education as a sole indicator of SES. Its stability can mask important changes in individuals' circumstances. There may also be a cohort effect distorting differences between populations of various ages. For example, the percent of the population obtaining at least a high school education has increased nearly threefold since 1940.<sup>17</sup> This has led to increasing homogeneity in the amount of education obtained, making differentiation between educational strata more difficult. Other potential problems include regional differences in education, the question of whether degrees or certification are better measurement parameters than years of schooling,<sup>17,26,27</sup> and the possibility that other dimensions of SES are more sensitive markers for health in some population subgroups. (For example, for foreign-born female Hispanics, acculturation may be a stronger measure of SES.)<sup>13</sup>

### Comparison with Past Studies

To our knowledge, this is the only study in the United States to examine associations between separate SES dimensions and risk factors or disease outcomes. Other studies, however, have examined associations between one measure of SES and one disease risk factor,<sup>6,8,28-32</sup> morbidity,<sup>33</sup> or mortality.<sup>1,33-35</sup> In general, these studies have found that education is more strongly associated with disease than is income or occupation. One of the most complete studies of mortality differentials found that lower SES groups exhibited higher rates of all-cause mortality than did higher SES groups, irrespective of whether education, income, or occupation was used as

the measure of SES.<sup>1</sup> Other studies have documented strong inverse associations between education and all-cause mortality<sup>31,34,36</sup> and life expectancy.<sup>37</sup> Framingham study data shows that, of 23 potential contributors to morbidity, only education and age at study enrollment were related in both sexes to "survival with good function."<sup>38</sup> Cardiovascular disease studies have shown that lower levels of education are associated with hypertension,<sup>6,28-29,31,39</sup> cigarette smoking,<sup>6,31,32,40-41</sup> and high cholesterol,<sup>6,32</sup> as well as with cardiovascular morbidity<sup>33</sup> and mortality.<sup>31,33,35</sup>

### Why Education May Be the Strongest Predictor of Good Health

Several different mechanisms through which education may positively influence health have been proposed. Fuchs has suggested that both education and health are markers for willingness to delay gratification in order to "invest in human capital."<sup>15</sup> Others have argued that education may simply serve as a marker for intelligence; however, studies showing that environmental factors are the strongest predictors of school dropout lend little support to this hypothesis.<sup>42</sup> Some have suggested that higher education may improve health by conferring economic advantages, but our low correlation coefficients between education and income, as well as the lack of significant income effects on risk factors, argue against this hypothesis. Neither does the health knowledge acquisition that accompanies higher education appear to explain the relationship between education and health, given that provision of information alone appears to be a weak stimulus to human behavior change.<sup>16,37</sup>

One hypothesis we find most plausible is that education may protect against disease by influencing life-style behaviors, problem-solving abilities, and values.<sup>17</sup> Moreover, education may facilitate the acquisition of positive social, psychological, and economic skills and assets, and may provide insulation from adverse influences.<sup>7</sup> Such skills and assets that may accompany higher educational attainment include positive attitudes about health, access to preventive health services,<sup>15</sup> membership in peer groups that promote the adoption or continuation of positive health behaviors, and higher self-esteem and self-efficacy.<sup>43,44</sup>

### Summary

There can be no SES measure that is universally valid and suitable for all populations. However, if economics and time

dictate that a single parameter be chosen and if the research hypothesis does not dictate otherwise, this study suggests that higher education, rather than income or occupation, may be the strongest and most consistent predictor of good health. □

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