The Impact of Socioeconomic Status on Health Functioning as Assessed by the SF-36 Questionnaire: The Whitehall II Study

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ABSTRACT

Objectives. This study measured the association between socioeconomic status and the eight scale scores of the Medical Outcomes Study short form 36 (SF-36) general health survey in the Whitehall II study of British civil servants. It also assessed, for the physical functioning scale, whether this association was independent of disease.

Methods. A questionnaire containing the SF-36 was administered at the third phase of the study to 5766 men and 2589 women aged 39 through 63 years. Socioeconomic status was measured by means of six levels of employment grades.

Results. There were significant improvements with age in general mental health, role-emotional, vitality, and social functioning scale scores. In men, all the scales except vitality showed significant age-adjusted gradients across the employment grades (lower grades, worse health). Among women, a similar relationship was found for the physical functioning, pain, and social functioning scales. For physical functioning, the effect of grade was found in those with and without disease.

Conclusions. Low socioeconomic status was associated with poor health functioning, and the effect sizes were comparable to those for some clinical conditions. For physical functioning, this association may act both via and independently of disease. (*Am J Public Health.* 1997;87:1484–1490)

Introduction

The goal of medical care has been described as the restoration and preservation of function and well-being.[1] Functional outcomes are now often measured by self-reported health status questionnaires in routine,[2] as well as research, clinical settings.[3,4] The Medical Outcomes Study short form 36 (SF-36) general health survey is among the most widely used validated[5] measures of health status, being administered internationally in more than 260 clinical trials.[6] Interventions aimed primarily at improving functional status have been tested in randomized trials.[7]

However, strong inverse associations between socioeconomic status (SES) and measures of health functioning have been reported in general population studies,[8,9] largely in those concentrating on physical functioning in older age groups.[10–12] In functional assessments of patient populations, social factors are usually measured as potential confounders.[13,14] However, since SES clearly influences the risk of both developing and dying from certain diseases[15]—an effect that is independent of established risk and prognostic factors[16–18]—effects on health functioning are to be expected. It has further been proposed that certain risk factors may predict physical disability via mechanisms independent of disease.[19]

The SF-36 consists of 36 items scored in eight scales covering physical and mental health functioning. Existing population studies using the SF-36 have patchily reported group differences by age, sex, social class, and region[20–23] in the context of population "norms" rather than as variables of interest. Such norms are relatively crude because of the wide range of age and social class of the subjects in these studies. By contrast, the participants in the Whitehall II study of British civil servants[24] were aged 35 to 55 years at baseline in 1985 through 1988, and all were employed in offices in and around Whitehall, London. We hypothesized that the SF-36 would demonstrate SES differences in health mirroring those seen in morbidity and mortality studies. For the physical functioning scale, we further hypothesized that the relationship with SES would be found in those both with and without disease.

Methods

Study Population

The Whitehall II Study was set up to investigate the potential psychosocial, behavioral, and biological explanations of the inverse social gradient in coronary and other diseases. All nonindustrial civil servants aged 35 through 55 years working in the London offices of 20 departments were invited to participate in the

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Editor's Note. See related editorial by Moss (p 1411) in this issue.

TABLE 1—Reliability of SF-36 Questionnaire in the Whitehall II Study: London, England, August 1991 through May 1993

	General Health Perceptions	Physical Functioning	Role Limitation, Physical	Pain	General Mental Health	Role Limitation, Emotional	Vitality	Social Functioning
Internal consistency (n = 8295)								
Cronbach's α	0.76	0.86	0.84	0.75	0.79	0.77	0.84	0.81
Cronbach's α estimated for 10-item scale	0.86	0.86	0.93	0.94	0.88	0.92	0.93	0.96
Test–retest reliability (n = 289, retest interval 1 mo)								
Correlation coefficient	0.89	0.60	0.38	0.66	0.83	0.60	0.81	0.60
Mean difference, repeat–first observation	0.6	2.0	−0.2	1.4	0.8	1.9	1.7	0.2
% subjects lying within 1.96 SD of mean differences	88.6	96.2	89.6	92.0	93.1	93.1	95.8	94.5

study. The overall response rate at recruitment (Phase 1) was 73%. The true response rate is likely to be higher, however, because around 4% of the civil servants on the lists provided by the civil service had moved before the study and were therefore not eligible for inclusion. In total, 10 308 civil servants participated, of whom 67% (6895) were men and 33% (3413) were women. Enrollment in the study occurred from November 1985 through March 1988. Phase 2 data collection consisted of a postal questionnaire. Phase 3 data collection was carried out from August 1991 through May 1993, when the participants were aged 39 through 63. Participants were sent a questionnaire and attended a screening examination where an interviewer sought missing information. There were 197 deaths by the end of May 1993. At Phase 3, 8355 participants (5786 men and 2589 women) responded to the questionnaire (83% response rate).

Questionnaire

The SF-36 consists of 36 items scored in eight scales: general health perceptions (5 items), physical functioning (10 items), role limitations due to physical functioning (4 items), bodily pain (2 items), general mental health (5 items), role limitations due to emotional problems (3 items), vitality (4 items), and social functioning (2 items). The remaining item, relating to change in health, is not scored as a separate dimension. The Phase 3 questionnaire included an Anglicized version of the SF-36 which substituted "walking half a mile," "walking one hundred yards," and "did you feel full of life?" for the US items "walking several blocks," "walking one block," and "did you feel full of pep?" respectively. As an example of scale content, the physical functioning scale comprises items on vigorous activities (e.g., strenuous sports, running), moderate activities (e.g., housework, playing golf), lifting and carrying, climbing stairs, bending, kneeling, and walking. The physical functioning scores ranged from 0, indicating severe limitation in performing all physical activities, including bathing or dressing, to 100, indicating no limitation in performing all types of physical activities, including the most vigorous. The proportion of missing data from each item of the SF-36 was 0.1% or less. If 50% or fewer of items per scale were missing, a person-specific estimate of the missing score was calculated, by substituting the mean score across completed items in the same scale for that respondent.[6] After an interval of 4 weeks, the complete questionnaire was readministered to a random sample of 289 individuals.

SES was assessed by means of civil service employment grade and access to the use of a car.[25] Information on grade of employment was obtained by asking participants to give their civil service grade. On the basis of salary, the civil service identifies 12 nonindustrial grades. To obtain sufficient numbers for meaningful analysis, we combined the top 6 groups into grade 1 and the bottom 2 groups into grade 6, thus producing 6 grade categories. The salaries ranged from £6483–£11 917 (grade 6) through £28 904–£87 620 (grade 1) in 1992.

The following diseases were identified (along with numbers of research subjects with disease): angina[26] (n = 450), probable or possible ischaemia on resting electrocardiogram (Minnesota codes 1-1 through 1-3, 4-1 through 4-4, 5-1 through 5-3, and 7-1-1; n = 707), hypertension (blood pressure > 160/90 mmHg or on an antihypertensive medication; n = 1554), claudication[26] (n = 125), diabetes (self-report or score on oral glucose tolerance test[27]; n = 222), chronic bronchitis[28] (n = 914), musculoskeletal disorders (self-report; n = 1257), and cancer (registration and self-report; n = 128). In addition, participants reporting any "limiting long-standing illness, disability, or infirmity" were identified. In order to determine whether effects on physical functioning were independent of disease, subjects with one or more of the above diseases or disabilities at phase 1 or phase 3 (2868 men and 1218 women) were analyzed separately.

Statistical Analysis

For each of the eight dimensions, item scores were coded, summed, and transformed to a scale score ranging from 0 (worst health) through 100 (best health). The internal consistency of each scale was assessed by means of Cronbach's α. Since internal consistency increases with the number of items in a scale, Cronbach's α was also estimated under the assumption of a 10-item scale. The Cronbach's α values were calculated by means of the Multitrait Analysis Program.[29] Calculation of the correlation coefficients between each item and each scale (corrected for overlap) revealed no definite scaling errors. All other analyses were performed by means of the statistical package SAS (SAS Institute Inc, Cary, NC).

Test–retest reliability was assessed by calculating the mean difference between the first and repeat measurements for each scale, along with the percentage

TABLE 2—SF-36 Mean Scale Scores by Age and Sex: London, England, August 1991 through May 1993

Age, y	No.[a]	General Health Perception	Physical Function	Role: Physical	Pain	General Mental Health	Role: Emotional	Vitality	Social Function
				Men					
39–44	1560	72.5	94.4	92.3	88.2	74.5	88.2	61.3	90.7
45–49	1597	72.5	93.1	92.9	88.4	75.8	88.5	62.8	91.0
50–54	1135	72.2	90.3	91.4	86.6	77.6	89.8	64.5	91.3
55–59	1174	72.3	89.2	90.5	86.5	79.8	91.8	65.8	91.6
≥60	270	74.8	89.8	93.0	88.8	82.9	96.2	71.1	95.7
P for trend		.5	.0001	.06	.02	.0001	.0001	.0001	.001
Mean score		72.5	91.9	91.9	87.6	77.0	89.7	63.7	91.3
SD		17.6	11.9	21.8	16.5	14.7	24.7	17.5	17.0
Effect size		0.13	−0.39	0.03	0.04	0.57	0.32	0.56	0.30
β[b]		0.03	−0.34	−0.09	−0.09	0.39	0.28	0.38	0.11
% at Ceiling		5.2	38.0	84.4	45.8	1.9	82.3	0.90	71.0
				Women					
39–44	577	73.0	90.4	86.8	80.8	71.0	83.1	55.8	85.8
45–49	635	70.4	85.0	83.7	77.7	72.3	83.9	55.8	84.3
50–54	555	72.1	82.5	83.2	78.2	73.9	87.0	57.4	85.8
55–59	640	71.9	78.8	85.1	79.0	76.2	89.3	60.4	88.3
≥60	161	71.8	77.5	80.1	77.3	76.9	87.8	63.3	88.3
P for trend		.7	.0001	.09	.2	.0001	.0001	.0001	.006
Mean score		71.8	83.7	84.4	78.8	73.6	86.0	57.8	86.2
SD		19.1	19.2	30.4	21.9	16.0	29.1	20.1	21.3
Effect size		−0.06	−0.68	−0.22	−0.16	0.34	0.16	0.37	0.12
β[b]		−0.02	−0.72	−0.16	−0.11	0.35	0.40	0.37	0.20
% at Ceiling		4.2	26.7	73.9	29.4	1.5	77.6	0.70	59.6

[a]Minimum number of observations.
[b]Regression coefficient: increase in scale score due to 1-year increase in age.

of differences lying within 1.96 standard deviations of the mean. If the scale and the health it is measuring are stable during this time period, then the mean should be zero.[30]

Ordinary least squares regression was used to estimate the effect of age, civil service employment grade, and access to use of a car, along with the interaction of age and grade on each of the eight scale scores, separately for men and women. Age effects were expressed as the increase in score per 1-year increase in age. Effect sizes (standard differences) were calculated by dividing the difference in two mean scores (e.g., between top and bottom grades) by the sex-specific standard deviation for the scale. The effect of grade was further assessed by calculating the age-adjusted odds of being in the lowest sex-specific quartile of physical functioning. The physical functioning scale was selected for further study because improving physical functioning may be considered a more directly relevant goal of medical care than improving, for example, general health perceptions or vitality. Two-tailed tests were used throughout. None of the distributions of the SF-36 scales are normal; however, nonparametric methods showed the same trends with age and grade.

Results

Reliability

The Cronbach's α was 0.75 or greater for all scales (Table 1); when estimated for a 10-item scale, it was 0.86 or greater, which is satisfactory.[31] There was an inverse association between Cronbach's α and grade, with lower grades having higher α coefficients. Women had consistently higher Cronbach's α values than men. This is likely to be a reflection of the higher variance of each scale among women and those in lower grades. The proportion of participants at the "ceiling" (i.e., scoring 100) was highest among the high grades. Since there is likely to be true but unmeasured variation in functioning among those at the ceiling, the true magnitude of SES differences in scale scores may be greater than measured. There was no effect of age on Cronbach's α.

The test–retest reliability showed a mean of the differences in scale scores ranging from −0.2 through 2.00; the correlation coefficients were statistically significant for each scale ($P < .0001$). All the scales except role limitation due to physical problems tended to show a small improvement; for physical functioning and vitality, this was significant ($P < .05$). This may represent regression to the mean in the presence of ceiling effects. There was no effect of age, sex, or grade on test–retest reliability.

Age and Sex

In these cross-sectional data, there were significant increases (i.e., improvements) with age in general mental health, role-emotional, vitality, and social functioning scale scores in men and women (test for linear trend $P < .01$ for each) (Table 2). The mean increase in these scale scores associated with each year's increase in age was from 0.11 through 0.40. Physical functioning scores decreased ($P < .0001$) with age; the regression coefficient was −0.34 in men and −0.72 in women. These effects were not attenuated when adjusted for grade of employment.

Apart from the general health perceptions scale, women scored consistently lower than men in every age group

TABLE 3—SF-36 Mean Scale Scores by Employment Grade, Adjusted for Age

Grade	No.[a]	General Health Perception	Physical Function	Role: Physical	Pain	General Mental Health	Role: Emotional	Vitality	Social Function
				Men					
1 (High)	1272	74.0	93.1	94.0	89.5	77.7	91.9	64.3	93.4
2	1497	72.7	92.9	91.6	87.9	77.5	90.1	63.4	92.1
3	954	73.4	92.4	92.5	87.8	78.2	90.5	64.2	92.0
4	1023	71.7	91.0	90.9	86.8	75.8	88.3	63.0	90.1
5	596	72.0	90.3	90.0	86.4	76.9	86.4	65.6	89.4
6 (Low)	381	69.1	86.3	90.0	83.7	74.9	90.0	64.3	87.1
P for trend		.0001	.0001	.0001	.0001	.0001	.0002	0.5	.0001
Effect size		0.28	0.57	0.18	0.35	0.19	0.08	0.00	0.37
β[b]		0.65	1.05	0.76	0.87	0.46	0.78	−0.11	1.08
				Women					
1 (High)	154	72.3	89.1	87.5	82.3	73.3	87.4	57.2	85.7
2	249	72.9	89.3	84.8	81.6	75.2	86.9	59.5	91.5
3	202	73.2	85.1	83.4	79.8	73.5	85.9	56.2	88.1
4	383	71.3	85.7	81.0	80.2	73.4	82.7	55.6	85.1
5	574	72.6	85.1	84.8	78.4	73.2	86.2	56.9	86.6
6 (Low)	1004	70.3	80.6	84.3	76.1	73.1	86.4	59.1	83.7
P for trend		.03	.0001	0.6	.0001	.3	.9	.2	.0002
Effect size		0.09	0.45	0.09	0.26	0.01	0.04	−0.09	0.08
β[b]		0.54	1.76	0.25	1.26	0.24	0.06	−0.30	1.07

[a]Minimum number of observations.
[b]Regression coefficient: increase in scale score due to 1 level higher grade.

TABLE 4—Age-Adjusted Odds Ratios for the Effect of Employment Grade on Being in the Lowest Sex-Specific Quartile on the SF-36 Physical Functioning Scale

	Men		Women	
	No Disease,[a] OR (95% CI) (n = 2861)	Disease Present[b] OR (95% CI) (n = 2868)	No Disease,[a] OR (95% CI) (n = 1353)	Disease Present[b] OR (95% CI) (n = 1212)
Grades 1 and 2 (high)	1.00	1.00	1.00	1.00
Grades 3 and 4	1.42 (1.11, 1.82)	1.32 (1.11, 1.57)	2.80 (1.46, 5.37)	1.59 (1.06, 2.38)
Grades 5 and 6 (low)	2.49 (1.62, 3.85)	1.92 (1.42, 2.58)	4.11 (2.14, 7.90)	2.50 (1.67, 3.73)

Note. OR = odds ratio; CI = confidence interval.
[a]None of the following diseases present: angina, probable or possible ischemia on resting electrocardiogram, hypertension, claudication, diabetes, chronic bronchitis, musculoskeletal disorders, cancer, or self-report of limiting long-standing illness.
[b]One or more of the above diseases present.

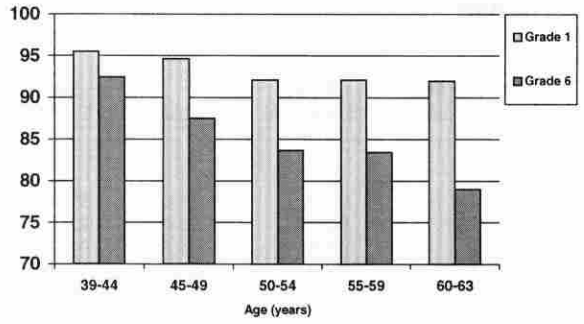
($P < .05$). The size of this effect was greatest for the physical functioning, role limitations due to physical problems, and pain scales. Examination of individual item responses showed that women scored lower across all items within a scale. The standard deviation of scores was higher among women because a smaller proportion of women had a "ceiling" score of 100.

Employment Grade

Table 3 shows that among men, there were significant ($P \leq .0002$) age-adjusted gradients across the six civil service employment grades in all the scales except vitality, with the higher status grades reporting better health functioning. The size of these effects was greater than that of age, with effect sizes greater than 0.3 for the physical functioning, social functioning, and pain scales.

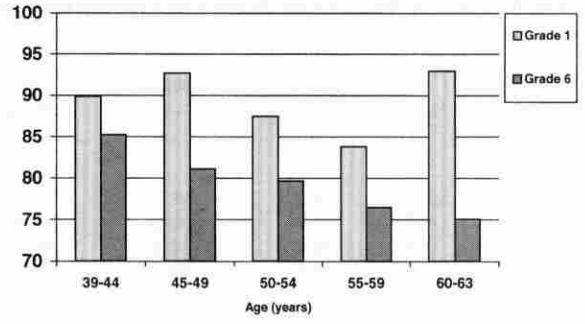
Among women, a similar inverse association between employment grade and scale score was observed in the physical functioning, pain, social functioning, and general health perceptions scales (Table 3). Scores on every scale were lower among women and men without access to a car ($P \leq .03$); this effect of access to a car remained after adjustment for grade (data not shown).

The median physical functioning score in the lowest quartile was 80 for men (range, 0 through 89) and 60 for women (range, 0 through 75). Subjects who were in the lowest quartile of physical functioning reported that their ability to perform vigorous activities and to climb several flights of stairs was limited a lot. Their ability to perform moderate activities, lift and carry, bend and kneel, and walk more than 1 mile tended to be limited a little. Table 4 shows that men and women in the lower grades



Note. Test for interaction: $P < .01$.

FIGURE 1—SF-36 physical functioning by age and grade (men).



Note. Test for interaction: $P = .4$.

FIGURE 2—SF-36 physical functioning by age and grade (women).

were at increased risk of poor physical functioning independent of disease status. In men without disease, the age-adjusted odds ratio of being in the lowest quartile of physical functioning was 2.49 (95% confidence interval [CI] = 1.62, 3.85) for grades 5 and 6 compared with grades 1 and 2; in men with disease, the corresponding odds ratio was 1.92 (95% CI = 1.42, 2.58).

Figures 1 and 2 show that the decline in physical functioning scores with age was more marked among men in the lowest grade (test for interaction $P < .01$). The small number of women in the highest grade meant that there was low power to detect such an interaction in women (test for interaction $P = .4$). Among men, there was a significant ($P < .0001$) age–grade interaction with the physical functioning scale, with older men having a stronger inverse grade gradient than younger men.

Discussion

There were strong inverse associations between the scale scores of the SF-36 and civil service grade of employment, with higher status grades reporting better health. In terms of effect sizes, the magnitude of these associations between health functioning and SES is comparable to the effect of a medical condition such as arthritis.[13] However, we demonstrated strong associations between SES and physical functioning in participants both with and without a wide range of diseases, suggesting that the effect is not wholly mediated via disease. The inverse relationship between SES and physical functioning is consistent with other studies using the SF-36 as well as other measures.[10,12,32]

Although the Whitehall II study is longitudinal in design, the data presented here are cross-sectional, and this represents a potential limitation. Interpreting the striking increases in mean scores with age in the mental health, role-emotional, vitality, and social functioning scales requires repeated measures of the SF-36 to distinguish a true age-related increase from a cohort effect. Prospective studies suggest that successive generations are more inclined to report their health adversely.[33,34] The increases in mental health scale scores could reflect a decline in prevalence of mental illness with age, although recent population data do not support this.[35] Although physical functioning scores declined overall with age, the effect was more marked among low-grade men. This is consistent with the hypothesis that changes in health function with age are heterogeneous and have environmental determinants; they are not simply the biologically inevitable consequence of the passage of time.[36]

Socioeconomic status may influence health functioning by affecting one or a combination of the following: (1) the risk of disease onset, (2) the risk of disability among people with disease, and (3) mechanisms independent of disease, for example, in the case of physical functioning via cardiorespiratory and locomotor "fitness." Previous studies have tended to concentrate on the first and second effects; we provide some evidence here of the third. The inverse grade gradient in physical functioning remained (indeed, increased) when participants who had disease were excluded. However, before a mechanism relating SES and physical function independent of disease can be confirmed, more sensitive measures of clinical and subclinical disease than were available in the present study are required.[37]

The Whitehall II study population is comparatively young and, as a white-collar occupational cohort, high functioning; the study population does not reflect the extremes of SES. In the general population, therefore, the effect of SES (particularly when accurately measured[38]) on the SF-36 may be larger. There was a tendency toward a monotonic inverse gradient in scale score with employment grade and no evidence of a threshold effect.

Among women, there was an inverse relation between employment grade and the physical functioning, pain, and social functioning scales. The lack of effect of grade on the other scales may reflect the meaning of employment grade among women. Social class based on the woman's own occupation predicts mortality less well than her partner's social class,[39] possibly because the latter is a more accurate reflection of material circumstances. To address this potential confounding, we therefore adjusted for the social class of the women's partner. The associations with grade were unchanged. Age-adjusted scores on each of the eight scales were, however, lower among women without access to the use of a car. Arber[40] has emphasized the distinction between structural (e.g., employment grade) and role (e.g., car access) measures of SES for women; such a distinction may be of particular importance since the SF-36 measures role functioning.

It is well recognized that SES can influence the mortality and other medical outcomes of patients with coronary heart disease,[17,18] cancer,[41,42] and HIV infec-

tion,[43] an effect that is independent of pathophysiological prognostic factors. It is less clear whether SES also influences the effectiveness of medical interventions. The relationships between SES, health functioning, and traditional medical outcomes should be assessed in clinical trials. Even in SF-36 studies where SES is not a variable of interest, the data presented here strongly suggest the potential for SES to bias or confound any observed effects.

It has been proposed that the SF-36 may provide a measure of health in general populations that will enable comparisons of health status across time, place, and person.[20,21,23] The Whitehall II study is obtaining repeated measures of the SF-36 and will examine psychosocial, lifestyle, biological, and health care predictors of the SF-36, and its change, in order to explain the gradients in health functioning across employment grades. The SF-36 will also be used as a predictor of socioeconomic and gender differences in subsequent sickness absence, health service utilization, morbidity, and mortality.

SES shows a strong inverse relation to the SF-36; the effect is comparable in magnitude to that of some medical conditions. However, the association between low SES and poor physical functioning is found in those both with and without concurrent or preexisting disease. Low SES has been associated with adverse outcomes of medical care, independently of clinical prognostic factors. Since one aim of medical care is to improve the health functioning of patients, further research is justified to ascertain whether specific, potentially modifiable aspects (psychosocial, behavioral, biological) of SES are associated with health functioning. □

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