Do Psychological Characteristics Explain Socioeconomic Stratification of Self-rated Health?

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Abstract

This study evaluated whether negative emotions explain socioeconomic status (SES) stratification of self-rated health (SRH) and whether this putative relation is independent of established SRH determinants. Mood disorders, trait negative affect and health status indices were assessed in a representative cross-sectional survey of 3032 adults in the National Survey of Midlife Development in the United States (MIDUS). Adjustment for health behaviors and health status appreciably reduced SES influence on SRH, but adjustment for negative emotions did not. However, both psychological resources (e.g. social support, extraversion) and negative emotions independently predicted SRH. Detection of SRH determinants was sensitive to binary versus ordinal SRH definitions.

Keywords

- *depression*
- *extraversion*
- *ordinal regression*
- *self-rated health*
- *socioeconomic status*

SELF-REPORTED HEALTH (SRH) status is an important element of clinical investigation (Detmar, Muller, Schornagel, Wever, & Aaronson, 2002; Pfisterer et al., 2003) and public health surveillance (Sadana, Mathers, Lopez, Murray, & Iburg, 2000; US Department of Health and Human Services, 2000). Such appraisals predict a number of important health outcomes, including functional ability (Idler & Kasl, 1995; Idler, Russell, & Davis, 2000), prospective use of physician services (Miilunpalo, Vuori, Oja, Pasanen, & Urponen, 1997) and changes in objective disease status over time (Goldberg, Gueguen, Schmaus, Nakache, & Goldberg, 2001). Similarly, global health status appraisals predict mortality across socioeconomic categories (Burström & Fredlund, 2001) even after adjusting for objective disease (Heistaro, Jousilahti, Lahelma, Vartiainen, & Puska, 2001; Idler & Benyamini, 1997). Thus, global SRH appraisals are valuable because they are sensitive to health changes, capture dimensions of health beyond traditional diagnostic indices, have practical significance and are easy to assess and are central to US (US Department of Health and Human Services, 2000) and international (Sadana et al., 2000) health surveillance efforts.

Socioeconomic status (SES) is a strong predictor of SRH (Pamuk, Makuc, Heck, Reuben, & Lochner, 1998), and recent models hypothesize that SES effects on health may be exerted via negative emotions (Gallo & Matthews, 2003). For example, depressive disorders are stratified by SES (Kessler et al., 1994) and in turn depressive symptoms predict change in SRH over time (Han, 2002). The contribution of major depressive and anxiety disorders to health appraisals exceeds that of common medical disorders (Molarius & Janson, 2002; Spitzer et al., 1995), so these negative emotions are critical when investigating SRH. Negative affect (NA), the superordinate dimension that subsumes discrete negative emotions such as depression, anxiety, anger, etc. (Watson & Clark, 1988, 1992) also predicts SRH (Bosma, van de Mheen, & Mackenbach, 1999; Mora, Robitaille, Leventhal, Swigar, & Leventhal, 2002; Muldoon, Barger, Flory, & Manuck, 1998) even after controlling for depressive symptoms (Kressin, Spiro, & Skinner, 2000). Thus, both clinical and nonclinical dimensions of NA have prognostic significance for SRH, and their associations with SES make them promising candidates as intermediaries of SES effects.

While NA is a strong predictor of SRH, indicators of psychological and social resources, such as extraversion[1] and social support, are theoretically important (Gallo & Matthews, 2003; Salovey, Rothman, Detweiler, & Steward, 2000), independently predict SRH (Benyamini, Idler, Leventhal, & Leventhal, 2000; Cohen, Kaplan, & Salonen, 1999), but are infrequently assessed when examining SES intermediaries (Gallo & Matthews, 2003). Those studies that have evaluated the contribution of positive and negative emotional factors to SRH (and mortality) were restricted to older adults and either failed to test (Kressin et al., 2000) or replicate (Benyamini, Leventhal, & Leventhal, 2000) the robust SES–SRH relation. Self-rated health is more strongly associated with mortality in younger age groups (Franks, Gold, & Fiscella, 2003; Helweg-Larsen, Kjoller, & Thoning, 2003), and thus it is especially important to evaluate SRH determinants among nongeriatric samples. Other work that investigated the impact of psychological resources on SRH was limited by a lack of functional and chronic disease status measures (Cohen et al., 1999) which strongly predict SRH (Cott, Gignac, & Badley, 1999) and could be considered markers of diminished reserve capacity which is hypothesized to mediate the association between negative emotions and SES (Gallo & Matthews, 2003). Similarly, lucid work examining associations among depressive and anxiety disorders with SRH (Spitzer et al., 1995) lacked measures of resources and other important SRH determinants such as body mass index (BMI) and smoking (Okosun, Choi, Matamoros, & Dever, 2001). Thus, disentangling the relative contribution of psychological variables is difficult without simultaneously considering these established SRH determinants, and understanding SRH determinants is a precondition for identifying characteristics amenable to intervention.

The present work expands this literature by addressing whether the associations among positive and negative psychological characteristics and SRH generalize beyond primary care settings and elderly samples, and whether they persist after adjustment for a broader range of established health determinants. These questions

complemented the principal research question, which was to test whether positive and negative psychological characteristics explain SES stratification of SRH. The present study addressed several limitations identified in the literature (Gallo & Matthews, 2003). First, negative psychological characteristics known to predict SRH were included, encompassing both emotional disorders (major depressive disorder and generalized anxiety disorder) and nonclinical emotional experience (trait NA). Second, psychological resources, such as social support and extraversion, were also assessed. These constructs predict SRH (Benyamini, Idler et al., 2000) and infectious disease vulnerability (Cohen, Doyle, Skoner, Rabin, & Gwaltney, 1997). Third, a broad range of known SRH predictors (BMI, medical history, physical symptoms, physical function) were included in multivariate models to more precisely estimate the relative contribution of psychological characteristics. Finally, these relations were assessed within a large representative sample of US adults aged 25–74. Because prior work examining psychological mediators of the SES–SRH relation showed modest effects (Cohen et al., 1999), a similar pattern of psychological mediation was expected in the present study. It was also hypothesized that both negative and positive psychological characteristics would predict SRH (Benyamini, Idler et al., 2000; Cott et al., 1999).

While the present study was specifically designed to test predictions made by Gallo and Matthews (2003), it can be nested within a broader conceptual framework of SES. Oakes and Rossi (2003) outlined three domains of SES, *material capital* (income, wealth), *human capital* (education, skills, abilities) and *social capital* (family, social networks and institutional-level influences). The present study includes measures of all three domains, but emphasizes aspects of human capital (education, extraversion) to include person-level characteristics such as negative emotions. This emphasis is supported by prior work which shows that other SES indicators such as income, employment status and occupation have substantially weaker associations with SRH relative to markers of human capital such as education (Farmer & Ferraro, 2005; Oakes & Rossi, 2003). Therefore this study focused on education as a marker of SES, and extended the evaluation of human capital effects on SRH to include measures of normal and pathological emotions.

In addition to the issues outlined above, this investigation addressed a potential statistical barrier to understanding SRH determinants. That is, are risk estimates for SRH determinants dependent upon how SRH is operationally defined? Although there are exceptions (Cott et al., 1999; Ferraro & Kelley-Moore, 2001; Idler et al., 2000; Zimmer, Natividad, Lin, & Chayovan, 2000), SRH is typically collapsed to create a binary dependent variable which is analyzed with logistic regression (Bosma et al., 1999; Chandola, Bartley, Wiggins, & Schofield, 2003; Cohen et al., 1999; Ford, Moriarty, Zack, Mokdad, & Chapman, 2001; Fuhrer et al., 2002; Fuhrer & Stansfeld, 2002; Han, 2002; Kennedy, Kawachi, Glass, & Prothrow-Stith, 1998; Marmot et al., 1998; Molarius & Janson, 2002; Power, Matthews, & Manor, 1998). This binary approach is troublesome because dichotomizing an ordered variable discards information in the data (Armstrong & Sloan, 1989; Scott, Goldberg, & Mayo, 1997), decreases power to detect associations among predictors (Scott et al., 1997) and the efficiency (Ananth & Kleinbaum, 1997) and stability (Manderbacka, Lahelma, & Martikainen, 1998) of estimated logistic regression coefficients may be undermined if the binary cutpoint is not optimal. These quantitative objections are supported by evidence that SRH predictors can discriminate among SRH levels that usually get combined (Manderbacka et al., 1998).

Because most SRH assessments generate ordered categories (e.g. poor, fair, good, very good or excellent), it is logical to use a regression model for ordered dependent variables (Long & Freese, 2003; Scott et al., 1997). One such ordinal regression model (ORM), the proportional or cumulative odds model (Ananth & Kleinbaum, 1997; Long & Freese, 2003; McCullagh, 1980; Scott et al., 1997), is an extension of the binary regression model (BRM) (McCullagh, 1980), can include any number of categorical and continuous covariates (Anderson, 1984; Scott et al., 1997) and provides readily interpretable odds ratios and confidence intervals. The obtained odds ratio (OR) is not based on one dichotomy of the outcome variable, but instead summarizes the

predictive association over all possible binary SRH cutpoints (Scott et al., 1997). This estimate parallels the OR generated by logistic regression, which reflects the association of interest restricted to a single arbitrary cutpoint. Given the importance of global SRH assessments (Idler & Benyamini, 1997; Sadana, 2000; US Department of Health and Human Services, 2000) and calls for more suitable statistical techniques (Armstrong & Sloan, 1989; Scott et al., 1997), the present study tested the sensitivity and statistical conclusion consistency of the typical (binary) versus novel (ordinal) SRH definition.

Materials and methods

Participants

Data came from the National Survey of Midlife Development in the United States (MIDUS), a nationally representative telephone and postal survey of 3032 adults aged 25–74 in the continental USA (Brim et al., 2000). Approximately 70 percent of those contacted participated in the telephone interview and 86.8 percent of those participants returned the postal survey, for an overall response rate of 60.8 percent. All participants consented to the telephone and postal surveys. Details of the sampling procedure are available elsewhere (Brim et al., 2000).

The primary outcome variable was SRH, assessed with the question, 'In general, would you say your physical health is poor, fair, good, very good or excellent?' This health ranking was analyzed both as a binary (poor/fair health versus good/very good/excellent) and ordered categorical variable. A small number of missing values (median = 34 of 3032 values; 1 percent of the sample) for 14 predictor variables were estimated by regressing these predictors on demographic variables (gender, ethnicity, age and marital status). Two values each of education level and SRH were also imputed (< 0.01 percent of the sample). This imputation permitted use of post-stratification weights calculated for all 3032 participants who completed both the telephone and postal surveys. These weights allowed the sample to approximate the 1995 US adult population aged 25–74 years by region, age, gender, education and marital status. All reported internal consistency reliabilities are specific to the present sample.

Measures

Sociodemographic variables Age (in 5 categories), gender (0 = *male*, 1 = *female*), marital status (0 = *unmarried*, 1 = *married*) and ethnicity (0 = *white*, 1 = *nonwhite*) were the primary demographic variables (the nonwhite subgroup was collapsed in the public data release to protect participant confidentiality). Socioeconomic status was assessed with years of education. Straightforward to report, this SES measure is likely to predate significant changes in health and is routinely collected in public health surveillance (Daly, Duncan, McDonough, & Williams, 2002). Education level was coded into 1 variable with 4 ordered categories (1 = some grade school to some high school; 2 = high school or equivalent; 3 = some college; 4 = college graduate or other professional degree). A household income variable did not significantly predict SRH in multivariate models nor did it substantially alter the pattern of significant predictors reported later.[2]

Psychological variables The presence or absence of major depressive and generalized anxiety disorders was measured during the telephone interview using the short form of the Composite International Diagnostic Interview (CIDI-SF) (Kessler, Andrews, Mroczek, Ustun, & Wittchen, 1998). Using trained lay interviewers, this instrument assesses major depressive and generalized anxiety disorders based on the *DSM-III-R* (American Psychiatric Association, 1987). These assessments have good classification accuracy relative to the full CIDI instrument (> 90%) and to clinical diagnoses (Kessler, Wittchen et al., 1998; Wittchen, 1994). Further details of this instrument are published elsewhere (Kessler, Andrews et al., 1998; Kessler et al., 1994; Wittchen, Kessler, Zhao, & Abelson, 1995).

Trait NA and extraversion were measured using an abbreviated set of indicator items that had the highest item-total correlations with their respective full scales (Lachman & Weaver, 1997). Traits were assessed by asking participants about the extent to which various adjectives described them ('not at all, a little, some, a lot'). Trait NA was measured using the sum of two descriptors (*nervous* and *worrying*) while extraversion was denoted by the sum of responses to five descriptors (outgoing, friendly,

lively, active and talkative). Both of these scales had acceptable internal consistency (Cronbach's α for each of these scales was 0.78).

Social support was assessed with the sum of responses to four questions (How much do your friends really care about you? How much do they understand the way you feel about things? How much can you rely on them for help if you have a serious problem? How much can you open up to them if you need to talk about your worries?) scored on the same metric as the trait affect scales ($\alpha = 0.88$).

Health status covariates

Medical history Medical history was coded by the presence or absence of any of four serious medical conditions (heart trouble, HIV, stroke or cancer). Because of restricted variability in some of the individual heath status covariates, they were summed and dichotomized rather than entered as separate dummy variables (Hardy, 1993). Medical history was thus transformed into no serious conditions/one or more serious conditions.

Chronic disease Only active conditions in the last 12 months for which the participant took prescription medication or consulted a physician were included. These conditions included hypertension, diabetes, high cholesterol, lung problems, ulcers or arthritis. These items were summed and recoded as 0 = *none* 1 = *one or more.* They capture a broad range of conditions, including common disorders found in primary care settings (Schappert, 1992).

Other conditions A range of other conditions experienced in the last year were also assessed, including migraine, lupus, thyroid disease, hernia and multiple sclerosis/epilepsy. These conditions were labeled *mild disease* and summed and recoded as 0 = *none* 1 = *one or more.*

Functional status Physical function was assessed with questions assessing the difficulty of seven activities: lifting groceries, climbing stairs, bending, walking more than a mile, walking several blocks and moderate (e.g. vacuuming) and vigorous (e.g. running) activities. Responses were scored on a 1 = *not at all* to 4 = *a lot* metric and summed ($\alpha = 0.93$). Dyspnea was assessed with four yes/no questions about shortness of breath when performing light to moderate activities (washing, walking on level ground alone and with others your age and hurrying or walking up a slight hill). Responses were summed to create a continuous dyspnea score ($\alpha = 0.64$).

Physical symptoms Participants rated recent (past 30 days) physical symptom frequency on a 6-point scale ranging from *not at all* to *almost every day.* A continuous summary score was created from 8 items encompassing headaches, aches or joint stiffness, trouble sleeping, pain/discomfort during intercourse, lower back aches, sweating, hot flashes and leaking urine ($\alpha = 0.69$).

Anthropometric measures Body mass index (weight in kilograms/height in meters^2) was calculated using self-reported height and weight. Participants were grouped into three categories corresponding to normal weight, overweight and obese (BMI $\leq$ 25, 25–30, and $>$ 30, respectively). Waist-to-hip ratio was calculated by dividing the circumference of the waist at the navel by hip circumference at its widest point. Participants were provided with a tape measure in their postal survey materials and instructions how to obtain the correct measurements. Participants were grouped into approximately equal waist–hip tertiles.

Behavioral covariates

Physical activity and smoking status Four questions assessed the typical frequency of two levels of physical activity intensity (moderate, vigorous) during both summer and winter. Participants who reported regular frequency of activity (several times a week or more) for two or more of the questions were considered active; others were considered inactive. Individuals were further classified as never, former or current smokers.

Statistical analysis

Ordinal and logistic regression were used to analyze ordered and binary SRH dependent variables. Odds ratios and 95 percent confidence intervals are presented for both models. Both models are nonlinear and can be interpreted in terms of ORs and probabilities of being in a particular SRH category. The logistic OR

represents the odds of having fair or poor health versus the other 3 categories combined. The proportional odds (ordinal) model summarizes the average change in odds for moving across any binary SRH cutpoint. For example, an ordinal OR of 1.6 for gender means that the odds of having better health ratings are 1.6 times higher for men versus women, where better health could be any possible SRH dichotomy, i.e. > poor; > fair or poor; > good, fair or poor, etc. Thus, the ORM provides an indication of the odds of being in a higher SRH category for each unit change in the independent variable (or standard deviation change for continuous predictors) (Long & Freese, 2003).

This summary measure of association in the ORM assumes that the regression coefficients are homogeneous across all binary cutpoints (Ananth & Kleinbaum, 1997; Anderson, 1984; Armstrong & Sloan, 1989; McCullagh, 1980; Scott et al., 1997). In the present study this assumption was satisfied by combining the *excellent* and *very good* health categories, which rendered the homogeneity test (Brant, 1990; Long & Freese, 2003) nonsignificant ($p > .05$).[3] All analyses were conducted with Stata 8.2 (College Station, TX). Odds ratios were estimated with Stata's survey commands (*svyologit*), which account for the complex survey design. All analyses were two-tailed and were considered significant if $p \leq .05$.

All SRH predictors were selected a priori. The predictive strength of each psychological predictor was evaluated by first controlling for demographic characteristics. Psychological effects were then re-estimated after adding all behavioral and health status SRH determinants to the model, followed by a final estimation that included the other psychological predictor variables. These analyses were conducted using both the BRM and the ORM. Earlier work evaluating psychological mediators of SES has been criticized for failing to evaluate interactions among psychological and SES variables (Gallo & Matthews, 2003). Therefore, after the primary analyses interaction terms were created to test joint effects of key demographic and psychological variables.[4] Interaction tests were considered exploratory, were conducted only with the ORM and were limited to second-order effects.

Results

Results are organized around two key questions—To what extent do psychological (both positive and negative), behavioral and health status predictors reduce the SES–SRH association? And, Do psychological variables predict SRH after controlling for said predictors? Results for the ORM are presented first, followed by a comparison of the BRM with the ORM. Demographic characteristics of the sample are presented in Table 1.

Variables that reduce the SES–SRH association

Education had a strong independent association with SRH both alone (OR = 1.69; 95% CI 1.56–1.84) and when controlling for other demographic variables (OR = 1.61; 95% CI 1.48–1.74; see Model 1 in Table 2). As education was only modestly related to the psychological variables (Table 3), this relation was affected little by the addition of all psychological variables simultaneously (education OR = 1.56; 95% CI 1.43–1.70; not in Tables). However, the OR for education was reduced substantially (by 47.5%) following adjustment for the block of behavioral and health status measures (Model 2 in Table 2). The ensuing addition of all psychological components to Model 2 did not further reduce the association between education and SRH (Model 3 in Table 2). After adjustment for all predictors, an increase in education level was associated with a statistically significant 1.31 increase in the odds of higher SRH.

Contribution of psychological factors to SRH

All psychological variables had independent associations with SRH, and all but generalized anxiety disorder were significant after adjusting for important behavioral and health status variables (Model 2 in Table 2). After adjusting for all predictors, depressive disorder, trait NA, extraversion and social support were significantly related to SRH (Model 3 in Table 2) in the expected fashion. Extraversion had the strongest relation to SRH—for a standard deviation increase in extraversion, the odds of higher SRH increased by 1.41. Social support had a smaller effect, where a standard deviation increase was associated with a 1.04 increase in

Table 1. Demographic characteristics of the MIDUS sample ($N = 3032$)

	Weighted percent (N)
Age	
25–34	26.0% (630)
35–44	27.8% (735)
45–54	19.1% (728)
55–64	15.2% (602)
65–74	11.8% (337)
Education	
Some grade school to some high school	13.2% (300)
Graduated high school	38.3% (888)
Some college	25.6% (947)
Graduated college	23.0% (897)
Gender	
Male	43.5% (1471)
Female	56.5% (1561)
Ethnicity	
White	84.0% (2667)
Nonwhite	16.0% (365)
Marital status	
Married	68.1% (1941)
Unmarried	31.9% (1091)
Self-rated health	
Poor	3.4% (102)
Fair	13.3% (370)
Good	36.2% (1061)
Very good/Excellent	47.1% (1499)
Smoking status	
Current	24.3% (696)
Former	28.6% (925)
Never	47.0% (1411)
Major depressive disorder	
Yes	14.1% (418)
No	85.9% (2614)
Generalized anxiety disorder	
Yes	3.3% (89)
No	96.7% (2943)

Note: Proportions are weighted to approximate the US population. Raw frequencies are in parentheses

the odds of higher SRH. Major depressive disorder was associated with 0.76 lower odds of better SRH, while a standard deviation increase in trait NA decreased the odds by 0.94. Of the interactions tested, only the education by ethnicity interaction was significant. The protective effects of greater education were less apparent for nonwhite participants at higher SRH levels (Fig. 1).

Statistical outcomes across ordinal and binary SRH definitions

Odds ratios for binary and ordered SRH analyses were generally similar, but divergent statistical conclusions emerged for ethnicity, depressive disorder and social support, where the ORM detected associations absent in the BRM (Table 2). The magnitude of difference between ORs was modest, but the smaller standard error in the ORM resulted in appreciable differences in null hypothesis probabilities (*p*s of .01 vs .31 for social support; .03 vs .10 for depressive disorder and < .001 vs .16 for ethnicity, respectively). Thus, had this study adopted the common binary SRH definition (Bosma et al., 1999; Cohen et al., 1999; Han, 2002) one demographic and two psychological SRH predictors would have been undetected.

There was also a consistent pattern of smaller confidence intervals and thus larger test statistics in the ORM versus the BRM (17 of 20 higher (1 tie), binomial $z = 3.13, p < .002$). This reduced efficiency of the BRM (Scott et al., 1997) is illustrated in Fig. 2, which plots the absolute value of the *t*-statistics obtained for the two analyses. In addition to illustrating the relative strength of the SRH determinants, it also shows that three additional predictors—dyspnea, BMI and smoking—were detected in ordered but not binary SRH definitions.

Discussion

These data do not support the hypothesis that negative emotions mediate SES stratification of SRH. Socioeconomic influence was, however, reduced by the addition of behavioral and health status variables, such as physical function, smoking and disease history. This is consistent with previous work that failed to find reduced SES risk for mortality when adjusting for psychological distress (Fiscella & Franks, 1997), although in that study distress was independently associated with mortality. Although SRH and mortality are not synonymous, the pattern of negative emotions being related to the health outcome but not SES stratification of those health outcomes is consistent. One report showing modest attenuation of SES effects on SRH (Cohen et al., 1999) lacked a number of important covariates (e.g. chronic disease status,

Table 2. Odds ratios (95% confidence intervals) for binary and ordered self-rated health predictors

	Model 1		*Model 2*		*Model 3*	
Predictors	*Binary SRH*	*Ordered SRH*	*Binary SRH*	*Ordered SRH*	*Binary SRH*	*Ordered SRH*
Education	1.70 (1.50, 1.93)	1.61 (1.48, 1.74)	1.36 (1.17, 1.58)	1.32 (1.20, 1.44)	1.36 (1.16, 1.58)	1.31 (1.19, 1.44)
Age	0.78 (0.71, 0.85)	0.82 (0.77, 0.87)	1.02 (0.90, 1.14)	1.05 (0.97, 1.13)	0.96 (0.85, 1.09)	1.02 (0.95, 1.10)
Female	0.84 (0.66, 1.06)	0.89 (0.76, 1.04)	0.93 (0.63, 1.37)	0.94 (0.74, 1.19)	0.92 (0.62, 1.37)	0.91 (0.71, 1.16)
Nonwhite	**0.79 (0.56, 1.11)**	0.64 (0.51, 0.80)	**0.80 (0.53, 1.21)**	0.66 (0.52, 0.85)	**0.73 (0.48, 1.13)**	0.63 (0.49, 0.82)
Married	1.09 (0.85, 1.39)	1.15 (0.97, 1.36)	0.97 (0.72, 1.31)	1.10 (0.92, 1.32)	0.96 (0.70, 1.31)	1.10 (0.91, 1.32)
Negative emotions						
Depressed	0.34 (0.25, 0.46)	0.41 (0.32, 0.52)	0.64 (0.44, 0.93)	0.71 (0.55, 0.92)	**0.73 (0.49, 1.07)**	0.76 (0.58, 0.98)
Anxious	0.24 (0.14, 0.40)	0.31 (0.18, 0.54)	0.61 (0.27, 1.38)	0.82 (0.46, 1.48)	0.84 (0.35, 1.99)	1.07 (0.58, 1.97)
Trait NA	0.77 (0.72, 0.83)	0.83 (0.79, 0.87)	0.88 (0.81, 0.96)	0.93 (0.88, 0.98)	0.90 (0.83, 0.98)	0.94 (0.89, 1.00)
Psychological and social resources						
Extraversion	1.92 (1.57, 2.35)	1.78 (1.53, 2.06)	1.63 (1.29, 2.06)	1.52 (1.31, 1.76)	1.52 (1.19, 1.95)	1.41 (1.21, 1.65)
Social support	1.09 (1.05, 1.14)	1.10 (1.07, 1.13)	1.05 (1.00, 1.11)	1.07 (1.03, 1.10)	**1.03 (0.97, 1.08)**	1.04 (1.01, 1.08)

Note: Model 1 adjusted for education, age, ethnicity, gender and marital status. Model 2 adjusted for Model 1 variables plus medical history, chronic disease, mild disease, body mass index, waist–hip ratio, change in health, physical activity, physical function, dyspnea, physical symptoms and smoking status. Model 3 adjusts for all predictors including psychological and social characteristics. Confidence intervals that include 1.00 are nonsignificant (two CIs with lower bounds of 1.00 are significant due to rounding—social support for binary SRH in Model 2 and trait NA for ordered SRH in Model 3). Only the referent categories for dichotomous predictors are listed above. **Bold text** highlights divergent statistical conclusions for binary versus ordered SRH definitions. NA = negative affect; Depressed = Major depressive disorder; Anxious = Generalized anxiety disorder

Table 3. Associations among psychological and social variables and education level

Variable	*Odds ratio (95% CI)*	*Education level*			
		< High school	*High school*	*Some college*	*≥ College graduate*
Depressive disorder	0.90 (0.80, 1.01)				
No		81.5% (0.02)	87.0% (0.01)	84.3% (0.01)	88.3% (0.01)
Yes		18.5% (0.02)	13.0% (0.01)	15.7% (0.01)	11.7% (0.01)
Anxiety disorder	0.76 (0.59, 0.98)*				
No		94.1% (0.02)	97.3% (0.01)	96.1% (0.01)	98.1% (0.01)
Yes		5.9% (0.02)	2.7% (0.01)	3.9% (0.01)	1.9% (0.01)
Trait NA	0.84 (0.78, 0.90)*	5.0 (0.11)	5.0 (0.06)	4.8 (0.06)	4.6 (0.06)
Extraversion	1.00 (0.97, 1.02)	3.2 (0.03)	3.2 (0.02)	3.2 (0.02)	3.2 (0.02)
Social support	1.27 (1.14, 1.42)*	8.4 (0.18)	8.8 (0.10)	8.9 (0.10)	9.2 (0.09)

Note: Odds ratios and descriptive statistics (standard error) are weighted to approximate the US population. Odds ratios were generated by regressing each psychological and social variable on education level. CI = confidence interval; NA = negative affect

* $p < .05$

physical function, adiposity, ethnicity) which might account for the discrepant findings.

The weaker benefit of high education for nonwhite participants closely replicates other work comparing whites and blacks (Farmer & Ferraro, 2005). In that study, education and ethnicity had the largest interaction term, although no apparent benefit was observed for higher education among blacks. The present data showed a benefit for higher education among a heterogeneous group of nonwhites, although this benefit was less than that observed for whites. These patterns add to a growing body of evidence showing health disparities at higher SES levels, and supports the idea that educational similarity does not necessarily correspond to health similarity in the population (Krieger, Williams, & Moss, 1997). Efforts

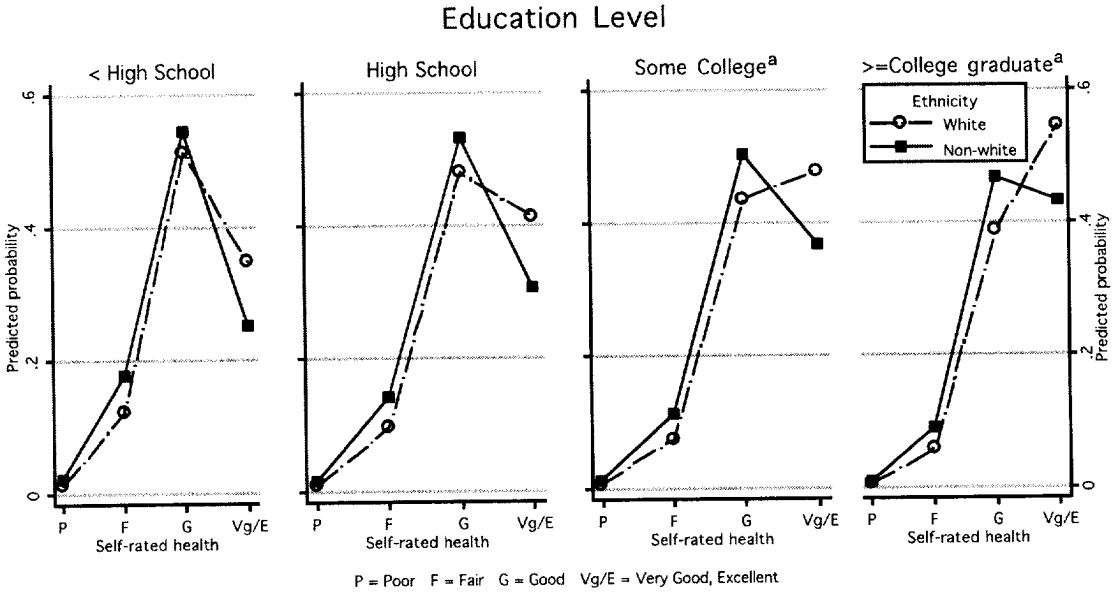

Figure 1. Predicted self-rated health probabilities by education level and ethnicity.
[a] Significant ethnicity by education interaction

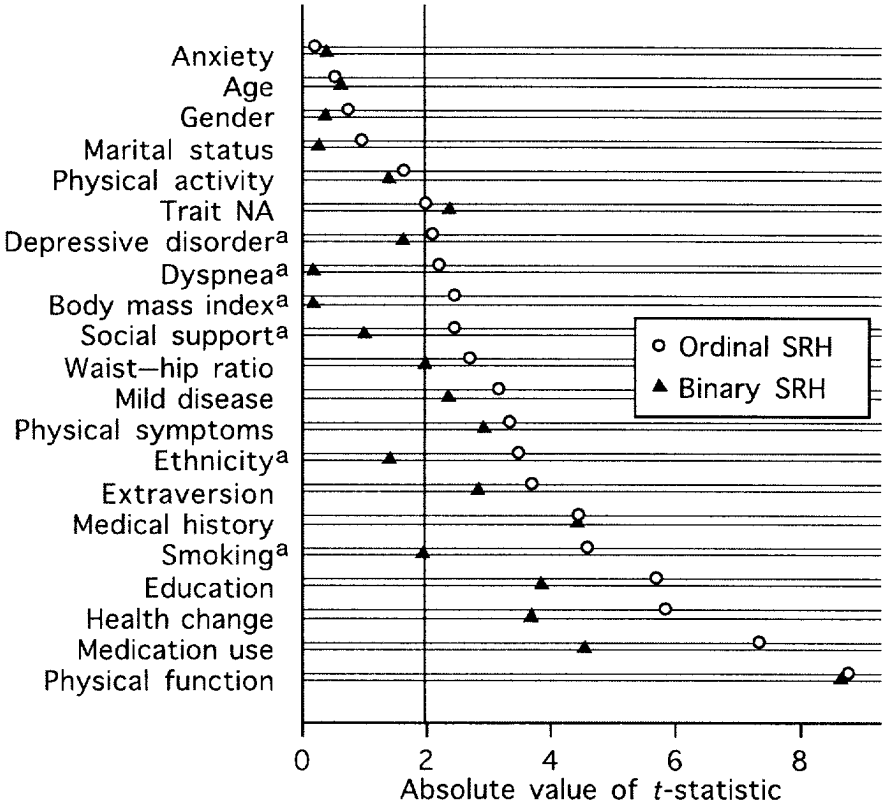

Figure 2. Absolute value of *t*-test statistics for each self-rated health predictor across binary and ordinal regression analyses ($N = 3032$).

Note: Values to the right of the vertical line are significant at $p < .05$. SRH = self-rated health; NA = negative affect

[a] Different statistical conclusions in binary vs ordinal SRH definitions

addressing health disparities will need to accommodate these patterns of asymmetry at higher socioeconomic levels in order to improve health and health care quality (National Research Council, 2004).

This study replicated the association between global health ratings and questionnaire depression measures (Spitzer et al., 1995), extending them to show that major depressive disorder (as assessed by a fully structured diagnostic interview) is also associated with lower health ratings. This association is particularly noteworthy given the adjustment for physical function, which is associated with depressive symptoms (Penninx, Deeg, van Eijk, Beekman, & Guralnik, 2000). The inverse association between SRH and the personality trait NA was also replicated (Kressin et al., 2000; Muldoon et al., 1998) and was observed to be independent of major depressive disorder and a large number of other previously unexamined SRH influences. As importantly, these associations generalize to a diverse population-based sample spanning young adult through elderly age groups. Even though depressive symptoms (which also predict SRH) (Goldberg et al., 2001; Han, 2002) overlap with and are considered a subdimension of trait NA (Watson & Clark, 1988, 1992), it appears that both clinical and nonclinical dimensions of NA contribute to SRH. The absence of a relation with generalized anxiety disorder may be due to its low prevalence in the population. Perhaps nonclinical assessments of anxiety would have more predictive utility in the general population, and it would be informative to see if such assessments could capture SRH variance in excess of trait NA.

Extending earlier work with elderly samples (Benyamini, Idler et al., 2000), extraversion was a robust predictor of SRH, of a magnitude similar to SES. These data also fit with reports utilizing objective disease outcomes, where extraversion was inversely associated with susceptibility to viral infection (Cohen et al., 1997). Extraversion is thought to represent the operation of a behavioral activation system that ensures acquisition of resources necessary for survival (Fowles, 1987). The concomitant engagement and pleasurable affect associated with these activities facilitates goal directed behavior (Watson et al., 1999), and therefore extraversion may capture resource acquisition domains parallel to, but not captured within, traditional SES indices. Conceptually, extraversion fits in the human capital SES domain described by Oakes and Rossi (2003), and its empirical and conceptual ties to health and well-being merit exploration in future research.

Social support had a modest but significant effect on SRH. The literature is mixed with regard to this effect, with some studies detecting (Cohen et al., 1999; Power et al., 1998) and others not detecting an effect (Cott et al., 1999). The multidimensionality of social support is a reasonable explanation for this inconsistency (Cohen, Mermelstein, Kamarck, & Hoberman, 1985; Gigliotti, 2002) as is the possibility that social support effects are overshadowed following adjustment for health status measures. This inconsistency might also be explained by the inefficiency of the binary SRH variable. In fact, the departure of the social support effect after multivariate adjustment in another report (Benyamini, Idler et al., 2000) was closely replicated in the binary analyses in this study (Model 3 in Table 2). Although there are certainly other measurement issues that create putative discrepancies in social support outcomes (Fuhrer & Stansfeld, 2002), another source of imprecision is the binary operational definition of SRH. Future research comparing these alternative explanations would clarify the role of social support in relation to health. In any event, the importance of social relations in health is generally accepted, and the ability of social interventions to change health outcomes is a topic of ongoing research (Goodwin et al., 2001).

Several limitations of the present study should be considered. Because these data are cross-sectional, one cannot make causal inferences regarding the observed associations. There were no objective measurements of disease status, medical history, etc., and the sample lacked sufficient numbers of minority participants to explore the hypotheses in detail among nonwhites. Personality traits were assessed with abbreviated forms, which may have attenuated the magnitude of the associations observed. These limitations should be kept in mind when considering other contributions of the study.

In spite of their putative subjectivity, both health and psychological self-reports predict morbidity and mortality (Fiscella & Franks, 1997; Miilunpalo et al., 1997) and are a practical compromise to more rigorous but costly objective assessments. Global SRH is an indirect measure of health, but has numerous virtues as an outcome measure. It predicts changes in health, function and mortality risk (Burström & Fredlund, 2001; Goldberg et al., 2001; Heistaro et al., 2001; Idler & Angel, 1990; Idler & Benyamini, 1997; Idler & Kasl, 1995; Miilunpalo et al., 1997) and explains much of the SES association with mortality (Franks et al., 2003). Finally, SRH appraisals are a lynchpin of public health promotion and surveillance (Sadana et al., 2000; US Department of Health and Human Services, 2000) and thus investigations of SRH determinants have clear practical importance. With these caveats in mind, it seems reasonable to identify health determinants in cross-sectional work initially and later incorporate such predictors into designs with stronger inferential leverage to elucidate their contribution to objective health outcomes.

There are other interpretational challenges when dissecting SRH determinants. Some argue that statistical adjustment for health status and health behaviors attenuates the apparent effect of psychological factors because the former are mediating pathways (Gallo & Matthews, 2003). Others argue that psychological influences have effects only through their association with socioeconomic position and are irrelevant to health otherwise (Macleod & Davey Smith, 2003). Statistical control of health covariates is imperfect, and associations between psychological and health outcomes may persist due to residual confounding. It is also plausible that

some psychological and related behavioral characteristics shape social trajectories, and thus could be precursors of putative SES effects on health. The present work cannot decisively address these issues, but their consideration helps contextualize extant, and hopefully future, SRH determinants research. Finally, even though education has merits as a SES indicator, there are multiple markers of relative and absolute social position that may qualify the effects observed here (Kennedy et al., 1998; Krieger et al., 1997). For outcomes such as mortality, education may be less predictive than measures of wealth and income (Daly et al., 2002).

Beyond these conceptual issues, the present study raises less recalcitrant concerns about the common practice of dichotomizing SRH, which reduced efficiency for detecting SRH determinants in the present study. The similarity of binary and ordered ORs for the SES variable replicates a rigorous comparison of binary and several ordered SRH analytic choices (Manor, Matthews, & Power, 2000), but shows that this analytic similarity does not extend to a broader array of SRH determinants. Depression and social support appear to be reliable SRH predictors, and dyspnea has been identified as a SRH predictor for men (Idler et al., 2000), while smoking and BMI predict SRH in other population-based samples (Ford et al., 2001; Okosun et al., 2001). Thus, the absence of effects for these variables in the BRM are likely Type II errors, which are noteworthy given the substantial statistical power afforded by this large sample. The mediocre efficiency of the BRM indicates it is an unreliable choice for detecting known and probable health determinants, and this inefficiency could be harmful if it redirects research resources away from important health determinants. Where appropriate, researchers should evaluate SRH as a continuous ordered variable using the most appropriate ORM (Ananth & Kleinbaum, 1997; Scott et al., 1997).

In sum, the present study found that both positive and negative psychological factors were independent determinants of, but not explanations for, SES effects on SRH. While understanding SES mechanisms is important (Goldman & Smith, 2002), we must remind ourselves that this search is in the service of identifying predictors of health outcomes in the hope of revealing causal pathways amenable to intervention. In this vein, a consistency is emerging in the literature with regard to the importance of both negative and positive psychological characteristics, and the present data particularly emphasize the role of psychological resources such as extraversion. By including such variables in future research, and by adopting the most sensitive analytic techniques, we can better understand and prioritize those characteristics that determine SRH.

Notes

1. Extraversion is also called trait positive affect in some models (Watson, Wiese, Vaidya, & Tellegen, 1999) and some of the later discussion of extraversion comes from literature labeling the construct as positive affect. The term extraversion is retained throughout this article for consistency.
2. Household income was created by summing interval midpoints for six questions regarding yearly income. These questions encompassed work, social security payments, government assistance and any other sources of income. Totals for the respondent personally, his or her spouse/partner and anyone else in the household were assessed. This sum was not adjusted for family size. Income was predictive of SRH in multivariate models, but was no longer predictive when education was included. The weaker association of income and SRH relative to education and SRH has been reported elsewhere (Farmer & Ferraro, 2005; Miech & Hauser, 2001; Oakes & Rossi, 2003). The rank correlation between income and education in this sample was 0.33, similar to the 0.37 value reported by Oakes and Rossi (2003).
3. The Brant test was conducted on unweighted data as extant software is unable to incorporate complex survey sampling weights.
4. These included education with age, gender, ethnicity, function and all psychological variables; age with ethnicity, gender and BMI; gender with ethnicity and affective disorders; ethnicity with social support, chronic disease and depression; depression and anxiety with social support; physical function and trait NA with social support; and affective disorders with each other and with social support.

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