

PERCEIVED HEALTH AND MORTALITY: A NINE-YEAR FOLLOW-UP OF THE HUMAN POPULATION LABORATORY COHORT¹

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The association between perceived health ratings ("excellent," "good," "fair," and "poor") and mortality was assessed using the 1965 Human Population Laboratory survey of a random sample of 6928 adults in Alameda County, California, and a subsequent nine-year follow-up. Risk of death during this period was significantly associated with perceived health rating in 1965. The age-adjusted relative risk for mortality from all causes for those who perceived their health as poor as compared to excellent was 2.33 for men and 5.10 for women. The association between level of perceived health and mortality persisted in multiple logistic analyses with controls for age, sex, 1965 physical health status, health practices, social network participation, income, education, health relative to age peers, anomy, morale, depression, and happiness.

health surveys; life style; longitudinal studies; mortality

An increasing number of epidemiologic studies have pointed to the importance of psychosocial factors in the incidence, prognosis, and mortality from noninfectious disease. Social disconnection and isolation, adverse life events, various personality characteristics, and excessive job strain all have been shown to increase the risk of disease (1-6). It is not clear whether these factors exert their influence independently of one another or whether, as others have suggested (7), they have a common feature which links them. Since these psychosocial factors are associated with a large and diverse set of disease outcomes, it is possible that such a

common feature results in disease via a decrease in host resistance (8, 9).

A variety of cross-sectional studies indicate that "poor" perceived health may be such a common feature. People who report higher levels of isolation, negative life events, depression, job problems, unhappiness, life dissatisfaction, unemployment, etc., also report higher rates of poor perceived health (10-14). The interpretation of such a pattern of associations is clouded by our lack of certainty as to the meaning of reports of perceived health. Do they, for example, reflect an individual's "true" health status? Or do they reflect only a correlation with other variables such as demographic status, social functioning, or psychological state? Or do they actually reflect a measure of overall susceptibility, controlling for current physical health status, which is of prospective significance? The answers to these questions have important implications for the understanding of psychosocial influences on health.

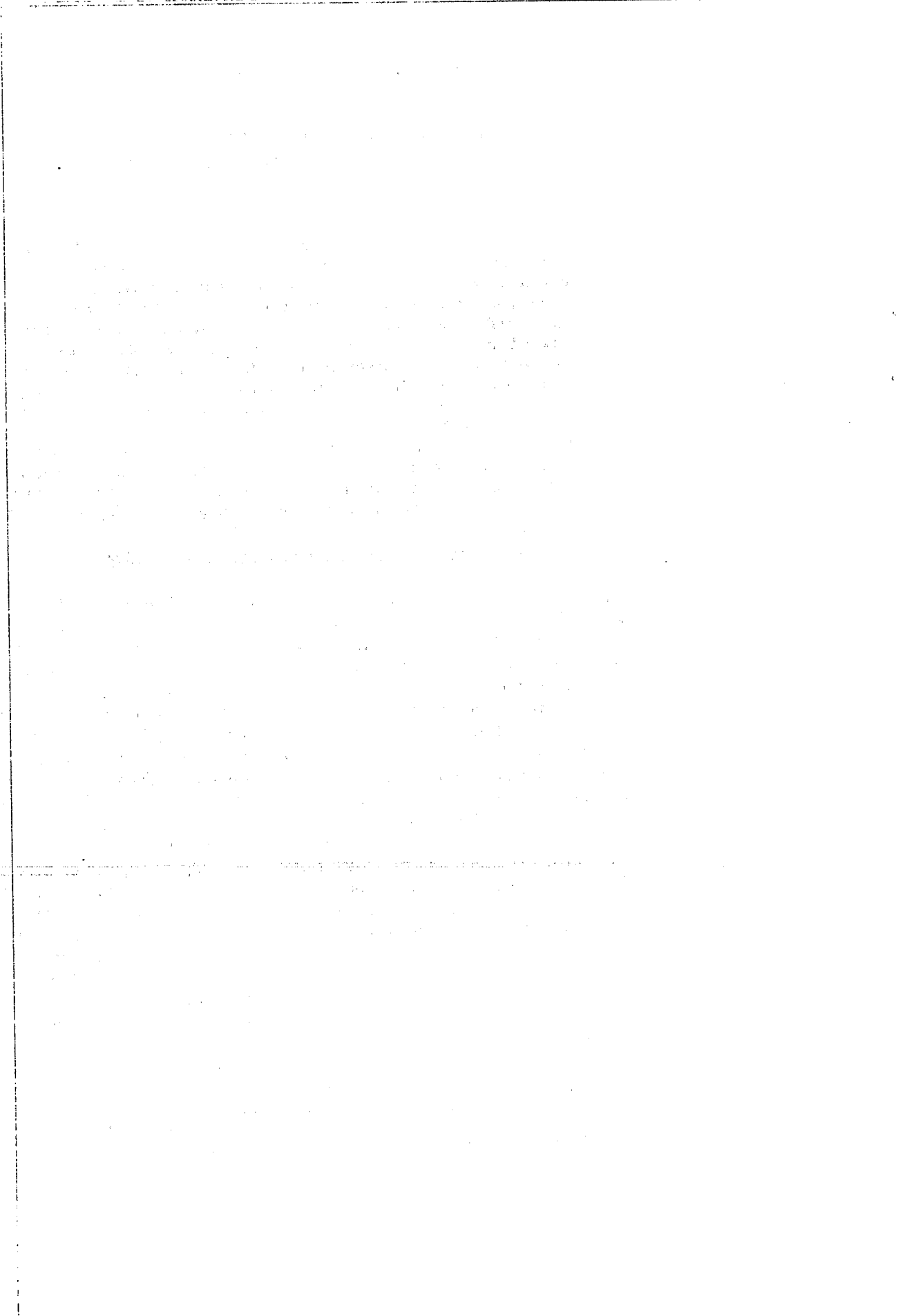
Research on the validity of perceived

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health measures has typically taken one of three approaches. In the first approach, investigators have examined the relationship between perceived health status and findings from physical examinations or physician ratings (15-19). In general, a moderate but significant correlation is found between perceived health measures and such clinical measures. Conceptually, however, this approach assumes that examination or physician-based measures are the standard by which to evaluate the validity of perceived health ratings. Because clinical measures vary widely in their specificity, sensitivity, and ability to predict future health status, this is not a defensible assumption.

A second approach examines the relationship between perceived health measures and various measures of functional ability (20-23). Here there is often a substantial correlation between the two measures, with those perceiving their health as fair or poor belonging to a more functionally impaired group. However, an individual's ability to perform various activities reflects both physical health status and the ability to cope with any health problems that may exist. It thus represents a mixture of physical and psychosocial factors which make it inappropriate as a standard by which to judge perceived health reports.

Finally, a third approach concentrates on the multitude of factors which can be shown to influence perceived health measures (10-14). For example, unhappiness, life stress, depression, and life satisfaction all have been found to be associated with perceived health, as have age, sex, marital status, and employment status. The fact that such associations exist does not necessarily mean that perceived health reports have no relationship to health status. Such a conclusion can be drawn only after the effects of confounding variables on perceived health have been statistically removed. Unfortu-

nately, the current literature does not allow us to make such calculations.

Thus, for a variety of reasons, physicians' ratings, clinical findings, and functional ability measures are not appropriate measures by which to assess the validity of perceived health reports. Analysis of the association between perceived health and mortality in a prospectively followed cohort avoids many of the above problems of interpretation, and evidence from two sources suggests that such an analysis might prove fruitful. In their 20-year follow-up of the Midtown Manhattan Study, Singer et al. (24) found that the strongest predictor of mortality, aside from sex and age, was perceived health. Similarly, in a prospective study of 3128 persons over 65 years old in Manitoba, Mossey and Shapiro (25) found that there was substantially increased mortality over seven years for those who perceived their health as poor rather than as excellent. Significantly, they were able to control for a number of important variables, including the use of a measure of physical health status derived from physician reports of diagnosed conditions, self-reports of conditions, utilization of health care services, number of hospitalizations and surgery, and other indicators.

In the analyses presented here, we examine the relationship between perceived health status and nine-year mortality in the cohort of 6928 people in Alameda County, California, followed since 1965 by the Human Population Laboratory. The representativeness of this population, the careful tracing and determination of vital status, and the presence of perceived health reports as well as a variety of other measures known to be associated with mortality provide an excellent data base for assessing the relationship between perceived health and mortality. The presence of information in 1965 concerning health practices, social network participation, and psychological functioning allows us to examine some of the pathways

by which perceived health may exert an influence on mortality.

MATERIALS AND METHODS

Study population. The data utilized in this report come from ongoing studies in Alameda County, California, conducted by the Human Population Laboratory, a part of the State of California Department of Health Services. In 1965, 8023 noninstitutionalized adults (age 20 years and over, or age 16 years and over if ever married) in 4452 housing units were selected on the basis of a stratified systematic sample of Alameda County housing units. The sampling procedures are discussed in greater detail by Hochstim (26). Completed questionnaires were received from 6928 of the respondents (86 per cent). When compared to respondents, the small group of nonrespondents contained more older people, males, whites, and single or widowed persons. The present analysis considers the entire group of 6928 respondents, which included 3158 men and 3770 women 16–94 years of age.

Ascertainment of vital status. Mortality data were collected for the nine-year period from 1965 to 1974, when a second wave of data collection was conducted (27, 28). Death certificates were obtained for respondents thought to be deceased and were verified against 1965 questionnaire data. Altogether, 717 deaths were discovered for the nine-year period. Through these procedures, all but 302 respondents (4 per cent) of the original sample were located. These unlocated respondents were not found to be significantly different with respect to 1965 physical health status from those respondents who were located. In addition, a marginally significant excess number of persons with fair or poor perceived health were lost to follow-up. Persons not located or positively identified as deceased were assumed to be living.

Variables studied. Eighteen variables were chosen for inclusion in this analysis

on the basis of their importance as adjustment factors, as variables known to be associated with mortality in this cohort, and as variables known or assumed to have an association with perceived health. Table 1 presents the 18 variables, scoring categories, and explanatory remarks. Perceived health status was measured by responses to the question, "All in all, would you say your health is excellent, good, fair, or poor?" A measure of perceived health relative to age peers was also included. Demographic variables included age, sex, education, and income in 1965. An index of physical health status in 1965 was constructed from reports of disability, chronic conditions, symptoms, and energy level (29). This six-level index has been shown to be strongly predictive of mortality in this cohort (28, 30, 31).

Two other factors predictive of mortality in the Human Population Laboratory cohort—health practices (28, 31–33) and social network participation (5)—were also included. For this analysis, we used an index of health practices in which one point is scored for each of five low risk behaviors in the areas of smoking, drinking, sleep habits, relative weight for height, and leisure-time physical activity. Social network participation was measured by a composite index of items relating to marital status, contacts with friends and relatives, and membership in various kinds of groups.

Finally, several measures of psychological functioning were included on the basis of preliminary analyses of their univariate relationships with perceived health and previous reports in the literature. In this category were measures of anomie (34), morale (35, 36), overall happiness, and depression (37).

RESULTS

Perceived health and mortality. Age-specific mortality rates from all causes for men and women at different levels of perceived health are presented in table 2. As

expected, both the age-sex specific rates and the age-adjusted rates showed a consistent and strong gradient associated with perceived health. This gradient of increased risk associated with poorer perceived health was violated in only one out of 24 comparisons. Using the Mantel-Haenszel chi-square statistic (39), the difference in mortality rates for men and women of different ages who perceived their health as excellent versus poor was highly significant ($\chi^2 = 20.0$ for men and 21.6 for women, $p < 0.001$). Similarly, when respondents who rated their health as excellent or good were compared with those who rated their health as fair or poor, the difference was highly significant ($\chi^2 = 54.6$ for men and 53.4 for women, $p < 0.001$).

Perceived health ratings were also related to baseline physical health status, as shown in table 3. The strength of the correlation (Kendall's τ_B) between the two was highly significant for all respondents ($\tau_B = 0.39$, $p < 0.001$) and was consistently strong for all age-sex groups ($\tau_B = 0.28-0.46$, $p < 0.001$). This correlation increased with age and was somewhat higher for women than it was for men. As expected, perceived health reports were also associated with a number of other variables, as presented in table 4. People who perceived their health as poor rather than excellent reported fewer health practices, greater social disconnection, greater anomy, fewer positive and more negative feelings, higher rates of being "not too happy," and higher rates of depression. Thus, as previous reports have indicated, perception of health as poor is associated with a wide variety of other measures.

To examine the influence of perceived health on mortality independent of these other associated factors, a multiple logistic model was utilized. Logistic coefficients were estimated using maximum likelihood procedures; discriminant analysis provided the initial values, and the

final values were arrived at via Gauss-Newton iteration (40-42). From this analysis, we can obtain an estimate of the approximate relative risk associated with excellent versus poor perceived health while controlling for the impact of other covariables. Univariate logistic analyses were first carried out in order to examine the relationship between each categorical variable and mortality. If this relationship was not found to be logistic, the subcategories were replaced by a series of $n - 1$ dichotomous variables representing each category of the variable.

Table 5 presents the results of the two multiple logistic analyses. The data from the first analysis (Analysis A in table 5) show an association between level of perceived health and nine-year mortality from all causes. Persons who in 1965 rated their health as poor rather than excellent had a nearly twofold increased risk of death over the period, even when the effects of other significant covariables were eliminated. Table 5 also shows that this effect was highly significant ($p < 0.001$) with a relatively small 95 per cent confidence interval (1.77-2.13). The impact of other variables such as physical health status, health practices, social networks, sex, and age was also highly significant, confirming previous analyses (5, 28, 31-33).

A second multiple logistic analysis was carried out on a set of variables which included all variables significant in the first analysis plus additional variables reflecting psychological functioning. The results of this analysis are presented in table 5 as well (Analysis B). Again, the impact of perceived health on mortality was strong and significant. The increased logistic coefficient for perceived health reflects the fact that several variables included in the previous analysis (income, education, and health relative to peers) were excluded from this analysis. Although they were not significant predictors in the first analysis, they do exert some impact on the

TABLE 1
Variables in the analysis of perceived health and mortality

Variable	Categories	Remarks
Demographic status		
Sex	Female/male	
Age	Years	
Income	Inadequate/marginal/ adequate/very adequate	1965 family income adjusted for family size (26, 30)
Education	0-8/9-12/ \geq 13 years	
Physical health status	Severe disability/ moderate disability/ 2 or more chronic conditions/1 chronic condition/symptoms/ symptom-free	Based on self-reports, coded by most serious condition reported. (29, 30)
Perceived health	Excellent/good/fair/poor	
Health relative to age peers	Better/same/worse	
Health practices		
Smoking history	Ever/never	
Weight	Average (9.9% underweight/ to 29.9% overweight)/ extreme underweight or overweight	Measured by the Quetelet Index, weight in pounds/height ² in inches, categories based on Metropolitan Life Insurance Reports (49) of desirable weights
Physical activity	Active/inactive	Based on frequency (often, sometimes, never) and presumed strenuousness of reported leisure time participation in active sports, or swimming or taking long walks, physical exercise, gardening, and/or hunting and fishing (50)
Alcohol consumption	1-45 drinks per month/ 0 or 46 or more	Based on frequency of drinking (no. of times/week) and amount consumed (usual no. of drinks/sitting) for beer, wine, and liquor combined
Sleeping patterns	7 or 8 hours per night/ more or less	
Social network participation	Most disconnected/ moderately disconnected/ moderately connected/ most connected	Based on questions concerning the extent and frequency of four scores of social ties (marriage, friends and relatives, church membership, informal and formal group membership) (5)

Anomy	Low (0-3)/high (4-9)	Based on McClosky and Schaar (34) and Berkman (36); no. of anomic statements endorsed
Morale		
Positive feelings	Low (0-3)/high (4-9)	Based on Bradburn (35); no. of positive or negative feelings endorsed
Negative feelings	Low (0-4)/high (5-9)	
Happiness	Very or pretty/ not too	
Depression	Present/absent	Based on Roberts and O'Keefe's (51) analysis of items on the 1965 questionnaire; presence of depression defined as a score >21 (approximately one standard deviation above mean)

risk estimates derived for perceived health and other variables. The analyses presented in table 5 demonstrate that anomy, morale, depression, and unhappiness are not significant covariables and cannot account for the impact of perceived health on mortality. Indeed, they appear to have no independent impact at all.

Time and cause of death. Because death certificates were secured for each decedent, it was possible to examine the relationship between perceived health and time and cause of death. Figure 1(a) presents the cumulative proportions of deaths for each successive year for the four perceived health categories. The trajectory of deaths for the poor perceived health group was substantially different from that for the other three perceived health groups. Respondents who judged their health as poor in 1965 and who died in the nine-year follow-up period died earlier than decedents who had reported their health as excellent, good, or fair. The median time of death for those who reported poor health was approximately two years earlier than that for those who did not. Survival curves presented in figure 1(b) present a similar picture. Here, however, the differences among the four perceived health groups are more pronounced. Furthermore, the differences between the two extreme groups—excellent versus poor—increased over time, suggesting that the association between perceived health and mortality is not a reflection of an excess of deaths occurring in the first year or two after 1965.

Adequate numbers of deaths were present for a separate consideration of deaths due to ischemic heart disease (*International Classification of Diseases*, 8th Revision, code nos. 410-414), cancer (140-209, 230-239), and other causes. Table 6 presents the age- and sex-specific mortality rates for different categories of perceived health for these three causes. In order to have at least four deaths per cell, the "excellent" and "good" categories

TABLE 2
Age-specific mortality rate per 100 (all causes) for men and women by perceived health,
Alameda County, CA, 1965-1974

Age (years)	Perceived health							
	Excellent		Good		Fair		Poor	
	Rate	n	Rate	n	Rate	n	Rate	n
	<i>Men</i>							
16-29	0.7	274	1.6	368	1.7	58	0.0	10
30-44	2.1	338	2.5	600	4.2	119	25.0	8
45-59	7.0	171	9.5	493	21.1	147	37.5	24
60+	41.4	87	35.4	285	57.1	140	63.0	27
Crude rate	6.6	870	9.7	1746	25.2	464	40.6	69
Age-adjusted rate*	9.5		9.8		17.2		22.1	
	<i>Women</i>							
16-29	0.0	286	0.8	531	0.9	107	0.0	3
30-44	1.5	268	2.6	718	6.8	161	7.1	14
45-59	3.2	190	5.6	536	10.7	196	31.6	19
60+	19.3	109	30.1	375	39.9	213	54.5	33
Crude rate	3.6	853	7.7	2160	17.4	677	36.2	69
Age-adjusted rate*	4.8		8.2		12.1		24.5	

* Adjusted, by the indirect method (38), to the total study population.

were combined and compared with the "fair" and "poor" categories. Inspection of table 6 reveals that persons who had excellent or good perceived health had lower mortality rates than those who had fair or poor perceived health in the 13 out of 15 comparisons for which there were adequate numbers of deaths. This increased risk due to fair or poor perceived health was present for deaths due to ischemic heart disease for all ages for both men and women, for cancer deaths for men of all ages and for women under 44 years of age, and for men and women in all age groups for the remaining causes of death.

DISCUSSION

The analyses presented above demonstrate a significant association between perceived health and mortality. The increased risk of death associated with poor perceived health is consistent, strong, and operates over time. Furthermore, for those respondents over 29 years of age, increasingly poor perceived health is associated with increasing mortality rates. Although levels of perceived health are associated with many other variables, multivariate analyses indicate that the impact of poor perceived health operates,

TABLE 3
Mean perceived health* for men and women at different levels of physical health status,
by age (in years), Alameda County, CA, 1965

Physical health status	Men				Women			
	16-29	30-44	45-59	60+	16-29	30-44	45-59	60+
Severe impairment	3.00	2.74	3.09	3.05	2.64	2.60	2.80	2.86
Lesser impairment	2.29	2.31	2.35	2.40	2.14	2.40	2.43	2.47
≥2 chronic conditions	2.60	2.13	2.38	2.15	2.35	2.41	2.27	2.14
1 chronic condition	1.87	1.95	2.03	1.96	2.02	2.04	2.05	1.98
≥1 symptom	1.78	1.81	1.95	1.95	1.87	1.87	1.85	1.82
No complaints	1.52	1.57	1.65	1.75	1.54	1.65	1.66	1.66

* Excellent = 1, poor = 4.

TABLE 4
*Association of perceived health with other variables for men and women aged 20 years and over,
 Alameda County, CA, 1965*

Per cent reporting:	Men		Women	
	Excellent	Poor	Excellent	Poor
Low health practices (0-2)	1.7	27.5	1.5	30.4
Most disconnected	7.7	33.3	11.5	31.9
High anomy	25.7	75.4	26.5	60.9
Low positive feelings (0-3)	38.7	79.7	33.7	62.3
High negative feelings (≥ 5)	20.3	62.3	20.9	50.7
"Not too" happy	5.4	50.7	4.3	44.1
Depression present	3.2	80.3	5.4	76.5

to some extent, independently of these variables. From these analyses, we can see that the effect of perceived health on mortality is not due to its association with other variables, particularly those related to health practices, social network participation, or psychological state. This independence of the impact of perceived health on mortality from discretionary behaviors, social functioning, and psychological state is especially noteworthy since participation in high risk activities, social isolation, or depression are plausible pathways by which perceived health might influence mortality.

On the other hand, the independent impact of perceived health on mortality should not be taken to indicate that these other variables are not important. Indeed, health practices and social network participation (but not psychological state) are significant factors in the mortality experience of this cohort, and they are also associated with perceived health. Individuals who have low perceived health tend also to engage in more high risk behaviors such as smoking and alcohol consumption, to be more isolated, and, in general, to be at higher risk on many other variables. According to the present analyses, those individuals who perceived their health as poor, were socially most disconnected, and had a low health practice score were at an almost eightfold increased risk of death in the nine-year follow-up period. The nature of the in-

teraction between these variables in their impact on mortality needs to be clarified and will be a subject of further exploration.

Our analyses demonstrate that the effect of perceived health is independent of physical health status. Because we have used a measure of physical health status derived from self-report items, this bears some comment. The physical health status measure used here has been utilized in a number of other studies (5, 29-33), and there exist data concerning its reliability and validity (43, 44). In studies conducted at the Human Population Laboratory, this measure has had a consistent and strong relationship to mortality and has demonstrated the appropriate age and sex gradients. We have examined the age- and sex-specific mortality rates for perceived health stratified by physical health status. To have enough cases, excellent and good perceived health were combined and compared with fair and poor perceived health, and physical health status was dichotomized into two or more chronic conditions or moderate or severe disability versus better levels of health status. There were sufficient data to examine this relationship for all respondents age 30 years or older. In the 12 age-sex-physical health status strata, there was only one case in which mortality rates were not worse for the fair or poor perceived health group. Thus the relationship between perceived health and

TABLE 5
Multiple logistic analyses of 1965-1974 mortality risk for perceived health and other variables in men and women aged 20 years and over, Alameda County, CA

Variable*	Analysis A			Analysis B		
	Logistic coefficient	Approximate relative risk†	95% confidence interval	Logistic coefficient	Approximate relative risk†	95% confidence interval
Perceived health	0.667‡	1.95	1.77-2.13	0.924‡	2.52	2.36-2.68
Physical health status	0.838‡	2.31	1.90-2.70	0.930‡	2.53	2.14-2.92
Health practices	1.089‡	2.97	2.87-3.07	1.076‡	2.98	2.84-3.02
Social networks	0.815‡	2.26	1.82-2.60	0.788‡	2.20	1.87-2.53
Sex	0.779‡	2.18	1.97-2.39	0.774‡	2.17	1.97-2.37
Age (per year)	0.089‡			0.086‡		
Income	0.022§	1.02	0.69-1.35	0.014§	1.02	0.81-1.23
Education	0.157§	1.17	0.87-1.47	0.066§	1.07	0.81-1.33
Health relative to peers	0.304§	1.36	0.90-1.82	0.042§	1.04	0.78-1.24
				0.228§	1.26	0.95-1.57
				0.028§	1.03	0.70-1.36
						Happiness

* Variables as defined in table 1.

† High risk vs. low risk group.

‡ $p < 0.001$.

§ Not significant ($p > 0.05$).

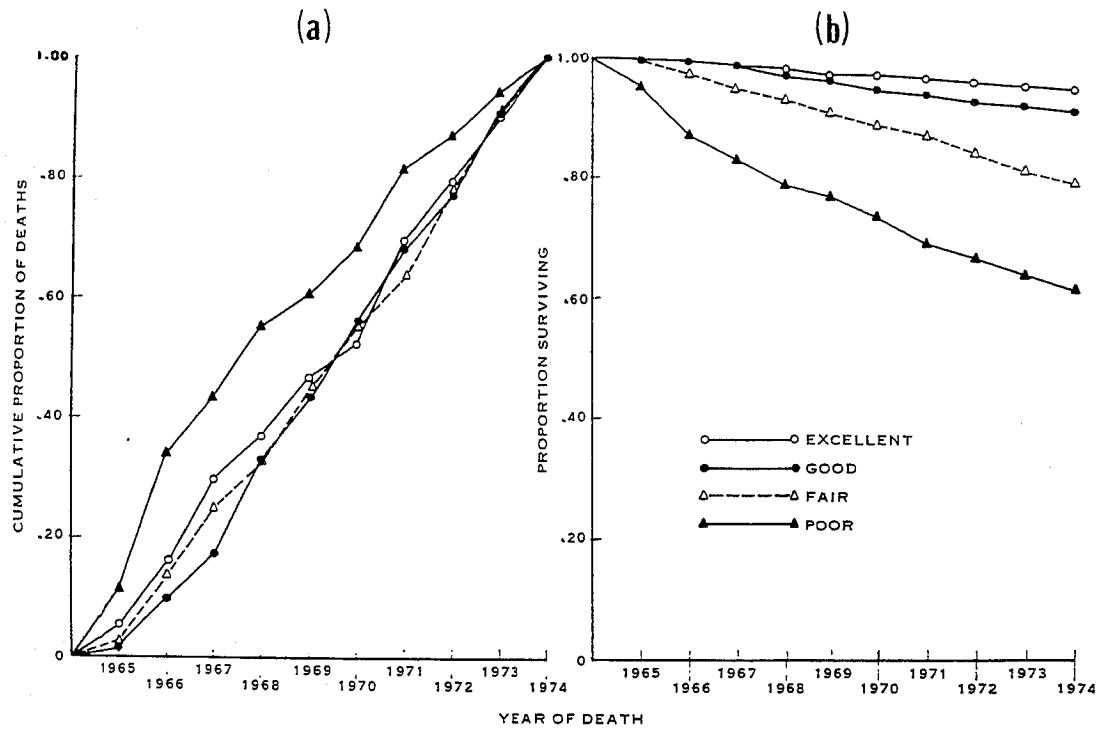


FIGURE 1. Distribution of deaths (a) and proportion of respondents surviving (b) by year for men and women age 16-94 years, Alameda County, CA, 1965-1974.

mortality holds for various levels of health status.

Mossey and Shapiro's (25) study of the relationship between mortality and perceived health in an over-65-year-old cohort also provides strong support for the independent influence of perceived health on mortality. They derived an index of physical health status from health care claims data which included physician-diagnosed conditions, number of visits for serious and chronic conditions, hospital admissions, and surgery. As in the present analysis, this index was significantly associated with perceived health, and the impact of perceived health on mortality was significant when both this index of physical health status and perceived health were entered into a multiple logistic analysis.

With the exception of mortality outcomes, all variables used in these analyses are based on self-report. It is thus possible that they merely tap some single

underlying dimension. If this were true, then the resultant multicollinearity would result in underestimates of the logistic coefficients associated with each variable. We conducted a series of stepwise multiple logistic analyses in which various models were compared in order to assess the extent of this problem (45). In general, the results do not support such an interpretation. These analyses, which examined only deaths from ischemic heart disease, suggest that perceived health has a singular role, with other psychosocial variables having relatively little effect on the association between perceived health and mortality (46).

If the association of perceived health with mortality is not entirely due to either physical health status, social network participation, or psychological state, then what are the pathways by which it operates? Several possibilities present themselves. It is of course possible that there are physiological, behavioral, so-

TABLE 6
Age-specific mortality rates per 100 for three causes by perceived health for men and women, Alameda County, CA, 1965-1974

Age (years)	Ischemic heart disease						Cancer						Other causes					
	Men			Women			Men			Women			Men			Women		
	Excellent or good	Fair or poor		Excellent or good	Fair or poor		Excellent or good	Fair or poor		Excellent or good	Fair or poor		Excellent or good	Fair or poor		Excellent or good	Fair or poor	
16-29	—*	—*		—*	—*		—*	—*		—*	—*		—*	—*		—*	—*	
30-44	0.64	—*		—*	—*		—*	—*		0.91	2.28		1.60	2.28		1.32	4.00	
45-59	2.86	9.94		1.86	1.86		4.68	4.68		2.20	1.86		3.61	8.77		2.07	8.84	
60+	18.01	26.15		18.29	18.29		16.17	16.17		6.20	6.10		8.33	16.77		9.50	19.11	

* Less than four deaths.

cial, or psychological factors which we have not measured, or have inadequately measured, that can shed further light on the pathways by which perceived health is associated with mortality. It is also possible that the perception of one's health as poor or excellent engages psychophysiological mechanisms which result in decreased or increased host resistance. Further information is needed to address either of those possibilities.

It is also possible that perceived health reports index occult disease, which although present is not represented either in diagnosed conditions or self-reports of symptoms or complaints. If this were true, then we might expect to see a differential impact of perceived health on various causes of death. Further analyses will examine this issue in greater detail; however, at the present, the analyses presented in table 6 do not support such a differential impact of perceived health on ischemic heart disease, cancer, or other cause deaths. The data point to still another possibility more consistent with the concept of generalized susceptibility. Although the pathways by which such generalized effects operate are unclear, recent work in the field of psychoneuro-immunology is suggestive (47). This evidence demonstrates the considerable interaction between nervous, endocrine, and immunologic systems and the existence of psychosocial influences on these interactions. It seems possible that individuals may be able to access information about the state of these systems and that such information can be utilized in arriving at judgments of perceived health. Although highly speculative, such a possibility suggests the need for studies that examine the relationship between perceived health and information on a wide range of physiological, social, and psychological levels.

Regardless of the mechanisms, these results seem to us to have profound implications. Increased emphasis on technolog-

ical medicine has tended to result in less and less attention to what people say about their health (48). The strong relationship between perceived health and mortality would argue for increased attention to the meaning of such reports.

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