

Mental Health Status as a Predictor of Morbidity and Mortality: A 15-Year Follow-Up of Members of a Health Maintenance Organization

ABSTRACT

Objectives. This study sought to relate preexisting depression, worries, affect balance, and mental health symptoms to subsequent risk of morbidity and mortality.

Methods. A random sample of members of a health maintenance organization were interviewed at home in a 1970/71 survey. Baseline psychological measures from that survey were then related to 15-year mortality and first incidence of cancer, heart disease, hypertension, stroke, functional gastrointestinal disease, and hyperimmune diseases.

Results. Baseline depression and the Langner Mental Health Index predicted incidence of functional gastrointestinal and hyperimmune diseases. The relationship of the Langner index to hyperimmune diseases was particularly strong; mortality, cancer, heart disease, hypertension, and stroke incidence were not related to that index. Except for affect balance, which was worst in the elderly, indications of psychological dysfunction were strongest in the young.

Conclusions. Psychological indices detected increased risk for functional gastrointestinal and hyperimmune diseases but were not related to mortality risk. Further research is needed to disaggregate relationships of the specific conditions that were included in the hyperimmune group. Functional gastrointestinal disease might be preventable with early attention to depressed persons and to those scoring high on the Langner index. (*Am J Public Health.* 1994;84:227-231)

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Introduction

An extensive literature examines the relationship of psychological distress to mortality risk.¹⁻¹¹ In presenting their own negative data, Roberts et al.⁴ surmised that reported associations of psychological state to mortality are misleading because case-control and cross-sectional studies have generally involved persons who are psychologically impaired and thus are not representative of the broader population. Community studies, on the other hand, have been less likely to make such associations.⁴⁻¹⁴ Animal studies demonstrate clear relationships between various stresses and immune response, both in vitro and in vivo^{15,16}; such effects, if they persist over long periods, might be expected to influence susceptibility to selected morbidities. A meta-analysis of the role of personality in disease causation¹⁷ suggests the possible existence of a "disease-prone" personality that is characterized by anger/hostility and anxiety.

This paper examines the extent to which four baseline measures of mental and emotional health and well-being were able to predict 15-year morbidity and mortality in a random sample of adult enrollees in a large health maintenance organization (HMO). The four measures examined were the Langner Mental Health Index, a depression scale, the Bradburn-Caplowitz Affect-Balance Scale, and the Bradburn Worries Index. The relation of morbidity and mortality in this group to social networks has been examined separately.¹⁸

Methods

Study Population

The study population was a random sample of 1659 household units with 2573

adult members of the Northwest Region of Kaiser Permanente, a large managed-care organization in Portland, Ore, whose membership is generally representative of the Portland, Ore/Vancouver, Wash, standard statistical metropolitan area.¹⁹ Subjects were respondents to a 1970/71 personal interview survey. Of the households randomly selected, 92% (1529) were successfully interviewed. Thirty individuals who left the health plan less than 6 months after the survey interview were eliminated from the analyses. To be eligible, individuals had to have been enrolled in the health plan prior to January 1, 1969, thus permitting 2 years of retrospective medical records review prior to the survey. Medical records for this population were routinely abstracted from the date of enrollment or January 1967, whichever was earlier.

Independent Variables

The baseline measures were derived from the 1970/71 personal interview survey. These measures include self-reported general health status and scores on the Langner Mental Health Index, a depression scale, the Bradburn-Caplowitz Affect-Balance Scale, and the Bradburn Worries Index.

The Langner index²⁰ is a count of the number of 22 symptoms (e.g., headaches, night sweats, heart pounding, trouble sleeping, etc.) the respondent often experiences. It is scored from 0 to 22 (mean = 2.19, SD = 2.38). Although de-

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This paper was accepted June 23, 1993.

TABLE 1—Baseline Characteristics of the Study Population (n = 2573)

	No.	%
Age, y		
18–29	398	15.5
30–44	776	30.2
45–59	741	28.8
60–74	529	20.6
75+	129	5.0
Sex		
Male	1187	46.1
Female	1386	53.9
Smoking		
Current	870	33.8
Former	643	25.0
Never	1045	40.6
Missing	15	0.6
Socioeconomic status (self-reported)		
Upper	26	1.0
Upper middle	357	13.9
Middle	1385	53.8
Working	721	28.0
Lower	22	0.9
Missing	62	2.4
Subjective health status		
Excellent	888	34.5
Good	1171	45.5
Fair/poor	461	17.9
Missing	53	2.1

Note. Percentages may not add to 100 because of rounding.

signed as a general measure of mental health, it is widely regarded as an index of psychophysiological symptomatology and general malaise.²¹

The depression index was created from questions on the survey that allowed a close approximation of the clinical definition of depression in the American Psychiatric Association's *Diagnostic and Statistical Manual*, 3rd edition.²² The instrument and distributions of scores on its component questions are discussed in McFarland et al.²³

The Bradburn-Caplowitz Affect-Balance Scale²⁴ was created from questions asking about five negative and five positive emotional states (e.g., during the past few weeks, did you ever feel proud? lonely?). To an initial score of 5, +1 is added for each "yes" response to a positive emotional state and -1 for each "yes" response to a negative emotional state. Scores range from 0 to 10, a higher score indicating a positive affect (mean = 7.22, SD = 1.79).

The Bradburn Worries Scale²⁵ consists of 12 items (e.g., during the past few weeks, have you been worried about money? job? world?) weighted from not

worried (0) to very worried (2). Scores range from 0 to 24 (mean = 3.48, SD = 2.66). This index is intended to reflect transitory mental states (unlike the Langner index, which purportedly measures more enduring states).

Dependent Variables

Vital status as of the end of 1985 was determined for all members of the study population through searches of the national death index and vital records for Oregon and Washington states.

International Classification of Diseases, version 7 (ICD-7)²⁶ codes were used to classify all confirmed morbidities for all years of the study. The use of a single coding system prevented discontinuities secondary to ICD code revisions.

The first incidence was determined for the following morbid outcome groups (ICD-7 codes): ischemic heart disease (420, 421.5, 422.1), cancer (140–205, excluding 191), stroke (330–334, 335.1), hypertension (447.0, 447.2), infection (002–138), diseases of hyperimmunity (allergy [240, 242–245], asthma [241], osteoarthritis [723], autoimmune diseases [252.0, 254.0, 256, 271.1, 290.0, 296, 456, 704, 744]), and functional gastrointestinal diseases (540–544, 571–573). Persons with a past history of a morbid condition were excluded from analyses of that condition so that the outcome was always defined as the first incidence of a morbidity.

Analyses

Cox proportional hazards regression models were used to assess the 15-year relative hazards of mortality and morbidity. These nonparametric models allow the hazards of death and disease incidence to include follow-up time but require that the proportional effects of predictors on hazards be constant over the entire follow-up interval. The Cox regression procedure allows censoring due to health plan disenrollment and includes a goodness-of-fit test of the proportional hazards assumption. The exponential function of a Cox regression coefficient is the relative hazard of the outcome for a unit difference in the predictor variable.

Analyses were adjusted for age, sex, self-reported health status, self-reported social class, cigarette smoking status, and duration of health plan membership. For most of the analyses, the predictor variables were divided into approximate tertiles, with the upper (high) tertile serving as the referent for comparisons with the bottom (low) tertile. The SAS SUGI procedure PHGLM²⁷ was used.

Kaplan Meier and log-log hazard plots and proportional hazard z scores were used to verify Cox model assumptions. Stepwise inclusion criteria were used to identify interactions of age, gender, and baseline subjective health status that significantly improved the predictive power of the main effects models.

Results

Table 1 shows the characteristics of the study population. The population is a broadly distributed group of HMO members generally representative of the metropolitan area from which they were drawn.

Table 2 presents the percentage of individuals within each of five age groups that fell into the approximate tertiles of the various psychosocial measures. For each measure, cut points were selected that most nearly distributed the respondents into thirds. Depression scores were highest in those under 30, followed by those over 75. Those from 30 to 74 years of age were least likely to be depressed. Persons under 30 were least likely to fall in the lowest (most healthy) tertile on the Langner scale and most likely to fall in the highest tertile. Persons aged 60 to 74 were most likely to fall in the lowest tertile. The worries index was inversely related to age, with the two oldest age groups (60 and above) showing the fewest worries. Persons over age 75 were most likely to fall in the lowest tertile of affect balance (worst affect balance), and those aged 30 to 44 had the highest affect-balance.

Table 3 presents the Pearson correlations among the four psychological scales. Depression and the Langner index were highly correlated ($r = .83$). The other measures were significantly but more weakly correlated.

Table 4 presents the 15-year relative hazards (RHs) of mortality and morbidity incidence. For each index, the lowest tertile was compared with the highest tertile. The table includes both unadjusted rates and rates adjusted for age, sex, smoking status, socioeconomic status (SES), self-reported health status, and duration of health plan membership.

Those in the low and medium tertiles of the depression index at baseline (not depressed) were at increased risk for subsequent hypertension compared with those scoring high on the depression index. Depression was also related to an increased incidence of functional gastrointestinal disease and was marginally as-

sociated with an increased hazard for diseases of hyperimmunity. The other five dependent variables were not related to depression. For men only (data not shown), the risk of dying during the follow-up interval was lower for the least depressed compared with the most depressed tertiles (RH = 0.71; confidence interval [CI] = 0.52, 0.97). No other interactions with sex were observed.

A high score on the Langner index was related to an increased risk of both functional gastrointestinal and hyperimmune diseases among all persons. The index interacted with age in predicting incidence of hypertension. Younger individuals with a low mental health score were at increased risk for hypertension (RH = 1.47; CI = 1.05, 2.04 at age 30), while older persons with a low mental health score were at reduced hazard (RH = 0.76; CI = 0.62, 0.92). No other main effects or interactions were noted.

A high score on the worries index was associated with an increased risk for functional gastrointestinal disease. The worries index was also strongly related to mortality and to incidence of ischemic heart disease, cancer, hypertension, and stroke in the unadjusted analyses. Adjustment for age, sex, smoking, health status, SES, and duration of health plan membership abolished these relationships.

The unadjusted affect balance score was significantly associated with mortality, ischemic heart disease, stroke, and functional gastrointestinal disease. After adjustment, the affect balance scale was not significantly associated with any of these outcomes, but low affect balance was marginally related to elevated risks of death and stroke.

To assess the degree to which the addition of the mental health variables improved the fit of a model involving only covariates, we reran all the models without the mental health variables (i.e., with covariates only). We then used the likelihood ratio test to determine whether the main effects models of covariates alone were significantly improved by the addition of the four mental health indices. Addition of the depression, Langner mental health, and worries indices to the model produced highly significant improvements in the model for all outcomes except in the case of the worries index as a predictor of stroke. *P* values associated with these chi-squares were extremely small—in most instances, much less than .0001. The affect balance scale was not associated with a significant improvement in the model for any of

TABLE 2—Percentage of Participants, Distributed by Age, within Tertiles of Psychological Scales

Index/Tertile	Age, y				
	<30	30–44	45–59	60–74	75+
Depression					
1 (least)	20.8	34.9	36.1	35.0	24.4
2	27.1	30.9	31.2	29.2	32.2
3 (most)	52.2	34.2	32.7	35.8	43.3
Langner Mental Health Index					
1 (best)	21.5	28.3	25.3	30.7	25.3
2	39.2	40.0	43.5	35.3	39.0
3 (worst)	39.2	31.7	31.2	34.0	35.8
Bradburn Worries Scale					
1 (fewest)	21.2	32.1	44.6	56.7	59.1
2	26.9	27.1	30.2	27.2	24.8
3 (most)	51.9	40.8	25.2	16.1	16.2
Bradburn-Caplowitz Affect-Balance Scale					
1 (worst)	32.7	27.1	30.0	36.1	41.8
2	41.2	43.2	42.7	42.9	40.9
3 (best)	26.1	29.5	27.4	21.0	17.3

TABLE 3—Pearson Intercorrelations of Psychological Measures*

	Langner Mental Health Index	Bradburn Worries Scale	Bradburn-Caplowitz Affect-Balance Scale
Depression	.83	.42	-.55
Langner Mental Health Index		.37	-.45
Bradburn Worries Scale			-.21

**P* < .001.

the outcomes except cancer incidence (*P* < .005).

Discussion

These analyses show a strong prospective association between the mental health, depression, and the worries indices, on the one hand, and the first incidence of functional gastrointestinal disease and a group of diseases we classified as diseases of hyperimmunity, on the other. Unfortunately, this latter grouping was created for other reasons, and we were not able to break up that group into its major component parts (allergies/hay fever, asthma, osteoarthritis, autoimmune diseases). We plan to do so in the future. In the adjusted models, psychological indices were not related to mortality hazard (except possibly for depression among men only) or to the incidence of major morbidities such as ischemic heart disease and cancer. The unadjusted worries and affect balance indices were strongly related to these outcomes, however, emphasizing the importance of appropriate

adjustments when analyzing the relationships of psychological variables to morbidity and mortality.

The relationship of three of the four indices to functional gastrointestinal and hyperimmune conditions is intriguing. Functional gastrointestinal diseases obviously have a strong psychological component. But, to our knowledge, this is the first evidence that a depression index, the Langner Mental Health Index, and the Bradburn Worries Scale can be used to identify those at high risk for future functional gastrointestinal disease. A 1957 study of army recruits²⁸ probably gave rise to the general perception that personality and ulcer are linked, but no well-controlled studies exist that confirm this commonly held perception. Similarly, arthritis, particularly rheumatoid arthritis, is often perceived to be related to psychological factors. Persons with rheumatoid arthritis have more psychological problems than controls and appear to have more psychological stress.²⁹ Certainly, rheumatoid arthritis is involved with immune response. But prospective studies

TABLE 4—Fifteen-Year Relative Hazard (RH) of Mortality and Morbidity, by Mental Health, Depression, Worries, and Affect-Balance Scores^a

Outcome	Unadjusted			Adjusted		
	RH	95% CI	P	RH	95% CI	P
Death						
Mental health	1.05	0.83, 1.34	.67	1.03	0.79, 1.34	.85
Depression	0.96	0.76, 1.20	.71	0.91	0.71, 1.17	.47
Worries	2.19	1.73, 2.78	<.001	0.94	0.74, 1.21	.64
Affect balance	1.99	1.54, 2.58	<.001	1.25	0.95, 1.64	.10
Ischemic heart disease						
Mental health	1.04	0.76, 1.42	.67	0.88	0.62, 1.24	.46
Depression	1.13	0.86, 1.49	.39	0.94	0.70, 1.28	.71
Worries	2.34	1.72, 3.20	<.001	1.18	0.85, 1.63	.32
Affect balance	1.46	1.08, 1.98	.01	1.13	0.82, 1.54	.47
Cancer						
Mental health	1.00	0.70, 1.43	1.00	1.01	0.69, 1.49	.94
Depression	1.08	0.79, 1.49	.60	1.08	0.77, 1.52	.66
Worries	1.63	1.17, 2.27	<.001	0.99	0.70, 1.40	.95
Affect balance	1.17	0.83, 1.65	.36	1.00	0.70, 1.43	1.00
Hypertension						
Mental health	1.13	0.90, 1.43	.29	1.08	0.84, 1.39	.56
Depression	1.43	1.15, 1.77	<.001	1.37	1.09, 1.73	<.001
Worries	1.42	1.14, 1.75	<.001	1.17	0.93, 1.46	.18
Affect balance	1.01	0.80, 1.27	.94	0.99	0.78, 1.26	.94
Stroke						
Mental health	0.83	0.57, 1.21	.32	0.83	0.55, 1.25	.37
Depression	0.85	0.60, 1.20	.35	0.84	0.57, 1.22	.34
Worries	1.98	1.38, 2.84	<.001	0.91	0.63, 1.33	.64
Affect balance	2.09	1.41, 3.10	<.001	1.44	0.95, 2.19	.08
Functional gastrointestinal diseases						
Mental health	0.62	0.49, 0.79	<.001	0.71	0.55, 0.92	.01
Depression	0.63	0.51, 0.79	<.001	0.68	0.54, 0.87	<.001
Worries	0.76	0.62, 0.94	.01	0.71	0.57, 0.89	<.001
Affect balance	1.27	1.01, 1.60	.04	1.19	0.94, 1.51	.15
Hyperimmune diseases						
Mental health	0.63	0.51, 0.78	<.001	0.67	0.53, 0.84	<.001
Depression	0.84	0.69, 1.01	.06	0.84	0.68, 1.03	.09
Worries	1.11	0.92, 1.33	.29	0.87	0.71, 1.07	.18
Affect balance	1.07	0.87, 1.31	.54	0.98	0.79, 1.21	.84

^aLow tertile relative to high tertile; adjusted for age, sex, socioeconomic status, length of health plan membership, subjective health status, and smoking.

on these issues are woefully lacking. Is it possible to intervene with appropriate therapy for those who score high on these indices and thereby to reduce future functional gastrointestinal conditions and/or conditions associated with excessive inflammatory/immune response? This question deserves further attention.

There are well-described biochemical pathways that might link hypothalamic-adrenocortical hormones to the risk of heart disease and cancer.^{30,31} Despite the common, yet relatively undocumented, knowledge that periods of stress are related to exacerbations of asthma, allergies, and arthritis, there is no comparable biological model to account for the relationships between psychological factors and excessive immune response. There have been observations that persons with

allergies are at decreased risk for cancer,³² but little has been done to specify whether (or how) psychological states might be involved. The present study suggests that perhaps these morbidities are linked to psychological states. This study has also examined the relationships of social networks¹⁸ and other psychosocial variables to these outcomes.

Although the depression and mental health indices are highly correlated, only the former was inversely related to the risk of newly diagnosed hypertension. Physicians may be less likely to diagnose asymptomatic conditions such as hypertension in depressed patients than in non-depressed patients, and/or depression may be associated with reductions in blood pressure. There is no basis for attributing this inverse relationship to anti-

depressant medications. Such medication might, in fact, be expected to increase blood pressure.

Although affect balance, a measure of well-being, tended to be negatively related to the risk of death and stroke, it was not significantly associated with any of the study outcomes after adjustment for covariates.

Persons under 30 years of age were more depressed and more worried and had more long-term mental health symptoms than other age groups. Only affect-balance was worse among the old than the young. The high completion rate (92%) of the random sample suggests that these findings are not the result of a healthy volunteer effect and that age does not lead to a general deterioration in these aspects of mental health. Indeed, some aspects appear to improve with age.

Of course, many comparisons were performed in conducting these exploratory analyses, and some significant associations might be expected by chance alone. However, the associations reported here are very powerful, and few are likely to have resulted from chance. It is possible that specific morbid conditions present at baseline may have confounded the observed relationships. Further exploration of the relationships of these mental health indices to morbid conditions would help to detect such problems.

Further exploration of the relationships between psychological states and the future risk of functional gastrointestinal and hyperimmune conditions is warranted. In particular, the relationship of these measures to the subcomponent conditions that make up the hyperimmune group would be of interest. □

Acknowledgments

This work was supported by National Institute on Aging grant R01 AG05682.

The authors thank Denise Ernst, Lisa Sha, Elizabeth O'Connor, and Mary Longacre for their contributions.

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