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An Archival Prospective Study of Mental Health and Longevity

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The relationship between mental health status and longevity was examined in an archival prospective cohort study (N = 1,103) derived from work begun by Lewis Terman in the 1920s. Degree of psychological maladjustment, cumulatively rated by Terman and his colleagues as of 1950, was found to be related to higher risk of all-cause mortality over a 4-decade follow-up period. The differences among causes of death were nonsignificant, but there was some indication that mental health problems were more strongly related to deaths from injury and cardiovascular disease. The overall relationship was significant for men but weaker for women. The effect was not substantially mediated by alcohol consumption, obesity, or cigarette smoking.

Key words: longevity, mental health, adjustment

Co-occurrence of psychological maladjustment and symptoms of ill health is well documented. Such correlations do not necessarily indicate that maladjustment is causing illness, because psychological state may affect perceptions of one's health (e.g., Costa & McCrae, 1987; Larsen, 1992), because disease may adversely affect psychological health (e.g., Hogg, Goldstein, & Leigh, 1994; Rapoport, Kreitler, Chaitchik, Algor, & Weissler, 1993), or because psychological and physical states may both be caused by underlying third variables. Because people cannot be randomly assigned to conditions of psychological maladjustment, long-term prospective studies of mental and physical health provide one of the best means of untangling these complex causal webs.

Aside from studies of special populations such as criminals or persons who are institutionalized, there has been surprisingly little long-term study of the relationships of mental health and longevity. Measures of moodiness, depression, and anxiety were all found by Markush, Schwab, Farris, Present, and Holzer (1977) to be significantly associated with mortality risk, and this association appeared not to be the result of preexisting physical status. Somervell et al. (1989) found that psychological distress, as measured by the Health Opinion Survey (MacMillan, 1957), was associated with increased mortality risk even after controlling for age, race, sex, and current illness. In some instances, specific psychoaffective patterns have been associated with particular diseases. For example, depression has been linked to increased incidence of cancer (Shekelle et al., 1981; Temoshok, 1985), but the evidence for causality in this relationship is weak (Andersen, Kiecolt-Glaser, & Glaser, 1994). Aspects of hostility seem associated with hypertension and cardiovascular disease (CVD; Barefoot, Dahlstrom, & Williams, 1983; Booth-Kewley & Friedman, 1987; Friedman & Booth-Kewley, 1987; Williams & Barefoot, 1988), and there is some evidence that manic–depressive disorder is associated not only with higher mortality from suicide but also from CVD (Weeke, Juel, & Vaeth, 1987). However, many studies do not investigate more than one illness or one cause of death, and this may lead to unjustified inferences.

Even in those cases in which psychological maladjustment plays a causal role in illness, the pathways may be complex. Direct behavioral pathways may be present, such as when a severely depressed individual commits suicide. Alternatively, there may be indirect behavioral pathways, such as when depression leads to alcoholism, which leads to cirrhosis of the liver. Also, direct and indirect psychosomatic mechanisms may be at work, such as when anxiety or psychological stress triggers a heart attack (Kawachi, Sparrow, Vokonas, & Weiss, 1994; see also Kamarck & Jennings, 1991, for a review of literature on psychological factors and sudden cardiac death)

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or when depression decreases immune response and viral infections take hold or spread (e.g., Cohen & Williamson, 1991; Herbert & Cohen, 1993; Jemmott & Locke, 1984; Schneiderman & Baum, 1992; Weiss, 1992). Therefore, comprehensive studies should attempt to determine not only whether or not psychological maladjustment is causally related to health outcomes but should also seek to identify the ways in which it may be so. Although epidemiologic studies cannot establish causality, a longitudinal design can test whether mental health predicts longevity. Furthermore, if it is found that mental health predicts more or less strongly to certain causes of death, this may yield information regarding likely causal pathways. Finally, it can be determined whether controlling for behavioral factors eliminates or significantly reduces the predictive power of mental health, thus suggesting a specific causal route.

The extant literature contains many studies on people who were initially chosen on the basis of criteria related to their physical or mental health. In the present study, we offer insight into the relationship between mental health and longevity using a prospective design, a 4-decade follow-up, and a reliable outcome (longevity and professionally coded cause of death).[1]

Method

Participants

The initial data for this study were derived from the Terman Life-Cycle Study, begun in 1921 and 1922 by Lewis Terman (Terman & Oden, 1947, 1959). The original study included 1,528 male and female children who were recruited from schools in California after being identified by their teachers as gifted. The children were mostly White, mostly middle class, and had IQ scores of at least 135. These participants have been followed at regular (5–10 year) intervals throughout their lifetimes, with the most recent wave of data collection occurring during 1991 and 1992. Because much of the information used in the present study was collected in 1950 (when the mean age of participants was approximately 40 years), those individuals who died or were lost to follow-up before 1950 ($N = 112$) were excluded. Thus, this is a study of how mental health at middle age predicts longevity and cause of death later in life. To ensure comparability with other studies emerging from this project and to minimize the effects of systematically missing data from those not of school age during the time of initial data collection, those not born between 1904 and 1915 inclusive ($N = 155$) were excluded, as were those missing all of the childhood personality information ($N = 46$). For individuals missing only some of the childhood personality information, scale-specific mean replacement was used to provide the missing personality data, so these participants were retained. Finally, those without information on mental status were also excluded ($N = 112$), resulting in a final sample size of 1,103 participants (622 men and 481 women). The mean age for men in 1950 was 39.8 years ($SD = 2.91$) and for women was 39.3 years ($SD = 2.77$). Individuals who were excluded because they were not born between 1904 and 1915 inclusive or because they were missing all of the childhood personality information did not differ from the 1,103 on the dimension of adult mental health.

This sample of individuals is not representative of the general population on intelligence or ethnicity. In addition, because participants were recruited on the basis of intelligence, the socioeconomic heterogeneity of the sample was also reduced (Schwartz et al., in press). Although socioeconomic status (SES) has been shown to be related to various mental health states, the gradient effect of SES on physical health appears to function across the full range of SES (see Adler et al., 1994, for a discussion of this relationship). Within this sample there was substantial variability in mental health (see also Tomlinson-Keasey, Warren, & Elliott, 1986, for an examination of suicides among these gifted women, and Hastings, 1991, for a discussion of mental health in Terman's World War II veterans), with approximately one third of participants experiencing at least some mental health problems as of 1950. The fact that the data were collected prospectively, combined with the group's relative homogeneity on many demographic characteristics, results in a data set that is free from several common sources of bias. For example, nothing was known about the ultimate longevity of participants at the time of data collection, and it is unlikely that participants misunderstood questions appearing on the surveys they completed. In addition, these participants were unlikely to have lacked adequate medical care.

Measures

Adult mental health. The 1936, 1939–1940, 1945, and 1950 questionnaires asked the Terman participants whether they had experienced any tendency toward nervousness, worry, special anxieties, or nervous breakdown in recent years, and if so, the "nature of such difficulties." Starting in 1940, the participants were also asked how the psychological difficulty, if any, had been handled and what their present condition was (Terman & Oden, 1959). On the basis of this information, and considered in light of the total case history (i.e., all information available including personal conferences with participants and their families), participants were, in 1950, classified by Terman and his associates into one of three categories: (a) satisfactory adjustment, (b) some maladjustment, or (c) serious maladjustment.[2] Individuals in the first category were those who were able to cope normally with everyday problems and who were judged to be essentially typical in terms of their emotional make-up. Falling into the second category were those who, although experiencing excessive feelings of inferiority or inadequacy, anxiety, or emotional conflicts, were nonetheless able to function. The third category was composed of individuals who had shown marked symptoms of anxiety, depression, personality maladjustment, psychopathic personality, or had suffered a nervous breakdown (whether or not this had necessitated their hospitalization). Within our sample, 447 men (72%) and 323 women (67%) fell into the first category, 128 men (20%) and 124 women (26%) fell into the second category, and 47 men (8%) and 34 women (7%) fell into the third category. To make the interpretation of results clearer, we rescaled this variable such that those experiencing satisfactory adjustment received a 0, those with some maladjustment received a 0.5, and those with considerable mental health problems received a 1. Thus a 1-point change on this scale corresponds to the change from satisfactory status to one of serious maladjustment.

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[1] This article is one of a series developed from our large-scale, multiyear, multidisciplinary project on psychosocial predictors of health and longevity (Howard S. Friedman, principal investigator; Friedman, Tucker, Schwartz, Tomlinson-Keasey, et al., 1995). Previous publications from our project are cited where appropriate, and care should be taken not to include overlapping findings in meta-analyses or other reviews. Note also that sample sizes may vary somewhat from article to article as old data are refined, new data are gathered, or time periods are changed.

[2] Some of this discussion is reminiscent of a distinction Terman made between an "A" group and a "C" group (Terman & Oden, 1947). However, Terman used only a small fraction of his sample in creating these groups, and he did so in a biased manner; we therefore take a more comprehensive approach by using the mental health measure, which is available on a much larger portion of the sample and which was more global in its creation.

Adult alcohol use, smoking, and obesity. Excessive use of alcohol is well known to be associated with a variety of mental difficulties, and thus alcohol consumption became a primary target for this investigation. Fortunately, good information on alcohol consumption in adulthood was available on a large portion of the sample, and we therefore used alcohol consumption as a control variable in this study. In 1950 and 1960, alcohol use was self-reported by participants. For each of these assessments, we classified participants as (a) never drinks or only rarely drinks, (b) drinks lightly to moderately (never or seldom intoxicated), and (c) drinks more heavily. The correlation between self-reported alcohol use in 1950 and 1960 was .60 ($p < .001$). Our analyses utilize alcohol use as reported in 1950 to indicate the level of alcohol consumption for each participant (because of missing data, the sample size decreases from 1,103 to 1,099).

In terms of coping mechanisms, other behaviors such as smoking and overeating may be used by individuals in response to psychosocial stressors, and we examined these as well. Although data on smoking had not been collected as part of the early assessments, retrospective self-report data on smoking was collected from 1991 through 1992. Participants who were still alive and could be located were asked to report whether or not they smoked, how long they had smoked, and the average number of cigarettes per day they had smoked during the time that they smoked. If the participant had died, this information was obtained from next of kin. On the basis of this information, we calculated pack-years for each respondent as (years smoked × cigarettes per day)/20. Pack-years ranged from 0 (*never smoked*) to 180, and this information was converted to a 4-category variable with 0 = *a nonsmoker*, 1 = *1–16 pack-years*, 2 = *16.01–44 pack-years*, and 3 = *44.01–180 pack-years*.

Additionally, although there was no available information on overeating per se, participants did report their height and weight in 1940, and we used this information to calculate body mass index (BMI; BMI = weight/height^2) as a measure of obesity.

Childhood personality. To better understand how poor psychological adjustment may be associated with longevity, as well as its stability over time, we also investigated childhood personality variables hypothesized to be discriminators of mental health in adulthood. If the relationship between adult mental health and longevity can be explained by childhood personality, then subsequent behavioral factors may be of less importance. We used scales created by Friedman et al. (1993) from parent and teacher reports, indicating childhood conscientiousness, permanency of moods, and cheerfulness, as well as a single item from 1922 indicating a child's "tendency to worry." Mood permanency and tendency to worry were selected for being theoretically relevant to mental health status, whereas conscientiousness and cheerfulness were included on the basis of previous findings regarding their relationship to longevity across the life span (Friedman et al., 1993; Friedman, Tucker, Schwartz, Martin, et al., 1995; Friedman, Tucker, Schwartz, Tomlinson-Keasey, et al., 1995). Intelligence, also rated in childhood, was used as a control variable, as was tested IQ. Although these variables were restricted in range, we tested the possibility that intelligence might account for some portion of the effects of mental health.

Cause of death. Cause of death data were obtained from death certificates, most of which we gathered from 1991 through 1993. A certified nosologist, supervised by our research team's physician (Michael H. Criqui), determined underlying cause of death from each certificate, using the ninth revision of the International Classification of Diseases (ICD–9–CM, 1980). Cancer deaths were those coded 140–239; deaths from CVD were those coded 400–448; and deaths from injury, accidents, and violence were those coded 800–999. In cases where death certificates were unavailable ($N = 88$), the physician used information from next of kin to classify deaths into the three preceding categories and "other" (this was possible in 46 of the 88 cases). Causes of death were classified into the following five categories: (a) CVD; (b) cancer; (c) accident, injury, or violence; (d) other causes; and (e) unknown causes.

Analyses. Survival analyses (Cox and Gompertz proportional hazards regressions) were used to test the effects of mental health and adjustment on longevity and cause of death for both men and women while controlling for relevant covariates. Interactions of poor psychological adjustment with sex and alcohol use were also used in these analyses. Both the Cox and the Gompertz models assess mortality rate while taking age into account. The Cox proportional hazards regression is a nonparametric model that does not make any assumptions about the shape of the survival curve but does assume that the ratio of the hazard functions for individuals with differing values of the covariates is invariant over time. The Gompertz is a parametric model that assumes that the risk of death at any given instant can be expressed with an exponential function that includes age; therefore, it is better suited for determining the varying effects of a predictor at different ages. Tuma's (1980) RATE program was used for these analyses because it appropriately treats both left-truncated and right-censored data. Correlations were also used to clarify certain relationships between mental health, alcohol use, and SES and to explore possible childhood precursors of later mental health problems.

Results

Mental Health and Longevity

As of 1991, 460 of the 1,103 participants were known to be dead. Our initial hazard regressions looked at the effect of mental health status on all-cause mortality, controlling for sex and age. The relative hazard (RH) comparing those with considerable mental difficulty to those with satisfactory adjustment was 1.61 ($p < .01$).[3] (Note that the RH is the estimated ratio of mortality risks for individuals who differ on the stated dimension. Thus, an RH of 1.61 indicates that those with considerable mental health problems have an increased risk for mortality of nearly two thirds when compared with satisfactorily adjusted individuals.) This finding was even stronger within the male subsample (RH = 1.78, $p < .01$) but was smaller and not significant for the female subsample (RH = 1.27, *ns*). The Sex × Mental Difficulty interaction term did not reach statistical significance, although the effect of mental difficulty is clearly stronger in the male subsample. Because mental health status may have been affected by chronic, severe, or terminal disease, and these individuals might be expected to die earlier, subsidiary analyses were conducted after eliminating those who died within 5 years of receiving the mental health rating (i.e., between 1950 and 1955). The results were nearly identical (RH = 1.59, $p < .01$; for men, RH = 1.76, $p < .01$; for women, RH = 1.28, *ns*). We also examined a self-reported adjustment scale (Tucker, 1993) composed of six items assessing happiness of temperament, self-confidence, ability to get along with others, moodiness, feelings of inferior-

[3] Because SES may be related to mental health, a measure of adulthood SES was used as a control variable in this study. In 1950, participants reported the highest level of education they had completed up to that point. This was coded as the number of years beyond eighth grade, and reports ranged from 1 (1 year of high school) to 18 (10 years of postgraduate training). This measure of SES was not correlated with mental health ($r = -.05$, *ns*), and thus controlling for it in the survival analysis failed to alter the effects of mental health (change in RH from 1.60 to 1.58).

ity, and sensitive feelings; these items were self-rated in 1950 on an 11-point scale ($\alpha = .73$). This index was created to assess how participants currently viewed themselves (note that this measure was not cumulative in nature and was self-reported). This self-report measure was only modestly related to Terman's more extensive assessment ($r = -.23$, $p < .001$). Nonetheless, as measured by this scale, more poorly adjusted men exhibited higher rates of mortality ($p < .05$), whereas no relationship was found for women.

To better understand the higher mortality risk of those with poor psychological adjustment, it is important to know whether only those with severe mental health problems are at risk or whether those with fewer or less severe problems are at higher risk as well. Therefore, dummy coding was used to compare those with considerable mental health problems to those with moderate problems and those who had experienced few if any problems. For the total sample, the relative risk of dying in any given year for those with few or no mental health problems was only 56% of that for individuals with considerable mental health difficulties (RH = 1.44, $p < .05$). The RH for those with some mental health problems was 64% of that for those with considerable difficulties (RH = 1.36, $p < .05$). In addition, although the risk of dying for those with little or no problems was in the expected direction when compared with those having moderate difficulties (RH = 1.12), this difference was not significant. Thus, it appears that there is a progression in risk as one experiences more problems with psychological adjustment but that the effect is strongest for those with poorest mental health.

Alcohol, Smoking, and Obesity

As can be seen in Table 1, the relationship between mental health problems and mortality risk was somewhat attenuated when the statistical control for alcohol consumption was used, but it remained significant.[4] The Mental Health Problems × Alcohol Use interaction failed to reach significance. Because moderate use of alcohol is sometimes found to have a protective effect against some forms of morbidity and mortality, dummy coding was used to explore the possibility of a curvilinear (i.e., U-shaped) effect, but no such effect was found. Instead, there appeared to be a threshold effect, with no differences in mortality between low and moderate drinking but increased mortality for heavier drinking. Therefore, low and moderate drinking were combined, and a dichotomous categorization contrasting heavy drinking with moderate and light drinking was used as a control. Although heavy alcohol use has a significant deleterious impact on mortality, controlling for the dichotomized measure of alcohol use had only a moderate impact on the relationship between poor psychological adjustment and mortality risk (RH = 1.45, $p < .02$). The male subsample still showed the stronger relationship (RH = 1.57, $p < .05$), and the female subsample showed a weaker one (RH = 1.22, *ns*).

Because smoking may be associated with poor psychological adjustment and is a known predictor of mortality, we considered the possibility that smoking might be a mediator of the effects of poor adjustment on mortality. Smoking was indeed a predictor of premature mortality in the subsample on which we had smoking information, but entering smoking in the survival analyses did not affect the RH associated with poor adjustment (the sample size in these analyses decreases substantially, from 1,103 to 648). This is consistent with the fact that the correlation between smoking and mental health problems was negligible ($r = .06$, *ns*). However, it is likely that this subsample is somewhat biased—this group lived longer and was more likely to have locatable next of kin. So, although we did not find a mediational effect of smoking, we cannot rule out the possibility that smoking would partially explain the effect if complete data were available. However, further evidence that smoking is not accounting for the relationship is provided by the weak effects of poor adjustment on cancer deaths (see *Cause of Death* below).

As with alcohol use, controlling for obesity failed to eliminate the relationship between mental health problems and mortality. Because of missing data on obesity the sample size decreased from 1,103 to 984, but mental difficulty remained a predictor of earlier mortality in the total sample when obesity was controlled (RH = 1.36, $p < .06$).

Table 1
Cox Proportional Hazards Model Predicting Age-Adjusted Mortality From Sex, Mental Health Status, and Alcohol Consumption (in 1950)

Variable	Model 1	Model 2	Model 3
Sex ($F = 1$)			
β	−0.43***	−0.37**	−0.30*
RH	0.65	0.69	0.74
Mental health status			
β	0.47**	0.56**	0.50**
RH	1.61	1.75	1.65
Mental Health Status × Sex			
β		−0.18	−0.17
RH		0.84	0.84
Alcohol			
β			0.32
RH			1.38***

Note. $N = 1{,}099$. β = hazard regression coefficient; RH = relative hazard.
*$p < .05$. **$p < .01$. ***$p < .001$.

Cause of Death

Of those known to be dead as of 1991, 160 (35%) died of CVD, 151 (33%) of cancer, 34 (7%) through accident or violence, 73 (16%) of other causes, and 42 (9%) of unknown causes. When investigating whether a certain variable predicts a particular cause of death, one must choose between two different approaches. One approach treats the problem as a simultaneous multiequation system, permitting a test of whether the effect of a predictor is invariant across different outcomes (i.e., causes of death). For example, if estrogen is protective of

[4] The effect remained when we substituted as the measure of alcohol use the highest level of alcohol use reported from either 1950 or 1960 and predicted deaths after 1960. The sample size decreased to 1,043, and adding alcohol use to the equation changed the RH associated with mental health problems from 1.41 to 1.38 ($p < .05$ for both).

death from CVD but increases the risk of death from cancer, we would see that the equation that allows differential prediction has a better fit. Another approach examines the predictive power of the variable in question as it relates to each individual cause of death. That is, causes of death are seen as independent of one another, and the questions of whether a predictor (in this case mental health status) predicts cancer death, cardiovascular death, or death from injury are asked individually.

Using the first approach described above, Table 2 summarizes the fit of three different Gompertz models predicting cause of death. This analysis confirms the overall association of mental health problems with mortality but further suggests that Terman's classification of mental health difficulties is not differentially related to particular causes of death. Model 1 predicts mortality from sex (allowing sex to be differentially related to each cause), whereas Model 2 predicts from both sex and mental health but constrains mental health problems to predict equally to all causes of death. Model 3 also predicts from sex and mental health, but there are no constraints, and mental health status is free to predict more or less strongly to different causes of death. When Model 1 and Model 2 are compared, we see that adding mental health as a predictor in the model significantly improves the fit of the model, $\Delta\chi^2(1, N = 1{,}103) = 9.60, p < .01$. A comparison of the constrained model (Model 2) and the nonconstrained model (Model 3) shows that when mental health is allowed to predict differentially to cause of death, the fit of the model is not significantly improved, $\Delta\chi^2(4, N = 1{,}103) = 4.76$, *ns*. Thus, this analysis implies that in the total sample, those who experienced mental health problems were more likely to die in any given year, but of a variety of causes.

We also used the second method described above—that of predicting each cause of death separately, and these results are presented in Table 3. When we examine the separate effect of mental health status on each cause of death (either from the third Gompertz model or by estimating separate Cox regressions for each cause of death) we find that mental health problems most strongly predict deaths from injury (RH = 3.52, $p < .01$) and that the risk associated with poor mental health for deaths from CVD also significantly exceeds 1.0 (RH = 1.87, $p < .02$).[5] Nonetheless, the fact that all of the RHs, with the exception of unknown causes of death, are in the same direction, coupled with the fact that relatively few individuals within this sample are dying from injury, helps to explain why none of the RHs are significantly different from each other or their pooled estimate from the second Gompertz model above.

Table 2
Goodness of Fit for Three Gompertz Models Predicting (Age-Adjusted) Cause of Death From Sex and Mental Health Status

Model	Statistical fit χ^2	*df*	*p*
Model 1: Predicting mortality from sex	388.56	10	<.001
Model 2: Predicting mortality from sex and mental health status, constraining the effect of mental health status to be equal across all causes of death	398.16	11	<.001
Model 3: Predicting mortality from sex and mental health status, not constraining the effect of mental health status to be equal across all causes of death	402.92	15	<.001
Model 2 vs. Model 1	9.60	1	<.01
Model 3 vs. Model 1	14.36	5	<.05
Model 3 vs. Model 2	4.76	4	*ns*

Note. $N = 1{,}103$.

Table 3
Cox Proportional Hazards Regressions for Mental Health Status Predicting (Age-Adjusted) Individual Causes of Death

Cause of death	RH	χ^2	*df*	*p*
CVD	1.87	6.61	1	<.02
Cancer	1.36	1.32	1	*ns*
Injury	3.52	7.27	1	<.01
Other	1.37	0.67	1	*ns*
Unknown	0.85	0.09	1	*ns*

Note. $N = 1{,}103$. RH = relative hazard; CVD = cardiovascular disease.

Because the relationship between poor mental health and earlier mortality was much stronger in the male subsample, we also tested whether mental health problems predicted specific causes of death for men. Results were similar, with the Gompertz models again showing a significant effect of mental health pooled across all causes of death and the individual models indicating that prediction of injury deaths was the strongest, with prediction of cardiovascular deaths second.

Childhood Precursors

Is it possible that mental health problems as described here are related to characteristics observable in childhood? Furthermore, if they are, what are these childhood precursors? Mental health problems in adulthood are slightly related to a lack of mood permanency in childhood ($r = -.11, p < .001$), lower levels of conscientiousness ($r = -.11, p < .001$), and a tendency to worry ($r = .17, p < .001$). These small but significant correlations are true for both men (permanency of moods: $r = -.12, p < .01$; conscientiousness: $r = -.15, p < .001$; tendency to worry: $r = .22, p < .001$) and women (permanency of moods: $r = -.08, p < .07$; conscientiousness: $r = -.07, p < .15$; tendency to worry: $r = .10, p < .03$). Mental health problems are not, however, related to childhood cheerfulness ($r = -.01$, *ns*).[6] We used simultaneous multiple regression to test the influence of childhood tendency to worry, conscientiousness, and permanency of moods on adult mental psychological adjustment. Results indicate that of the three, tendency to worry in childhood best predicts psychological adjustment problems in adulthood (B = 0.16, $p < .001$), with conscientious-

[5] Because it was hypothesized that these two causes of death (injury and CVD) might be particularly influenced by alcohol use, these analyses were also done with alcohol consumption entered as a control variable. This made little difference, with the RH associated with injury death becoming 3.39 and that associated with CVD becoming 1.80.

[6] In this sample, both childhood tested IQ and rated intelligence were unrelated to mortality or adult mental health status.

Table 4
Cox Proportional Hazards Model Predicting Age-Adjusted Mortality From Sex, Mental Health Status, and Childhood Personality

Variable	Model 1	Model 2
Sex ($F = 1$)		
β	−0.42***	−0.38***
RH	0.66	0.69
Mental health status		
β	0.52***	0.42*
RH	1.68	1.52
Conscientiousness		
β		−0.21*
RH		0.81
Permanency of mood		
β		−0.06
RH		0.94
Tendency to worry		
β		0.16
RH		1.17

Note. $N = 1{,}024$. Interquartile relative hazards (comparing those at the 75th percentile with those at the 25th) are presented for the childhood personality scales. β = hazard regression coefficient; RH = relative hazard.
*$p < .05$. ***$p < .001$.

ness second ($B = -0.07, p < .05$), and permanency of moods third ($B = -0.06, p < .10$), $R^2 = 0.04, F(3, 1020) = 13.9$. Thus, those rated in childhood as worrying, unconscientious, and moody were more likely to grow up to face mental health problems.

Controlling for childhood conscientiousness, permanency of moods, and tendency to worry slightly decreased the effect of adulthood mental health problems on mortality, as seen in Table 4. However, the change was not large (change in RH from 1.68 to 1.52), indicating that although these childhood precursors may be modestly related to later mental stability, most of the relationship between adult mental health and mortality is not due to the effects of childhood personality on each.

Discussion

The results give good indication that adult mental health is related to longevity across a large portion of the life span in the Terman cohort. We found that those who had experienced greater mental health problems as of 1950 (when the mean age of the participants was approximately 40 years) were at greater risk for earlier all-cause mortality, with some indication of an especially heightened risk for deaths from injury and CVD. That is to say that although there were no significant differences in the predictive power associated with particular causes of death, the effect on injury deaths was highest, and the effect on cardiovascular deaths also exceeded unity. It is interesting to note that the association between mental health problems and mortality risk is substantially weaker for women, and this does not seem to be due to differences in the prevalence of mental health problems between the sexes. However, the coefficient for the Sex × Mental Health interaction term failed to reach statistical significance, indicating that the male–female difference may be due in part to the smaller size of the female subsample (see Table 1). Other explanations, such as a protective effect from the types of relationships women tend to form, are also possible, and future research will be aimed at understanding why the women in this group seem relatively less affected in terms of longevity by their mental health status.

We also see some evidence that adulthood mental health problems are mildly related to factors identifiable early in life. Children who were impulsive, tended to worry, and had less stable moods were more likely to have experienced mental health problems by midlife. However, as indicated by the multiple regression analyses, it is the tendency to worry in childhood that best predicts the experience of such difficulties later in life ($r = .17, p < .001$). Perhaps tendency to worry comes closest to really measuring what might be termed (poor) "mental adjustment" in childhood. These children would be expected to experience more anxiety and less stability in adulthood, as reflected by more evidence of mental problems and poor adjustment. Also, we found that controlling for these childhood variables accounted for a modest part of the relationship between mental health and mortality, but poor psychological adjustment remained a significant predictor of mortality (see Table 4).

Neither alcohol consumption nor obesity can account for the observed relationship between mental health problems and mortality in this sample. In addition, although definitive conclusions regarding smoking behavior cannot be made, the fact that the RH associated with cancer (see Table 3) is substantially smaller than that associated with either CVD or injury (and deaths due to lung cancer would be the most likely link to smoking) leads us to believe that if better smoking data were available, the observed association between mental health problems and earlier mortality would still be only partially explained. Nonetheless, we assume that mental health and adjustment problems may sometimes be related to longevity through other behavioral pathways. For example, individuals experiencing mental health problems might be expected to practice fewer preventive behaviors and to take more risks with their physical health, such as paying less attention to proper nutrition or failing to exercise. The exploration of a variety of late life mediational variables is the focus of complex, ongoing research. In addition, it remains possible that behavioral variables do not completely account for the relationship seen between mental health problems and earlier mortality. Unstable emotional patterns such as hostility, depression, and repression, which are common in many mental illnesses, are also known to be predictive of physical health problems, perhaps through neuroendocrine pathways. Future research should continue to investigate whether there are links between specific emotional patterns and specific diseases or whether there is a more general effect of homeostatic disturbance.

When considering whether these results may be generalized to other groups, the uniqueness of the Terman sample must be kept in mind. These were very intelligent, middle class, White individuals who grew up in the 1920s, and this no doubt had some effect on both the causes of and their responses to mental health problems. Additionally, although the measure of mental health used in this study was based on a rich variety of data available to Terman and his colleagues, it nevertheless groups individuals with various sorts of psychological problems into three broad categories, disallowing an analysis of which spe-

cific psychological problems (such as are differentiated in the *Diagnostic and Statistical Manual of Mental Disorders;* American Psychiatric Association, 1994) are most predictive of earlier mortality. The relationship between mental and physical health is a complex one, with a variety of factors, both behavioral and psychosocial, presumably interacting to increase health risks for individuals with mental health problems. What is clear from these data is that intelligent people, especially men, who have experienced mental health problems by middle age are at significantly increased risk of all-cause premature mortality during the second half of their lives. Future research should aim at clarifying the roles of mediators of the relationship between mental health and longevity.

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