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Psychological Distress and Mortality among Adults in the U.S. Household Population

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Abstract

Objective. This report examines the relationship between psychological distress status in the past month preceding interview and mortality status over the follow-up period among adults aged 18 or older in the U.S. household population.

Methods. This study used data from the public use files of the 1997 to 2004 National Health Interview Survey (NHIS), which were linked to death certificate data from the 1997 to 2006 National Death Index (NDI). We measured psychological distress using the past month Kessler-6 (K6) scale to create (1) a two-category measure of serious psychological distress (SPD) as defined by a K6 score of 13 or greater and (2) a four-category measure of no, low, moderate, or high psychological distress based on scores of 0, 1 to 5, 6 to 10, and 11 to 24, respectively. Four mortality-related indices were used to assess the robustness of the influence of psychological distress on subsequent mortality during the follow-up period: (1) age-adjusted death rates per 100,000 person-years; (2) cumulative survival rates using a Kaplan-Meier survival function; (3) adjusted hazard ratios from Cox proportional hazards regression models; and (4) years of potential life lost (YPLL).

Results. In the 1997 to 2004 NHIS, an annual average of 3.1 percent (95 percent confidence interval [CI] = 3.0-3.2) of the adult population reported past month SPD. Overall, the analyses revealed a robust association between psychological distress and mortality. The age-adjusted death rate was more than twice as high for adults with SPD (1,763 per 100,000 person-years) compared with adults without SPD (840 per 100,000 person-years). Kaplan-Meier estimates revealed that the cumulative probability of dying by the end of the follow-up period was approximately 0.16 for those with SPD and approximately 0.09 for those without SPD.

Cox proportional hazards regression models indicated that SPD remained a significant risk factor for mortality even after controlling for sociodemographic characteristics, chronic health conditions, and behavioral risk factors. Compared with their counterparts without SPD, those aged 18 to 34 with SPD were 2.44 times more likely to have died during the follow-up period (hazards ratio [HR] = 2.44; 95 percent CI = 1.53-3.89); persons aged 35 to 54 with SPD were 1.25 times more likely to have died (HR = 1.25; 95 percent CI = 1.04-1.50); and persons aged 55 or older with SPD were 1.30 times more likely to have died (HR = 1.30; 95 percent CI = 1.18-1.44).

Adults with SPD at baseline who died had an excess mean YPLL of 3.8 (95 percent CI = 2.8-4.8); this indicates that persons with SPD who died during the follow-up period lost 4 years more of potential life than persons without SPD who died during the follow-up period. Persons with mental illness tend to smoke more than those without mental illness; although some of this excess premature mortality may be associated with smoking, the excess mean YPLL was still 1.5 (95 percent CI = 0.1-2.9) among never smokers aged 35 or older at baseline.

Conclusions. Using multiple mortality-related indices, this study shows that there is a robust association between psychological distress and mortality, even after adjusting for potentially confounding effects such as smoking and chronic health conditions. Our findings suggest that the integration of primary and behavioral health care may work toward reducing the mortality gap between persons with and without high levels of psychological distress.

Introduction

Mental illness is a major public health issue in the United States because it is associated with increased risk of premature death.[1,2,3] Reducing the mortality impact associated with mental illness and increasing life expectancy are important public health goals.[4] To that end, organizations such as the Substance Abuse and Mental Health Services Administration (SAMHSA) and the National Association of State Mental Health Program Directors (NASMHPD) have indicated that monitoring premature mortality attributable to mental illness is crucial to improve the lives of persons with mental illness.[5,6,7] This effort is important because in recent years the mortality gap appears to be widening between persons with mental illness, especially schizophrenia or bipolar disorder, and those without mental illness.[8,9]

The report contributes to the literature of mental illness and mortality by attempting to clarify the relationship between psychological distress and mortality using multiple analytic techniques.

Summary of Literature

Most previous studies estimating premature mortality associated with mental illness rely on data from clients receiving treatment for mental health problems. For example, findings from a study of 7 States that participated in the 16-State Study on Mental Health Performance Measures indicated that the mean years of potential life lost (YPLL) for deceased mental health clients ranged from 13.5 to 32.2.[6,7,10] Another study found that patients who were admitted to Ohio public mental health hospitals between 1998 and 2002 and who subsequently died during the same time period had a mean YPLL of 32.0.[11]

One issue with these estimates is that they provide the mean YPLL only for deceased persons with mental illness who received public mental health treatment. To truly understand how much mental illness contributes to premature mortality, it is necessary to compare the mean YPLL of deceased persons with mental illness and the mean YPLL of deceased persons without mental illness. Client-based studies are limited to just those who have sought mental health treatment, and thus

typically do not include any persons without mental illness. Furthermore, not all persons with mental illness receive mental health treatment, so the sample of mentally ill persons included in client-based samples may not represent the full population of persons with mental illness. However, several studies do provide a comparison of the mean YPLL between mental health clients with major mental illnesses (MMI) such as schizophrenia, major depressive disorders, bipolar disorders, delusional and psychotic disorders, or attention deficit/hyperactivity disorders versus clients with non-MMI diagnoses, based on criteria from the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).[6,7,10,12] In the States that included these data, the excess mean YPLL of mental health clients diagnosed with MMI compared to those with non-MMI ranged from -3.1 to 8.1 depending on the State and the year, with a median of about 2 years. Note that all individuals in this study had mental illness and were receiving mental health treatment. These comparisons show the excess mean YPLL for deceased persons who received mental health treatment and had MMI versus deceased persons who received mental health treatment and had a non-MMI. Thus, these comparisons do not provide information on the overall impact of mental illness on YPLL in the total population.

A few client-based studies have estimated the excess mean YPLL associated with mental illness and receiving public mental health treatment. For example, one study found that adults served by the Massachusetts Department of Mental Health who died between 1989 and 1994 had 8.8 more YPLL than adults in the State who died during the same period and did not receive departmental services.[13] Another study of clients of a community mental health center in Akron, Ohio, compared YPLL among decedents with serious and persistent mental disorders to the YPLL of nonclients; this study found that decedents in the client sample died an average of 4.2 years earlier than decedents who were not clients.[14]

Client-based studies have the advantage of providing a convenient sample of individuals, but these studies are not without limitations. First, participants in client-

based studies typically represent severe cases of mental illness and, therefore, may not represent all persons with mental illness in the household population. As data from the 2011 National Survey on Drug Use and Health (NSDUH) show, only 64.9 percent of adults with serious mental illness (SMI) in the past year and 40.8 percent of adults with any mental illness in the past year received mental health treatment services in the past year.[15] Client-based studies would underrepresent persons with mild to moderate mental illness because the most severely impaired patients usually receive services. Second, client-based studies have limited ability to control for factors that vary across patients because mental health clients often have similar characteristics, such as demographics and ability to access health services.[16]

Population-based studies using nationally based samples overcome the limitations of client-based studies by capturing a diverse range of mental illnesses among individuals who have varying degrees of contact with treatment systems; additionally, these studies often capture sufficient variation in demographic, health, and behavioral risk characteristics that enables the investigation of associations within particular subgroups. In one such study, data from the 1989 National Health Interview Survey (NHIS) linked with death records from the National Death Index (NDI) showed that having major depression was related to an increased risk of mortality for men but not for women during a 2.5-year follow-up period.[17] Another study used the 1997 to 2000 NHIS linked to the NDI for a follow-up period of up to 5 years to examine how premature death was related to experiencing psychological distress,[18] which is strongly associated with mental illness.[19,20] This study found that increases in levels of psychological distress were associated with corresponding increases in the risk of death. Although these studies avoided several pitfalls inherent to client-based samples, they used a relatively brief (5 years or less) follow-up period.

A more recent study examined the relationship between self-reported mental disorders and mortality using a longer follow-up period that averaged 17.5 years by linking the 1989 NHIS with NDI death records

through the end of 2006.[16] This study found that (1) persons with a mental disorder lost an average of 5.4 more years of life than those without a mental disorder and (2) the association between mental disorders and premature death became nonsignificant after adjusting for socioeconomic variables, health system factors, and baseline clinical characteristics. Additional investigation of the association between mental illness and mortality is needed to confirm findings across different data sources.

Objectives

The first objective of this *Data Review* is to update findings of prior household population-based studies of the relationship between mental illness and mortality using a nationally representative sample survey that is linked to the NDI. Both overall and selected causes of death were examined in relation to an indicator of mental illness (psychological distress) collected via a validated scale. When examining the relationship between psychological distress at baseline (i.e., time of interview) and death over the follow-up period, our analyses adjusted for important covariates, including sociodemographics, number of self-reported health conditions, and behavioral risk factors (e.g., overweight and obesity as measured by body mass index [BMI] and smoking) that have been linked to mental illness and/or mortality in prior studies.[11,18,21,22,23] The second objective is to assess the overall burden of premature death associated with psychological distress for those with different levels of BMI and by smoking status.

Data Sources and Measures

Data Sources

This report uses data from the NHIS public use files for the years 1997 to 2004 and the NDI for the years 1997 to 2006. The NHIS is sponsored by the National Center for Health Statistics (NCHS) within the Centers for Disease Control and Prevention (CDC). The NHIS gathers data on health conditions, health care access, behavioral risk factors, demographics, and socioeconomic factors. NHIS data are collected by the U.S. Census Bureau through face-to-face household interviews using computer-assisted personal

interviewing. NHIS data are weighted to account for selection probabilities and nonresponse. The data also are weighted to provide national estimates for the U.S. civilian, noninstitutionalized population. From 1997 to 2004, there were 258,279 adult respondents in the NHIS (**Table 1**). Response rates for these years ranged from 69 to 77 percent. Further information on the NHIS content, design, and sampling methodology are available on the CDC Web site and in other publications.[24,25]

The NDI is a centralized index of death records compiled by NCHS from State vital records' offices. It contains data on cause, place, and age of death and contains identifiers necessary for linking death records to national surveys.[26] Further information on the NDI content, design, and sampling methodology is available on the CDC Web site and in other publications.

NHIS and NDI data were matched using personal identifying information (e.g., Social Security number, gender, data of birth, last name, first initial).[27] This matched data set is available as a public use file, which was used in this report. Of the 258,279 adults

included in the NHIS from 1997 to 2004, 15,882 (approximately 6 percent) could not be matched to NDI and were excluded from analysis (**Table 1**). Additionally, a total of 3,586 records were deleted because of missing information on psychological distress. Therefore, these analyses are based on a sample of 238,811 adults, of whom 16,568 were identified as having died during the period between NHIS interview and December 31, 2006.[28]

Outcome Measures

The primary outcomes in this study included overall death and the three leading causes of death: (1) *heart diseases*; (2) *malignant neoplasms* (e.g., cancer and malignant tumors); and (3) *assaults/accidents/unintentional poisonings*.[29] Between 1997 and 2006, heart diseases accounted for 28 percent of all deaths, malignant neoplasms for 25 percent, and assaults/accidents/unintentional poisonings for 2 percent.

Four types of analyses were conducted to examine the association between psychological distress and mortality to enable comparisons with prior findings and

Table 1. Number of National Health Interview Survey Adult Participants, by Eligibility Status for National Death Index Linkage, Availability of Kessler-6 Data, Number of Deaths, and Follow-Up Time (1997 to 2004)

NHIS Year	Adults (N)	Not Eligible for NDI Data Linkage (N)[1]	Eligible for NDI Data Linkage (N)	Eligible for NDI Data Linkage (%)	Excluded from Analysis Due to Missing K6 Data (N)	Final Analysis Sample (N)	Deaths over Follow-Up Period (1997-2006) (N)	Minimum Length of Follow-Up Time (Years)	Maximum Length of Follow-Up Time (Years)
1997	36,116	1,723	34,393	95.2	356	34,037	3,875	9.13	9.87
1998	32,440	1,863	30,577	94.3	354	30,223	3,158	8.13	8.87
1999	30,801	1,725	29,076	94.4	356	28,720	2,484	7.13	7.87
2000	32,374	1,779	30,595	94.5	422	30,173	2,160	6.13	6.87
2001	33,326	1,968	31,358	94.1	701	30,657	1,819	5.13	5.87
2002	31,044	2,049	28,995	93.4	492	28,503	1,332	4.13	4.87
2003	30,852	2,642	28,210	91.4	462	27,748	1,050	3.13	3.87
2004	31,326	2,133	29,193	93.2	443	28,750	690	2.13	2.87
Total	258,279	15,882	242,397	93.9	3,586	238,811	16,568	--	--

-- = not applicable; K6 = Kessler-6 scale; NDI = National Death Index; NHIS = National Health Interview Survey.

[1] Ineligibility resulted from the NHIS record not containing enough personal identifying information (e.g., an appropriate combination of Social Security number, gender, date of birth, last name, and/or first initial) to enable linkage to the NDI.

Source: 1997 to 2004 CDC/NCHS National Health Interview Survey.

to ensure a robust evaluation: (1) age-adjusted death rates per 100,000 person-years; (2) cumulative survival rates (likelihood of surviving the follow-up period); (3) hazard ratios (likelihood of death during the follow-up period for persons with high levels of psychological distress relative to those with low levels); and (4) years of potential life lost (YPLL) for those with high levels of psychological distress relative to those with low levels.

For the analyses involving the calculation of death rates per 100,000 person-years, we created a data file in which each participant contributed as many discrete person-years (range of 1 to 10) over the follow-up period from the date of interview through the date of death or December 31, 2006 (i.e., the study end date). To protect participants' identities, the NHIS-linked public use files do not contain the exact date of the interview or death. Instead, they provide the quarter of the year for the NHIS interview and the quarter of the year for the date of death, if deceased.

The minimum and maximum length of the follow-up period of the study subjects varies by the NHIS survey year. For example, it was 2.13 and 2.87 years for those interviewed in the last and first quarters of 2004, respectively; the corresponding minimum and maximum length was 9.13 and 9.87 years for those interviewed in the last and first quarters of 1997, respectively (**Table 1**). The mean follow-up time was 5.75 years (range = 2.13-9.87 years) for all study respondents.

The survival time in years was calculated as the time elapsed between the approximate date of the interview (midpoint of the quarter) and the approximate date of death (midpoint of the quarter) or the last known date alive (midpoint of the last quarter of 2006) for those who lived. Then the total number of person-years contributed was calculated by rounding the survival time to the next year. Computed survival times that did not contain partial years (e.g., 1.0 or 2.0) were also rounded to the next year. For example, a person who was interviewed in the first quarter of 2003 who died in the first quarter of 2004 survived for 1.0 years but contributed 2 person-years to the analysis (death occurred during the second study year). Although, in this example, we do not know whether the person

actually died during the first or second year of follow-up, instances in which an individual was interviewed and died in the same quarter and same year necessitated using this convention (because it is known that the person died in the first year of follow-up). Otherwise, persons who were interviewed and died in the same quarter and same year would not have contributed any information to the person-year file. For persons who survived to the study end date, the survival time was exactly the same as the maximum length of follow-up (e.g., 2.87 years for those interviewed in the first quarter of 2004 and 9.87 years for those interviewed in the first quarter of 1997; the corresponding person-years of observation were 3 and 10, respectively). For individuals who died during the follow-up period, the survival time ranged from 0 to 9.75 years; the corresponding person-years of observation ranged from 1 to 10.

The following examples illustrate how person-years of observation were created. First, persons interviewed in the first quarter of 1997 who died in the same quarter of that year each contributed 0 years of survival time or 1 person-year of observation. Second, persons interviewed in the second quarter of 1999 who died in the third quarter of 2002 each contributed 3.25 years of survival time (May 15, 1999, through August 15, 2002) or 4 person-years of observation. Third, persons interviewed in the fourth quarter of 2002 who died in the fourth quarter of 2003 each contributed 1 year of survival time and 2 person-years of observation (November 15, 2002, through November 15, 2003). Fourth, persons interviewed in the first quarter of 1999 who died in the last quarter of 2006 contributed 7.87 years of survival time, or 8 person-years of observation. Using similar logic, we constructed 1,523,205 discrete person-years of observation that were contributed by 238,811 survey participants over the follow-up period that ranged from 2.13 to 9.87 years. In the person-year-level file, all characteristics collected at the NHIS interview were held constant across respective person-years of observation for each participant. The only time-varying characteristic across the follow-up period was the respondent's current age.

The mean YPLL measure was used to compare the burden of premature death between the group of

individuals with and without serious psychological distress (SPD). YPLL was calculated by multiplying the number of deaths at each age by the life expectancy at the age of death, and then summing the product across all deaths in the population of interest. Next, the YPLL count was divided by the total number of deaths to get the mean YPLL per decedent in that population. The life expectancy estimates were used from the CDC's 2006 U.S. life tables by gender.[30] For example, according to the CDC tables, a male who lives to the age of 45 years is expected to live 33.1 more years (until the age of 88.1); thus a male who dies at the age of 45 had a YPLL of 33.1 years. This life expectancy-based YPLL measure was chosen to allow comparisons with prior studies that have estimated the burden of mental illness on premature mortality.[10,11,13,14]

Psychological Distress

Past month psychological distress was measured in the NHIS using the Kessler-6 (K6) scale.[20] The K6 measures psychological distress with six questions (e.g., "How often did you feel nervous?" "How often did you feel hopeless?") scored on a five-point Likert scale ranging from none of the time to all of the time. The K6 scale is a widely used indicator of nonspecific psychological distress, and is highly correlated with mental illness. Moreover, studies have shown that having a score of 13 or greater on the K6 is a strong indicator of the presence of a diagnosable mental illness with considerable disability.[19,20]

Two measures are used in this analysis. The first is a dichotomous measure of SPD based on a score of 13 or greater on the K6 scale. The second is a four-category measure of level of psychological distress (no, low, moderate, and high); these are based on scores on the K6 scale of 0, 1 to 5, 6 to 10, and 11 to 24, respectively. These categories correspond with approximately 50, 35, 10, and 5 percent of the adult population in our household sample.

Other Variables

Several sociodemographic factors have been shown in previous studies to influence the association between mental illness and mortality.[18] The following such factors were included in this analysis: (1) *age in years*

(18 to 34, 35 to 54, and 55 or older); (2) *gender*; (3) *education* (less than high school, high school graduate/GED [general equivalency diploma]/some college, college graduate); (4) *insurance coverage* (any type of individual coverage, no coverage); (5) *race/ ethnicity* (white, not Hispanic or Latino; black or African American, not Hispanic or Latino; Hispanic or Latino; and "other," which included non-Hispanic Asians, Pacific Islanders, and Native Americans); and (6) *marital status* (currently married, separated or divorced, widowed, never married).

Health behaviors included in this study were (1) *smoking status* (current daily smoker, current occasional smoker, former smoker [none in the past month], and never smoked)[31]; (2) *alcohol use* (current [past month] alcohol use, former alcohol use [none in the past month], never used alcohol)[32]; and (3) *BMI calculated from self-reported height and weight* (BMI < 20 = underweight, 20 ≤ BMI < 25 = normal weight, 25 ≤ BMI < 30 = overweight, and BMI ≥ 30 = obese).[33]

Six chronic health conditions were included: (1) *heart disease* (coronary heart disease, angina, myocardial infarction, or other heart condition); (2) *stroke*; (3) *cancer*; (4) *lung disease* (emphysema, asthma, or chronic bronchitis); (5) *diabetes*; and (6) *hypertension* (high blood pressure at two or more doctor visits). Conditions were examined both individually and with a summed physical health measure of the six physical health indicators (categorized as none, one, or two or more). Functional impairment included (1) *needing an assistive living device* (e.g., a walker, a special bed) and (2) *having any limitations in the activities of daily living*. Health care utilization included four levels of past year care: (1) *received general medical care (GMC) but no specialized psychiatric care (SPC)*; (2) *received SPC but no GMC*; (3) *received both GMC and SPC*; and (4) *received no GMC or SPC*.

Statistical Analyses

The relationship between past month psychological distress at the time of the interview and at death during the follow-up period was examined in four ways. First, death rates were calculated based on 100,000 person-years for overall mortality and for each of the three

leading causes of death. Age adjustment was completed using direct standardization to the age distribution of the U.S. population in the year 2000, thereby removing the confounding effect of age when comparing death rates. Death rates were estimated by respondent characteristics, SPD, level of psychological distress, and different lengths of follow-up period. Analyses examining death rates for the three leading causes of death (i.e., heart diseases, malignant neoplasms, and assaults/accidents/unintentional poisonings) are also presented. We present age-adjusted rates for all of the other covariates. Thus, differences in death rates are reported for each group after taking into account differences in ages between the groups.

Second, the cumulative survival rates for those with and without SPD were estimated at each follow-up time for the full sample and by age groups using the Kaplan and Meier method.[34] This approach accounts for variation in the length of the follow-up period and for censoring, which occurs when the outcome of interest (i.e., death in this study) has not occurred by the end of the observational period.

Cox proportional hazards regression models were estimated to identify the likelihood of death by SPD status.[35] Cox proportional hazards regression also accounts for censoring and unequal follow-up periods and has the advantage of allowing for the inclusion of covariates. For each of three age groups (18 to 34, 35 to 54, 55 or older), three sets of Cox proportional hazards regression models were estimated: (1) an unadjusted model including SPD as the only predictor; (2) a model that included SPD and adjusted for gender, race/ethnicity, education, and marital status; and (3) a model that included SPD and adjusted for gender, race/ethnicity, education, and marital status, as well as factors that have been closely linked with both SPD and premature death: number of chronic conditions, BMI category, and current and past history of smoking. These models then were repeated using the four-level measure of psychological distress in place of SPD.

Finally, the mean YPLL among those with SPD who died was compared to the mean YPLL among those without SPD who died. We analyzed adults aged 18 or older, and also analyzed those aged 35 or older because

few deaths occur between the ages of 18 and 34. For a description of how we validated our findings with those produced by CDC and NCHS-compiled mortality data, please see Appendix A.

All statistical analyses were performed using SUDAAN® release 10.0.[36] Unless otherwise noted, appropriate weights were applied to permit generalization to the U.S. civilian, noninstitutionalized adult population. The sample design variables were used to adjust for clustering and stratification in order to produce correct standard errors (SEs) of the estimates. For all statistical tests, a p value of < .05 was considered statistically significant.

Results

Sample Characteristics

An annual average of 3.1 percent of adults (6 million persons) had past month SPD (K6 ≥ 13). This prevalence varied significantly by age (**Figure 1**), with the highest rates at baseline among those aged 45 to 54. Regarding the four-level measure of psychological distress, approximately 5 percent of the sample had high levels of psychological distress (K6 score of 11 or greater), about 10 percent had moderate levels (K6 score of 6 to 10), more than one third had low levels (K6 score of 1 to 5), and more than one half reported no past month psychological distress symptoms (K6 score of 0).

The characteristics of those with and without SPD are shown in **Table 2**. Adults with SPD were more likely than adults without SPD to be aged 45 to 54, be female, have less than a high school education, and not have insurance coverage. Compared with adults without SPD, adults with SPD were also more likely to be obese, to be current daily smokers, and to use assistive living devices. Furthermore, persons with SPD were more likely than persons without SPD to have been told by a doctor that they had heart disease, stroke, cancer, lung disease, diabetes, or hypertension.

Psychological Distress and Associated Risk of Mortality

The overall age-adjusted death rate between 1997 and 2004 for adults aged 18 or older was 865 per

100,000 person-years (**Table 3**). The death rate was more than twice as high among those with SPD (1,763 per 100,000 person-years) than among those without SPD (840 per 100,000 person-years). In addition, the death rate increased with each increase in the level of psychological distress based on K6 score (725, 861, 1,267, and 1,700 per 100,000 person-years for no, low, moderate, and high levels of psychological distress, respectively).

To determine whether death rates between those with and without SPD varied by length of follow-up, death rates for 2-, 5-, and 9-year follow-up intervals were calculated. Determining whether the rates of deaths for those with and without SPD were constant across the follow-up period would lend further clues about the consistency and temporal nature of the associations. As **Figure 2** shows, the age-adjusted death rate was 1,927 per 100,000 person-years versus 761 per 100,000 person-years in the 2-year follow-up, 1,915 per 100,000 person-years versus 867 per 100,000 person-years in
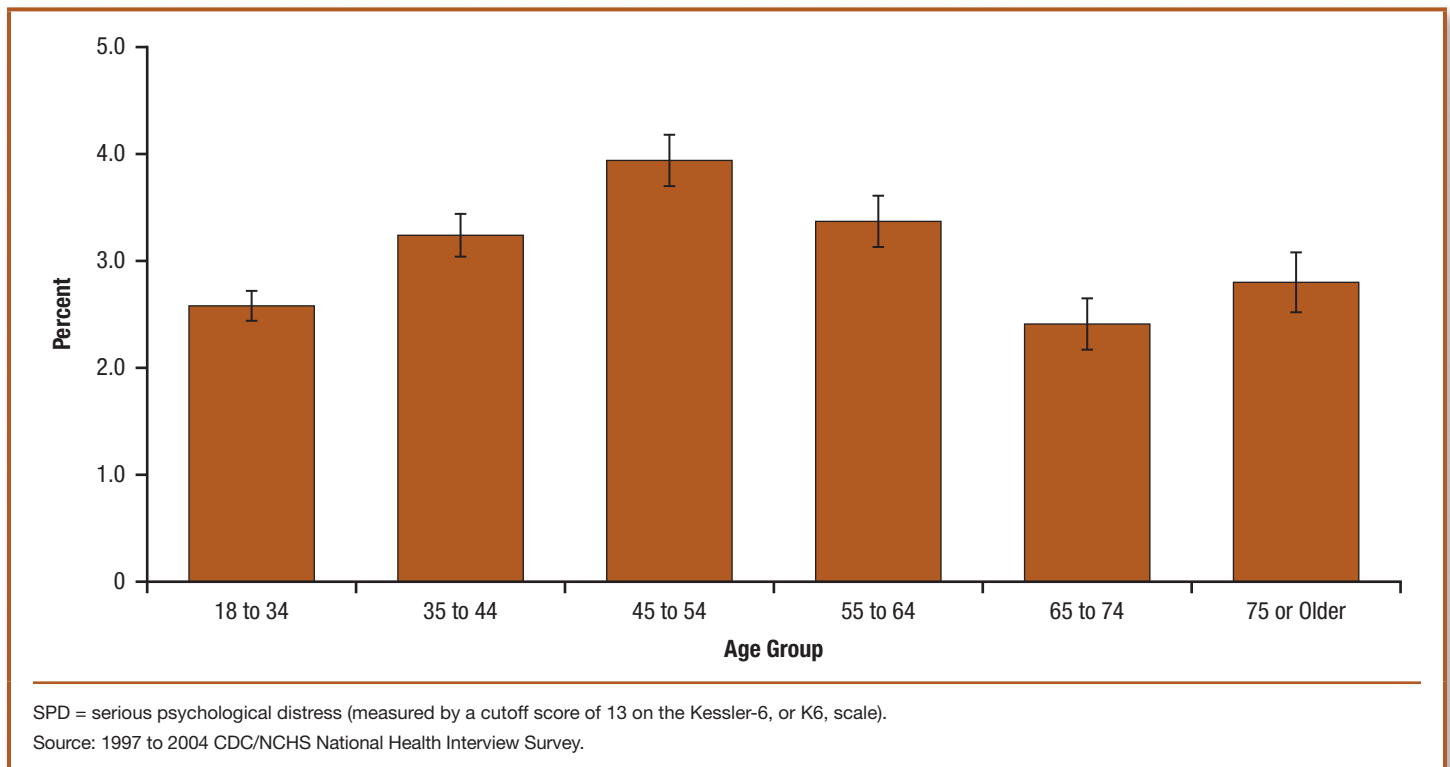
the 5-year follow-up, and 1,856 per 100,000 person-years versus 937 per 100,000 person-years in the 9-year follow-up among adults with and without SPD, respectively. Thus, the death rate was higher for those with SPD than for those without SPD, regardless of the length of the follow-up period.

Sociodemograpic and Health Risk Behaviors Associated with Mortality

Death rates varied by sociodemographic factors (**Table 3**). The age-adjusted death rates increased with age and were higher among males than females, among non-Hispanic blacks than other racial/ethnic groups, and among those with less than a high school education than those with higher levels of education. Rates were lower among those who were married than those who were widowed, never married, or separated/divorced.

Both smoking status and BMI were related to differences in death rates. Current daily smokers had a higher age-adjusted death rate than those who

Figure 1. Past Month Serious Psychological Distress (SPD) Prevalence, by Age Group at Time of Interview: National Health Interview Survey (1997 to 2004)

SPD = serious psychological distress (measured by a cutoff score of 13 on the Kessler-6, or K6, scale).
Source: 1997 to 2004 CDC/NCHS National Health Interview Survey.

Table 2. Characteristics at Time of Interview for Persons Aged 18 or Older: National Health Interview Survey (1997 to 2004)

Characteristic	Total (n = 238,811) Weighted Percentage (SE)	Individuals with SPD[1] (n = 8,451) Weighted Percentage (SE)	Individuals without SPD[1] (n = 230,360) Weighted Percentage (SE)
Age in Years			
18 to 34	31.95 (0.22)	26.87 (0.59)	32.11 (0.23)
35 to 44	21.66 (0.11)	22.84 (0.55)	21.62 (0.11)
45 to 54	18.35 (0.12)	23.54 (0.54)	18.18 (0.12)
55 to 64	12.05 (0.10)	13.25 (0.42)	12.01 (0.10)
65 to 74	8.78 (0.09)	6.91 (0.31)	8.84 (0.10)
75 or Older	7.22 (0.10)	6.58 (0.31)	7.24 (0.10)
Gender			
Male	47.92 (0.13)	36.40 (0.68)	48.29 (0.13)
Female	52.08 (0.13)	63.60 (0.68)	51.71 (0.13)
Education (n = 237,583)			
Less than High School	17.63 (0.19)	35.84 (0.72)	17.05 (0.19)
High School Graduate/GED/Some College	58.87 (0.20)	55.64 (0.70)	58.97 (0.21)
College Degree	23.50 (0.24)	8.52 (0.39)	23.98 (0.25)
Insurance Coverage (n = 238,287)			
Yes	85.05 (0.14)	75.60 (0.61)	85.35 (0.14)
No	14.95 (0.14)	24.40 (0.61)	14.65 (0.14)
Race/Ethnicity			
White, Not Hispanic or Latino	73.82 (0.31)	70.13 (0.80)	73.94 (0.31)
Black or African American, Not Hispanic or Latino	11.26 (0.23)	12.85 (0.55)	11.21 (0.23)
Hispanic or Latino	10.97 (0.22)	13.60 (0.50)	10.89 (0.22)
Other[2]	3.95 (0.11)	3.42 (0.30)	3.97 (0.11)
Marital Status (n = 238,278)			
Currently Married	64.07 (0.21)	50.93 (0.73)	64.49 (0.22)
Separated/Divorced	10.47 (0.08)	21.25 (0.49)	10.13 (0.08)
Widowed	6.51 (0.08)	8.97 (0.33)	6.44 (0.08)
Never Married	18.95 (0.20)	18.85 (0.52)	18.95 (0.20)
Activities of Daily Living (n = 238,477)			
Any Limitations	31.87 (0.20)	73.00 (0.63)	30.57 (0.20)
No Limitations	68.13 (0.20)	27.00 (0.63)	69.43 (0.20)
BMI (n = 231,385)			
Underweight	6.68 (0.07)	8.52 (0.40)	6.62 (0.07)
Normal Range	35.80 (0.15)	29.92 (0.64)	35.98 (0.15)
Overweight	35.30 (0.12)	29.32 (0.60)	35.49 (0.12)
Obese	22.23 (0.13)	32.24 (0.59)	21.91 (0.13)
Smoking Status (n = 237,918)			
Current Daily	18.99 (0.15)	37.86 (0.65)	18.39 (0.15)
Current Occasional	4.21 (0.05)	5.57 (0.30)	4.17 (0.05)
Former	22.54 (0.13)	19.93 (0.53)	22.62 (0.13)
Never	54.23 (0.19)	36.59 (0.64)	54.79 (0.18)

(continued)

Table 2. Characteristics at Time of Interview for Persons Aged 18 or Older: National Health Interview Survey (1997 to 2004) *(continued)*

Characteristic	Total (n = 238,811) Weighted Percentage (SE)	Individuals with SPD[1] (n = 8,451) Weighted Percentage (SE)	Individuals without SPD[1] (n = 230,360) Weighted Percentage (SE)
Drinking Status (n = 236,186)			
Current	62.71 (0.25)	52.31 (0.79)	63.03 (0.25)
Former	14.91 (0.13)	23.69 (0.58)	14.63 (0.12)
Never	22.38 (0.22)	23.99 (0.66)	22.33 (0.22)
Assistive Device[3] (n = 238,758)			
Yes	5.20 (0.07)	18.38 (0.50)	4.78 (0.06)
No	94.80 (0.07)	81.62 (0.50)	95.22 (0.06)
Type of Care (n = 236,269)			
GMC Only	75.04 (0.14)	55.85 (0.65)	75.64 (0.15)
SPC Only	0.29 (0.01)	1.14 (0.13)	0.26 (0.01)
Both GMC and SPC	5.85 (0.06)	30.80 (0.61)	5.06 (0.06)
No Care	18.83 (0.13)	12.21 (0.44)	19.04 (0.14)
Chronic Conditions			
Heart Disease (n = 238,009)			
Yes	11.20 (0.10)	23.66 (0.62)	10.81 (0.10)
No	88.80 (0.10)	76.34 (0.62)	89.19 (0.10)
Stroke (n = 238,626)			
Yes	2.26 (0.04)	7.30 (0.34)	2.10 (0.04)
No	97.74 (0.04)	92.70 (0.34)	97.90 (0.04)
Cancer (n = 238,621)			
Yes	6.69 (0.07)	10.27 (0.43)	6.58 (0.07)
No	93.31 (0.07)	89.73 (0.43)	93.42 (0.07)
Lung Disease (n = 238,372)			
Yes	13.40 (0.09)	31.25 (0.63)	12.84 (0.09)
No	86.60 (0.09)	68.75 (0.63)	87.16 (0.09)
Diabetes (n = 238,680)			
Yes	7.05 (0.07)	15.24 (0.44)	6.79 (0.07)
No	92.95 (0.07)	84.76 (0.44)	93.21 (0.07)
Hypertension (n = 238,424)			
Yes	20.46 (0.14)	35.64 (0.62)	19.98 (0.14)
No	79.54 (0.14)	64.36 (0.62)	80.02 (0.14)

BMI = body mass index; GED = general equivalency diploma; GMC = general medical care; SE = standard error; SPC = specialized psychiatric care; SPD = serious psychological distress (measured by a cutoff score of 13 on the K6).

NOTE: Cases with missing data were excluded from analysis.

[1] All characteristics significantly differed by SPD status at *p* < .05.

[2] "Other" includes not Hispanic Asians, Pacific Islanders, and Native Americans.

[3] Examples include a walker, wheelchair, special bed, or special telephone.

Source: 1997 to 2004 CDC/NCHS National Health Interview Survey.

Table 3. Estimated Age-Adjusted Death Rates per 100,000 Person-Years from All Causes Combined, Averaged across the Follow-Up Period (1997 to 2006), by Characteristics at Time of Interview: National Health Interview Survey (1997 to 2004)

Characteristic	Age-Adjusted Death Rate[1,2] (SE)
Total	865 (8)
Gender	
Male	1,047 (14)
Female	724 (9)
Education	
Less than High School	1,193 (18)
High School Graduate/GED/Some College	816 (11)
College Degree	617 (18)
Insurance Coverage	
Yes	854 (8)
No	971 (91)
Race/Ethnicity	
White, Not Hispanic or Latino	849 (9)
Black or African American, Not Hispanic or Latino	1,148 (25)
Hispanic or Latino	742 (22)
Other[3]	560 (49)
Marital Status	
Currently Married	739 (11)
Separated/Divorced	1,055 (25)
Widowed	1,101 (43)
Never Married	1,099 (35)
Activities of Daily Living	
Any Limitations	1,186 (14)
No Limitations	546 (10)
SPD	
Yes	1,763 (69)
No	840 (8)
K6 Score	
0	725 (10)
1 to 5	861 (14)
6 to 10	1,267 (29)
11 to 24	1,700 (51)
BMI	
Underweight	1,547 (46)
Normal Range	895 (15)
Overweight	735 (12)
Obese	853 (17)

Characteristic	Age-Adjusted Death Rate[1,2] (SE)
Smoking Status	
Current Daily	1,424 (33)
Current Occasional	1,185 (65)
Former	923 (14)
Never	657 (10)
Drinking Status	
Current	715 (11)
Former	1,205 (20)
Never	855 (15)
Assistive Device[4]	
Yes	2,262 (63)
No	723 (8)
Type of Care	
GMC Only	849 (9)
SPC Only	N/E
Both GMC and SPC	1,340 (58)
No Care	762 (22)
Chronic Conditions	
None	565 (12)
One	792 (14)
Two or More	1,453 (28)

BMI = body mass index; GED = general equivalency diploma; GMC = general medical care; SE = standard error; SPC = specialized psychiatric care; SPD = serious psychological distress (measured by a cutoff score of 13 on the K6).

NOTE: The death rate is the number of deaths per 100,000 person-years and is annualized. The age-adjusted death rates were calculated by standardizing the age distribution of the study population to that of the U.S. population in the year 2000.

[1] The overall association between each characteristic at the time of interview and the death rate is significant (p < .05) except for the age-adjusted death rate for insurance coverage.

[2] The death rate (and standard error) for each "current" age group was as follows: aged 18 to 34 = 74 (5); aged 35 to 44 = 154 (7); aged 45 to 54 = 362 (12); aged 55 to 64 = 802 (23); aged 65 to 74 = 1,930 (40); aged 75 or older = 5,862 (68). Unlike the age at time of interview, the current age is defined as the respondent's age at each year of follow-up (see text for details).

[3] "Other" includes not Hispanic Asians, Pacific Islanders, and Native Americans.

[4] Examples include a walker, wheelchair, special bed, or special telephone.

Sources: 1997 to 2006 CDC/NCHS National Death Index; 1997 to 2004 CDC/NCHS National Health Interview Survey.

occasionally smoked, those who formerly smoked, and those who never smoked. The age-adjusted death rates were also higher among those who were underweight compared with those who were of normal weight, overweight, or obese.

Psychological Distress and Leading Causes of Death

Adults with SPD had significantly higher adjusted death rates for each of the three leading causes of death compared with those without SPD (**Table 4**). Examining levels of psychological distress, adults with high psychological distress (K6 scores of 11 or greater) had significantly higher rates of each cause of death than adults with K6 scores of less than 6. Interpretations of the death rates presented in **Tables 3 and 4** should be made with caution, because these rates were age adjusted only and did not control for other characteristics.
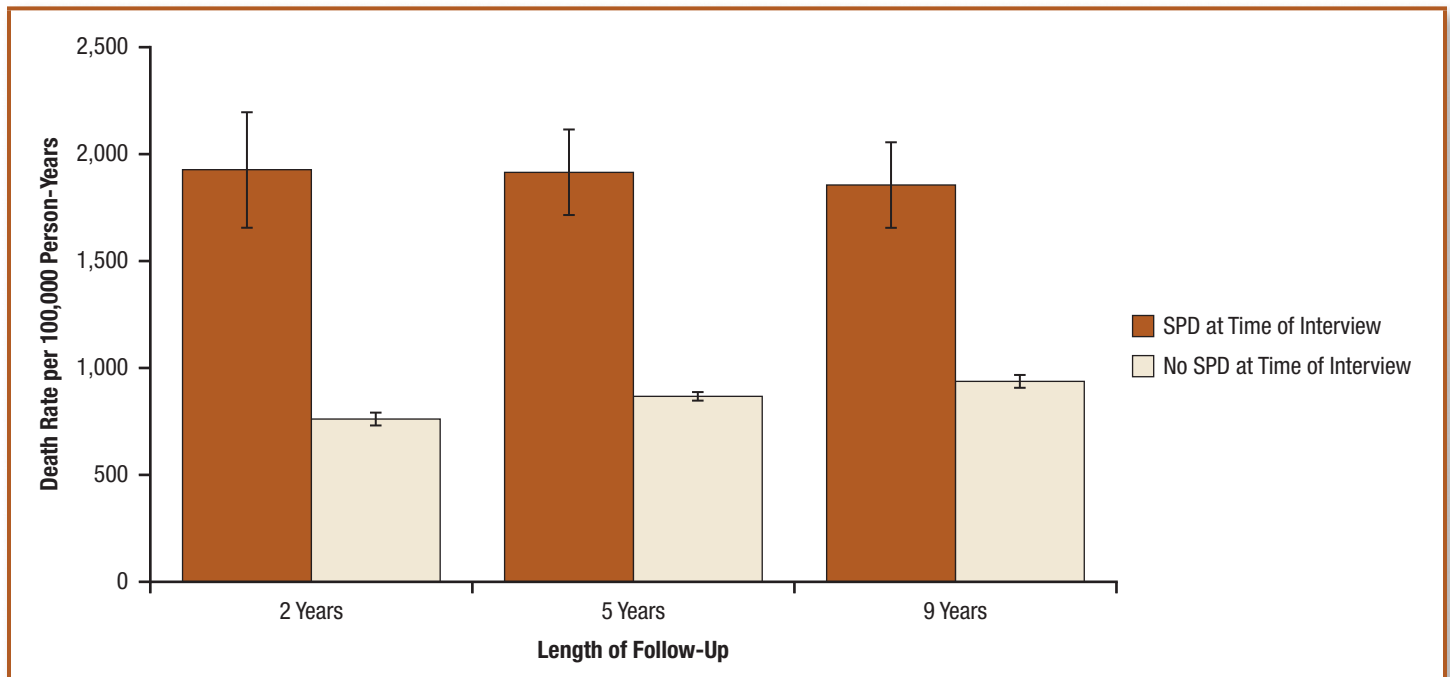
Psychological Distress and Time to Death

Figure 3 presents Kaplan-Meier estimates of the cumulative probability of survival during the course of the follow-up period for adults with and without SPD. These curves indicate that 84 percent of those with past month SPD at the time of the interview were estimated to have survived throughout the 10-year follow-up; therefore, 16 percent (1.00 – 0.84 = 0.16) of individuals with SPD were estimated to have died. This contrasts with the estimated 9 percent of adults without SPD who were estimated to have died during the first 10 years following the NHIS interview.

Psychological Distress and Risk of Death

A series of unadjusted Cox proportional hazards regression models were estimated, followed by models adjusted for various demographic and behavioral risk factors to show any reduction in significance of the SPD variable (evidence that the demographic or behavioral risk factors help to explain the association between SPD and death). The models were run separately by age group because of the higher likelihood of death among those in older age groups.

Figure 2. Age-Adjusted All-Cause Death Rates per 100,000 Person-Years, by Past Month Serious Psychological Distress (SPD) Status for 2-, 5-, and 9-Year Follow-Up Periods (1997 to 2006): National Health Interview Survey (1997 to 2004)

SPD = serious psychological distress (measured by a cutoff score of 13 on the Kessler-6, or K6, scale).
NOTE: The age-adjusted death rates were calculated by standardizing the age distribution of the study population to that of the U.S. population in the year 2000.
Sources: 1997 to 2006 CDC/NCHS National Death Index; 1997 to 2004 CDC/NCHS National Health Interview Survey.

Table 4. Estimated Age-Adjusted Death Rates per 100,000 Person-Years from Specific Causes, Averaged across the Follow-Up Period (1997 to 2006), Characteristics at Time of Interview: National Health Interview Survey (1997 to 2004)

Characteristic	Heart Diseases: Age-Adjusted Death Rate[1] (SE)	Malignant Neoplasms: Age-Adjusted Death Rate[1] (SE)	Assaults/Accidents/ Unintentional Poisonings: Age-Adjusted Death Rate[1] (SE)
Total	251 (4)	221 (4)	19 (1)
Gender			
Male	319 (8)	280 (7)	24 (2)
Female	200 (5)	178 (4)	14 (1)
Education			
Less than High School	354 (10)	285 (9)	29 (3)
High School Graduate/GED/Some College	227 (6)	218 (6)	18 (2)
College Degree	176 (9)	167 (9)	13 (3)
Insurance Coverage			
Yes	250 (4)	219 (4)	17 (1)
No	286 (61)	244 (38)	17 (3)
Race/Ethnicity			
White, Not Hispanic or Latino	244 (5)	220 (4)	18 (1)
Black or African American, Not Hispanic or Latino	362 (14)	275 (14)	23 (4)
Hispanic or Latino	233 (15)	174 (13)	17 (3)
Other[2]	130 (24)	162 (21)	11 (5)
Marital Status			
Currently Married	203 (6)	211 (5)	15 (2)
Separated/Divorced	281 (13)	258 (12)	30 (6)
Widowed	346 (27)	237 (15)	10 (2)
Never Married	348 (21)	250 (18)	28 (6)
Activities of Daily Living			
Any Limitations	346 (7)	273 (7)	25 (3)
No Limitations	136 (5)	182 (5)	15 (1)
SPD			
Yes	523 (40)	350 (32)	68 (15)
No	244 (4)	217 (4)	17 (1)
BMI			
Underweight	403 (22)	385 (24)	42 (8)
Normal Range	252 (7)	235 (8)	17 (2)
Overweight	210 (6)	203 (6)	16 (2)
Obese	273 (10)	196 (8)	20 (3)
Smoking Status			
Current Daily	355 (17)	475 (21)	37 (5)
Current Occasional	346 (37)	305 (34)	37 (10)
Former	259 (7)	253 (8)	15 (2)
Never	210 (5)	138 (4)	13 (1)

(continued)

Table 4. Estimated Age-Adjusted Death Rates per 100,000 Person-Years from Specific Causes, Averaged across the Follow-Up Period (1997 to 2006), Characteristics at Time of Interview: National Health Interview Survey (1997 to 2004) *(continued)*

Characteristic	Heart Diseases: Age-Adjusted Death Rate[1] (SE)	Malignant Neoplasms: Age-Adjusted Death Rate[1] (SE)	Assaults/Accidents/ Unintentional Poisonings: Age-Adjusted Death Rate[1] (SE)
Drinking Status			
Current	186 (5)	216 (6)	17 (2)
Former	362 (11)	293 (10)	25 (4)
Never	266 (9)	188 (7)	17 (2)
Assistive Device[3]			
Yes	660 (25)	393 (25)	63 (17)
No	198 (4)	208 (4)	17 (1)
Type of Care			
GMC Only	251 (5)	217 (5)	16 (1)
SPC Only	N/E	N/E	N/E
Both GMC and SPC	351 (33)	248 (25)	52 (13)
No Care	209 (11)	223 (12)	18 (3)
Chronic Conditions			
None	145 (6)	155 (6)	15 (2)
One	201 (7)	218 (7)	25 (3)
Two or More	446 (12)	348 (14)	22 (3)

BMI = body mass index; GED = general equivalency diploma; GMC=general medical care; N/E = not estimated due to small cell size (number of deaths < 20); SE = standard error; SPC = specialized psychiatric care; SPD = serious psychological distress (measured by a cutoff score of 13 on the K6).

NOTE: Heart diseases, malignant neoplasms, and assaults/accidents/unintentional poisonings were the three most common causes of death and accounted for 55 percent of all deaths. Malignant neoplasms include cancer or other malignant tumors.

NOTE: The death rates are the number of deaths per 100,000 person-years and are annualized. The age-adjusted death rates were calculated by standardizing the age distribution of the study population to that of the U.S. population in the year 2000.

[1] The overall association between all characteristics at time of interview and the death rate is significant (p < .05) except for the age-adjusted death rates for insurance coverage, type of care (for malignant neoplasms only), and race/ethnicity (for assaults/accidents/unintentional poisonings only).

[2] "Other" includes not Hispanic Asians, Pacific Islanders, and Native Americans.

[3] Examples include a walker, wheelchair, special bed, or special telephone.

Sources: 1997 to 2006 CDC/NCHS National Death Index; 1997 to 2004 CDC/NCHS National Health Interview Survey.
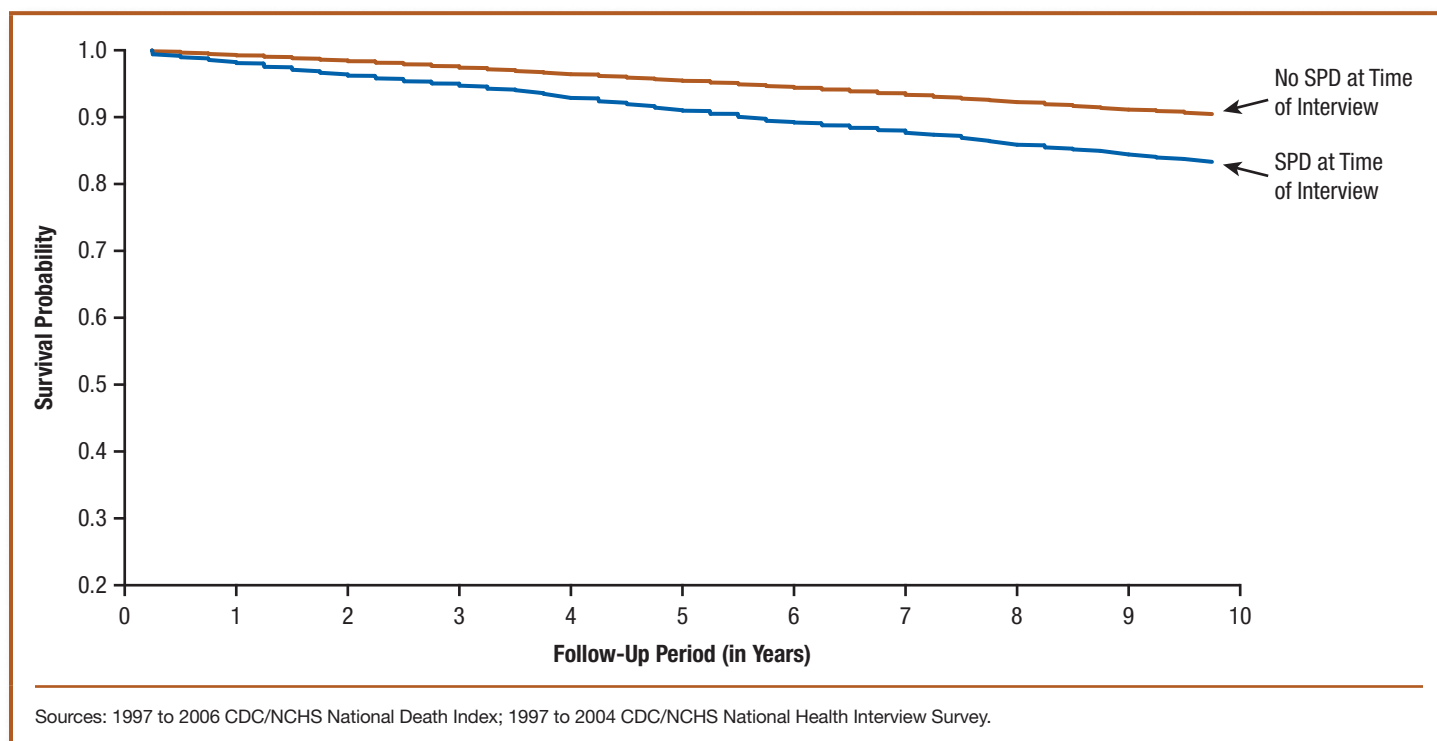
SPD. Across all age groups, the unadjusted comparisons indicated that the risk of death for adults with SPD was significantly higher than for adults without SPD. For example, for adults aged 18 to 34, those with SPD were more than 3 times as likely to die as those without SPD (**Table 5**, model A1). The risk of death remained significantly associated with SPD status after controlling for the sociodemographic characteristics of gender, race/ethnicity, and marital status, although the magnitude of these risks was slightly reduced (**Table 5**, models A2, A5, A8). The magnitude of the associations between SPD and death were further decreased by adding the health and behavioral risk factors, which included chronic conditions, BMI, and smoking status, although these associations remained statistically significant (**Table 5**, models A3, A6, A9). Additional analyses across all three age groups indicated that the reduction in the magnitude of the association between SPD and mortality between the models adjusted for sociodemographic variables only and the models adjusted for sociodemographic, health, and behavioral risk variables was largely attributable to the stepwise

addition of the variable indicating the presence of one or more chronic health conditions.[37]

Levels of Psychological Distress. Adjusted analyses for the youngest age group found a significant increased risk of death over the follow-up period among adults with high levels of distress only. Adults aged 18 to 34 who had a K6 score of 11 or greater were 1.94 times more likely to die than adults in this age group with no distress (K6 = 0) when adjusted for various covariates (**Table 5**, model B3). Among adults aged 35 to 54 and those aged 55 or older, all levels of distress (low, moderate, and high) were also associated with an increased adjusted risk of death, but at much lower magnitudes, when compared with adults with no distress (**Table 5**, models B4-B9).

Overall, adding sociodemographic characteristics to the regression models only slightly reduced the magnitude of the association between levels of psychological distress and death. There was a greater reduction in the magnitude of the risk of death associated with psychological distress when chronic health condition and

Figure 3. Estimated Cumulative Survival Probability for the Follow-Up Period (1997 to 2006), by Serious Psychological Distress (SPD) Status at Time of Interview: National Health Interview Survey (1997 to 2004)

Sources: 1997 to 2006 CDC/NCHS National Death Index; 1997 to 2004 CDC/NCHS National Health Interview Survey.

Table 5. Association between All-Cause Death over the Follow-Up Period (1997 to 2006) and Psychological Distress, Stratified by Age Group at Time of Interview: National Health Interview Survey (1997 to 2004)

Characteristic	Cox Regression Models for SPD		
	Aged 18 to 34		
	Model A1: SPD Only	Model A2: SPD + Gender, Race/Ethnicity, Education, Marital Status	Model A3: SPD + Model A2 Covariates + Chronic Health Conditions, BMI, Smoking
	HR (95% CI)	HR (95% CI)	HR (95% CI)
SPD			
No	1.00	1.00	1.00
Yes	3.53* (2.31-5.39)	3.26* (2.09-5.09)	2.44* (1.53-3.89)
Gender			
Male		1.00	1.00
Female		0.55* (0.44-0.68)	0.53* (0.42-0.67)
Race/Ethnicity			
White, Not Hispanic or Latino		1.00	1.00
Black or African American, Not Hispanic or Latino		1.36* (1.00-1.87)	1.51* (1.10-2.07)
Hispanic or Latino		0.82 (0.60-1.12)	0.99 (0.73-1.35)
Other[1]		0.93 (0.51-1.70)	1.00 (0.54-1.87)
Education			
Less than High School		1.00	1.00
High School Graduate/GED/Some College		0.85 (0.62-1.17)	0.90 (0.66-1.24)
College Degree		0.39* (0.25-0.61)	0.48* (0.30-0.76)
Marital Status			
Married, Living with Partner		1.00	1.00
Divorced, Separated		1.74* (1.22-2.48)	1.57* (1.10-2.25)
Widowed		1.15 (0.16-8.06)	1.21 (0.17-8.41)
Never Married		1.10 (0.88-1.39)	1.11 (0.87-1.41)
Chronic Conditions			
None			1.00
One			1.82* (1.40-2.35)
Two or More			2.83* (1.82-4.41)
BMI			
Underweight			1.19 (0.76-1.85)
Normal Range			1.00
Overweight			0.95 (0.73-1.24)
Obese			1.00 (0.72-1.41)
Smoking Status			
Current Daily			1.65* (1.25-2.19)
Current Occasional			2.03* (1.35-3.05)
Former			1.20 (0.81-1.77)
Never			1.00
Sample Size	71,722	71,299	68,952
Model *df* (BIC)	1 (13,369)	10 (13,154)	19 (12,909)

(continued)

Table 5. Association between All-Cause Death over the Follow-Up Period (1997 to 2006) and Psychological Distress, Stratified by Age Group at Time of Interview: National Health Interview Survey (1997 to 2004) *(continued)*

Characteristic	Cox Regression Models for SPD		
	Aged 35 to 54		
	Model A4: SPD Only	Model A5: SPD + Gender, Race/Ethnicity, Education, Marital Status	Model A6: SPD + Model A5 Covariates + Chronic Health Conditions, BMI, Smoking
	HR (95% CI)	HR (95% CI)	HR (95% CI)
SPD			
No	1.00	1.00	1.00
Yes	2.96* (2.51-3.49)	2.20* (1.86-2.60)	1.25* (1.04-1.50)
Gender			
Male		1.00	1.00
Female		0.58* (0.53-0.64)	0.53* (0.48-0.60)
Race/Ethnicity			
White, Not Hispanic or Latino		1.00	1.00
Black or African American, Not Hispanic or Latino		1.49* (1.31-1.69)	1.51* (1.33-1.73)
Hispanic or Latino		0.75* (0.64-0.89)	1.03 (0.87-1.21)
Other[1]		0.69* (0.51-0.95)	0.77 (0.56-1.05)
Education			
Less than High School		1.00	1.00
High School Graduate/GED/Some College		0.58* (0.52-0.65)	0.69* (0.62-0.78)
College Degree		0.33* (0.28-0.39)	0.48* (0.40-0.58)
Marital Status			
Married, Living with Partner		1.00	1.00
Divorced, Separated		1.96* (1.76-2.19)	1.69* (1.51-1.90)
Widowed		2.40* (1.79-3.21)	1.83* (1.33-2.52)
Never Married		1.84* (1.61-2.10)	1.80* (1.58-2.07)
Chronic Conditions			
None			1.00
One			2.20* (1.95-2.48)
Two or More			4.62* (4.05-5.28)
BMI			
Underweight			1.92* (1.53-2.42)
Normal Range			1.00
Overweight			0.90 (0.78-1.03)
Obese			0.95 (0.82-1.09)
Smoking Status			
Current Daily			1.96* (1.72-2.23)
Current Occasional			1.48* (1.18-1.85)
Former			1.32* (1.13-1.53)
Never			1.00
Sample Size	92,257	91,591	88,112
Model *df* (BIC)	1 (66,344)	10 (65,032)	19 (61,375)

(continued)

Table 5. Association between All-Cause Death over the Follow-Up Period (1997 to 2006) and Psychological Distress, Stratified by Age Group at Time of Interview: National Health Interview Survey (1997 to 2004) *(continued)*

Characteristic	Cox Regression Models for SPD		
	Aged 55 or Older		
	Model A7: SPD Only	Model A8: SPD + Gender, Race/Ethnicity, Education, Marital Status	Model A9: SPD + Model A8 Covariates + Chronic Health Conditions, BMI, Smoking
	HR (95% CI)	HR (95% CI)	HR (95% CI)
SPD			
No	1.00	1.00	1.00
Yes	1.84* (1.68-2.02)	1.60* (1.45-1.76)	1.30* (1.18-1.44)
Gender			
Male		1.00	1.00
Female		0.56* (0.54-0.59)	0.56* (0.53-0.58)
Race/Ethnicity			
White, Not Hispanic or Latino		1.00	1.00
Black or African American, Not Hispanic or Latino		0.91* (0.87-0.97)	0.96 (0.91-1.01)
Hispanic or Latino		0.60* (0.55-0.65)	0.72* (0.67-0.78)
Other[1]		0.57* (0.47-0.68)	0.55* (0.45-0.66)
Education			
Less than High School		1.00	1.00
High School Graduate/GED/Some College		0.65* (0.62-0.68)	0.70* (0.67-0.73)
College Degree		0.46* (0.43-0.49)	0.52* (0.48-0.56)
Marital Status			
Married, Living with Partner		1.00	1.00
Divorced, Separated		1.25* (1.17-1.33)	1.20* (1.12-1.27)
Widowed		2.57* (2.45-2.69)	2.27* (2.17-2.38)
Never Married		1.57* (1.43-1.71)	1.55* (1.41-1.71)
Chronic Conditions			
None			1.00
One			1.58* (1.49-1.69)
Two or More			3.05* (2.87-3.23)
BMI			
Underweight			1.94* (1.81-2.08)
Normal Range			1.00
Overweight			0.64* (0.60-0.67)
Obese			0.57* (0.53-0.60)
Smoking Status			
Current Daily			1.21* (1.13-1.29)
Current Occasional			1.16* (1.02-1.33)
Former			1.17* (1.12-1.23)
Never			1.00
Sample Size	74,832	74,201	70,898
Model *df* (BIC)	1 (435,260)	7 (426,434)	19 (401,354)

(continued)

Table 5. Association between All-Cause Death over the Follow-Up Period (1997 to 2006) and Psychological Distress, Stratified by Age Group at Time of Interview: National Health Interview Survey (1997 to 2004) *(continued)*

Characteristic	Cox Regression Models for K6		
	Aged 18 to 34		
	Model B1: K6 Only	Model B2: K6 + Gender, Race/Ethnicity, Education, Marital Status	Model B3: K6 + Model B2 Covariates + Chronic Health Conditions, BMI, Smoking
	HR (95% CI)	HR (95% CI)	HR (95% CI)
K6			
0	1.00	1.00	1.00
1 to 5	0.97 (0.75-1.27)	1.03 (0.78-1.34)	0.92 (0.70-1.21)
6 to 10	1.33 (0.90-1.97)	1.32 (0.90-1.95)	1.05 (0.70-1.57)
11 to 24	2.87* (1.99-4.16)	2.76* (1.88-4.06)	1.94* (1.28-2.93)
Gender			
Male		1.00	1.00
Female		0.54* (0.44-0.68)	0.53* (0.42-0.67)
Race/Ethnicity			
White, Not Hispanic or Latino		1.00	1.00
Black or African American, Not Hispanic or Latino		1.37 (1.00-1.87)	1.49* (1.09-2.04)
Hispanic or Latino		0.82 (0.60-1.13)	0.98 (0.71-1.33)
Other[1]		0.92 (0.51-1.69)	0.99 (0.53-1.84)
Education			
Less than High School		1.00	1.00
High School Graduate/GED/Some College		0.84 (0.62-1.15)	0.89 (0.65-1.22)
College Degree		0.39* (0.25-0.61)	0.47* (0.30-0.75)
Marital Status			
Married, Living with Partner		1.00	1.00
Divorced, Separated		1.69* (1.19-2.41)	1.56* (1.09-2.23)
Widowed		1.12 (0.16-7.95)	1.21 (0.17-8.45)
Never Married		1.09 (0.86-1.37)	1.10 (0.87-1.40)
Chronic Conditions			
None			1.00
One			1.81* (1.39-2.36)
Two or More			2.83* (1.82-4.40)
BMI			
Underweight			1.18 (0.76-1.84)
Normal Range			1.00
Overweight			0.95 (0.73-1.23)
Obese			1.01 (0.72-1.41)
Smoking Status			
Current Daily			1.64* (1.24-2.17)
Current Occasional			2.02* (1.33-3.06)
Former			1.19 (0.81-1.76)
Never			1.00
Sample Size	71,722	71,299	68,952
Model *df* (BIC)	3 (13,369)	12 (13,154)	21 (12,912)

(continued)

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Table 5. Association between All-Cause Death over the Follow-Up Period (1997 to 2006) and Psychological Distress, Stratified by Age Group at Time of Interview: National Health Interview Survey (1997 to 2004) *(continued)*

Characteristic	Cox Regression Models for K6		
	Aged 35 to 54		
	Model B4: K6 Only HR (95% CI)	Model B5: K6 + Gender, Race/Ethnicity, Education, Marital Status HR (95% CI)	Model B6: K6 + Model B5 Covariates + Chronic Health Conditions, BMI, Smoking HR (95% CI)
K6			
0	1.00	1.00	1.00
1 to 5	1.28* (1.14-1.45)	1.36* (1.21-1.53)	1.15* (1.02-1.30)
6 to 10	2.13* (1.85-2.46)	1.94* (1.68-2.24)	1.40* (1.20-1.63)
11 to 24	3.67* (3.10-4.34)	2.90* (2.43-3.45)	1.61* (1.32-1.96)
Gender			
Male		1.00	1.00
Female		0.55* (0.50-0.61)	0.52* (0.47-0.58)
Race/Ethnicity			
White, Not Hispanic or Latino		1.00	1.00
Black or African American, Not Hispanic or Latino		1.53* (1.35-1.74)	1.54* (1.35-1.75)
Hispanic or Latino		0.79* (0.67-0.93)	1.03 (0.88-1.22)
Other[1]		0.71* (0.52-0.97)	0.77 (0.56-1.05)
Education			
Less than High School		1.00	1.00
High School Graduate/GED/Some College		0.61* (0.54-0.68)	0.71* (0.63-0.79)
College Degree		0.36* (0.30-0.42)	0.50* (0.42-0.60)
Marital Status			
Married, Living with Partner		1.00	1.00
Divorced, Separated		1.85* (1.66-2.06)	1.65* (1.47-1.84)
Widowed		2.24* (1.67-3.00)	1.77* (1.28-2.43)
Never Married		1.75* (1.53-2.00)	1.76* (1.54-2.02)
Chronic Conditions			
None			1.00
One			2.12* (1.88-2.39)
Two or More			4.29* (3.74-4.93)
BMI			
Underweight			1.90* (1.51-2.38)
Normal Range			1.00
Overweight			0.90 (0.79-1.03)
Obese			0.94 (0.82-1.09)
Smoking Status			
Current Daily			1.89* (1.66-2.16)
Current Occasional			1.43* (1.14-1.79)
Former			1.30* (1.12-1.52)
Never			1.00
Sample Size	92,257	91,591	88,112
Model *df* (BIC)	3 (66,167)	12 (64,899)	21 (61,340)

(continued)

Table 5. Association between All-Cause Death over the Follow-Up Period (1997 to 2006) and Psychological Distress, Stratified by Age Group at Time of Interview: National Health Interview Survey (1997 to 2004) *(continued)*

Characteristic	Cox Regression Models for K6		
	Aged 55 or Older		
	Model B7: K6 Only	Model B8: K6 + Gender, Race/Ethnicity, Education, Marital Status	Model B9: K6 + Model B8 Covariates + Chronic Health Conditions, BMI, Smoking
	HR (95% CI)	HR (95% CI)	HR (95% CI)
K6			
0	1.00	1.00	1.00
1 to 5	1.21* (1.15-1.27)	1.20* (1.15-1.26)	1.10* (1.05-1.15)
6 to 10	1.76* (1.64-1.89)	1.61* (1.50-1.73)	1.33* (1.25-1.43)
11 to 24	2.12* (1.96-2.29)	1.88* (1.74-2.03)	1.47* (1.35-1.59)
Gender			
Male		1.00	1.00
Female		0.55* (0.52-0.57)	0.55* (0.52-0.57)
Race/Ethnicity			
White, Not Hispanic or Latino		1.00	1.00
Black or African American, Not Hispanic or Latino		0.93* (0.88-0.98)	0.97 (0.92-1.03)
Hispanic or Latino		0.60* (0.55-0.65)	0.72* (0.66-0.78)
Other[1]		0.56* (0.46-0.68)	0.54* (0.45-0.66)
Education			
Less than High School		1.00	1.00
High School Graduate/GED/Some College		0.67* (0.64-0.70)	0.71* (0.68-0.74)
College Degree		0.49* (0.45-0.52)	0.53* (0.50-0.58)
Marital Status			
Married, Living with Partner		1.00	1.00
Divorced, Separated		1.21* (1.14-1.29)	1.17* (1.10-1.25)
Widowed		2.53* (2.41-2.65)	2.25* (2.15-2.36)
Never Married		1.55* (1.41-1.69)	1.54* (1.40-1.70)
Chronic Conditions			
None			1.00
One			1.56* (1.47-1.66)
Two or More			2.93* (2.76-3.11)
BMI			
Underweight			1.92* (1.79-2.06)
Normal Range			1.00
Overweight			0.64* (0.60-0.67)
Obese			0.56* (0.53-0.59)
Smoking Status			
Current Daily			1.18 (1.11-1.26)
Current Occasional			1.14* (1.00-1.30)
Former			1.17* (1.11-1.22)
Never			1.00
Sample Size	74,832	74,201	70,898
Model *df* (BIC)	3 (434,760)	12 (426,073)	21 (401,228)

BIC = Bayesian information criterion; BMI = body mass index; CI = confidence interval; *df* = degrees of freedom; GED = general equivalency diploma; HR = hazards ratio; K6 = Kessler-6 scale; SPD = serious psychological distress (measured by a cutoff score of 13 on the K6).

* $p < .05$.

NOTE: Reference level is denoted by 1.00.

[1] "Other" includes not Hispanic Asians, Pacific Islanders, and Native Americans.

Sources: 1997 to 2006 CDC/NCHS National Death Index; 1997 to 2004 CDC/NCHS National Health Interview Survey.

behavioral risk factor variables were added to the model. Despite the reduction in magnitude, however, the risk of death associated with psychological distress remained significant ($p < .05$). Thus, the adjusted risk of death associated with high psychological distress among adults aged 18 to 34 and the adjusted risk associated with all levels of psychological distress (low, moderate, and high) in the two older age groups (aged 35 to 54 and aged 55 or older) remained significant.

Years of Potential Life Lost

Adults aged 18 or older who met criteria for SPD and who died during the follow-up period had a mean YPLL of 17.9, which was significantly higher than the 14.1 mean YPLL for deceased persons who did not have SPD (**Table 6**). Therefore, deceased persons aged 18 or older who had SPD at the time of interview had an excess mean YPLL of 3.8 more YPLL than deceased persons aged 18 or older without SPD. Similar differences were seen for the 35 or older age group (excess mean YPLL of 3.4).

To adjust for the influence of important behavioral risk factors, such as smoking and BMI, the mean YPLL was examined by SPD status combined with smoking status and BMI category for groups of adults aged 18 or older and 35 or older to isolate the middle and older age groups (**Table 6**). Among deceased adults aged 18 or older and deceased adults aged 35 or older, SPD was associated with significantly higher mean YPLL across all BMI categories. SPD also was associated with significantly higher mean YPLL in both age groups across all smoking categories except among occasional smokers. These mean YPLL differences between those with and without SPD ranged from 2.1 among adult never smokers aged 18 or older to 4.3 among adult current daily smokers aged 18 or older and from 1.5 among adult never smokers aged 35 or older to 4.2 among adult current daily smokers aged 35 or older.

The final set of analyses focused on the mean YPLL for the three leading causes of death (**Table 7**). Adults with SPD had a higher mean YPLL than those without SPD for deaths from heart diseases and malignant neoplasms (3.4 and 3.0, respectively). There appears to be a large difference by SPD status in the mean YPLL (4.5) for deaths from assaults/accidents/unintentional poisonings;

however, this difference did not reach statistical significance.

Discussion

The results of this study clearly show that mental illness contributes to premature death in the U.S. household population. Using several mortality-related indices, this study confirms that one measure of mental illness (psychological distress) is a strong predictor of premature death, independent of sociodemographic risk factors and co-occurring physical and behavioral health factors.

Our study supports previous findings in which (1) the effect of psychological distress on the overall death rate was reduced upon adjustment for demographic and behavioral risk factors and chronic diseases and (2) a relationship exists between levels of psychological distress and the overall death rate.[18] Particularly notable are the influences of chronic health conditions, which reduced the strength of the association between SPD and overall death rates, although the associations were still significant.[16,18]

In recent years, the finding that persons "with serious mental illness served by our mental health systems die, on average, 25 years earlier than the general population" has been commonly cited in reviews of mental illness and mortality studies.[7] This finding is based upon data on patient deaths submitted by public mental health agencies in 7 States as part of the 16-State Study on Mental Health Performance Measures on clients served in inpatient and outpatient service facilities from 1997 through 2000[6,7,10]; thus, this result does not reflect the extra YPLL for persons with mental illness compared to those with no mental illness. The results of this widely cited study differ from ours because of differences in the population covered, follow-up times, and how mental illness was measured. For example, the severity of mental illness is likely higher among patients receiving treatment for mental illness than those who simply meet screening criteria for SPD in a household population. To assess how many additional years of life individuals with mental illness lose compared with those without mental illness, it is necessary to take the difference in the mean YPLL between the two groups.

Table 6. Comparison of Estimates of Mean Years of Potential Life Lost of All-Cause Death for the Follow-Up Period[+] (1997 to 2006), by Age Group, Serious Psychological Distress (SPD), Body Mass Index, and Smoking Status at Time of Interview: National Health Interview Survey (1997 to 2004)

Characteristic	Mean Age at Death (95% CI)		Mean YPLL (95% CI)		Net Difference in Mean YPLL for SPD vs. No SPD (95% CI)
	SPD	No SPD	SPD	No SPD	
Aged 18 or Older	67.6 (66.3, 68.9)	72.8 (72.5, 73.2)	17.9 (17.0, 18.9)	14.1 (13.9, 14.3)	3.8 (2.8, 4.8)*
Weight Category					
Underweight	69.6 (66.5, 72.8)	75.7 (74.6, 76.7)	16.5 (14.1, 18.9)	12.7 (12.0, 13.5)	3.8 (1.4, 6.2)*
Normal Weight	69.1 (66.8, 71.5)	74.8 (74.3, 75.3)	16.8 (15.1, 18.6)	12.9 (12.5, 13.2)	3.9 (2.2, 5.7)*
Overweight	67.6 (65.0, 70.3)	72.3 (71.8, 72.8)	17.8 (15.9, 19.7)	14.2 (13.9, 14.6)	3.6 (1.6, 5.6)*
Obese	64.2 (61.9, 66.4)	68.5 (67.9, 69.1)	20.3 (18.5, 22.1)	16.9 (16.4, 17.3)	3.4 (1.6, 5.2)*
Smoking Status					
Current Daily	58.5 (56.8, 60.1)	64.1 (63.6, 64.7)	24.1 (22.7, 25.5)	19.8 (19.3, 20.2)	4.3 (2.9, 5.8)*
Current Occasional	57.6 (51.7, 63.5)	62.7 (61.0, 64.4)	25.1 (20.5, 29.7)	21.2 (19.8, 22.5)	3.9 (0.0, 8.7)
Former	73.1 (71.5, 74.7)	75.5 (75.1, 75.9)	13.6 (12.5, 14.7)	11.8 (11.6, 12.1)	1.7 (0.6, 2.9)*
Never	72.4 (69.8, 75.1)	75.2 (74.6, 75.7)	15.2 (13.2, 17.2)	13.1 (12.7, 13.5)	2.1 (0.1, 4.1)*
Aged 35 or Older	69.2 (68.2, 70.3)	74.1 (73.8, 74.4)	16.5 (15.8, 17.3)	13.1 (12.9, 13.3)	3.4 (2.6, 4.3)*
Weight Category					
Underweight	70.5 (67.5, 73.4)	77.2 (76.4, 78.0)	15.7 (13.6, 17.9)	11.5 (11.0, 12.1)	4.2 (2.1, 6.4)*
Normal Weight	71.1 (69.1, 73.1)	76.3 (75.8, 76.7)	15.2 (13.8, 16.6)	11.7 (11.4, 12.0)	3.5 (2.1, 4.9)*
Overweight	69.7 (67.4, 72.1)	73.4 (73.0, 73.9)	16.2 (14.5, 17.8)	13.3 (13.0, 13.6)	2.8 (1.1, 4.5)*
Obese	65.6 (63.7, 67.4)	69.6 (69.0, 70.1)	19.1 (17.7, 20.5)	15.9 (15.6, 16.3)	3.1 (1.7, 4.6)*
Smoking Status					
Current Daily	60.2 (58.8, 61.6)	65.8 (65.2, 66.3)	22.6 (21.5, 23.7)	18.4 (17.9, 18.8)	4.2 (3.0, 5.5)*
Current Occasional	63.4 (59.3, 67.4)	66.2 (64.9, 67.5)	20.4 (17.4, 23.5)	18.3 (17.4, 19.2)	2.1 (0.0, 5.3)
Former	73.1 (71.6, 74.7)	75.8 (75.5, 76.2)	13.5 (12.4, 14.6)	11.5 (11.3, 11.8)	2.0 (0.8, 3.1)*
Never	74.8 (72.7, 76.9)	76.8 (76.4, 77.3)	13.3 (11.9, 14.7)	11.8 (11.5, 12.1)	1.5 (0.1, 2.9)*

SE = standard error; SPD = serious psychological distress (measured by a cutoff score of 13 on the Kessler-6, or K6, scale); YPLL = years of potential life lost.

* $p < .05$.

[+] Average length of follow-up for those who died during follow-up = 3.66 years.

NOTE: Mean YPLL compared rather than median YPLL to enable comparisons with prior studies that have estimated the mean YPLL differences.

Sources: 1997 to 2006 CDC/NCHS National Death Index; 1997 to 2004 CDC/NCHS National Health Interview Survey.

Table 7. Comparison of Estimates of Mean Years of Potential Life Lost of Cause-Specific Death for the Follow-Up Period[+] (1997 to 2006), by Serious Psychological Distress (SPD) Status: National Health Interview Survey (1997 to 2004)

Characteristic	Mean Age at Death (95% CI)		Mean YPLL (95% CI)		Net Difference in Mean YPLL for SPD vs. No SPD (95% CI)
	SPD	No SPD	SPD	No SPD	
Heart Diseases	71.6 (69.3, 73.9)	76.2 (75.7, 76.7)	15.1 (13.4, 16.8)	11.7 (11.4, 12.0)	3.4 (1.7, 5.0)*
Malignant Neoplasms	66.2 (63.6, 68.8)	70.3 (69.7, 70.8)	18.5 (16.5, 20.5)	15.5 (15.1, 15.9)	3.0 (1.0, 5.0)*
Assaults/Accidents/Unintentional Poisonings	52.6 (44.1, 61.2)	57.7 (54.9, 60.6)	30.1 (23.8, 36.4)	25.6 (23.4, 27.7)	4.5 (0.0, 11.3)

SE = standard error; SPD = serious psychological distress (measured by a cutoff score of 13 on the Kessler-6, or K6, scale); YPLL = years of potential life lost.

* $p < .05$.

[+] Average length of follow-up for those who died during follow-up = 3.66 years.

NOTE: Heart diseases, malignant neoplasms, and assaults/accidents/unintentional poisonings were the three most common causes of death and accounted for 55 percent of all deaths. Malignant neoplasms include cancer or other malignant tumors.

Sources: 1997 to 2006 CDC/NCHS National Death Index; 1997 to 2004 CDC/NCHS National Health Interview Survey.

Our study assessed the mean YPLL between those with and without one measure of mental illness (SPD), finding that the mean YPLL estimate between those with SPD and those without was 3.8 (95 percent CI = 17.9-14.1). This estimate of excess mean YPLL of 3.8 is consistent with those reported by other studies, such as 5.4 by Druss and colleagues[16] and 4.2 by Piatt and colleagues.[14] In addition, this excess mean YPLL is similar to the estimate of 1.8 reported by Lutterman,[6] although in that study the comparison was between mental health clients with MMI and mental health clients without MMI, not between persons with mental illness and persons without mental illness.

We found that the differences in mean YPLL between those with and without SPD were significant for each BMI and smoking category (even normal weight persons and nonsmokers). Thus, the association did not appear to be solely due to persons with SPD having an increased risk of being overweight or a smoker. The associations, however, did appear to be larger for those who were current or former smokers than for those who had never smoked.[38] This pattern may suggest an increased risk of premature mortality for smokers with SPD as compared with nonsmokers with SPD. Additional studies are needed to determine the role of smoking, BMI, or chronic health conditions in the causal pathway between SPD and premature death.

This study has several notable limitations. First, there were no longitudinal data available on psychological distress, smoking, BMI, and chronic health conditions. Possible changes in these variables, if they occurred after the baseline measurement, could have altered the findings. Second, because the NHIS did not collect data on the potentially confounding effects of antipsychotic medication use, the association between SPD and death may have been overestimated. Antipsychotic medications are frequently used by individuals with serious mental illness, and several studies have shown a significant association between antipsychotic medications and death, particularly due to cardiovascular morbidity.[39,40,41] Third, our analyses were limited by the NHIS-NDI data, such as being unable to study persons who had ineligible NHIS-NDI matches (n = 15,882) and being unable to study those who died before they could participate in the

NHIS. There was also the potential for mismatched data causing false positives, although several provisions were made to maximize the proportion of people correctly matched, minimize the number of people incorrectly matched, and especially, minimize the false positives.[27] Finally, multiple specific causes of death were not considered because this information was not included in the publicly available NHIS-NDI linked file. Despite these limitations, the study reinforces the importance of efforts to reduce the burden associated with psychological distress that currently affects more than 6 million adults per year in the U.S. household population. Future studies that use the linked NHIS-NDI data set to study the impact of psychological distress on mortality in younger cohorts are warranted, particularly if they use longer follow-up periods, consider multiple causes of death, and combine several years of data to increase sample sizes. Additional assessment of individual mental disorders diagnosed using standardized criteria, such as those included in the 1999 NHIS, would be helpful to understand whether specific mental disorders have differential associations with mortality.[12]

This study shows a robust association between SPD and death even after adjusting for factors including smoking and chronic health conditions. Our findings suggest that the integration of primary and behavioral health care may work toward reducing the mortality gap between persons with and without SPD.

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31. *Smoking status* was assessed via the NHIS recoded variable that combined the responses to the question, "Have you smoked at least 100 cigarettes in your ENTIRE LIFE? (Yes/No)," and the question, "Do you NOW smoke cigarettes every day, some days or not at all?"

32. *Alcohol use* was assessed via the NHIS recoded variable that combined the responses to the question, "In your ENTIRE LIFE, have you had at least 12 drinks of any type of alcoholic beverage?" and the question, "In the PAST YEAR, how often did you drink any type of alcoholic beverage?"

33. The BMI categories were in concordance with guidelines from the National Heart, Lung, and Blood Institute (NHLBI). (1998). Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. *Archives of Internal Medicine, 158*, 1855-1867. However, the normal weight group based on the NHLBI guidelines (i.e., BMI = 18.5 up to 25) was split into low (BMI < 20) and high normal (BMI = 20 up to 25) based on literature showing higher mortality in the low end of the usual normal BMI group (Adams, K. F., Schatzkin, A., Harris, T. B., Kipnis, V., Mouw, T., Ballard-Barbash, R., Hollenbeck, A., & Leitzmann, M. F. [2006]. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. *New England Journal of Medicine, 355*, 763-778; Zajacova, A., & Burgard, S. A. [2012]. Shape of the BMI-mortality association by cause of death, using generalized additive models: NHIS 1986-2006. *Journal of Aging and Health, 24*, 191-211). The low end of the usual normal BMI group (BMI = 18.5 up to 20) was thus combined with the usual underweight group (BMI < 18.5).

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37. The estimates were as follows: *aged 18 to 34*: HR = 2.69, 95 percent CI = 1.69-4.27; *aged 35 to 54*: HR = 1.42, 95 percent CI = 1.18-1.69; *aged 55 or older*: HR = 1.33, 95 percent CI = 1.21-1.47.

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Appendix A: Validation of Years of Potential Life Lost (YPLL) Estimates

Methods

We indirectly validated our YPLL estimates from the CDC-supplied calculations of YPLL for persons between the ages of 18 and 74 (YPLL-18-74) (P. K. Muhuri, personal communications to B. I. Truman & M.-H. Chang, March 23, 2012, and March 27, 2012).[42] YPLL was derived by subtracting the age at death (ranging from 18 to 74) from the potential limit to life as 75 years for each death, then summing the differences across all deaths in that range. These estimates were originally derived from the NCHS-compiled mortality data in conjunction with the population estimates extracted from the CDC WONDER online databases (http://wonder.cdc.gov), which are the same ones used by the CDC Web-based Injury Statistics Query and Reporting System (WISQARS™; http://webappa.cdc.gov/sasweb/ncipc/ypll10.html). For validation purposes, we considered three types of YPLL-18-74: YPLL-18-74 (total population sum), mean YPLL-18-74, and crude YPLL-18-74 rates. These types of YPLL were made available by CDC for each year from 1999 to 2008 (available on request). We then generated similar calculations (i.e., YPLL-18-74) from our data, representing the 1997 to 2004 NHIS study subjects by the duration of follow-up (available on request). Although we reviewed all of these results, this analysis only presents comparisons of the annualized results from the NHIS 1997-2004 study subjects, whose survival status was followed up for 1 year, and the CDC-supplied WISQARS™ results for 1999.

Results

By examining the proportion of all deaths in selected age groups, we found the distribution of age at death of the 1997 to 2004 NHIS study subjects in the first year of follow-up to be remarkably similar to the corresponding distribution of deaths in the 1999 to 2009 data extracted from the CDC WONDER online databases. Other validation analyses confirmed the similarity between our estimates and the CDC estimates for 1999: (1) YPLL-18-74: 14,769,488 (95 percent CI = 13,530,234-16,008,742) versus CDC's estimate of 15,939,011; (2) mean YPLL-18-74: 16.3 (95 percent CI = 15.5-17.2) versus CDC's estimate of 16.0; and (3) crude YPLL-18-74 rate: 6,060 (95 percent CI = 5,510-6,609) per 100,000 person-years versus CDC's estimate of 8,357 per 100,000 population.

Despite slight difference in the reference period, both sets of the mean YPLL-18-74 results are in agreement and provide some evidence of validity. We could not directly validate the life expectancy-based mean YPLL estimate presented in our analysis because the CDC-supplied data are not stratified by gender. However, given that our mean YPLL-18-74 estimates were similar to the CDC-supplied national results, we infer that the estimates of the life expectancy-based mean YPLL for the U.S. adult population aged 18 or older would also approximate the similar estimate in the national death certificate data.