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The Association Between Self-Rated Mental Health Status and Total Health Care Expenditure

A Cross-Sectional Analysis of a Nationally Representative Sample

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Abstract: Both clinical diagnoses and self-rated measures of mental illness are associated with a variety of outcomes, including physical well-being, health utilization, and expenditure. However, much of current literature primarily utilizes clinically diagnosed data.

This cross-sectional study explores the impact of mental illness and health care expenditure using 2 self-rated measures: self-rated measure of perceived mental health status (SRMH) and Kessler Screening Scale for Psychological Distress (K6).

Data from the 2011 Medical Expenditure Panel Survey Household Component, a nationally representative sample of noninstitutionalized individuals ($n = 18,295$), were analyzed using bivariate χ^2 tests and a 2-part model (logistics regression and generalized linear model regression for the first and second stages, respectively).

Although predictive of any health expenditure, SRMH alone was not highly predictive of the dollar value of that health expenditure conditional on any spending. By comparison, the K6 measure was significantly and positively associated with the probability of any health expenditure as well as the dollar value of that spending. Taken together, both the K6 and SRMH measures suggest a positive relationship between poor mental health and the probability of any health expenditure and total expenditure conditional on any spending, even when adjusting for other confounding factors such as race/ethnicity, sex, age, educational attainment, insurance status, and some regional characteristics.

Our results suggest that psychological distress and SRMH may represent potential pathways linking poor mental health to increased health care expenditure. Further research exploring the nuances of these relationships may aid researchers, practitioners, and policy makers in addressing issues of inflated health care expenditure in populations at risk for poor mental health.

(*Medicine* 94(35):e1410)

Abbreviations: BRR = balanced repeated replication, GLM = generalized linear model, K6 = Kessler Screening Scale for Psychological Distress, MEPS = Medical Expenditure Panel Survey, MEPS-HC = Medical Expenditure Panel Survey Household Component, MSA = metropolitan statistical area, NIMH = National Institute of Mental Health, SRMH = self-rated mental health.

Editor: Hai Fang.

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INTRODUCTION

Mental illness persists as a pressing public health issue. Indiscriminate of demographic and socioeconomic status, mental illness has a widespread impact that affects individuals of all ages, ethnicities, and income levels. A 2014 report from the Substance Abuse and Mental Health Services Administration estimated that 42.5 million adults in the United States experienced mental illness in the past year¹; moreover, the National Institute of Mental Health (NIMH) further reported that 1 in 17 Americans currently live with a serious mental illness.²

Although these statistics are startlingly high, the actual prevalence is likely higher. Although the majority of severe cases of mental illness will encounter professional treatment, many individuals fly under the radar³; nevertheless, just because an individual remains untreated, it does not imply that the individual does not need treatment. As a result, stated prevalence values likely underrepresent need, especially among those with moderate mental health illness.

Because many mental health conditions remain undiagnosed, self-rated assessment tools provide a useful and perhaps more revealing indicator of mental well-being. Existing literature demonstrates the reliability of both self-rated assessment tools and more formal screening tools.^{4,5} When assessed by both clinical diagnoses and self-rated measures, mental illness was associated with a variety of outcomes, including physical health, health utilization, and expenditure.^{6–8} However, the predominant method of measuring mental illness in the literature continues to be clinical diagnoses, a method that necessarily excludes individuals with “poor” mental health who remain undiagnosed.

As such, self-rated measures may capture a more comprehensive understanding of mental health in the general population. These sorts of measures may also help researchers better understand how mental health relates to other important outcomes such as health expenditure. The literature has shown that the association between mental health and patterns of health care cost may be more pronounced when using self-rated measures because individuals who have undiagnosed mental illness utilize similar medical services as those who are diagnosed.⁹

This article examined the impact of mental illness on health expenditure through self-rated mental health (SRMH) measures. Drawing on the 2011 household component of the Medical Expenditure Panel Survey (MEPS), we relied on 2 measures of SRMH: a Likert-style measure assessing whether an individual rates oneself to be in “excellent, very good, good, fair, or poor” mental health, which we broke into 5 separate dummy variables, and (2) the self-rated Kessler Screening Scale for Psychological Distress (K6). In defining expenditure, we considered total health care expense, including both indemnified and out-pocket payments. We hypothesized that individuals with relatively poorer SRMH experience elevated health care spending.

METHODS

Data Source

Data are cross-sectional, drawn from the publicly available Medical Expenditure Panel Survey Household Component (MEPS-HC). Specifically, we used the 2011 full-year consolidated data file (MEPS-HC 147), which contains a nationally representative sample of noninstitutionalized US civilians.¹⁰ MEPS data have undergone review and have been approved by the RTI International Institutional Review Board, granted by the Office for Protection from Research Risks. The data included important information regarding demographic characteristics, health utilization, and health expenditures by Americans.

The data were collected using an overlapping panel design.^{10,11} Each year, a new panel of sample households is selected to capture 2 calendar years of data. The 2 years of data for each panel are collected in 5 rounds of interviews. The panel design of the survey reflected the changes in respondents' health status, income, employment, eligibility for public and private insurance coverage, use of services, and payment for care over the survey period.

Sample Population

We limit our sample to civilian, working-age adults. As such, we excluded individuals under the age of 18 and over the age of 65. We made this choice for several reasons. First, individuals over the age of 64 experience a higher proportion of physical health conditions¹² and per person personal health care spending;¹³ seniors also pay for health care in a fundamentally different way (ie, they qualify for Medicare). Second, similar to seniors, returning veterans may also experience unique health issues. Importantly, the literature emphasizes the increased risk of mental health problems that many returning veterans face.⁶ Taken together, this suggested that the relationship between mental health and expenditure maybe distinct for these groups. As a result, we limited our sample to working-age, adult civilian population.

Excluding individuals outside the 18 to 64 age range reduces the sample population from 35,313 to 21,510 (13,803 observations dropped). Next, we excluded individuals who indicated that they served as active duty military personnel during any of the 3 rounds (removing an additional 82 observations). Lastly, we excluded those observations with incomplete data for the relevant variables (a further 3133 observations deleted), resulting in a final sample size of 18,295.

Dependent Variable: Health Expenditure

MEPS contained a question gauging self-rated total 2011 health expenditure between January 1, 2011 and December 31, 2011.¹³ Total expenditure included both out-of-pocket and indemnified spending on variety of health care costs, including inpatient visits, outpatient visits, emergency room, prescribed medicine, and other.⁸ Based on this question, we created 2 expenditure measures. First, we created a binary measure, indicating whether an individual had any health expenditure over this period. Second, we created a continuous measure, which reflected the dollar value of spending.

Key Explanatory Variable: Perceived Mental Health and Psychological Stress

We included 2 measures of SRMH as our explanatory variable: the K6 and a series of dummies gauging perceived mental health. The K6 is a widely used 6-item self-administered

screening scale developed by Kessler et al. The K6 measures nonspecific psychological distress by asking respondents how often they felt symptoms of mental illnesses (eg, hopelessness and depression) within the past 30 days.¹⁴⁻¹⁶ Responses were categorized on a 5-point scale (none of the time, a little of the time, some of the time, most of the time, or all of the time). The scale ranges from 0 to 24, with higher K6 scores indicating the greater likelihood of psychological distress.

The K6 is endorsed as an important tool in both clinical and research practice.¹⁷ Kessler et al¹⁴ reported there is "excellent internal and consistent reliability" associated with the K6 (Cronbach's alpha=0.89) – a result that has also been replicated in other studies.^{18,19} As such, the K6 provides a valid, standardized estimation of the prevalence of psychological disorders among nonclinical populations.²⁰ Moreover, many argue that the K6 is a superior predictor of health-related quality of life compared with diagnoses.^{14,20}

In addition to the K6 assessment, MEPS also asked respondents to rate their overall perceived mental health status. Specifically, the survey asked, "In general, would you say your mental health is excellent, very good, good, fair, or poor?" Based on this question, we created a series of 5 dummy variables, which gauged perceived mental health status. Research suggests that SRMH measures are a good proxy for clinical criteria. Paralleling the literature on clinical mental health diagnoses,²¹ the literature highlights a positive association between "poor" self-perceived health status, depressive symptoms, and health care expenditure.^{9,22,23} Given that the K6 is administered during Round 4 of Panel 15 and Round 2 of Panel 16, we drew on the mental health measure from the same periods (Round 4/2).

Other Control Variables

Additional controls included sex, age, race/ethnicity, geographic region, metropolitan statistical area (MSA), employment status, education, family income (percentage above or below the federal poverty level), marital status, insurance coverage, and perceived physical health. Our measures of perceived mental health, perceived physical health, and employment status all came from the same period (Round 4/2). During the reference period, 28 individuals indicated that they did not work, but they had job to which to return. These individuals were considered "employed." The remaining variables reflect the final 2011 measures.

Statistical Analysis

The data were analyzed using the statistical software package Stata 13 (StataCorp, College Station, TX). To account for the complex survey design, we adhered to the weight guidelines outlined by MEPS. We used balanced repeated replication (BRR) weights for our variance estimates to adhere to the weight guidelines outlined by MEPS. As a result, all summary statistics and empirical model estimates incorporated these BRR weights. In finalizing our replicate weights, we drew from the MEPS 1996 to 2011 Replicates for Variance Estimation File (MEPS HC-036BRR).

In carrying out our empirical analysis, we first conducted a series of bivariate χ^2 tests, assessing whether differences existed between those with any positive expenditure versus those with no expenditure for each categorical outcome.

Given the large number of individuals with zero health expenditure (24% of the sample population), we ran a 2-part model. In the first part of the model, we estimated the

TABLE 1. Descriptive Statistics and Bivariate χ^2 Test: Any Positive Expenditure (Yes or No) vs Categorical Outcomes

Categorical Measures	Zero Expenditure		Positive Expenditure		Total		P*
	Mean	SE	Mean	SE	Mean	SE	
Total health expenditure	0.000	n/a	5253.493	161.212	4334.103	135.701	
Self-rated mental health							0.000
Excellent	0.443	0.016	0.366	0.007	0.379	0.008	
Very good	0.324	0.012	0.310	0.006	0.312	0.006	
Good	0.204	0.011	0.241	0.006	0.234	0.006	
Fair	0.026	0.003	0.069	0.003	0.062	0.002	
Poor	0.003	0.001	0.014	0.001	0.012	0.001	
K6 score	2.247	0.075	3.700	0.054	3.446	0.046	
Self-rated physical health							0.000
Good/very good/excellent	0.957	0.004	0.863	0.004	0.880	0.004	
Fair/poor	0.043	0.004	0.137	0.004	0.120	0.004	
Sex							0.000
Female	0.330	0.008	0.555	0.004	0.516	0.003	
Male	0.670	0.008	0.445	0.004	0.484	0.003	
Age	35.900	0.238	42.546	0.187	41.383	0.169	
Race/ethnicity							0.000
Caucasian, non-Hispanic	0.458	0.018	0.688	0.011	0.648	0.011	
African American, non-Hispanic	0.152	0.010	0.112	0.007	0.119	0.007	
Native American, non-Hispanic	0.003	0.001	0.006	0.001	0.005	0.001	
Asian, non-Hispanic	0.069	0.007	0.048	0.005	0.052	0.005	
Pacific Islander, non-Hispanic	0.007	0.002	0.004	0.001	0.004	0.001	
Hispanic	0.300	0.020	0.130	0.008	0.160	0.009	
Multiple race/ethnicity categories	0.010	0.002	0.012	0.001	0.012	0.001	
Education							0.000
Less than high school	0.206	0.008	0.105	0.004	0.122	0.004	
High school or equivalent	0.370	0.010	0.273	0.006	0.290	0.006	
Associates degree	0.246	0.009	0.284	0.005	0.277	0.005	
4-yr college	0.137	0.009	0.225	0.006	0.209	0.005	
Some graduate school	0.041	0.005	0.114	0.005	0.101	0.004	
Employment status							0.317
Employed	0.733	0.009	0.719	0.005	0.722	0.005	
Left previous job and does not have new job	0.042	0.004	0.041	0.003	0.041	0.002	
Not employed	0.226	0.008	0.239	0.005	0.237	0.005	
Marital status							0.000
Married	0.415	0.011	0.554	0.007	0.530	0.007	
Widowed	0.010	0.002	0.017	0.001	0.015	0.001	
Divorced/separated	0.116	0.008	0.151	0.004	0.144	0.004	
Single	0.458	0.010	0.279	0.006	0.310	0.005	
% above/below poverty level							0.000
Poor	0.177	0.009	0.126	0.004	0.135	0.004	
Near poor	0.066	0.005	0.036	0.002	0.041	0.002	
Low income	0.182	0.008	0.117	0.004	0.129	0.004	
Middle income	0.335	0.012	0.296	0.006	0.303	0.006	
High income	0.240	0.013	0.424	0.008	0.392	0.008	
Insurance status							0.000
Any private insurance	0.479	0.013	0.761	0.006	0.712	0.007	
Public insurance only	0.094	0.006	0.122	0.005	0.117	0.005	
Uninsured	0.427	0.013	0.117	0.004	0.171	0.005	
Metropolitan statistical area							0.123
MSA	0.866	0.013	0.848	0.013	0.851	0.012	
Region							0.000
West	0.269	0.013	0.223	0.008	0.231	0.008	
Northeast	0.176	0.011	0.180	0.008	0.180	0.007	
Midwest	0.149	0.009	0.231	0.007	0.216	0.006	

Categorical Measures	Zero Expenditure		Positive Expenditure		Total		P*
	Mean	SE	Mean	SE	Mean	SE	
South	0.405	0.018	0.366	0.010	0.373	0.009	
Number of observations	4420		13,875		18,295		

MSA = metropolitan statistical area, SE = standard error.

* P values from a bivariate χ^2 test assessing whether differences exist between those with any positive expenditure versus those with no expenditure for each categorical outcome.

probability of any health expenditure using a logistic regression model. In detailing the results, we presented the adjusted odds ratios. In the second part of the model, we estimated health expenditure conditional on any positive spending (ie, we excluded individuals with zero health expenditure from the analysis). We analyzed this relationship using a generalized linear model (GLM) with a gamma distribution and a log link. The log-linked GLM with a gamma distribution facilitates the modeling of response variables that are positively censored at zero.²⁴ In addition, many have argued that GLM models may help address skewedness in health expenditure variables specifically.^{25,26} Buntin and Zaslavsky²⁵ provide a detailed analysis of the relative benefits of using this class of models when analyzing health expenditure.

RESULTS

Descriptive Statistics and Bivariate Analyses

Table 1 provides descriptive statistics for the sample population. The typical observation is age 41, female, Caucasian (non-Hispanic), employed, married, in a middle-income bracket, has earned a high school degree, and holds private insurance. Close to 40% of those sampled rate themselves to be in “excellent” mental health. Close to 90% of observations rated themselves to be in at least “good” physical health. Almost a quarter of those sampled (24%) spent zero dollars on health expenditure in 2011. Conditional on a positive level of health expenditure, the average respondent spent \$5253 total on health care (including out-of-pocket and indemnified expenses).

The summary statistics highlight several important distinctions between spending groups. Relative to those with positive health expenditure, a larger fraction of individuals with zero expenditure ranked themselves to be in “excellent” mental health (44% compared with 37%) and at least “good” physical health (96% compared with 86%). A larger proportion of men had zero health expenditure. As expected, those with zero health expenditure tended to be younger. The high-income bracket makes up 42% of those with positive expenditure and, by comparison, makes up only 24% of those with zero expenditure. Not surprisingly, a significant fraction of those with zero health expenditure (43%) report being uninsured.

These differences are further emphasized by a series of bivariate χ^2 tests, which assessed whether significant differences exist between those with any positive expenditure relative to those with no expenditure for each categorical outcome (Table 1). The bivariate χ^2 tests underline significant differences for all categories except MSA and employment status.

Self-Rated Mental Health and Health Expenditure, Results From the 2-Part Model

The results from the 2-part model (Table 2) suggest a nuanced relationship between health expenditure and SRMH.

Compared with those who rate themselves to be in “excellent” mental health, individuals who rated themselves to be in “good” or “fair” mental health experienced significantly higher odds of any health expenditure. On the contrary, relative to those with “excellent” SRMH, individuals who rated themselves to be in “very good” or “poor” mental health did not experience significantly higher odds of any spending. Looking at the adjusted odds ratios associated SRMH dummies as a whole, the results signaled that the relationship between SRMH and the probability of any spending might be nonlinear.

Conditional on positive spending, SRMH dummy variables did not appear to be highly associated with health expenditure. Recall, the higher the K6 score, the higher the likelihood of psychological distress. Unlike the SRMH indicators, K6 was significantly and positively associated with both the probability of any health expenditure and the dollar value of expenditure conditional on a positive level of spending.

Figure 1 presents the predictive margins of total health expenditure conditional on positive spending across the quartile values of the K6 within our study sample: Q₀ (minimum) = 0, Q₁ (25th percentile) = 2, Q₂ (50th percentile) = 2, Q₃ (75th percentile) = 5, and (maximum) = 24. Confidence intervals associated with these measures are also presented. One observes a dramatic increase in expenditure as K6 score increases. Even when focusing on the interquartile range, Figure 1 highlights a marked differential between health expenditures associated with the 25th and 75th percentile K6 scores.

Taken together, both the K6 and the SRMH measures indicated a positive relationship between poor mental health and the probability of any health expenditure and total expenditure conditional on any spending. As expected, physical health and insurance indicators were highly significant. Relatively worse physical health was associated with a higher probability of any spending and a higher level of expenditure conditional on positive spending. Conversely, compared with privately insured individuals, being uninsured was negatively associated with the probability and level of spending. Education was highly associated with both the probability of any expenditure and the level of spending. Although the income measures are largely insignificant, income is highly correlated with education, suggesting that education may be picking up most of this effect. The results further suggested that factors like race/ethnicity, gender, age, education, and some regional characteristics also shaped spending behaviors. Non-Hispanic African American and Hispanic groups experienced a significantly lower likelihood of any health expenditure relative to non-Hispanic whites. Although these differences continued in the second stage of the analysis, the result was only significant for Hispanics.

DISCUSSION

Our findings indicate an essential link between self-rated perceived “poor” mental health, K6, and total health care

TABLE 2. Two-Part Model, Total Health Expenditure in 2011

	Logistic Regression, Pr(Exp. >0)	GLM Regression Conditional on Exp. >0
	(1) Adjusted Odds Ratios	(2) Coefficient
Self-rated mental health (excellent omitted)		
Very good	1.103 (0.0748)	1.037 (0.0598)
Good	1.273 (0.105)**	1.107 (0.0730)
Fair	1.541 (0.240)**	1.149 (0.142)
Poor	1.319 (0.464)	1.089 (0.183)
K6 score	1.085 (0.0110)***	1.024 (0.00630)***
Fair or poor self-rated physical health	2.678 (0.274)***	2.685 (0.203)***
Male	0.408 (0.0218)***	0.825 (0.0452)***
Age	0.951 (0.0142)**	1.009 (0.0132)
Age ²	1.001 (0.000180)***	1.000 (0.000148)
Race/ethnicity (Caucasian, non-Hispanic omitted)		
African American, non-Hispanic	0.650 (0.0553)***	0.913 (0.0618)
Native American, non-Hispanic	2.111 (0.970)	0.761 (0.190)
Asian, non-Hispanic	0.476 (0.0511)***	0.709 (0.112)*
Native Hawaiian/Pacific Islander non-Hispanic	0.435 (0.202)	0.429 (0.0807)***
Hispanic	0.578 (0.0525)***	0.791 (0.0636)**
Multiple races reported, non-Hispanic	0.812 (0.215)	0.819 (0.152)
Education (less than high school omitted)		
High school or equivalent	1.102 (0.0715)	1.289 (0.122)**
Associates degree/some college	1.608 (0.124)***	1.217 (0.0960)*
4-y college, bachelors degree	1.891 (0.200)***	1.319 (0.138)**
At least some graduate school	2.779 (0.396)***	1.405 (0.163)**
Employment status (employed omitted)		
Employed during the reference period but no job at the interview date	1.197 (0.162)	1.647 (0.305)**
Unemployed during the reference period	1.085 (0.0658)	1.286 (0.0788)***
Marital status (married omitted)		
Widowed	0.696 (0.156)	0.859 (0.101)
Divorced or separated	0.985 (0.0950)	0.982 (0.0846)
Single	0.813 (0.0631)**	0.942 (0.0614)
Income (poor omitted)		
Near poor	0.831 (0.0981)	1.042 (0.155)
Low income	0.958 (0.0849)	0.899 (0.0841)
Middle income	0.981 (0.0883)	0.959 (0.0825)
High income	1.384 (0.139)**	1.078 (0.0999)
Insurance (private insurance only omitted)		
Public insurance only	0.910 (0.0858)	1.112 (0.104)
Uninsured	0.244 (0.0178)***	0.436 (0.0295)***
MSA	1.006 (0.107)	1.219 (0.0691)***
Region (west omitted)		
Northeast	0.898 (0.0868)	0.985 (0.0682)
Midwest	1.355 (0.126)**	0.919 (0.0706)
South	0.974 (0.0829)	0.884 (0.0614)
Constant	9.076 (3.109)***	1372.7 (364.5)***
Observations	18,295	13,875

GLM = generalized linear model, MSA = metropolitan statistical area. Standard errors in parentheses. **P* < 0.05; ***P* < 0.01; ****P* < 0.001.

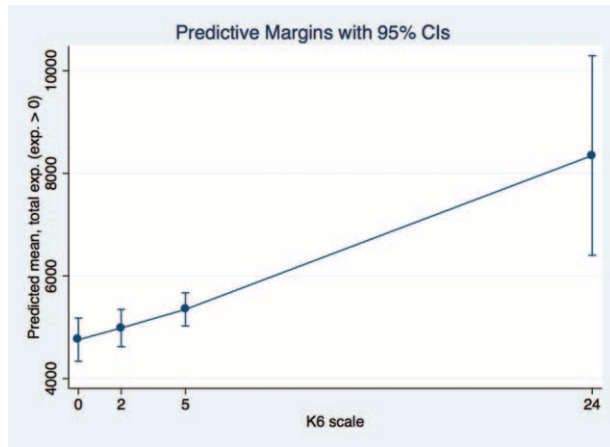


FIGURE 1. Predictive margins of total health expenditure conditional on positive spending. The predictive margins of total health expenditure conditional on positive spending across the quartile values of the K6 within our study sample— Q_0 (minimum) = 0, Q_1 (25th percentile) = 2, Q_2 (50th percentile) = 2, Q_3 (75th percentile) = 5, and (maximum) = 24.

expenditure. Taken together, our results suggest that “poor” mental health and psychological distress, as reported by an individual, are associated with an increased probability of any expenditure and the actual level of expenditure conditional on any spending. This relationship appears to be particularly strong when looking at the K6 measure. These associations remain significant after controlling for other important covariates such as race/ethnicity, sex, age, educational attainment, and regional characteristics. Our study reinforces the findings in the literature.²⁷ Our work not only exposes the association between SRMH and health expenditure, but the differential impact of varying SRMH measures on this relationship.

The results can be contextualized within the larger debate surrounding health care inflation. Indeed, US health care spending grew by 3.7% in 2012, reaching \$2.8 trillion or \$8915 per person.²⁸ NIMH reported that serious mental illness alone costs the United States an estimated \$193.2 billion per year; much of this cost is attributable to medications used to treat mental disorders, hospitalization, and clinic visits.²⁹ Although the Affordable Care Act is estimated to save the federal government approximately \$20 billion over 10 years, the “health care costs remain unevenly distributed: 10% of patients account for 64% of costs”; this elevated spending is mostly attributed to patients with chronic conditions.³⁰ Even when controlling for co-occurring physical health issues, mental illness still predisposed an individual toward elevated expenditure.⁸ Despite spending more on health care than other economically advanced countries, Americans are not much healthier.³¹

Within this context, SRMH measures may be a helpful resource in identifying those individuals who are both in need of mental health resources and at risk of elevated health care expenditure. Like any disease that remains untreated, mental illness can worsen over time, leading to higher costs of treatment^{32,33} and lower quality of life.³⁴ Although the majority of severe cases will seek professional advice and/or take medication, more moderate cases may slip through the cracks.³ Catching these individuals early may enhance the relative efficacy of mental health treatment and, as our results suggest, potentially impact broader health expenditure. In a recent study,

Jang et al³⁵ found SRMH to be significantly predictive of health service use and beneficial in raising one’s awareness of a mental health problem. Such results further support our findings, which highlight the potential usefulness of SRMH measures both in identifying unmet and high needs cases and in predicting those at risk of increase health care spending.

Our study has several limitations. First, our data are cross-sectional, which limits our ability to make causal inferences. That said, our data are nationally representative, which aids the external validity of our study. Second, given that our data are cross-sectional, we cannot discuss the impact of an individual’s cumulative mental health history on expenditure across the life span. Finally, mental health can be assessed using different instruments; these instruments may be more or less sensitive to varying aspects of a given condition. As a result, using different mental health measures may result in different findings. That said, we do draw on several mental health measures, which diversifies this risk. Moreover, each of these SRMH measures is positively associated with the probability and level of spending.

Despite these limitations, this study offers new information on the association between SRMH and health care expenditure, while controlling for other important factors influence this relationship. Building upon previous research, our findings provide further rationale for investments in self-rated assessments tools. Such tools will help identify the marginal patient in need of care who might otherwise go untreated, impacting not only the trajectory of treatment and patient health, but also the long-term costs. Health care providers, employers, researchers, and policy makers may want to consider the elevated risks of increased health care expenditure among persons with poorer SRMH in developing policies and interventions to contain health care expenditures.

REFERENCES

1. SAMHSA report provides information on mental illness levels in each state and the District of Columbia. Substance Abuse and Mental Health Services Administration (SAMHSA) website; February 28, 2014. Available at <http://www.samhsa.gov/newsroom/press-announcements/201402281030>. Accessed April 23, 2014.
2. Mental illness facts and numbers. National Alliance on Mental Illness (NAMI) website; March 2013. Available at http://www.nami.org/factsheets/mentalillness_factsheet.pdf. Accessed April 23, 2014.
3. Mechanic D. Is the prevalence of mental disorders a good measure of the need for services? *Health Aff (Millwood)*. 2003;22:8–20.
4. Kongsted A, Aambakk B, Bossen S, et al. Brief screening questions for depression in chiropractic patients with low back pain: identification of potentially useful questions and test of their predictive capacity. *Chiropr Man Therap*. 2014;22:1–8.
5. Berwick DM, Murphy JM, Goldman PA, et al. Performance of a five-item mental health screening test. *Med Care*. 1991;29:169–176.
6. Cohen BE, Gima K, Bertenthal D, et al. Mental health diagnoses and utilization of VA non-mental health medical services among returning Iraq and Afghanistan veterans. *J Gen Intern Med*. 2010;25:18–24.
7. Egede LE, Zheng D, Simpson K. Comorbid depression is associated with increased health care use and expenditures in individuals with diabetes. *Diabetes Care*. 2002;25:464–470.
8. Shen C, Sambamoorthi U, Rust G. Co-occurring mental illness and health care utilization and expenditures in adults with obesity and chronic physical illness. *Dis Manag*. 2008;11:153–160.
9. Druss BG, Rosenheck RA. Patterns of health care costs associated with depression and substance abuse in a national sample. *Psychiatr Serv*. 1999;50:214–218.

10. MEPS HC-147: 2011 Full year consolidated data file. Agency for Healthcare Research and Quality; September 2013. Available at http://meps.ahrq.gov/data_stats/download_data/pufs/h147/h147doc.-shtml#2511Utilization. Accessed April 23, 2014.
11. MEPS-HC sample design and collection process. Agency for Healthcare Research and Quality, 2011. Available at http://www.meps.ahrq.gov/survey_comp/hc_data_collection.jsp. Accessed February 28, 2015.
12. Physical and mental health condition prevalence and comorbidity among fee-for-service Medicare-Medicaid enrollees. Centers for Medicare & Medicaid Services (CMS) website; September 2014. Available at http://www.cms.gov/Medicare-Medicaid-Coordination/Medicare-and-Medicaid-Coordination/Medicare-MedicaidCoordinationOffice/Downloads/Dual_Con dition_Prevalence_Comorbidity_2014.pdf. Accessed February 25, 2015.
13. NHE fact sheet. Centers for Medicare & Medicaid Services (CMS) website; December 3, 2014. Available at <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NHE-Fact-Sheet.html>. Accessed February 25, 2015.
14. Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med*. 2002;32:959–976.
15. Zhao G, Ford ES, Li C, et al. Serious psychological distress and its associations with body mass index: findings from the 2007 Behavioral Risk Factor Surveillance System. *Int J Public Health*. 2009;54:30–36.
16. Pirraglia PA, Hampton JM, Rosen AB, et al. Psychological distress and trends in healthcare expenditures and outpatient healthcare. *Am J Manag Care*. 2011;17:319–328.
17. Mitchell CM, Beals J. The utility of the Kessler Screening Scale for Psychological Distress (K6) in two American Indian communities. *Psychol Assess*. 2011;23:752–761.
18. Cornelius BL, Groothoff JW, van der Klink JJ, et al. The performance of the K10, K6 and GHQ-12 to screen for present state DSM-IV disorders among disability claimants. *BMC Public Health*. 2013;13:128: pp 1–8.
19. Furukawa TA, Kessler RC, Slade T, et al. The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being. *Psychol Med*. 2003;33:357–362.
20. Kessler RC, Barker PR, Colpe LJ. Screening for serious mental illness in the general population. *Arch Gen Psychiatry*. 2003;60:184–189.
21. Bayliss M, Rendas-Baum R, White MK, et al. Health-Related Quality of Life (HRQL) for individuals with self-reported chronic physical and/or mental health conditions: panel survey of an adult sample in the United States. *Health Qual Life Outcomes*. 2012;10:154.
22. Desai PR, Lawson KA, Barner JC, et al. Identifying patient characteristics associated with high schizophrenia-related direct medical costs in community-dwelling patients. *J Manag Care Pharm*. 2013;19:468–477 <http://www.amcp.org/WorkArea/DownloadAsset.aspx?id=16754>.
23. Unützer J, Schoenbaum M, Katon WJ, et al. Healthcare costs associated with depression in medically ill fee-for-service Medicare participants. *J Am Geriatr Soc*. 2009;57:506–551.
24. Hardin JW, Hilbe J. Generalized Linear Models and Extensions. Lakeway Drive, College Station, Texas: Stata Press; 2007:203–206.
25. Buntin MB, Zaslavsky AM. Too much ado about two-part models and transformation: comparing methods of modeling Medicare expenditures. *J Health Econ*. 2004;23:525–542.
26. Manning WG, Mullahy J. Estimating log models: to transform or not to transform. *J Health Econ*. 2001;20:461–494.
27. Ahmad F, Jhaji AK, Stewart DE, et al. Single item measures of self-rated mental health: a scoping review. *BMC Health Serv Res*. 2014;14:398.
28. National health expenditures 2012 highlights. Center for Medicare and Medicaid Services website; 2012. Available at <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/downloads/highlights.pdf>. Accessed April 23, 2014.
29. Mental disorders cost society billions of unearned income. National Institute of Mental Health (NIMH) website; May 7, 2008. Available at <http://www.nimh.nih.gov/health/statistics/prevalence/serious-mental-illness-smi-among-us-adults.shtml>. Accessed April 23, 2014.
30. Orszag PR, Emanuel EJ. Health care reform and cost control. *N Engl J Med*. 2010;363:601–603.
31. Woolf SH, Aron L, eds. U.S. Health in International Perspective: Shorter Lives, Poorer Health; January 2013. The National Academies Press, Institute of Medicine, 500 Fifth St., NW, Washington, DC 20001. Available at http://www.iom.edu/~media/Files/Report%20Files/2013/US-Health-International-Perspective/USHealth_Intl_PerspectiveRB.pdf. Accessed April 23, 2014.
32. Hirschfeld RM, Keller MB, Panico S, et al. The National Depressive and Manic-Depressive Association consensus statement on the undertreatment of depression. *JAMA*. 1997;277:333–340.
33. Insel T. Assessing the economic costs of serious mental illness. *Am J Psychiatry*. 2008;165:663–665.
34. Ho BC, Andreasen NC, Flaum M, et al. Untreated initial psychosis: its relation to quality of life and symptom remission in first-episode schizophrenia. *Am J Psychiatry*. 2000;157:808–815.
35. Jang Y, Yoon H, Chiriboga DA, et al. Bridging the gap between common mental disorders and service use: the role of self-rated mental health among African Americans. *Am J Geriatr Psychiatry*. 2014.