Published in final edited form as:

J Appl Gerontol. 2011 April ; 30(20): 241–253. doi:10.1177/0733464810361348.

The Relationship Between Mentally Unhealthy Days and Depressive Symptoms Among Older Adults Over Time

Kimberly A. Skarupski, PhD, MPH¹, Matthew M. Zack, MD, MPH², Julia L. Bienias, ScD, MA¹, Paul A. Scherr, PhD, DSc², and Denis A. Evans, MD¹

¹ Rush University Medical Center, Chicago

² Centers for Disease Control and Prevention, Atlanta, GA

Abstract

This article sought to determine the extent to which the number of self-reported mentally unhealthy days (MUDs) in the past 30 days estimates depressive symptoms in older adults. The sample of 4,321 community-dwelling residents aged 65 and above originated from an ongoing population-based study of older Blacks and Whites. Participants' data from 1993 through 2005 included the single MUD question and questions from the Center for Epidemiologic Studies Short Depression Scale (CES-D). Fourteen percent of participants had four or more depressive symptoms at baseline; of these, only 52% reported one or more MUD. Thirty-eight percent of those with one or more MUDs had four or more depressive symptoms. The results illustrate an interesting association regarding the measurements of two distinct, but related, mental health constructs. Although the number of MUDs was associated with having more depressive symptoms over time, the single-question MUD measure does not fully capture depressive symptomatology.

Keywords

depression; psychological well-being; psychometrics; prospective

Introduction

Depression is a serious disease among older adults. The rate of suicide, which depression often causes, is higher in those aged 65 years or older than in younger persons, especially in men (Pearson, 2002). In addition to being a risk factor for mortality (Barefoot & Schroll, 1996; Simonsick, Wallace, Blazer, & Berkman, 1995; Whooley & Browner, 1998), a host of chronic conditions (Barefoot & Schroll, 1996; Everson-Rose et al., 2005; Ford et al., 1998; Jonas & Mussolino, 2000), and overall poor health (Bruce, Seeman, Merrill, & Blazer, 1994), depression has been estimated to cost the United States US\$44 billion per year (Greenberg, Stiglin, Finkelstein, & Berndt, 1993) and results in approximately 50% higher total health care costs for older depressed patients than their nondepressed peers, regardless of chronic morbidity (Katon, Lin, Russo, & Unutzer, 2003).

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Corresponding Author: Kimberly A. Skarupski, PhD, MPH, Rush Institute for Healthy Aging, Rush University Medical Center, 1645 W. Jackson Blvd., Suite 675, Chicago, IL 60612 Kimberly_Skarupski@rush.edu.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

Financial Disclosure/Funding

The authors received no financial support for the research and/or authorship of this article.

One of Healthy People 2010's objectives is to "increase the proportion of adults with mental disorders who receive treatment" (U.S. Department of Health and Human Services, 2004). Yet identification of depression among older adults is oftentimes a significant challenge. Depression may be difficult to identify and diagnose because its symptoms resemble those of other conditions (for example, dementia), because it may be dismissed as a normal part of aging, and because distinguishing depression from other conditions has often required the use of a lengthy set of screening questions that busy physicians may be reluctant to administer (Robins et al., 1988; Robins, Helzer, Croughan, & Ratcliff, 1981). Although briefer screening instruments for depressive symptoms would be quicker to administer, their use would also increase the risks of a true case of depression not being diagnosed (false negative) or of some other condition being incorrectly diagnosed as depression (false positive; Kroenke, Spitzer, & Williams, 2001; Rogers, Wilson, Bungay, Cynn, & Adler, 2002).

In the early 1990s, the Centers for Disease Control and Prevention (CDC) and its partners (CDC, 2006) developed a single question that surveillance systems could use to assess people's perceived mental health and mental distress: "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" This question has been used by the CDC's Behavioral Risk Factor Surveillance System (BRFSS) since 1993 (CDC, 2000; CDC, 2006) and has acceptable test-retest reliability (Andresen, Catlin, Wyrwich, & Jackson-Thompson, 2003), construct validity (Newschaffer, 1998), "known-groups" validity (Newschaffer, 1998), and predictive validity (Dominick, Ahern, Gold, & Heller, 2002).

In this article, we sought to determine the extent to which the number of recent mentally unhealthy days (MUDs) could estimate depressive symptoms, as identified through the Center for Epidemiologic Studies Short Depression Scale (CES-D; Irwin, Artin, & Oxman, 1999; Kohout, Berkman, Evans, & Cornoni-Huntley, 1993), based on a population study of older adults in Chicago. If our evaluation shows good correspondence between the two methods of assessing depression, the single-item MUD may be used to estimate the prevalence of depressive symptoms in other older populations (Rogan & Gladen, 1978).

Method

Study Population

Our data come from the Chicago Health and Aging Project (CHAP), a population-based prospective cohort study of risk factors for incident Alzheimer's disease and other conditions among people aged 65 or older living in one of three adjacent neighborhoods on the South Side of Chicago (Bienias, Beckett, Bennett, Wilson, & Evans, 2003). From 1993 to 1996, 6,158 residents (response rate of 78.9%) participated in a baseline survey in their homes during which they answered questions from trained interviewers about their sociodemographic characteristics, health, and lifestyle. Participants were reinterviewed every 3 years. Two modifications have been made to the composition of the original CHAP cohort: (a) successive age cohorts have been enrolled as community residents reach 65 years of age to ensure that the cohort does not become increasingly older and smaller and (b) a supplemental cohort of residents aged 65 and above from an adjacent neighborhood has been enrolled to add more older Whites to reduce the racial imbalance in the cohort. Our report is based on participants who provided complete data for our key measures for at least two of four possible follow-up cycles of data collection: Cycle 1/baseline (1993–1996), Cycle 2 (1997–1999), Cycle 3 (2000–2002), and Cycle 4 (2003–2005).

Measures

Depressive symptoms—CHAP participants are given the 10-item CES-D, an abbreviated version of the original CES-D (Kohout et al., 1993; Radloff, 1977). The CES-D asks respondents to indicate if they, much of the time during the past week, felt depressed, felt that everything they did was an effort, said their sleep was restless, were happy, felt lonely, felt people were unfriendly, enjoyed life, felt sad, felt that people disliked them, and felt that they could not get going. An endorsement of four or more depressive symptoms has been strongly associated with depression (Irwin et al., 1999).

MUDs—Participants are also asked, “Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?” (CDC, 2000; CDC, 2006).

Covariates—We included use of antidepressant medications (any use vs. no use [reference group]) and the following sociodemographic variables: age (centered at age 75), sex (male vs. female [reference group]), years of education (centered at 12), and race (African American vs. White non-Hispanic [reference group]).

Analysis

We assessed the relationship between the MUDs question and the CES-D via (a) correlation for convergent validity, (b) standard test diagnostics, and (c) multivariable regression modeling. For the correlational analysis, we used Spearman’s rank correlation coefficient because neither variable was normally distributed. For the test diagnostics, we examined the sensitivity, specificity, and positive and negative predictive values (Weiss, 1998) of the single-item MUD question in identifying participants having more depressive symptoms via the “gold standard” CES-D. We compared assessments at baseline using four different MUD “cutpoints” (≥ 1 day, ≥ 5 days, ≥ 14 days, and 30 days [the maximum possible]) with the established CES-D cutpoint score of ≥ 4 . The sensitivity is the proportion of participants having more depressive symptoms (CES-D score ≥ 4) at or above a specified MUD cutpoint. The specificity is the proportion of participants with CES-D scores ≤ 3 below a specified MUD cutpoint. The positive predictive value is the proportion of those at or above a specified MUD cutpoint with CES-D scores ≥ 4 . The negative predictive value is the proportion of those below a specified MUD cutpoint with CES-D scores ≤ 3 . We then used a trapezoidal approximation (Yeh, 2002) to compute the area under the receiver operating character (ROC) curve (sensitivity vs. 1-min specificity; see Pepe, 2000).

We also assessed the association between CES-D score ≥ 4 and the number of MUDs using generalized estimating equations (GEEs) modeling, which accounts for the inherent correlation of repeated measurements (Diggle, Heagerty, Liang, & Zeger, 2002; Zeger & Liang, 1986). In modeling CES-D scores as a dichotomous variable, we used a logit link and a binomial error structure (analogous to logistic regression). This approach allowed us to consider models unadjusted and adjusted for age, sex, education, race, and use of antidepressant medications.

Results

Table 1 shows the number of study participants per study cycle and the corresponding percentage reporting four or more depressive symptoms, the mean CES-D scores, the mean number of MUDs, and the correlation between the CES-D and MUDs. Of 4,321 study participants at baseline, 623 (14.4%, 95% confidence interval [CI] = 13.3%–15.6%) reported four or more depressive symptoms. Both measures remained positively correlated at the same level (~ 0.4) during follow-up cycles.

Table 2 shows the test validity and test performance results for the MUD question in detecting four or more depressive symptoms. Regarding sensitivity, 52% of participants with CES-D scores ≥ 4 also reported ≥ 1 MUD. As expected, increasing the MUD cutpoint decreased the sensitivity of the MUD measure in detecting depressive symptoms from 0.52 at ≥ 1 day to 0.42 at ≥ 5 days, 0.30 at ≥ 14 days, and 0.16 at 30 days. For specificity, 86% of the participants with CES-D scores ≤ 3 reported zero MUDs. Specificity increased more gradually as the MUD cutpoint increased, from 0.86 at zero days to 0.98 at < 30 days. The positive predictive value also generally increased gradually. Thirty-eight percent of participants who reported 1 or more MUDs also had four or more depressive symptoms, 48% who reported 5 or more MUDs also had four or more depressive symptoms, and more than half who reported both 14 or more (56%) and 30 MUDs (55%) also had four or more depressive symptoms. The negative predictive value of the test shows that 91% of respondents who reported zero MUDs also had three or fewer depressive symptoms, as did 87% of those who reported < 30 MUDs.¹ The estimated area under the ROC curve was 0.70, which indicates a relatively fair ability of the test to classify correctly.

Table 3 shows the modeling results. For each additional MUD that study participants reported, the odds that they would have a CES-D score ≥ 4 increased by about 7% (odds ratio [OR] = 1.07, 95% CI = 1.06–1.08; Model 1). When we adjusted for time since the baseline assessment, participants' age, sex, education, race, and interactions between time and these demographic variables, the OR was virtually unchanged (OR = 1.07, 95% CI = 1.05–1.08; Model 2). We did find a small but significant negative interaction between the number of MUDs reported and the time since the baseline assessment, indicating that each additional MUD reported by participants increased the odds of their having four or more depressive symptoms according to their CES-D score slightly more at baseline than later on during follow up. For example, each additional MUD increased these odds by 8% at baseline but by only 6% at 5 years after baseline (Model 3). Neither did adjusting for participants' use of antidepressant medications change the magnitude of these effects (Models 4 and 5) nor did adjusting for interactions between race and sex; race, sex, and time since baseline; race and education; and race, education, and time since baseline (results not shown).

We found that having four or more depressive symptoms according to the CES-D score was positively associated with being older, being female, being an African American, having less education (Model 2), and having ever used antidepressant medications (Model 4). As time since baseline increased, the strength of the associations between having four or more depressive symptoms and age, being an African American, and having ever used antidepressant medications increased (Model 5), whereas the strength of the associations between having four or more symptoms and sex and education level both decreased.

Discussion

In these analyses to determine the extent to which the number of recent MUDs could estimate depressive symptoms, we first found that the mean CES-D scores increased between the baseline and the first follow-up period but returned to near baseline levels during later follow-up periods. However, the mean number of MUDs increased during successive follow-up periods. The difference in the trend of these two measures may be because the MUDs item reflects perceived mental health problems (for example, stress) that

¹Most screening tests show high specificities and high negative predictive values because the proportion of those without the “gold standard” condition (e.g., three or fewer Center for Epidemiologic Studies Short Depression Scale [CES-D] symptoms) is much larger than that of those with the condition (e.g., four or more symptoms). Indeed, 86% of our baseline sample reported three or fewer CES-D depressive symptoms.

the CES-D scores do not. Alternatively, the difference may reflect changes over time in the make up of the cohort (for example, age differences). We also found that the MUDs question and the CES-D measure were modestly correlated; this was not surprising because we would expect that the number of MUDs would increase as the number of reported depressive symptoms would also increase. The test diagnostics indicated modest sensitivity (0.52) of the MUD measure in detecting those having four or more CES-D depressive symptoms at a cutpoint of one or more MUD; however, the specificity (0.86) and the positive predictive value (PPV; 0.38) at this cutpoint were surprisingly high for a single-question measure. Moreover, a PPV of 0.38 is considered large in a population-based screening study, especially when the proportions of participants endorsing four or more depressive symptoms ranged from 0.144 to 0.193.

Finally, in the multivariable modeling, we indeed found that the number of MUDs was associated with having four or more depressive symptoms. Furthermore, this association remained statistically significant over 11 to 13 years after accounting for the correlation of repeated measurements and after adjusting for age, sex, education, race, and for participants' use of antidepressant medications. Interestingly, this association was slightly stronger closer to baseline than during later follow-up periods; it is unclear why this change in the strength of the association occurred.

This study has at least three weaknesses. First, although all study participants reported at least two sets of measurements, there is a slight chance that attrition of the sample because of death or ill health may have been partly responsible for the diminished association between the number of MUDs reported by study participants and the number of depressive symptoms during follow-up surveys. Second, we did not assess whether the number of MUDs reported by survey participants may have been associated more strongly with "depressed" responses to some CES-D questions than with "depressed" responses to others. Finally, we were unable to explain why almost half of the participants with four or more depressive symptoms reported no MUDs.

The main strength of this study is that it involved a large population-based sample of more than 4,000 respondents who were followed for several years and from whom at least two sets of CES-D scores and MUDs were collected. In addition, we were able to include adjustment for some potential confounders.

In conclusion, we found that the MUDs and the CES-D are distinct but related mental health constructs. Because the MUDs question asks the participant to think about their "mental health, which includes stress, depression, and problems with emotions," it likely captures a broader spectrum of mental and emotional health that may or may not include depression. Thus, clinicians should know that using the one-item MUD question does not substitute for a depression screener. We are not aware of any other published studies examining the association between MUDs and depressive symptoms via the CES-D or any other depression scales; however, future researchers interested in this line of research might explore subject-specific mixed models, analyze associations between the number of MUDs and "depressed" responses to specific CES-D 10-item questions, and analyze why some participants with four or more depressive symptoms via the CES-D reported no MUDs.

Biographies

Kimberly A. Skarupski, PhD, MPH, is an associate professor at the Rush Institute for Healthy Aging at Rush University Medical Center. Her primary gerontologic research interests include quality of life and depressive symptoms in older age, the mind-body

connection, health services utilization, and race/ethnic health disparities; she also does program evaluation.

Matthew M. Zack, MD, MPH, is a medical epidemiologist at the National Center for Chronic Disease Prevention and Health Promotion at the Centers for Disease Control and Prevention. His primary gerontologic research interests are the physical and mental aspects of health-related quality of life and the public health interventions that may improve it among the elderly.

Julia L. Bienias, ScD, MA, is a research statistician with interests in gerontology, social science, neurology, and survey design.

Paul A. Scherr, PhD, DSc, is an epidemiologist in the National Center for Chronic Disease Prevention and Health Promotion at the Centers for Disease Control and Prevention. His primary research interests are the epidemiology of Alzheimer's disease and changes in the levels of cognitive function among older adults in the general population.

Denis A. Evans, MD, is the Jesmer professor of internal medicine at Rush University, a member of the Rush Institute for Healthy Aging, and principal investigator of the Chicago Health and Aging Project. His research interests are mainly in the occurrence of common chronic diseases of older people in the general population.

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Table 1

Proportion of Study Participants, Percentage Depressed According to CES-D Scores, Mean CES-D Scores, Mean Number of MUDs, and Correlations Between CES-D Scores and MUDs—CHAP, 1993–2005

Survey cycles	Number of study participants	Percentage depressed according to CES-D scores ^a (95% CI)	Mean CES-D score (95% CI)	Mean number of MUDs (95% CI)	Correlation between mean CES-D score and mean number of MUDs (95% CI) ^b
1993–1996	4,321	14.4 (13.3–15.6)	1.53 (1.47–1.59)	2.38 (2.18–2.58)	.35 (0.32–0.38)
1997–1999	4,190	19.3 (18.1–20.6)	1.81 (1.75–1.87)	3.00 (2.76–3.24)	.38 (0.35–0.41)
2000–2002	2,827	15.3 (13.9–16.7)	1.57 (1.49–1.65)	3.17 (2.87–3.47)	.41 (0.38–0.45)
2003–2005	2,253	16.4 (14.9–18.1)	1.58 (1.50–1.66)	3.25 (2.91–3.59)	.41 (0.37–0.45)

Note: CES-D = Center for Epidemiologic Studies Short Depression Scale; MUDs = mentally unhealthy days; CHAP = Chicago Health and Aging Project; CI = confidence interval.

^a A score of ≥ 4 .

^b Spearman correlation.

Table 2

Test Validity and Test Performance of the MUDs Question for the Detection of Four or More Depressive Symptoms Using the CES-D—CHAP (Cycle 1), Point Estimates (95% CI)

MUD cutpoints	Number of study participants ^a	Sensitivity ^b	Specificity	Positive predictive value	Negative predictive value
≥1 day	844	0.52 (0.47–0.56)	0.86 (0.84–0.87)	0.38 (0.34–0.42)	0.91 (0.90–0.93)
≥5 days	551	0.42 (0.38–0.47)	0.92 (0.91–0.94)	0.48 (0.43–0.52)	0.90 (0.89–0.92)
≥14 days	334	0.30 (0.26–0.34)	0.96 (0.95–0.97)	0.56 (0.50–0.62)	0.89 (0.88–0.90)
≥30 days	187	0.16 (0.13–0.20)	0.98 (0.97–0.99)	0.55 (0.47–0.62)	0.87 (0.86–0.89)

Note: MUDs = mentally unhealthy days; CES-D = Center for Epidemiologic Studies Short Depression Scale; CHAP = Chicago Health and Aging Project; CI = confidence interval.

^a 3,477 participants reported zero MUDs.

^b The sensitivity is the proportion of participants with CES-D scores ≥4 at or above a specified MUD cutpoint. The specificity is the proportion of participants with CES-D scores ≤3 below a specified MUD cutpoint. The positive predictive value is the proportion of participants at or above a specified MUD cutpoint with CES-D scores ≤4. The negative predictive value is the proportion of those below a specified MUD cutpoint with CES-D scores ≤3.

Table 3

Odds Ratios of Having Four or More Depressive Symptoms Using CES-D (≥ 4), by Covariate, CHAP

Covariate	Model 1	Model 2	Model 3	Model 4	Model 5
MUDs, overall	1.07	1.07			
MUDs, at baseline ^a			1.08	1.08	1.08
Additional effect of one additional MUD, per year			0.995	0.995	0.995
Time (in years and fractions of years) since baseline		0.999	1.02	1.02	1.003
Age (centered at 75 years), at baseline		1.03	1.03	1.03	1.03
Additional effect of one additional year of age, per year		1.002	1.002	1.002	1.002
Male, at baseline		0.59	0.59	0.60	0.60
Additional effect of male, per year		1.05	1.04	1.05	1.05
Years of education (centered at 12), at baseline		0.90	0.90	0.90	0.90
Additional effect of one additional year of education, per year		1.008	1.007	1.007	1.007
Black, at baseline		1.55	1.54	1.65	1.60
Additional effect of Black, per year		1.03	1.03	1.04	1.04
Antidepressant use, overall				1.98	—
Antidepressant use, at baseline					1.59
Additional effect of antidepressant use, per year					1.05

Note: CES-D = Center for Epidemiologic Studies Short Depression Scale; CHAP = Chicago Health and Aging Project; MUDs = mentally unhealthy days. All odds ratios differed statistically significantly from 1.00 at a significance probability less than .05, except for time since baseline (all five models) and for the interaction between Black and time since baseline (in Model 2). Because these estimates are odds ratios, each “additional effect” (interaction) is multiplicative of the corresponding “at baseline” effect.

^aBaseline = participants’ baseline.