

Toward a Threshold for Subthreshold Depression: An Analysis of Correlates of Depression by Severity of Symptoms Using Data From an Elderly Community Sample

Celia F. Hybels, PhD,¹ Dan G. Blazer, MD, PhD,^{1,2} and Carl F. Pieper, DrPH^{1,3}

Purpose: The prevalence of depressive symptoms in elderly adults is high, yet the criteria to identify clinically significant depression may leave many elders undiagnosed and untreated. We explored the demographic and risk factor profiles of two groups, one with more severe depression and one with less severe depression. **Design and Methods:** The data come from the Duke University Established Populations for Epidemiologic Studies of the Elderly (EPESE) baseline survey of 4,162 community-dwelling adults aged 65 or older. **Results:** The prevalence of depression meeting criteria of the Center for Epidemiologic Studies–Depression scale (CES–D) and sub-threshold depression was 9.1% and 9.9%, respectively. In ordinal logistic regression, both CES–D and subthreshold depression were associated with impairment in physical functioning, disability days, poorer self-rated health, use of psychotropic medications, perceived low social support, female gender, and being unmarried. **Implications:** Depression appears to exist along a continuum, with demographic and social and physical health predictors of subthreshold depression similar to predictors of depression as defined by the CES–D scale.

Key Words: Aging, Depressive symptoms, Epidemiology

Much research over the last decade has focused on residual cases of depression that do not meet criteria according to the nomenclature, but are potentially clinically significant. Wells and colleagues (1989) reported that many patients seen in primary care had depressive symptoms but failed to meet the criteria for major depression or dysthymia. Yet, these patients exhibited a decreased quality of life and more dysfunction and disability than did patients with either hypertension or diabetes. Similarly, Broadhead, Blazer, George, and Tse (1990) reported that individuals in the community with minor depression had 51% more disability days than persons with major depression. The number of days lost from work among those with minor depression was similar to that reported by individuals with major depression. Johnson, Weissman, and Klerman (1992) reported that depressive symptoms were associated with as much service utilization and social morbidity as clinical depression. Philipp and colleagues (1992) applied several existing criteria to a sample of both psychiatric inpatients and outpatients and found the definition for depression too restrictive. Relaxing the time criteria and reducing the necessary symptom count to introduce a category of minor depression reduced the number of Depression Not Otherwise Specified cases by 80%.

Minor depression was classified in the Research Diagnostic Criteria (RDC; Spitzer, Endicott, & Robins, 1978), but it did not appear in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM; American Psychiatric Association, 1980) criteria until reintroduced in the appendix to *DSM-IV* (American Psychiatric Association, 1994). The lifetime prevalence of minor depression reported from the National Comorbidity Study using an approximation of the DSM criteria for minor depression was 10% (Kessler, Zhao, Blazer, & Swartz, 1997). Judd, Rapaport, Paulus, and Brown (1994) reported that the one-year prevalence of subsyndromal depression (defined as depressive symptomatology not meeting the criteria for major or minor depression or dys-

This research was supported by National Institute on Aging Training Grant 5T32 AG00029 to Dr. Hybels and by National Institute on Aging Contract N01 AG12102 and Grant AG12765-03 to Dr. Blazer and Dr. Pieper. This study was presented in part at the annual conference of the American Public Health Association, November 12–16, 2000 in Boston, Massachusetts.

Address correspondence to Dr. Celia Hybels, Center for the Study of Aging and Human Development, Duke University Medical Center, Box 3003, Durham, NC 27710. E-mail: cfh@geri.duke.edu

¹Center for the Study of Aging and Human Development, Duke University Medical Center, Durham, NC.

²Department of Psychiatry and Behavioral Sciences, Duke University Medical Center, Durham, NC.

³Department of Community and Family Medicine, Duke University Medical Center, Durham, NC.

thymia) in adults 18 or older in the landmark Epidemiologic Catchment Area (ECA) data was 11.8%, higher than that for all diagnosed *DSM-III* (American Psychiatric Association, 1980) mood disorders combined. While this phenomenon has been referred to by different names including subthreshold, subclinical, minor, mild, and subsyndromal depression, a summary of the research to date concludes that, regardless of label, depressive symptoms not meeting diagnostic criteria are prevalent and associated with morbidity and functional impairment (Pincus, Davis, & McQueen, 1999). The specific criteria applied to capture these subthreshold symptoms have uniformly identified persons who do not meet traditional criteria, yet experience dysfunction secondary to depressive symptoms.

The issue of subthreshold depression is particularly relevant for elderly people. As older age often brings a decline in physical health and functioning, decreases in cognitive functioning, bereavement, loss of independence, reduced income and role loss through retirement, and other factors associated with depression, one would assume the prevalence of depression to be high among older adults. In a sample of community-dwelling elders, the prevalence of significant dysphoric symptomatology was 14.7%, whereas the prevalence of major depression was much lower, 3.7% (Blazer & Williams, 1980). In the ECA study, the prevalence of *DSM-III*-defined major depressive disorder among those 65 or older was 1.0% compared to 2.3% in those aged 45–64 and 3.4% in those aged 18–44 (Robins & Regier, 1991). These findings have led to suggestions that the current diagnostic criteria for depression may be less applicable to elders and need to be broadened to include depression as seen in older adults (Blazer, 1994; Ernst & Angst, 1995). Lyness, King, Cox, Yoediono, and Caine (1999) recently reported that subsyndromal depression in older primary care patients was more prevalent than major depression, minor depression, and dysthymia, and was associated with functional disability and medical comorbidity similar to that seen in major or minor depression.

The Longitudinal Aging Study Amsterdam (LASA) of community-dwelling adults aged 55–85 reported a one-month prevalence of minor depression of 12.9% (Beekman, Deeg, Van Tilberg, et al., 1995). Data from the LASA have shown that chronic physical illness, perceived poorer health, functional limitation, and lower scores on cognitive functioning tests are associated with minor depression. The LASA investigators defined minor depression as a score of 16 or more on the Center for Epidemiologic Studies–Depression scale (CES–D; Radloff, 1977) but not meeting *DSM-III* criteria (American Psychiatric Association, 1980) for major depression.

The objective of these analyses was to broaden the definition of subthreshold or minor depression and to examine the prevalence and correlates of subthreshold depression in a sample of community-dwelling elders. We hypothesized that: (1) The prevalence of subthreshold depression in older adults

would be higher than that of CES–D-defined depression; (2) Subthreshold depression would be more prevalent in women, and the prevalence in both genders would increase with age; and (3) The symptom patterns and associations with demographic and social and physical health correlates observed in elders with subthreshold depression would be similar to those observed in individuals with CES–D-defined depression.

Methods

Sample Design.—The data were obtained from the Duke University Established Populations for Epidemiologic Studies of the Elderly (EPESE). This longitudinal study of community-dwelling elders aged 65 or older was sponsored by the National Institute on Aging and conducted at four sites—East Boston, Massachusetts; Iowa and Washington Counties, Iowa; New Haven, Connecticut; and the Piedmont area of North Carolina. The data used in these analyses are from the baseline survey conducted in North Carolina 1986–87. The study design has been documented elsewhere (Blazer, Burchett, Service, & George, 1991). Briefly, the sample is a stratified multistage area probability sample in which African Americans were oversampled. A total of 4,000 interviews were completed with sample members and an additional 162 interviews were completed with proxy informants, for an overall baseline survey response rate of 80%. The baseline survey data were collected through in-person interviews. Written consent was obtained, and all data collection and processing were conducted according to a prescribed protocol that had been approved by the institutional review boards at participating institutions. Only sample members who participated themselves are included in these analyses because depression questions were not asked of proxy informants.

Subthreshold Depression and CES–D Depression.—The EPESE measured depressive symptomatology using the CES–D scale (Radloff, 1977). The CES–D is a 20-item scale that asks the respondent to indicate to what extent he or she had a particular feeling the previous week. A modified version was used at the Duke EPESE site, where respondents were asked to indicate whether or not the feeling had been present the previous week. In its original form, the CES–D has a range of scores from 0 to 60 with a score of 16 or greater considered depressed. Beekman, Deeg, Van Limbeek, and colleagues (1997) studied the validity of the CES–D in an elderly community-based sample. Using the one-month prevalence of major depression derived from the Diagnostic Interview Schedule (Robins, Helzer, Croughan, & Radcliff, 1981) as criterion, the CES–D had a positive predictive value of 13.2%. Although the majority of those depressed according to the CES–D did not fulfill the *DSM-III* criteria for major depression, the authors concluded the validity of the CES–D was satisfactory in their sample of older adults.

As described elsewhere (Blazer et al., 1991), a score of 9 or more symptoms on the modified scale used in the Duke EPESE was determined to be comparable to a score of 16 or greater on the original scale. In Figure 1 we present the cumulative frequency by gender of CES-D-defined depressive symptoms observed in our sample. As expected, men were more likely to have fewer symptoms than women. However, as indicated by the smooth curves, no clearly defined cutpoints for CES-D-scale depression or subthreshold depression were observed for either gender. For purposes of these analyses, subthreshold depression was then arbitrarily defined as a score of 6 to 8 depressive symptoms on the modified scale to lower the threshold from the usual cutpoint for CES-D-scale depression. Sample members with fewer than six symptoms were classified as nondepressed. The categories are therefore mutually exclusive.

Sociodemographic Variables.—We computed age from the sample member's self-reported date of birth and date of interview. The range of ages was 65–105 at baseline, and we used age as a continuous variable in the regression model. Race/ethnicity was determined by self-report, and we classified subjects as African American or White/Other. Less than 1% of the sample members was neither White nor African American and was classified as Other. Years of education ranged from 0 to 17 years. We used a dichotomous variable for the bivariate analyses, having completed 11 or more years or fewer than 11 years. For many older members of this cohort, only 11 years were required to receive a high school diploma. Education was used as a continuous variable in the regression model. Finally, we classified subjects as currently married (regardless of whether currently living with spouse) or not married (never married, widowed, separated, or divorced).

Physical Functioning and Disability.—Self-perceived health was classified as excellent, good, fair, or poor. The four-level variable was modeled as a continuous

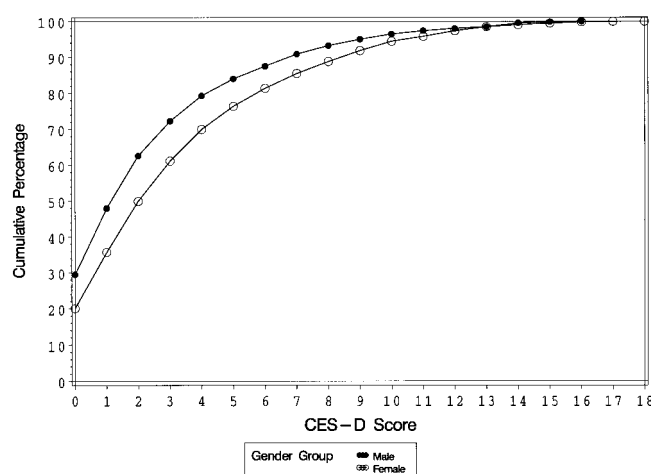


Figure 1. Cumulative frequency of depressive symptoms by gender.

variable in the multivariable analysis, with “excellent” as the reference group. To measure chronic disease, we used a measure of health status (Fillenbaum, Leiss, Pieper, & Cohen, 1998) that summed all chronic conditions present from those listed (heart problems, hypertension, diabetes, stroke, and cancer), with each condition weighted according to the estimated impact on overall health status. For the bivariate analyses, we used a dichotomous variable created from the full sample comparing the upper 35% to the lower 65%. For the regression analyses, we used the continuous variable with a range of 0 to 206, with 0 being no chronic disease. We used number of doctor visits as a continuous variable in the regression model, with a range of 0 to 100 visits. We measured self-reported disability and physical limitations in two ways. First, we asked, “During the past 3 months did you ever have to cut down on things you usually do because of illness or injury (not counting days in bed)?” to capture disability days. We also used a summary measure incorporating the seven activities of daily living (ADL) tasks identified by Katz, Downs, Cash, and Grotz (1970), three of the six items reported by Rosow and Breslau (1966), and the seven items from the instrumental ADL scale used in the Older Americans Resources and Services (OARS) survey (Duke University, 1978). Subjects having difficulty or needing help with two or more activities were classified in the bivariate analyses as having some limitations in physical functioning. We used the continuous variable with a range of 0 to 13 in the regression model, with 0 indicating no difficulty. The summary measure was an attempt to capture an overall rating of physical functioning.

Cognitive Functioning.—Cognitive impairment was assessed using the Short Portable Mental Status Questionnaire (SPMSQ; Pfeiffer, 1975). We compared sample members with three or more errors to those with less than three, consistent with the cutpoint used by Pfeiffer to indicate mild to moderate impairment. Items marked “Can’t do” or “Refused” were counted as errors. We had very few persons with six or more errors, most likely because the SPMSQ was used as a screening tool in the EPESE. Individuals with many errors participated by proxy because of cognitive reasons; they were not included in these analyses because depression was not ascertained through proxy respondents. These scores were not adjusted for race and education as done by Pfeiffer, because these demographic variables were included in the final regression model.

Use of Psychotropic Medications.—The coding of the medication data has been described elsewhere (Hanlon et al., 1992). The field interviewer obtained detailed information concerning prescription medications taken within the past 2 weeks or prescribed to be taken as needed. In these analyses, psychotropic medications included antidepressants, sedatives, hypnotics, and antianxiety and antipsychotic medications.

Perceived Social Support.—The Duke EPESE included multiple measures of social support. Previous research has shown that, although social support is multidimensional, perceived social support is significantly associated with adverse health outcomes (e.g., Blazer, 1982). We used two questionnaire items to measure perceived social support, specifically, the degree to which a respondent feels he or she has someone to turn to if needed. The items were: “In times of trouble, can you count on at least some of your family or friends most of the time, some of the time, or hardly ever?” and “Can you talk about your deepest problems with at least some of your family or friends most of the time, some of the time, or hardly ever?” The responses to these items were summed, with a resulting range of 2 to 6. We classified a score of less than 5 as impaired for the bivariate analyses because the majority of the sample had a score of 6, and used the continuous measure for the regression with 2 being the reference group.

Data Analysis.—Weighted data were used for all analyses as well as for significance testing. The use of weights adjusted for the unequal probabilities of selection for each sample member. All analyses were first run using Statistical Analysis System (SAS) software (SAS Institute, 1990) with a weight statement attached. The sample weights were downweighted to the original sample size for the purpose of significance testing in the initial analyses. The analyses were then run using SURVEY DATA ANALYSIS (SUDAAN) software (Research Triangle Institute, 1997) to adjust for the clustering effect in the sample design.

We first conducted general descriptive analyses and looked at the bivariate associations between selected factors and each of the levels of depression. To simultaneously control for the effects of various factors, we employed ordinal logistic regression with a three-level depression variable as the outcome and the social and physical health variables as independent predictors of depression status. Depression data were available for 3,996 of the 4,000 participants. Data from 3,674 of these sample members were complete for all independent variables. Nearly all of the predictors had at least some missing values, but those with the most missing data were physician visits (4%) and limitations in physical functioning (2%). Persons with missing data on one or more of the variables used in the logistic regression analyses were removed from all analyses.

Results

Table 1 shows the prevalence of depression. A total of 9.1% of the 3,996 sample members with depression data had scores of 9 or greater on the modified CES-D scale, and 9.9% had scores of 6 to 8 symptoms, indicating subthreshold depression. The majority, 81%, reported experiencing five or fewer symptoms the week prior to the interview. As expected, the prevalence of both subthreshold depression and CES-D-scale depression was higher in

Table 1. Prevalence of Depression Among the 3,996 Self-reporting Baseline Participants by Age and Gender (Weighted Data) in Percentages

Characteristic	% With Subthreshold Depression	% With CES-D-Scale Depression
Males and Females		
65–74	9.2%	8.1%
75–84	11.0	10.4
85+	12.9	12.5
Females Only		
65–74	10.7	9.8
75–84	11.2	11.5
85+	12.2	14.3
Total	10.9	10.6
Males Only		
65–74	6.9	5.6
75–84	10.7	8.2
85+	14.7	8.0
Total	8.3	6.4
Total	9.9	9.1

Notes: The prevalence among participants used in these analyses with complete data on all the control variables ($n = 3,674$) was as follows: subthreshold depression (9.3%) and CES-D-scale depression (8.4%). CES-D-scale depression was defined as 9 or more symptoms on the modified scale. Subthreshold depression was operationalized as 6–8 symptoms on the modified scale.

women compared to men. Across both genders, there was a clear gradient of increased prevalence with age for both types of depression. Among those subjects with complete data on all control variables ($n = 3,674$), the prevalence of CES-D-scale depression was 8.4%, and the prevalence of subthreshold depression was 9.3%.

In Table 2 we present the responses to each of the 20 depression items for nondepressed individuals, those with subthreshold depression, and those with CES-D-defined depression. The proportion of sample members with subthreshold depression reporting each symptom was lower than the proportion of those with CES-D-defined depression, but all symptoms were represented. These data suggest that persons with subthreshold depression have a similar symptom complex to those with CES-D-defined depression, but fewer symptoms overall. We also ranked the items by the proportion of respondents reporting that symptom, and the rankings are very similar among those with subthreshold or CES-D-criteria depression (Pearson correlation coefficient = 0.93). The four most common symptoms reported by both those with subthreshold and CES-D-scale depression were Item 6 (felt depressed), Item 18 (felt sad), Item 14 (felt lonely), and Item 7 (felt everything I did was an effort). By contrast, Item 6 (felt depressed) was the seventh most frequently reported symptom in the nondepressed group, and Item 18 (felt sad) was the fifth most frequently reported. We observed some differences in the particular symptoms reported comparing men to women, but within each gender, we found similar rankings of symptoms among those with CES-D or subthreshold depression compared to the nondepressed.

Table 2. Proportion of Sample Members With Complete Data ($n = 3,674$) Reporting Specific Depressive Symptoms by Depression Category (Weighted Data) in Percentages

Scale Item			Nondepressed	Rank	Subthreshold Depression	Rank	CES-D-Scale Depression	Rank
Item 1	Bothered by things that don't usually bother me	% Yes	7.8%	10	29.3%	12	60.9%	9
Item 2	Did not feel like eating; appetite poor	% Yes	8.9	9	40.8	9	62.1	8
Item 3	Felt I could not shake off the blues even with help	% Yes	4.6	13	42.3	8	73.9	6
Item 4	Felt I was just as good as other people	% No	4.5	14	11.3	17	18.9	20
Item 5	Had trouble keeping my mind on what I was doing	% Yes	13.2	5	44.9	7	60.8	10
Item 6	Felt depressed	% Yes	11.6	7	70.0	1	92.8	1
Item 7	Felt everything I did was an effort	% Yes	17.0	1	57.8	4	83.4	4
Item 8	Felt hopeful about the future	% No	15.2	3	35.1	10	44.8	14
Item 9	Thought my life had been a failure	% Yes	1.9	19	7.5	19	34.1	16
Item 10	Felt fearful	% Yes	5.2	12	26.8	13	54.1	11
Item 11	Sleep was restless	% Yes	16.5	2	55.4	5	71.1	7
Item 12	Was happy	% No	3.9	15	21.2	14	45.4	13
Item 13	Seemed I talked less than usual	% Yes	6.9	11	29.5	11	51.2	12
Item 14	Felt lonely	% Yes	13.8	4	60.1	3	84.4	3
Item 15	People were unfriendly	% Yes	2.4	17	11.3	17	30.0	18
Item 16	Enjoyed life	% No	3.1	16	13.0	16	26.7	19
Item 17	Had crying spells	% Yes	2.1	18	19.5	15	41.0	15
Item 18	Felt sad	% Yes	13.2	5	62.9	2	89.3	2
Item 19	Felt people disliked me	% Yes	1.7	20	6.2	20	31.9	17
Item 20	Could not get going	% Yes	10.6	8	49.3	6	75.9	5

Notes: CES-D-scale depression was defined as 9 or more symptoms on the modified scale. Subthreshold depression was operationalized as 6–8 symptoms on the modified scale. Individuals classified as nondepressed had fewer than 6 symptoms.

Table 3 presents the characteristics of the sample and provides comparisons of these characteristics across depression status. Consistently, the proportion with a particular risk factor was highest among those with CES-D or subthreshold depression and lowest among the nondepressed. For example, although 62% of the overall sample were women, 73% of those with CES-D-scale depression and 67% of those with subthreshold depression were women.

The same pattern was observed comparing those 75 or older to those 65–74 years of age. Overall, 35% of the sample was aged 75 or older, but among those with CES-D-scale depression and subthreshold depression, the proportion was higher, 42%. Differences were very pronounced for physical limitations. Overall, 30% had some difficulties with physical functioning. The proportion with difficulty among the nondepressed was only 24%, compared to 50%

Table 3. Distribution of Sample Characteristics Across Depression Status for Those With Complete Data at Baseline Survey (Weighted Data)

Characteristic	Total ($n = 3,674$)	Nondepressed Participants ($n = 2,954$)	Participants w/Subthreshold Depression ($n = 388$)	Participants w/CES-D-Scale Depression ($n = 332$)
Females	61.8%	60.1%	67.1%	72.5%
Age 75+	35.4%	33.9%	42.0%	42.0%
Mean age	73.0	72.8	74.0	73.9
White or Other	65.9%	66.8%	60.1%	63.2%
<11 Years of education	55.8%	52.7%	72.8%	67.1%
Mean years of education	9.4	9.7	7.9	8.2
Not currently married	48.0%	45.2%	61.1%	60.6%
With 3 or more SPMSQ errors	18.7%	16.5%	28.5%	28.9%
Some physical limitations	29.5%	23.8%	50.2%	62.1%
Mean number of limitations	1.5	1.2	2.6	3.3
Some chronic health problems	34.0%	31.4%	43.5%	49.5%
Mean health index score	37.0	34.9	44.5	48.5
Health fair or poor	43.4%	37.5%	66.2%	76.5%
4 or more physician visits past year	43.1%	39.4%	56.5%	64.2%
Mean number of physician visits	4.6	4.1	6.0	7.8
With psychotropic medication use	16.5%	13.3%	29.4%	33.6%
Cut down activities past 3 months	31.9%	26.0%	50.9%	67.9%
Perceived social support low	13.6%	11.3%	20.5%	28.9%

Notes: CES-D-scale depression was defined as 9 or more symptoms on the modified scale. Subthreshold depression was operationalized as 6–8 symptoms on the modified scale. Individuals classified as nondepressed had fewer than 6 symptoms.

of those with subthreshold depression and 62% of those with CES-D-scale depression. Other measures of health status showed the same gradients in proportions in these uncontrolled analyses. Note that the means for these items increase as the number of depressive symptoms increase. These bivariate analyses show similar patterns of associations among those with subthreshold and CES-D-defined depression compared to the nondepressed.

Table 4 presents these data in the form of crude prevalence odds ratios, comparing those with subthreshold depression or CES-D-scale depression to the nondepressed. With the exception of the association between race/ethnicity and CES-D-defined depression, each of the odds ratios was significant.

The associations of the factors with the three levels of depression were then tested through ordinal logistic regression so the covariates could be simultaneously controlled to measure independent effects. The test for the proportional odds assumption was used to determine whether the constant proportionality assumption was valid for the odds for the two levels of depression with respect to their associated risk factors. The test was run on the full model that

Table 4. Uncontrolled Prevalence Odds Ratios (PORs) Showing Relationship Between Selected Variables and Levels of Depression in Baseline Sample Members With Complete Data on All Variables of Interest ($n = 3,674$) (Weighted Data)

Variable	POR Subthreshold Depression	POR CES-D-Scale Depression
Females	1.36*	1.75***
Males	0.00	0.00
Age 75+	1.41**	1.41*
Age 65–74	0.00	0.00
White or Other	0.75*	0.85 <i>ns</i>
African American	0.00	0.00
<11 Years of education	2.4***	1.83***
11+ Years of education	0.00	0.00
Not married	1.91***	1.87***
Married	0.00	0.00
3 or more SPMSQ errors	2.02***	2.06***
<3 SPMSQ errors	0.00	0.00
Some ADL limitation	3.21***	5.23***
Little/No ADL limitation	0.00	0.00
Some chronic health problems	1.69***	2.15***
Little/No chronic health problems	0.00	0.00
Health fair or poor	3.27***	5.43***
Health excellent or good	0.00	0.00
4 or more physician visits past year	1.99***	2.75***
<4 physician visits past year	0.00	0.00
Psychotropic medication use	2.71***	3.29***
No use	0.00	0.00
Cut down usual activities past 3 months	2.95***	6.02***
No cut down past 3 months	0.00	0.00
Perceived social support low	2.02***	3.20***
Perceived support high	0.00	0.00

Notes: CES-D-scale depression was defined as 9 or more symptoms on the modified scale. Subthreshold depression was operationalized as 6–8 symptoms on the modified scale. Individuals classified as nondepressed had fewer than 6 symptoms.

* $p < .05$; ** $p < .01$; *** $p < .001$.

included the independent variables of interest and the three-level dependent variable. The chi square with 18 degrees of freedom was not significant ($p = .27$), allowing an ordinal model with parallel slopes but separate intercepts to be fitted to the data.

To be sure the model assumptions of linearity were not violated, each of the continuous variables to be used in the model was tested individually in the full model. Specifically, each continuous variable was included along with higher order terms up to the fifth power. We used the log likelihood ratio test to see if the additional higher order terms as a group were significant. The only two variables with significant nonlinear relationships with depression were number of doctor visits and number of limitations in physical functioning. By progressively dropping out the highest order terms, we found physical functioning was only significant to the second power. We plotted the summary of the odds of the continuous variable and its squared term and found the odds of depression increased as the number of limitations increased to an approximate score of 7 and then began to decrease. To adjust for this nonlinear relationship, we included the squared term in the final model. The number of doctor visits was significant for the highest order term. Again, we plotted the summary of these odds and found the odds of depression increased as the number of doctor visits increased to an approximate value of 16 and then decreased to a value of 51, increased again to 62, and then decreased. To accommodate this nonlinear relationship, we included the four higher order terms in the model.

Finally, we assessed the model for collinearity between the independent variables and found that the social and physical health variables were relatively independent. Self-rated health had the lowest tolerance (0.69). Interaction terms between both age and gender and each of the social and physical health correlates were not significant.

The resulting odds ratio for the association between each of the independent variables and depression in our final logistic model compares the change in the relative odds for being in a more depressed group (CES-D-defined depression and subthreshold depression vs nondepressed and CES-D-scale depression vs subthreshold depression and nondepressed) for a one-unit change in the factor of interest. The associations of the sociodemographic variables of age, race/ethnicity, and education with depression were not significant (Table 5). Multiplying the beta coefficient for age, 0.0031, by 10 and exponentiating the result, we found the odds of being in a more depressed group are 1.03 for each decade-increase in age. Gender ($p < .05$) and marital status ($p < .01$) were associated with depression. The odds of a higher level of depression were 1.28 in women compared to men and 1.50 in unmarried men and women compared to married. Chronic health problems were not significantly associated with a higher depression group. The association between the number of doctor visits and depression group depends on the number of visits.

Table 5. Ordinal Logistic Regression Results Showing Relationship of Three Levels of Depression With Selected Social and Physical Health Variables in Baseline Subjects With Complete Data ($n = 3,674$) (Weighted Data)

Variable	Beta Coefficient	Standard Error	Odds Ratio	95% CI	<i>p</i> Value
Overall Model					
Intercept 1 9+ Depressive Symptoms	-3.173	0.75			
Intercept 2 6-8 Depressive Symptoms	-2.135	0.74			
Age at baseline	0.003	0.01	1.00	(0.99, 1.02)	
Female	0.246	0.13	1.28	(1.00, 1.64)	*
Male	0.000				
White or Other	-0.044	0.12	0.96	(0.76, 1.21)	
African American	0.000				
3 or more SPMSQ errors	0.221	0.13	1.25	(0.96, 1.62)	
<3 SPMSQ errors	0.000				
Cut down usual activities past 3 months	0.732	0.12	2.08	(1.63, 2.65)	***
No cut down past 3 months	0.000				
Chronic health problems	0.003	0.00	1.00	(1.00, 1.01)	
Self-rated health	0.571	0.07	1.77	(1.55, 2.02)	***
Not married	0.403	0.13	1.50	(1.17, 1.92)	**
Married	0.000				
Perceived social support	-0.395	0.06	0.67	(0.60, 0.75)	***
Physician visits past year	-0.025	0.06	0.98	(0.87, 1.10)	
Physician visits to 2nd power	0.009	0.01	1.01	(0.99, 1.02)	
Physician visits to 3rd power	-0.001	0.00	1.00	(1.00, 1.00)	
Physician visits to 4th power	0.000	0.00	1.00	(1.00, 1.00)	
Physician visits to 5th power	-0.000	0.00	1.00	(1.00, 1.00)	*
Years of education	-0.028	0.02	0.97	(0.94, 1.00)	
Limitation in physical functioning	0.223	0.06	1.25	(1.12, 1.40)	***
Functional limitations to 2nd power	-0.015	0.01	0.98	(0.97, 1.00)	**
Psychotropic medication use	0.657	0.13	1.93	(1.49, 2.50)	***
No use	0.000				

* $p < .05$; ** $p < .01$; *** $p < .001$.

The associations between measures of physical health and disability, including limitations in physical functioning, self-perceived health, and disability days (having to cut down on usual activities) were all highly significant in controlled analyses. Again, because the relationship between physical functioning and depression is not linear, the odds ratio cannot be directly interpreted, but depends on the particular value on the scale. It is important to note that because items from different scales were summed, the measuring of a unit change is not necessarily constant. The reference group for self-perceived health was those individuals who said their health was excellent. Therefore, compared to excellent health, the odds of being in a depressed group for those who said their health was good were higher, at 1.77. The odds of belonging to a more depressed group in those who perceive their health as fair were 3.13, and in those who perceive their health as poor, 5.55.

Impaired perceived social support and psychotropic medication use were also significantly associated with depression group ($p < .001$), whereas the association between cognitive impairment and depression group was not significant. The reference group for perceived social support was those with a score of 2 on the scale. The odds of belonging to a group with higher depression scores decreased as perceived social support increased. That is, perceived social support is protective. For example, relative to the lowest support group, the odds of belonging to a more depressed group were 0.67 for those with a value of 3

and 0.21 for those with a value of 6, the highest value on our scale. Finally, the odds of being in a more depressed group were 1.93 in those using psychotropic medication in the last week compared to nonusers.

Discussion

These findings show that depressive symptoms not meeting the CES-D threshold are very prevalent in older adults. Overall, 19% of the sample had six or more depressive symptoms in the week prior to the interview. In these data, the prevalence of subthreshold depression (which we operationally defined as 6-8 symptoms) was higher than the prevalence of CES-D-criteria depression. Results from the ordinal logistic regression suggest depression in these elders appears to exist along a continuum, with individuals with subthreshold depression similar to those with CES-D-criteria depression in terms of demographics and social and physical health correlates. These results are particularly important in showing that, among community-dwelling elders, depressive symptomatology below the threshold for the CES-D is also significantly associated with poorer self-rated health, disability days in the past 3 months, limitations in physical functioning, psychotropic medication use, and perceived low social support. Our proportional odds test indicates that a parallel model is appropriate for these data. That is, it is appropriate to force the odds to be constant across the two categories of depression.

In the controlled analyses, age was not significantly related to either level of depression, suggesting that perhaps much of the relationship between age and depression is indirect through some other variable(s) such as physical functioning. Female gender was associated with depression, whereas race/ethnicity and level of education were not. Our finding that depressive symptoms were associated with functional limitations and disability days was consistent with previous research (Beekman, Deeg, Van Tilberg, et al., 1995; Beekman, Deeg, Braam, Smit, & Van Tilberg, 1997; Blazer & Williams, 1980; Broadhead et al., 1990; Maier, Gansicke, & Weiffenbach, 1997; Wells et al., 1989). Because this is a cross-sectional analysis, whether depression leads to a decrease in physical functioning as a result of decreased activity or whether decreased functioning leads to depression is unclear and will be the subject of future investigation. In controlled analyses, depression group was not associated with chronic disease, but was correlated with self-rated health, consistent with the findings of Beekman, Kriegsman, Deeg, and Van Tilberg (1995) that the more subjective aspects of illness were more strongly associated with depression than disease categories.

Depression group was not independently associated with cognitive functioning in controlled analyses, a finding in contrast to previous work (Beekman, Deeg, Van Tilberg, et al., 1995; Fichter, Bruce, Schroppel, Meller, & Merikangas, 1995). This finding may be due, in part, to our excluding from the analyses those with more severe cognitive impairment. Although an association between impaired social support and depression in elders has been documented (Blazer, 1983), the association with subthreshold depression is less known. Our finding that being unmarried and having impaired perceived social support were associated with depression is consistent with that of Beekman, Deeg, Van Tilberg, and colleagues (1995), who found that minor depression was associated with smaller network size, less instrumental support given, and more emotional support received. Finally, our finding that psychotropic medication use was correlated with subthreshold depression is consistent with the findings of Lyness and colleagues (1999), who reported that in a sample of primary care patients, the proportion of subjects with subsyndromal depression taking an antidepressant (38.5%) was comparable to the proportion of major depressives (47.8%) and minor depressives (46.2%) taking an antidepressant.

The CES-D scale (Radloff, 1977) was developed for use in community studies; it was not designed to elicit clinical diagnoses, but to screen for clinically significant depressive symptoms. Most of the validity literature has assessed the validity of the CES-D scale to capture clinically significant depression. For example, Lyness and colleagues (1997) have suggested that the cutpoint should be raised to 21 to capture only clinically significant depression. As Beekman, Deeg, Van Limbeek, and associates (1997) note, the positive predictive value of the CES-D scale

is low. That is, many individuals identified as depressed do not meet *DSM* criteria for major depression. Yet, Beekman, Deeg, Van Tilberg, and colleagues (1995) found that those with CES-D-criteria depression not meeting *DSM* criteria had a similar risk factor profile to those with *DSM* major depression. In other words, the ability of the CES-D scale to validate a diagnosis of major depression does not capture the strength of the CES-D scale to identify community-dwelling elders with clinically significant depression. Therefore, the validity of the CES-D with *DSM* criteria is less relevant here, as we are interested in depressive symptomatology. In fact, most of the literature regarding subthreshold depression is not so much concerned with establishing whether such an entity exists, but rather exploring the public health burden of depressive symptoms that do not meet typical diagnostic or screening criteria. Rather than creating a new nosological category of depression, our intent was to ask: If the threshold were lowered for elders, would we see the risk factors and associations seen with more symptomatic depression? We found that depressive symptomatology below the threshold of the CES-D cutpoint was associated with impairments in functioning in older adults.

As in the original CES-D, our cutpoint was decided arbitrarily in the absence of obvious breaks. Our hypothesis comparing the prevalence in the two groups, therefore, cannot be tested, but the finding of a large proportion of elders with depressive symptomatology below the current CES-D threshold can be noted. These results suggest that depression appears to exist along a continuum, with demographic and physical health predictors of subthreshold depression similar to predictors of CES-D-criteria depression.

The sample was drawn from community-dwelling elders who may not be representative of older adults who go to physicians for treatment or reside in long-term care institutions. In particular, no depression data were available for sample members who participated by proxy (approximately 4% of the baseline sample). The CES-D scale does not measure duration of symptoms; therefore, *DSM* criteria for major or minor depression or dysthymia cannot be applied to these data. The depression data were obtained through self-report, which could be viewed as a limitation by clinicians. Nevertheless, self-report data are the norm for community-based studies.

Research is needed to further characterize subthreshold depression in these older adults, particularly its course and relationship to a course of more symptomatic depression. Beekman, Deeg, Smit, and Van Tilberg (1995) reported that, after one year, 32% of subjects with minor depression relapsed, 25% remitted but relapsed later, and 43% were chronically depressed. Beekman, Deeg, Van Tilberg, and colleagues (1995) also found that a history of major depression was associated with current minor depression, supporting the hypotheses that the subtypes are different manifestations of the same illness. Questions remain concerning the longitudinal course

of subthreshold depression in older adults, particularly whether it predicts more symptomatic depression and whether the course is affected by treatment. We also plan to look at the depression continuum and test the threshold against an outcome such as mortality.

Finally, these results have public health implications with regard to recognizing depression in older adults and preventing undertreatment. Clinicians and researchers should recognize that not only older individuals who do not meet DSM criteria for depression, but also those who fall below the threshold on instruments such as the CES-D, may experience symptoms of depression that deserve attention because of their potential to be associated with adverse health consequences.

References

- American Psychiatric Association. (1980). *DSM-III: Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, DC: Author.
- American Psychiatric Association. (1994). *DSM-IV: Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Beekman, A. T. F., Deeg, D. J. H., Braam, A. W., Smit, J. H., & Van Tilberg, W. (1997). Consequences of major and minor depression in later life: A study of disability, well-being and service utilization. *Psychological Medicine*, 27, 1397-1409.
- Beekman, A. T. F., Deeg, D. J. H., Smit, J. H., & Van Tilberg, W. (1995). Predicting the course of depression in the older population: results from a community-based study in the Netherlands. *Journal of Affective Disorders*, 34, 41-49.
- Beekman, A. T. F., Deeg, D. J. H., Van Limbeek, J., Braam, A. W., De Vries, M. Z., & Van Tilberg, W. (1997). Criterion validity of the Center for Epidemiologic Studies Depression scale (CES-D): Results from a community-based sample of older subjects in the Netherlands. *Psychological Medicine*, 27, 231-235.
- Beekman, A. T. F., Deeg, D. J. H., Van Tilberg, T., Smit, J. H., Hooijer, C., & Van Tilberg, W. (1995). Major and minor depression in later life: A study of prevalence and risk factors. *Journal of Affective Disorders*, 36, 65-75.
- Beekman, A. T. F., Kriegsman, D. M. W., Deeg, D. J. H., & Van Tilberg, W. (1995). The association of physical health and depressive symptoms in the older population: Age and sex differences. *Social Psychiatry and Psychiatric Epidemiology*, 30, 32-38.
- Blazer, D. G. (1982). Social support and mortality in an elderly community population. *American Journal of Epidemiology*, 115, 684-694.
- Blazer, D. G. (1983). Impact of late-life depression on the social network. *American Journal of Psychiatry*, 140, 162-166.
- Blazer, D. G. (1994). Is depression more frequent in late life? An honest look at the evidence. *American Journal of Geriatric Psychiatry*, 2, 193-199.
- Blazer, D., Burchett, B., Service, C., & George, L. (1991). The association of age and depression among the elderly: An epidemiologic exploration. *Journal of Gerontology: Medical Sciences*, 46, M210-M215.
- Blazer, D., & Williams, C. D. (1980). Epidemiology of dysphoria and depression in an elderly population. *American Journal of Psychiatry*, 137, 439-444.
- Broadhead, W. E., Blazer, D. G., George, L. K., & Tse, C. K. (1990). Depression, disability days and days lost from work in a prospective epidemiologic survey. *Journal of the American Medical Association*, 264, 2524-2528.
- Duke University Center for the Study of Aging and Human Development. (1978). *Multidimensional functional assessment: The OARS methodology* (2nd ed.). Durham, NC: Duke University.
- Ernst, C., & Angst, J. (1995). Depression in old age. Is there a real decrease in prevalence? A review. *European Archives of Psychiatry and Clinical Neuroscience*, 245, 272-287.
- Fichter, M. M., Bruce, M. L., Schroppel, H., Meller, I., & Merikangas, K. (1995). Cognitive impairment and depression in the oldest old in a German and in U.S. communities. *European Archives of Psychiatry and Clinical Neuroscience*, 245, 319-325.
- Fillenbaum, G. G., Leiss, J. K., Pieper, C. F., & Cohen, H. J. (1998). Developing a summary measure of medical status. *Aging: Clinical and Experimental Research*, 10, 395-400.
- Hanlon, J. T., Fillenbaum, G. G., Burchett, B., Wall, W. E., Service, C., Blazer, D. G., & George, L. K. (1992). Drug-use patterns among Black and nonblack community-dwelling elderly. *The Annals of Pharmacotherapy*, 26, 679-685.
- Johnson, J., Weissman, M. M., & Klerman, G. L. (1992). Service utilization and social morbidity associated with depressive symptoms in the community. *Journal of the American Medical Association*, 267, 1478-1483.
- Judd, L. L., Rapaport, M. H., Paulus, M. P., & Brown, J. L. (1994). Subsyndromal symptomatic depression: A new mood disorder? *Journal of Clinical Psychiatry*, 55(Suppl.), 18-28.
- Katz, S., Downs, T. D., Cash, H. R., & Grotz, R. C. (1970). Progress in development of the index of ADL. *The Gerontologist*, 10, 20-30.
- Kessler, R. C., Zhao, S., Blazer, D. G., & Swartz, M. (1997). Prevalence, correlates, and course of minor depression and major depression in the national comorbidity survey. *Journal of Affective Disorders*, 45, 19-30.
- Lyness, J. M., King, D. A., Cox, C., Yoediono, Z., & Caine, E. (1999). The importance of subsyndromal depression in older primary care patients: Prevalence and associated functional disability. *Journal of the American Geriatrics Society*, 47, 647-652.
- Lyness, J. M., Noel, T. K., Cox, C., King, D. A., Conwell, Y., and Caine, E. D. (1997). Screening for depression in elderly primary care patients: A comparison of the Center for Epidemiologic Studies-Depression Scale and the Geriatric Depression Scale. *Archives of Internal Medicine*, 157, 449-454.
- Maier, W., Gansicke, M., & Weiffenbach, O. (1997). The relationship between major and subthreshold variants of unipolar depression. *Journal of Affective Disorders*, 45, 41-51.
- Pfeiffer, E. (1975). A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *Journal of the American Geriatrics Society*, 23, 433-442.
- Philipp, M., Delmo, C. D., Buller, R., Schwarze, H., Winter, P., Maier, W., & Benkert, O. (1992). Differentiation between major and minor depression. *Psychopharmacology*, 106(Suppl.), S75-S78.
- Pincus, H. A., Davis, W. W., & McQueen, L. (1999). "Subthreshold" mental disorders: A review and synthesis of studies on minor depression and other "brand names." *British Journal of Psychiatry*, 174, 288-296.
- Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1, 385-401.
- Research Triangle Institute. (1997). SUDAAN: Software for the Statistical Analysis of Correlated Data (Release 7.5) [Computer software]. Research Triangle Park, NC: Author.
- Robins, L., Helzer, J. E., Croughan, J., & Radcliff, K. S. (1981). National Institute of Mental Health Diagnostic Interview Schedule: Its history, characteristics, and validity. *Archives of General Psychiatry*, 38, 381-389.
- Robins, L. N., & Regier, D. A. (Eds.). (1991). *Psychiatric disorders in America*. New York: Free Press.
- Rosow, I., & Breslau, N. (1966). A Guttman health scale for the aged. *Journal of Gerontology*, 21, 556-559.
- SAS Institute. (1990). Statistical Analysis System (Version 6) [Computer software]. Cary, NC: Author.
- Spitzer, R. L., Endicott, J., & Robins, E. (1978). Research Diagnostic Criteria: Rationale and reliability. *Archives of General Psychiatry*, 35, 773-782.
- Wells, K. B., Stewart, A., Hays, R. D., Burnam, M. A., Rogers, W., Daniels, M., Berry, S., Greenfield, S., & Ware, J. (1989). The function and well-being of depressed patients: Results from the Medical Outcomes Study. *Journal of the American Medical Association*, 262, 914-919.

Received June 13, 2000

Accepted December 11, 2000

Decision Editor: Laurence G. Branch, PhD