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A Longitudinal Community-Based Study of Chronic Illness, Cognitive and Physical Function, and Depression

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Abstract

Objective—Recent studies have tried to determine which aspects of chronic illness heighten the risk for depression, with functional impairment receiving the most attention. There is growing evidence that functional impairment accounts for most of the association between chronic illness and depression. This study examines the relative contribution of cognitive function, physical function, and chronic illness to depression two years later in a nationwide sample of elders aged 70 and older.

Methods—This is a longitudinal community-based study of 5289 elders completing two waves of assessment in the Asset and Health Dynamics among the Oldest Old (AHEAD) study. Depression assessment included an abbreviated version of the CES-D and of the Composite International Diagnostic Interview (the CESD-8 and the CIDI-S). Cognitive function, physical function, and presence of chronic illness assessed at Wave 1 were examined as predictors of depression at Wave 2 while controlling for Wave 1 CESD-8 score.

Results—In a full multivariate model, most baseline cognitive function, physical function, and chronic illness variables predicted depression as measured by the CESD-8 at Wave 2. The associations were markedly weaker between baseline variables and the Wave 2 CIDI-S. The Wave 1 CESD-8 score predicted all-cause mortality by Wave 2 ($Z=3.13$; $P>|Z|=0.002$) even after controlling for key health and functioning variables.

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Conclusion—Chronic illness, physical function, and cognitive function all independently predict depressive morbidity in late-life. The CIDI-S appeared less informative about these key relationships when compared to the CESD-8. The significance of depressive symptoms was demonstrated by their independent association with all-cause mortality at two-year follow-up.

Keywords

depression; chronic illness; geriatric; functional impairment

Introduction

Understanding the relation between chronic illness and depression is increasingly important as chronic illness is now the predominant illness presentation in late-life. Among Medicare beneficiaries, 82% suffer a chronic illness, and 64% of those suffer two or more chronic illnesses(1). Chronic illness accounts for 75% of total United States health care expenditures. Patients with chronic illness have a 41% increase in recent psychiatric disorders, and the prevalence rates of comorbid depression typically range between 20% and 30%(2, 3).

Recent studies have tried to determine which specific aspects of chronic illness heighten the risk for depression, with functional impairment receiving the most attention (4-7). Braam et al.(4) conducted a meta-analysis of a multinational epidemiologic study of depression in Europe (EURODEP) and found that the strength of the association between depression and physical impairment ranged between 0.16 and 0.37, whereas the association between depression and chronic illness ranged between 0.08 and 0.20. Similarly, Dunlop et al. 2004 (6) using the Health and Retirement Survey (HRS) sample determined that the relation between depression and chronic illness was due primarily to increased risk in people with arthritis or heart disease and that risk was mediated by functional limitations. These authors argue that the long-observed relationship between medical illness and depression is due primarily to the mediating role of functional limitations. However, most of this work is cross-sectional in design.

Longitudinal studies have also confirmed the association between medical illness and later depressive course, with impairment contributing independently. Kennedy et al.(8) examined a community sample of 1457 elders aged 65 or older and found decline in health and function predicted onset of significant depressive symptoms at 24 months, while social support and life events did not. A subsequent study with the same sample found that changes in health also predicted persistence and remission of depressive symptoms in late-life(9). Smits et al. (10) conducted a longitudinal, community-based study to define target groups for depression prevention and found that elders with anxiety, functional impairment, and two or more chronic illness were at heightened risk for chronic or recurrent depression in late-life.

The following study examines the relative contribution of chronic illness and functional impairment to depressed mood two years later in a nationwide sample of elders aged 70 and older participating in the Assets and Health Dynamics among the Oldest Old study (AHEAD)(11). It extends prior examinations of the relative contribution of chronic illness and functional impairment to depression in late-life in three important ways. First, the longitudinal associations between these variables will be examined while controlling for their baseline association with depressed mood. Prior studies have documented that functional impairment leads to depression, yet depression also contributes to the development of functional impairment(12). Controlling for baseline depression will tease

apart methodologic artifact related to bi-directionality of the association, overlap in symptoms, or imprecise measurement.

Second, this study examines a broader array of functional measures to determine if specific chronic illnesses or domains of impairment confer greater risk than others. Dunlop et al.(6) determined that arthritis and heart disease accounted for most of the association between chronic illness and depression using the HRS sample. Chiu et al.(13) examined individual functioning items and found that difficulties in toileting, shopping, and housework were more strongly associated with depression than other activities of daily living such as bathing, grooming, and dressing.

This study examines the longitudinal risk of specific chronic illnesses for depression assessed two years later. It also examines the relative contribution of cognitive functioning and physical functioning to later depression. Most prior studies on the relation between functional impairment and depression focus on physical function without also including measures of cognitive function. However, there is considerable evidence of the relation between cognitive function and depressed mood(14, 15). Therefore, examining both physical and cognitive function can provide a clearer understanding of the unique contribution of each.

Finally, the AHEAD study is unique in that its second wave included two types of depression assessment-- a revised version of the Center for Epidemiologic Studies-Depression Scale(16) (CES-D) and a DSM-IV-based (17) structured interview assessing one-year prevalence of a depressive episode. Most of the larger community-based studies in late-life have used a depressive symptom measure only, usually the CES-D. The investigators are often left to assume that their results generalize to major depression as defined by the DSM. In this study, we compare the relationship between health variables and either the CES-D or a DSM-based measure of a depressive episode. This will inform the ongoing discussion of the most appropriate assessment of depression in late-life(18-20).

Methods

Sample

Asset and Health Dynamics Among the Oldest Old (AHEAD) is a companion study to the Health and Retirement Survey(11). It is intended to investigate the impact of changes in health status on financial management and service utilization. AHEAD participants were a nationally representative, multistage probability sample of individuals. The two sampling frames for the study were the 1991 screening of housing units enumerated for the Health and Retirement Survey and the Health Care Finance Administration's Master Enrollment file of Medicare enrollees who were living in a household. Primary respondents had to be greater than or equal to 70 years old and, if married, their partners were invited to participate regardless of the partner's age. Although the initial sampling frame excluded institutionalized older adults, the respondents who were institutionalized after the first assessment (Wave 1) remained in the sample and were interviewed two years later at Wave 2.

Wave 1 of AHEAD occurred in 1993-1994; Wave 2 occurred in 1995-1996. Wave 1 included 6637 respondents aged 70 or older who completed the core interview in person. Sociodemographic characteristics examined in this study include age, gender, race/ethnicity, and education assessed at Wave 1. Of the total 6637 Wave 1 sample, 581 died between Wave 1 and Wave 2, and 367 were lost to follow-up or refused to be interviewed by Wave 2. Of those interviewed at Wave 2, 400 were interviewed by proxy and did not provide any data on depression. This reflects an 86% follow-up rate including those who died as lost to

follow-up in the numerator, and a 94% follow-up rate not including those who died in the numerator. These response rates include proxy respondents. Since our study requires data on depression status, the total sample size for Wave 2 is 5289. Individual participants may have had some sporadic missing data on variables but this did not alter the sample size more than 15 for any given analysis. All demographic, health, cognitive function, and physical function measures were associated with loss to follow-up (all p-values <0.005) with the exception of gender (chi-square=2.98, df=1, p=0.08) and presence of high blood pressure (chi-square=2.63, df=1, p=0.10). Therefore, Wave 1 participants who were more ill, more functionally impaired, and more depressed were more likely to be lost to follow-up.

Depression and cognitive measures were not administered to respondents receiving proxy interviews in either Wave 1 or Wave 2. There were no systematic criteria for determining who would be administered the interview by proxy. All participants provided verbal informed consent, and internal ethics review board approval was obtained.

Interviewers underwent a 1-week training session conducted at the University of Michigan Survey Research Center. Interviewers conducted several trial interviews and received extensive feedback before they were authorized to conduct interviews in the field. All interviews collected in the field were reviewed by an interview supervisor. Interviews were conducted either in person or by telephone. Wave 1 interview mode was determined by age, with respondents between ages 70 and 79 being interviewed by phone. Wave 2 interview mode was randomly assigned to all participants.

Measures of Cognitive Function, Physical Function, Chronic Illness, and Depression

Cognitive measures—Cognitive measures were administered in all non-proxy interviews at both Wave 1 and Wave 2. The AHEAD cognitive measures were derived from the psychological research on intelligence and cognition as well as geriatric and neurological research on dementia(21). Many of the measures were adapted from the Telephone Interview for Cognitive Status (TICS)(22), which was modeled after the Mini-mental State Exam (23) to be administered over the telephone. The original TICS correlates highly (Pearson $r = 0.94$) with a Mini-Mental Status Exam administered directly. The TICS had a sensitivity of 94% and specificity of 100% in discriminating between 16 patients with Alzheimer's disease and 33 normal controls(22). Duff et al.(24) examined the validity of the modified TICs in mild cognitive impairment and found that it discriminated well between individuals with mild cognitive impairment and cognitively intact elders.

Given the current interest in specific neuropsychological contributors to depression in late-life, differences in prediction for each subscale are examined. The full cognitive assessment included:

1. Immediate and delayed free-recall. Ten short, concrete, high-frequency nouns were read to the respondent, who was asked to recall as many of them as possible immediately and then again after approximately a five-minute delay. The number of correct recall items for both the immediate and delayed recall was combined to form the recall measure, with a range of 0 to 20.
2. A modified mental status exam indicating language and orientation abilities. Respondents were asked to name the day of the week; date (including month, day, and year); president and vice-president; and the object that “people usually cut paper with” as well as the “kind of prickly plant that grows in the desert.” Respondents were also asked to count backwards from 20 to 10. The range for the mental status measure was from 0 to 10.

3. The Serial 7s test of working memory. One point was given for each correct subtraction from 100 in increments of 7 for a maximum of 5 points.

Measure of Depression—A revised 8-item version of the Center for Epidemiologic Studies-Depression Scale (CESD-8) was administered at both Wave 1 and Wave 2. A prior analysis of the AHEAD data showed that the CESD-8 had adequate internal reliability (Cronbach's alpha= $r=0.78$) and a comparable factor structure and distribution to the larger full-item scale(25). The CESD-8 contained a simple yes/no format for each question. Each subject was asked to endorse the item if he or she experienced the symptom “much of the time during the past week.”

As stated, at Wave 2, respondents were re-administered the CESD-8. In Wave 2, a DSM-based measure of a depressive episode was also added. Respondents were asked if they experienced an episode of depression in the year prior to the Wave 2 assessment using a short form of the Composite International Diagnostic Interview (CIDI-S). The original CIDI is a structured interview originally developed by the World Health Organization which was subsequently adapted for the National Comorbidity Study(26). Agreement between the original CIDI and an independent diagnosis made by a psychiatrist has been demonstrated with kappa values for depressive disorders ranging from 0.7 to 0.84, and one study documenting a test-retest reliability of 0.67(27-29). The items for the CIDI-S were selected based on a multivariate logistic regression analysis using data collected in the National Comorbidity Study (R Kessler and D Mroczek, personal communication). All the items in the depression module of the University of Michigan -CIDI were included in a regression model where the final dichotomous score on the full-scale CIDI was the outcome variable. The most efficient items for predicting caseness were selected.

The CIDI-S assesses eight of the nine associated symptoms required for diagnosis of a depressive episode by DSM-IV criteria. The major difference between this measure and the full CIDI is that motor slowing was not assessed. A general question about having thoughts of death was asked rather than a direct question about suicide because this was more predictive of caseness on the full CIDI. The exclusionary criteria for medical illness and bereavement were not applied. The threshold of five symptoms or more, one of which must be depressed mood or anhedonia, and a two-week duration were required for diagnosis. This criteria set corresponds to a 0.89 probability of caseness based on a sensitivity analysis between the shortened version and the full version of the UM-CIDI (R Kessler and D Mroczek, personal communication). Consistent with a structured interview format, a skip-out rule was applied in which the interviewer did not assess the associated symptom criteria if the respondent denied either of the two core symptoms of major depression-- depressed mood or anhedonia.

Although AHEAD has multiple waves, only Wave 2 included both measures of depression, the CESD-8 and the revised CIDI. Wave 1 included the CESD-8 only. Due to time constraints, only the CESD-8 was included in the AHEAD waves following Wave 2. The analyses in this study are limited to Waves 1 and 2 because the central focus of the paper is comparing the longitudinal association between health variables and these two different measures of depression.

Measures of Chronic Illness and Vital Status—At both Wave 1 and Wave 2, participants reported whether they had been previously diagnosed with high blood pressure, diabetes, lung disease, heart disease, or arthritis by a physician or other health care provider. Bush et al. (30) compared self-report of chronic illness to medical record-based diagnosis. They found percentage agreement ranging from 76 to 98% and Kappa values ranging from 0.57 to 0.93, with most values higher than 0.70 indicating good to excellent reproducibility

(31). Vital status was determined through the AHEAD tracking protocol that confirmed all deaths with the National Death Index. Some participants were presumed alive based on contact with a reliable source capable of reporting a death.

Measures of Physical Function—Measures of respondent's functioning on Activities of Daily Living (ADL's) and Instrumental Activities of Daily Living (IADL's) were assessed. In the ADL assessment, respondents reported if they had difficulty walking, dressing, bathing, eating, getting into bed, and using the bathroom(32). Difficulty walking was also analyzed as a separate variable to indicate mobility impairment. The ADL items were selected based on the original instrument described by Katz et al. (33), and IADL items are based on three of the five items selected by Fillenbaum(34) as essential for determining the need for services and the addition of telephone use and medication management(32). Assessment of instrumental ADL's included meal preparation, grocery shopping, telephone use, taking medication, and managing money. In this study, total score on difficulty in ADL's, range 0 to 6, and IADL's, range 0 to 5, were used.

Statistical analysis—All analyses were conducted using SAS statistical software(35). Study regression analyses were conducted using generalized estimating equations in SAS (Proc GENMOD). The analyses answered the question “What illness and functioning variables at Wave 1 predict depression status at Wave 2 on either the CESD-8 or the CIDI-S while controlling for the Wave 1 correlation between the predictor variable and depression?” Generalized estimating equations were used to control for correlations between spouses, as AHEAD recruited couples to be in the study whenever possible. It was decided to conduct the models based on the assumption of a negative binomial distribution for the CESD-8 because it is highly skewed and this is consistent with prior analyses of revised versions of the CES-D that have a similar skewed distribution(36). The analysis of mortality presented in Table 2 used multiple logistic regression, with vital status at Wave 2 as the dichotomous outcome variable.

The use of generalized estimating equations precluded the inclusion of design variables such as the weights for each respondent, as most generally established software programs do not perform such equations for outcomes with a negative binomial distribution. All analyses presented were also examined in regular regression models that included respondent weights (PROC SURVEYREG, PROC SURVEYLOGISTIC). The results were highly similar as were the relative strengths of the risk estimates for each variable (analyses available upon request). For parsimony, only one set of results, those from the generalized estimating equations, are presented. For multivariate models, tests for multicollinearity were conducted and revealed that none of the variables included in these models were significantly collinear (analyses available upon request).

A preliminary multivariate analysis revealed that Wave 1 age, gender, and education predicted Wave 2 depressive symptoms, while race did not. Therefore, for each variable examined, a separate regression model was conducted that included the Wave 2 depression score as the outcome variable; the variable of interest (e.g. Serial 7's score, presence or absence of diabetes) as the predictor variable; and age, gender, education, and the Wave 1 CESD-8 score as covariates.

This study includes multiple comparisons and the sample size provides extraordinary power to detect differences. The main analyses of interest involve the predictive ability of 11 health variables assessed at Wave 1 in predicting depression at Wave 2. Therefore, the threshold for significance is set at $p < 0.005$, which is $0.05/11$ rounded up. Since the study is descriptive, all probability values are provided and those falling between 0.05 and 0.005 are

mentioned with the caveat that they do not meet a-priori levels of significance. All tests of significance are two-tailed.

Results

Table 1 presents basic descriptive data assessed at Wave 1 for the Wave 1 sample and the Wave 1 values for the sample remaining in Wave 2 of AHEAD. The composition of the Wave 2 sample is of primary interest since it is used for all longitudinal analyses. Respondents mean age was 76.8 years, with 37% being male. The sample was predominately white, with 12.4 % African American and 1.7% being either Asian, Pacific Islander, or Native American. Chronic illnesses were highly prevalent, with half the sample reporting high blood pressure and one quarter of the sample reporting arthritis. As attrition was not random, Wave 2 participants report fewer health problems than Wave 1 participants.

Between Wave 1 and Wave 2, 581 (8.8%) participants died. Of the original participants, 6578 (99%) had Wave 2 vital status and Wave 1 data. This data was used in a multivariate model to examine risk factors for all-cause mortality at two-year follow-up (Table 2). Though all variables showed some mild association with mortality, only the CESD-8, lung disease, heart disease, and the number of IADL's met the a-priori level of statistical significance of <0.005 .

The Wave 1 CESD-8 score was strongly associated with the Wave 2 CESD-8 score (estimate=0.27, robust standard error=0.007, $Z=41.62$, probability $>|Z|=0.0001$) in a model that includes age, gender, and education as covariates. Likewise, Wave 1 CESD-8 predicted CIDI-S depression (estimate=0.32, robust standard error=0.03, $Z=10.54$, probability $>|Z|=0.0001$) while controlling for the same covariates. At Wave 2, elders who met CIDI-S criteria for depression had a mean score on the Wave 2 CES-D of 4.4 ($SD=2.6$) while those who did not meet CIDI-S criteria for depression scored 1.4 ($SD=1.8$) on average. This difference was highly significant even after controlling for age, sex, and education ($Z=16.72$, probability $>|Z|=0.0001$).

Table 3 presents the longitudinal associations between Wave 1 health and functioning variables and Wave 2 CESD-8 score. The second column provides descriptive information indicating the unadjusted association between Wave 1 variables and the Wave 2 CESD-8. When examining individual variables separately while controlling for age, gender, education, and Wave 1 CESD-8 score, most cognitive function, chronic illness, and physical function variables predicted Wave 2 CESD-8, with the exception of scores on the language/orientation measure and presence of high blood pressure. In the multivariate analysis including all health variables, presence of diabetes, and the number of IADL's were no longer significant and, again, language/orientation and high blood pressure did not predict Wave 2 depressive symptoms.

The prevalence of CIDI-S depression at Wave 2 was 3.6%. Associations between Wave 1 health variables and the CIDI-S measure of depressive episodes at Wave 2 were considerably weaker, though the relative strength of associations between variables was similar (Table 4). Individual associations adjusted for age, sex, and education but not Wave 1 CESD-8 reveal that lung disease, heart disease, arthritis, and all physical functioning measures predicted a depressive episode at Wave 2. The cognitive measures were not associated with the CIDI-S. When controlling for baseline CESD-8, none of these variables remained significant predictors of depression at Wave 2.

Discussion

This study demonstrates that the cross sectional associations between chronic illness, functioning, and depression are confirmed in longitudinal models controlling for baseline depressive morbidity and key covariates. These results support the validity of assertions found in cross-sectional studies that both medical illness and functioning in late-life are independent predictors of later depressive morbidity. However, there was considerable variability in the strength of associations depending on which health indicators were being examined and which measure of depressive morbidity was used.

The most striking difference was between results for the Wave 2 CESD-8 and the CIDI-S. The strength of the associations was far weaker when the CIDI-S was the outcome, and almost all associations disappeared when controlling for scores on the Wave 1 CESD-8. However, the relative strength of the associations between health indicators and depression outcome were remarkably similar between the two measures.

Myers and Weissman(37) argued that the CES-D taps into a broader range of constructs than a diagnostic interview measure of depression, so elevated scores may reflect chronic illness burden, comorbid anxiety, or cognitive function as well as depressive symptoms. However, the Wave 1 CESD-8 measure remained highly predictive of both Wave 2 measures of depression even after controlling for comorbid chronic illness and physical and cognitive functioning. Moreover, Wave 1 CESD-8 predicted death by the time of administration of Wave 2 in a full multivariate model controlling for these variables. Therefore, the CESD-8 does appear to be assessing depressive morbidity specifically. It is also tapping into an important and powerful construct that is distinct from chronic illness or functioning.

In contrast, the associations between health variables and Wave 2 CIDI-S seem less informative. It may be that the abbreviation of the full CIDI depression module omitted key components of the assessment and that the differences in results between Tables 3 and 4 are due primarily to a poor version of the CIDI. Though the prevalence of depression using this measure was a low 3.6%, this is comparable to rates of depression found in other geriatric samples(38, 39). It is also notable that the patterns of association were similar between the CESD-8 and the CIDI-S; they were just far weaker for the latter measure.

Wave 1 CESD-8 was strongly associated with the Wave 2 CIDI-S so it appears they are tapping into the same construct. However, dichotomous measures contain less information because subtle gradations are not represented and clinically significant depressive symptoms may be misclassified. A categorical model for depression may be necessary for many reasons, but further investigation of the proper threshold for clinically significant depression is needed.

Structured interviews contain protocols that may further reduce the amount of information gained by the use of skip-outs. For example, in the CIDI-S depression module, the assessment of depression ends if respondents do not endorse either depressed mood or anhedonia. In addition, the requirement that the depressive symptoms last two-weeks or longer, and persist through most of the day, may not capture the fluctuating but clinically significant course of depressive symptoms in late-life.

This study suffers several limitations. Both measures of depression are abbreviated versions of standard assessments. Though prior work demonstrates their comparability to the full measure, their validity is not as well documented. This is also true of the cognitive assessment. Presence of chronic illness and functional impairment is based on self-report. Self-report is often the sole source in large epidemiologic studies for reasons of cost. Prior studies have found self-report to be reliable in the elderly(30, 40). There was considerable

attrition from the sample between Wave 1 and Wave 2 and it was associated with most of the health variables examined in this study. Therefore, there was the illusion of improvement of health status between Wave 1 and Wave 2. The statistical analyses did not control for this attrition and the resulting bias to study results is unknown. Finally, this study only examined the one direction in the bi-directional relationship between chronic illness, impairment, and depression. Future studies examining dual trajectories between these clinical outcomes will better illustrate the complexity of illness and depression in late-life.

This study confirms that chronic illness, physical function, and cognitive function all independently predict depressive morbidity in late-life. Lung disease, heart disease, and arthritis were strong predictors of depressive symptoms on the CESD-8 even after controlling for cognitive and physical function. A structured interview assessment of depression in late-life does not appear as informative about these key relationships when compared to a standard measure of depressive symptoms. The significance of depressive morbidity was demonstrated by its independent association with all-cause mortality at two-year follow-up.

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Table 1

Demographic and Health Variables:
 Wave 1 Values for Wave 1 Sample and
 Wave 1 Values for those remaining in the Wave 2 Sample.

Variable	Wave 1 N=6637	Wave 2 N=5289
% Male	37.80	37.29
Age- Mean (SD)	77.35 (5.66)	76.80(5.34)
Race/Ethnicity		
% White	84.86	85.92
% African American	13.34	12.38
% Asian/Native American/Other	1.81	1.70
CESD-8 Mean (SD)	1.69 (2.0)	1.55 (1.9)
COGNITIVE FUNCTION	Mean (SD)	Mean (SD)
Recall (Range 0-20)	7.25 (4.02)	7.70 (3.90)
Language/Orientation (Range 0-10)	8.80 (1.71)	9.03 (1.43)
Serial 7's (Range 0-5)	2.96 (1.90)	3.13 (1.84)
CHRONIC ILLNESS		
High Blood Pressure %	50.20	49.70
Diabetes %	13.12	12.45
Lung Disease %	11.02	10.00
Heart Disease %	31.12	29.74
Arthritis %	26.15	25.86
PHYSICAL FUNCTION		
Difficulty walking across the room	21.83	18.43
Number of ADL's (Range 0-6)	0.56 (1.15)	0.44(1.00)
Number of IADL's (Range 0-5)	0.42 (0.86)	0.31 (0.71)

Table 2

Baseline demographic and health predictors of death two years later (N=6578).

	Wave 1 Health Values Unadjusted			Multivariate Model Results		
VARIABLE	Living n=5997	Deceased n=581	Estimate	SE	Z=	p> Z
Age	77.07 (5.49)	80.16 (6.42)	0.06	0.008	7.31	0.0001
% Male	37.03	44.94	0.49	0.10	5.06	0.0001
Education	11.01 (3.66)	10.24 (3.93)	-0.03	0.01	2.39	0.02
CESD-8 M(SD)	1.61 (1.95)	2.43 (2.28)	0.07	0.02	3.13	0.002
COGNITIVE FUNCTION						
Recall M (SD)	7.42 (4.01)	5.70 (3.75)	-0.03	0.02	-1.66	0.10
Language/Orientation M (SD)	8.88 (1.63)	8.08 (2.19)	-0.05	0.03	-1.78	0.08
Serial 7's M (SD)	3.02 (1.88)	2.38 (1.99)	-0.06	0.03	-2.05	0.04
CHRONIC ILLNESS						
High Blood Pressure %	49.70	55.84	0.21	0.09	2.23	0.03
Diabetes %	12.50	18.70	0.30	0.12	2.48	0.01
Lung Disease %	10.29	18.35	0.58	0.12	4.70	0.0001
Heart Disease %	29.88	43.99	0.34	0.10	3.59	0.0003
Arthritis %	25.86	29.16	-0.18	0.11	-1.62	0.11
PHYSICAL FUNCTION						
Difficulty walking across the room	19.78	42.20	0.19	0.15	1.29	0.20
Number of ADL's M (SD)	0.49 (1.06)	1.25 (1.65)	0.11	0.05	2.18	0.03
Number of IADL's M (SD)	0.37 (0.79)	0.96 (1.27)	0.19	0.05	3.65	0.0003

Table 3
Wave 1 predictors of Wave 2 CESD-8: Results from analyses of individual associations and the full multivariate model. (N=5289)

	Wave 2 CESD-8 Values Unadjusted*	Individual Associations Controlling for Age, Gender, Education, and Wave 1 CESD-8				Full Multivariate Model Including Health Variables and Age, Gender, and Education			
		Estimate	Standard Error	Z=	P> Z	Estimate	Standard Error	Z=	p> Z
COGNITIVE FUNCTION									
Recall (Range 0-20)	r= -0.18	-0.02	0.005	-5.06	0.0001	-0.03	0.006	-5.07	0.0001
Language/Orientation (Range 0-10)	r= -0.17	-0.03	0.01	-2.63	0.02	-0.002	0.01	-0.17	0.87
Serial 7's (Range 0-5)	r= -0.20	-0.05	0.01	-5.15	0.0001	-0.05	0.01	-3.77	0.0002
CHRONIC ILLNESS	-								
	+								
High Blood Pressure %	1.32	0.08	0.03	2.44	0.01	0.09	0.04	2.54	0.01
Diabetes %	1.44	0.13	0.04	2.97	0.005	0.11	0.05	2.19	0.03
Lung Disease %	1.42	0.25	0.04	5.51	0.0001	0.33	0.05	6.88	0.0001
Heart Disease %	1.33	0.18	0.03	5.21	0.0001	0.23	0.04	6.22	0.0001
Arthritis %	1.31	0.15	0.04	4.24	0.0001	0.17	0.04	3.86	0.0001
PHYSICAL FUNCTION									
Difficulty walking across the room	1.27	0.20	0.04	5.40	0.0001	0.19	0.06	3.18	0.002
Number of ADL's (Range 0-6)	r= 0.27	0.08	0.01	5.94	0.0001	0.10	0.02	4.48	0.0001
Number of IADL's (Range 0-5)	r= 0.21	0.08	0.02	4.30	0.0001	0.05	0.02	2.16	0.03

* Note: For non-dichotomous variables, the unadjusted correlation between the variable and Wave 2 CESD-8 was provided. For dichotomous variables, the Wave 2 CESD-8 value for respondents + or - on each variable at Wave 1 are provided.

Table 4

Wave 1 predictors of Wave 2 CIDI-S Depression. (N=5289)

Variable	Wave One Health Values- Unadjusted		Individual Associations Adjusted for Age, Gender, and Education				Individual Associations Adjusted for Age, Gender, Education, and Baseline CES-D-8 Score			
	Not Depressed N=4099	Depressed N=190	Estimate	Standard Error	Z=	P> Z	Estimate	Standard Error	Z=	P> Z
COGNITIVE FUNCTION										
Recall (Range 0-20)	7.72	7.01	-0.04	0.02	-1.69	0.09	-0.008	0.02	-0.38	0.71
Language/Orientation (Range 0-10)	9.04	8.74	-0.05	0.05	-0.97	0.33	0.004	0.05	0.09	0.93
Serial 7's (Range 0-5)	3.15	2.59	-0.09	0.05	-2.04	0.04	-0.05	0.04	-1.20	0.23
CHRONIC ILLNESS										
High Blood Pressure %	49.46	56.08	0.18	0.15	1.20	0.23	0.08	0.15	0.55	0.58
Diabetes %	12.50	11.05	-0.23	0.23	-0.98	0.33	-0.38	0.24	-1.59	0.11
Lung Disease %	9.71	17.89	0.72	0.19	3.71	0.0002	0.52	0.20	2.54	0.01
Heart Disease %	29.26	42.63	0.60	0.15	3.93	0.0001	0.41	0.16	2.65	0.008
Arthritis %	25.43	37.37	0.44	0.16	2.78	0.005	0.22	0.16	1.35	0.18
PHYSICAL FUNCTION										
Difficulty walking across the room	17.98	30.53	0.60	0.16	3.67	0.0002	0.16	0.16	0.97	0.33
Number of ADL's (Range 0-6)	0.43	0.90	0.28	0.05	5.36	0.0001	0.11	0.06	1.92	0.06
Number of IADL's (Range 0-5)	0.30	0.61	0.36	0.07	4.62	0.0001	0.18	0.08	2.20	0.03