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The Association Between Mental Health and Cognitive Screening Scores in Older Veterans

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Abstract

Objectives—To examine overall cognitive screening results and the relationship between of cognitive screen score and sociodemographic characteristics, reason for referral, and clinical outcomes of older Veterans referred by primary care for a behavioral health assessment.

Design—Cross-sectional, naturalistic study.

Setting—Primary care clinics affiliated with two VA Medical Centers.

Participants—The sample included 4,325 older veterans referred to the Behavioral Health Laboratory who completed an initial mental health/substance abuse (MH/SA) assessment. Veterans were categorized into 3 groups based on cognitive status: Within Normal Limits (WNL), Possible Cognitive Impairment (PCI), and Possible Dementia (PD).

Measurements—Sociodemographic and clinical data on reason for referral, cognitive functioning (i.e., Blessed Orientation-Memory-Concentration (BOMC) Test), and behavioral health assessment outcomes were extracted from patients' medical records. Data were analyzed using multiple linear and logistic regression.

Results—Results of cognitive screenings indicated that the majority of the sample was WNL (62.5%), with 25.8%, 8.1%, and 3.6% of patients evidencing PCI, PD, and BOMC scores ≥ 17 , respectively. With regard to reason for referral, patients with greater cognitive impairment were more likely to be identified by the antidepressant casefinder than patients with less impairment. Increased age, non-Caucasian ethnicity, self-perceived inadequate finances, Major Depressive Disorder, and symptoms of psychosis were associated with greater cognitive impairment.

Conclusions—Findings highlight the importance of evaluating cognitive status in older adults who are referred for a behavioral health assessment and/or receive a new MH/SA diagnosis. Doing

so has the potential to improve recognition and treatment of cognitive impairment and dementia, thereby improving quality of care for many older adults.

Screening for depression is recommended for all adult primary care patients when resources are in place to address treatment needs of patients that screen positive (1, 2). There is a considerable evidence base to suggest that in addition to depression, brief screening can correctly identify Post Traumatic Stress Disorder (PTSD) (3), risky drinking and substance use disorders (4). Because depression, PTSD and substance use disorders are common in primary care and can cause considerable morbidity and mortality (5–8) the US Department of Veterans Affairs Health Administration (VHA) recommends that all veterans in primary care are routinely screened for depression, PTSD and alcohol misuse. While primary care screening of common mental health conditions is a routine practice in VHA there is no uniform strategy to screen older adults for cognitive impairment. More information is needed in order to understand the effect of commonly occurring cognitive impairments on the outcomes of these primary care screening programs.

As primary care patients age, there is an increased risk of cognitive impairment (9) yet relatively little is known about the impact of cognitive impairment on screening outcomes for mental health and substance abuse (MH/SA) concerns in older adults. MH/SA screening tools are typically, and intentionally, developed in populations where cognitive impairment is excluded. This strategy is a logical one while screens are in development as it allows developers to more accurately assess the validity of their measures. Unfortunately, once screens are implemented in a population of older adults, the impact of unrecognized cognitive impairment cannot be predicted. Symptoms of mild cognitive impairment (MCI) and dementia, such as poor memory, slowed cognitive processing and decreased initiation, may be mistaken for depression in older adults and may be caused acutely by substance use disorder in the elderly. Conversely, depression (10, 11), substance abuse (12) and PTSD (13) may be risk factors for dementia in older adults. The interplay between these symptoms makes accurate mental health diagnosis challenging in an older adult population and is liable to cause false positives on common MH/SA screening tools. With approximately 40% of veterans receiving care in VHA aged 65 years and older (14), it is particularly important to consider the interplay between cognitive status and MH/SA screening in older primary care veterans.

The Behavioral Health Laboratory (BHL) was developed as a clinical service to support screening, assessment and referrals for mental health and substance abuse (MH/SA) in primary care veteran patients at the Philadelphia VA Medical Center (15). Oslin and his colleagues have described the BHL and its demonstrated effectiveness in increasing the recognition of depression in primary care, providing comprehensive assessments, and identifying complex patients with comorbid MH/SA treatment needs in addition to depression (15). With a mean age of 56.5 (SD = 13.2) in the population screened by the BHL (15), it is clear that a significant portion of these veterans were over the age of 65. In respondents over the age of 55, 5.2% scored within a severe cognitive impairment range and were omitted from further assessment by the BHL (15) as the validity of their assessment results would have been questionable. Therefore, the remaining sample of older adults likely included a significant number of veterans with mild to moderate cognitive difficulties. It is unclear what impact those cognitive difficulties may have had on assessment outcomes.

Given that nearly 40% of veterans are age 65 or older (16), and age is the most important risk factor of MCI (17) and dementia (18), it is important to understand the interplay between cognitive impairment and mental health diagnosis when applying screening protocols to older veterans in primary care. Therefore, in this naturalistic study, we seek to describe the population of older veterans referred by primary care for a behavioral health

assessment who also screen positive for cognitive impairment. We also examine the relationship of cognitive impairment to reasons for referral to the BHL and to outcomes of the MH/SA assessments performed.

METHODS

Procedures: The Behavioral Health Laboratory

This evaluation is based on clinical patient record reviews of veterans receiving care in the Philadelphia and Lebanon Veterans Affairs Medical Centers (i.e., PVAMC and LVAMC) and affiliated community-based outpatient clinics. All veterans were assessed by the Behavioral Health Laboratory (BHL), an evidence-based, clinical management program that focuses on the identification, screening, assessment, and triage of primary care patients who may be in need of care for behavioral health issues such as depression, anxiety, alcohol misuse, and PTSD. An overview of the procedures and components of the BHL are described in detail elsewhere (15) and briefly outlined below.

Patients are identified by the BHL through three main mechanisms. First, providers in the VA Medical Center system are encouraged to screen all patients for alcohol misuse, PTSD, and depression on a yearly basis. Electronic prompts for annual screening are programmed into the VA computerized medical record system, and providers' responses are recorded and tracked. In the PVAMC and LVAMC, providers are given the option of referring their patients to the BHL for further screening via electronic consult requests. Second, in some instances, based on their clinical judgment, providers choose to refer patients to the BHL for assessment independent of the annual screening. Lastly, in order to capture patients who are in the early phases of treatment, the BHL routinely conducts queries of the computerized record system for patients who have been newly prescribed an antidepressant within the PVAMC/LVAMC (i.e., antidepressant casefinder).

BHL Health Technicians contact patients by telephone and conduct a behavioral health assessment. This structured telephone interview takes approximately 20–30 minutes to administer and is completed by direct entry of clinical data in a computer program. The interview begins by asking all patients sociodemographic questions. For patients aged 55 and older, cognitive status is assessed by the Blessed Orientation-Memory-Concentration test (BOMC) (19). In order to avoid unreliable self-reports due to cognitive impairment, the remainder of the interview is terminated if the patient scores greater than 16 on the BOMC. Clinicians are advised to consider further evaluation for cognitive impairment in these patients. For patients scoring below 17 on the BOMC, the clinical assessment portion of the interview continues. The BHL uses standardized assessment tools for symptoms related to the following conditions: depression, psychosis, mania, generalized anxiety disorder, panic disorder, PTSD, and alcohol abuse/dependence.

Study Sample

Data for the current set of analyses were extracted from a parent sample of 7,654 older adults (age 60+) contacted for a BHL interview from March 2003 through August 2009. In some cases, patients were referred to and contacted by the BHL on more than one occasion. We included only those BHL interviews that represented each patient's first contact with the BHL. As this evaluation is focused on veterans without known or suspected cognitive impairments, we omitted patients who were referred by providers in geriatric specialty care clinics (n=663) and those referred for cognitive impairment or "other" reasons (n=112). Of the remaining cases (n=5,413), 4,325 (79.9%) completed the initial interview. Interviews were considered "completed" if patients with BOMC scores 0 to 16 completed the full BHL interview (n=4168) or if the interview was terminated after the BOMC due to cognitive

impairment (BOMC>16; n=157). Sociodemographic data was available for all completed interviews. Reasons for lack of completion of the BHL interview included: hearing/speech impairment (n=129, 2.4%), unable to contact (n=417, 7.7%), and patient refusal (n=542, 10.0%).

Measures

Sociodemographic Characteristics—Variables included age, gender (*female* vs. *male*), marital status (*unmarried* vs. *married*), financial status [*not financially secure* (i.e., “can’t make ends meet”) vs. *financially secure* (i.e., “have just enough to get along” or “comfortable”)], and ethnicity (*non-Caucasian* vs. *Caucasian*). Patients were also asked if they had had an appointment with a mental health professional in the previous 2 years.

Reason for Referral—The reason for primary care providers’ referral of patients to the BHL, was categorized into the following categories: depression (0=*no*, 1=*yes*), PTSD (0=*no*, 1=*yes*), substance misuse (0=*no*, 1=*yes*); antidepressant casefinder (0=*no*, 1=*yes*); or any combination of the four categories (e.g., PTSD and depression; antidepressant casefinder, substance misuse, and PTSD) (0=*no*, 1=*yes*). Data on reasons for referral were available for all patients.

Clinical Assessments—Computer algorithms were used to generate scores for the behavioral health measures included in the BHL clinical interview. As mentioned above, the BOMC test was used to screen for MCI and dementia (19, 20). Previous work has shown that the BOMC can be used reliably over the telephone ($r = .957$) (20). The BOMC gives an error score with higher total scores indicating greater risk of cognitive impairment. Scores range from 0 to 28 and scores of 10 and greater have been shown to be consistent with dementia (19). The BOMC score is highly correlated with MMSE with correlations in the range of -0.79 (21) to -0.83 (22). Because the BOMC is an error score, its approximate equivalent Folstein MMSE score would be 30 (total score for MMSE) less the 0.8 times the BOMC score. Thus, a score of 6 on the BOMC would be approximately equivalent to an MMSE score of 25 ($30 - 0.83(6)$). While a briefer test than the MMSE, the BOMC has been shown to have better sensitivity to mild dementia than the MMSE (23).

Given that the BHL interview terminated upon a BOMC score of 17 or greater, the subset of patients considered in the final regression analyses of MH/SA assessment outcomes (described in greater detail below) had BOMC scores ranging from 0 to 16. To better describe and more easily discuss the range of scores of the BOMC in our sample, we categorized scores into 3 groups based on the sample standard deviations and prior work. The 3 groups were: (1) Within Normal Limits (WNL): BOMC Score of 0–5 = 0 to 1 Standard Deviations; (2) Possible Cognitive Impairment (PCI): BOMC Score of 6–10 = 1 to 2 Standard Deviations; Possible Dementia (PD): BOMC Score of 11–16 = greater than 2 Standard Deviations.

Mental health assessments included the MINI International Neuropsychiatric Interview modules for mania, psychosis, panic disorder, generalized anxiety disorder, illicit drug use, and alcohol abuse/dependence (24). Patients who reported either illicit drug use and/or alcohol dependence were classified in the “substance misuse” category. The Patient Health Questionnaire-9 (PHQ-9) was used to assess for depressive symptoms and disorder (25). Patients reported how often they experienced each of 9 symptoms (0=*not at all*, 3=*nearly every day*) during the previous 2 weeks. The scale was used as both a continuous (total summed score, range 0–27) and categorical (*no major depression* vs. *major depression diagnosis*) variable in analyses. PTSD was assessed with the PTSD Patient Checklist (PCL) (26).

Analytic Strategy

First, we conducted descriptive analyses of sociodemographic factors and reason for referral for the entire sample of patients ($n=4,325$), including all patients that had completed the full sociodemographic interview and the BOMC. Descriptive, univariate analyses included means and standard deviations for continuous outcomes and percentages for binary outcomes. Bivariate tests of significance included t-tests for equality of means for continuous outcomes and chi-square tests for dichotomous outcomes. Next, in order to examine the relationship between reason for referral and cognitive status, we ran linear and multinomial logistic regression models for continuous and categorical cognitive outcomes, respectively. Finally, for the subset of patients completing the full clinical interview (i.e., patients scoring below a 17 on the BOMC), we examined the association between MH/SA assessment outcomes and BOMC total score and category. For the multinomial logistic regression models, “within normal limits” was used as the reference category. Each model adjusted for covariates (i.e., age, gender, financial status, marital status, and ethnicity). When treating total BOMC score as a continuous outcome, we ran linear regression analyses using both the measured, raw total score as well as a $\log_{10}$ transformed total score to adjust for the significant positive skew in the observed distribution. The results for the models were similar. Thus, for ease of interpretation, we only present results from regression models using the raw continuous BOMC scores. Finally, to reduce the Type 1 error rate and adjust for multiple comparisons, the threshold for statistical significance was lowered to $p \leq 0.01$. All analyses were conducted with the PASW Statistics version 17.0 software package (SPSS Inc., Chicago, IL, USA).

RESULTS

The Association between BOMC Categorical Outcome and Sociodemographics

The full study sample included 4,325 adults aged 60 to 95 years old ($M=68.62$, $SD=8.11$). The majority of the sample was male (97.4%), Caucasian (62.9%), and reported being financially secure (80.3%). Roughly half of the sample was married (52.1%). Patients had a mean BOMC total score of 4.92 (median=4.00, $SD=4.95$) (please refer to Figure 1 for the frequency distribution of BOMC scores). Table 1 presents a summary of the sociodemographic characteristics of the study sample, stratified by categorical BOMC outcome. A small portion of the sample (3.6%) had BOMC scores ≥ 17 , with 62.5%, 25.8%, and 8.1% of patients evidencing intact cognition, possible cognitive impairment, and possible dementia, respectively. Groups only differed with regard to age and ethnicity; greater cognitive impairment was associated with older age and non-Caucasian ethnicity.

The Association between BOMC Categorical Outcome and Reason for Referral

As shown in Table 2, the majority of the full sample (61.3%) was referred to the BHL for depression, with 21.9% and 15.1% referred for PTSD and substance misuse, respectively. Approximately 17.2% of patients were identified via the antidepressant casefinder and 12.4% had multiple reasons for referral (e.g., depression and PTSD, substance misuse and depression, etc.). Reason for referral did not differ across BOMC categories.

The Association between BOMC and MH/SA Clinical Outcomes

Table 3 presents results from multinomial logistic regression analyses of the relative odds of having possible cognitive impairment (PCI), possible dementia (PD), or BOMC ≥ 17 vs. intact cognition as a function of sociodemographic factors and referral reason. Older patients and non-Caucasians had a greater odds of having PCI and PD or BOMC scores ≥ 17 than intact cognitive functioning. Likewise, patients with fewer finances were more likely to have PD than patients with adequate financial means. Although not significant at the $p \leq 0.01$ level,

patients identified by the antidepressant casefinder were more likely to have PCI (OR=1.38, 95% CI=1.06–1.80, Wald $\chi^2=5.86$, df=1, $p=0.02$) or PD (OR=1.52, 95% CI=1.01–2.29, Wald $\chi^2=3.95$, df=1, $p=0.05$), while those referred for PTSD were significantly more likely to have PCI than intact cognitive function.

When examining the relationship between total BOMC score and referral reason, results from an adjusted linear regression model indicate that older age, non-Caucasian ethnicity, being identified by the antidepressant casefinder, and being referred to the BHL for PTSD were significantly associated with greater BOMC scores when other factors were held constant (Table 3a).

Next, we used multinomial logistic regression to examine the odds of meeting criteria for PCI or PD as opposed to intact cognitive functioning as a function of sociodemographic factors and MH/SA clinical outcomes (Table 4). Increasing age was associated with a greater odds of having PCI and PD than intact cognitive functioning. Compared to Caucasians, non-Caucasians had a greater odds of having PCI or than intact cognition. When examining clinical assessment outcomes, patients meeting criteria for major depression had greater odds of PD relative to those not meeting criteria.

Table 4a presents results from a hierarchical linear regression model of the relationship between MH/SA clinical assessment outcomes and total BOMC score, controlling for sociodemographic factors and comorbidity across conditions. Results indicate that increasing age, non-Caucasian ethnicity, and meeting criteria for major depression and psychosis were associated with higher total BOMC scores.

DISCUSSION

The distribution of BOMC total error scores in our population of veterans aged 60 and older is roughly equivalent to other studies (19, 27). It is noteworthy that 11.7% of this population of older adults referred for MH/SA assessment or started on a new antidepressant actually had BOMC scores consistent with dementia. Further, an additional quarter of the population (25.8%) made errors on the BOMC at a rate higher than 1 standard deviation above the average of their peers. While further evaluation would be needed to determine if these screening results were consistent with MCI, early dementia, or cognitive symptoms of their MH/SA conditions, the findings strongly suggest that cognitive functioning should be routinely evaluated when older adult mental health issues are evaluated in primary care. For example, it is possible that a significant portion of the PCI group are currently experiencing reversible causes of cognitive impairment resulting from treatable conditions such as substance abuse, polypharmacy, or the variety of medical conditions that can have an impact on cognition in older adults.

Our results suggest that approximately 11% of this group of older adults referred for screening of MH/SA symptoms is likely to have unrecognized dementia. This rate is lower than might be expected in a general primary care population where 50 to 75 percent of patients with dementia may not be recognized (28–30). The lower rate may reflect some degree of screening related to the severity of the patient's functional status. When considering referral to BHL, primary care providers may not opt to refer patients who seem less capable of managing responses to the telephone interview. As a result, the older patients who were not referred to BHL may include those with more severe cognitive impairments. Nevertheless, those patients screened by BHL with cognitive impairment would still likely benefit from family support and education, additional dementia-specific services such as day care and aide service, and possibly from cholinesterase inhibiting medications. The fact that this segment of the population likely has dementia and is being referred or treated for MH

concerns in primary care strongly suggests the need to also provide non-pharmacological and pharmacological treatments for behavioral symptoms of dementia. Implementation of dementia-specific behavioral screening measures may improve the identification of this subgroup of patients. Without more routine and careful evaluation, multiple opportunities to improve patient care and quality of life are being lost.

In our study, increased age, non-Caucasian ethnicity and self-perceived inadequate finances were associated with increased scores on the indicator of cognitive impairment. Age is generally accepted as the single greatest risk factor for MCI and dementia across multiple studies (31, 32). Further, common risk factors typically include ethnicity and SES level (33, 34). Unfortunately, as our study is solely a naturalistic examination of clinical findings, it is not possible to determine whether our findings of increased BOMC scores in non-Caucasian and less financially secure veterans in primary care is a reflection of true impairment or a reflection of the too-common finding that cognitive assessment tools are subject to bias when used in minority populations or with those who have lower education levels as is common in lower SES populations. Further work is necessary to delineate whether the BOMC is subject to this nearly universal failing of all cognitive screening tools (35).

One intriguing finding of our study was the association between the initiation of a new antidepressant and higher BOMC scores. This finding begs the question of causality. Do subtle symptoms of early cognitive impairment and dementia present a picture in the primary care clinic suggesting depression to the primary care provider? Alternatively, is our study picking up the well-documented association between cognitive function and depression in older adults (36)? Depression has been noted to be both a risk factor for cognitive decline (37) and an early manifestation of both Alzheimer's disease (38) and Vascular Dementia (39). Further, Butters and colleagues have demonstrated that the relationships between treated and untreated late life depression and cognitive impairment are complex (40, 11) and that the diagnosis of depression in late life can be used to identify patients at high risk for dementia (11). Similarly, this study suggests that the initiation of antidepressant treatments for older primary care patients can be a useful marker for the prediction of dementia. Therefore, it is important when considering the initiation of an antidepressant in older adult primary care patients, that cognitive screening is performed. More thorough evaluation for dementia should be considered whenever family members report functional decline out of proportion to symptoms of depression (29).

Our study also found an association between the outcome assessment and BOMC scores. Veterans whose assessments indicated diagnoses of Major Depressive Disorder or symptoms of psychosis were more likely to have higher BOMC scores. Depression and psychosis are known to have an impact on cognitive function irrespective of age (41, 42), but cross-sectional studies of older adults frequently have found correlations between high levels of depressive symptoms and cognitive impairment in older adults (43–46). Interestingly, Dufouil and colleagues found that high levels of depressive symptoms were not predictive of later cognitive decline when they used a longitudinal approach (47). Conversely, depressive symptoms and psychosis are common in Alzheimer's patients (48) and both can be present in early stages (49, 50). Our results did not reveal the association between PTSD and dementia recently reported by others (13). Nor did we find an association between Generalized Anxiety Disorder and cognitive impairment, a relationship which has been documented with increasing consistency in recent years (51). The lack of association between anxiety and cognitive impairment in our study may be due to the use of only the BOMC screening in BHL procedures. The impact of late-life anxiety is more likely to be seen on neuropsychological tests than on tests of general cognitive functioning such as MMSE and BOMC. Further, many studies of anxiety and cognitive impairment use longitudinal approaches. Because our study is cross-sectional, some associations that

become apparent over time could not have been detected. We also cannot determine whether the associations seen are the result of increased risk for onset of dementia or are the result of poorer cognitive function often seen in MDD and psychotic disorders. Nevertheless, evaluation of cognitive status should be conducted whenever a new diagnosis of these disorders is made. For example, even if dementia is ruled out and apparent cognitive decline represents the impact of depression on the older adult's cognitive function and not an early stage of a degenerative dementia process, it is important to evaluate the impact of the patient's cognitive functioning on his or her ability to adhere to treatments for depression and other illnesses.

Our study has several limitations. First, as mentioned, this study is a naturalistic, cross-sectional design. We are therefore unable to determine the temporal relationship of the symptoms being measured. It would be valuable to have follow-up information on the patients in order to evaluate the change in symptoms with treatment and whether depression symptoms, initiation of a new antidepressant medication or new onset psychotic symptoms are markers for the onset of dementia. Also because of the naturalistic nature of this study, we are unable to include Veterans with the highest level of cognitive impairment as they were excluded from BHL services. Second, the findings of our study cannot be applied to non-patient veterans or to non-veteran populations without consideration of how the average veteran primary care patient differs from patients in other settings. VA patients tend to be male, older, and more medically complex than non-VA primary care settings (14). While our findings should not be uniformly applied to all general populations of primary care, it may be helpful, nevertheless to consider these findings when assessing individual primary care patients who are older and more medically complex. Finally, despite the robust relationship between cognitive status and education level (52), we unfortunately did not have access to data regarding years of education. Therefore we could not include it as a covariate in our analyses.

Overall, our findings and the literature point to the importance of evaluating cognitive status in older adults when a new MH/SA diagnosis is made. This practice would improve recognition of cognitive impairment and dementia, both reversible and progressive, and allow for improved quality of care and life for many older adults.

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Figure 1.
Distribution of Total BOMC^a Scores Across All Patients Interviewed (n=4325).

Table 1

Background characteristics of the study sample by BOMC screen categorical outcome (n=4325).

	All (n=4325)	Within Normal Limits (n=2702, 62.5%)	Possible Cognitive Impairment (n=1116, 25.8%)	Possible Dementia (n=350, 8.1%)	BOMC Score ≥ 17 (n=157, 3.6%)	Significance Test	p
<i>Age (M, SD)</i>	68.62 (8.11)	67.44 (7.52)	69.62 (8.36)	72.00 (8.87)	74.29 (8.84)	$F(3, 4321)=74.22$	<.001
<i>Gender</i>						$\chi^2(3)=6.52$	0.09
Female	111 (2.6%)	80 (3.0%)	25 (2.2%)	3 (0.9%)	3 (1.9%)		
Male	4214 (97.4%)	2622 (97.0%)	1091 (97.8%)	347 (99.1%)	154 (98.1%)		
<i>Marital Status</i>						$\chi^2(3)=1.83$	0.61
Not married	2071 (47.9%)	1299 (48.1%)	542 (48.6%)	156 (44.6%)	74 (47.1%)		
Married	2253 (52.1%)	1402 (51.9%)	574 (51.4%)	194 (55.4%)	83 (52.9%)		
<i>Ethnicity</i>						$\chi^2(3)=50.38$	<.001
Non-Caucasian	1605 (37.1%)	898 (33.2%)	468 (41.9%)	165 (47.1%)	74 (47.1%)		
Caucasian	2720 (62.9%)	1804 (66.8%)	648 (58.1%)	185 (52.9%)	83 (52.9%)		
<i>Financial Status</i>						$\chi^2(3)=1.82$	0.61
Secure	3475 (80.3%)	2187 (80.9%)	889 (79.7%)	275 (78.6%)	124 (79.0%)		
Non-secure	850 (19.7%)	515 (19.1%)	227 (20.3%)	75 (21.4%)	33 (21.0%)		
<i>Mental Health Care in Past 2 Years</i>	847 (19.6%)	537 (19.9%)	212 (19.0%)	60 (17.2%)	38 (24.2%)	$\chi^2(3)=3.79$	0.29
<i>Mental Health Care in Past 3 Months</i>	457 (10.6%)	295 (10.9%)	112 (10.0%)	31 (8.9%)	19 (12.1%)	$\chi^2(3)=2.13$	0.55

Note. Cell values represent frequency (percentage) and mean (standard deviation) for categorical and continuous variables, respectively. Significance tests include analysis of variance (ANOVA) with corresponding F-values and degrees of freedom (df) for continuous outcomes and chi-square tests with corresponding df for categorical outcomes.

Table 2

Reason for referral by BOMC screen categorical outcome (n=4325).

Referral Reason	All (n=4325)	Within Normal Limits (n=2702, 62.5%)	Possible Cognitive Impairment (n=1116, 25.8%)	Possible Dementia (n=350, 8.1%)	BOMC Score ≥ 17 (n=157, 3.6%)	Significance Test	p
Depression	2652 (61.3%)	1667 (61.7%)	674 (60.4%)	211 (60.3%)	100 (63.7%)	$\chi^2 (3)=1.09$	0.78
PTSD	946 (21.9%)	597 (22.1%)	253 (22.7%)	68 (19.4%)	28 (17.8%)	$\chi^2 (3)=3.22$	0.36
Substance Misuse	653 (15.1%)	406 (15.0%)	174 (15.6%)	55 (15.7%)	18 (11.5%)	$\chi^2 (3)=1.94$	0.58
Antidepressant Casefinder	743 (17.2%)	430 (15.9%)	207 (18.5%)	72 (20.6%)	34 (21.7%)	$\chi^2 (3)=9.55$	0.02
Comorbid Conditions	535 (12.4%)	331 (12.3%)	144 (12.9%)	42 (12.0%)	18 (11.5%)	$\chi^2 (3)=0.49$	0.92

Note. Cell values represent frequencies (percentages). Column percentages exceed 100% due to the fact that categories are not mutually exclusive. Significance tests include chi-square tests with corresponding df.

Table 3

Odds of BOMC category as a function of sociodemographic characteristics and reason for referral (n=4324).

BOMC Category ^a	Variable	OR	95% CI	Wald χ^2 (df=1)	p
<i>Possible Cognitive Impairment</i>					
	Age	1.05	(1.04, 1.06)	83.25	<.001
	Marital status (married)	0.99	(0.86, 1.15)	0.01	0.92
	Gender (male)	1.24	(0.78, 1.97)	0.83	0.36
	Ethnicity (Non-Caucasian)	1.68	(1.44, 1.95)	43.43	<.001
	Financial status (non-secure)	1.18	(0.98, 1.41)	3.02	0.08
	Referral-Substance Misuse	1.31	(1.02, 1.68)	4.38	0.04
	Referral-Antidepressant Casefinder	1.38	(1.06, 1.80)	5.86	0.02
	Referral-Depression	1.20	(0.97, 1.49)	2.86	0.09
	Referral-PTSD	1.34	(1.09, 1.64)	7.55	0.01
<i>Possible Dementia</i>					
	Age	1.09	(1.07, 1.11)	123.38	<.001
	Marital status (married)	1.18	(0.93, 1.50)	1.95	0.16
	Gender (male)	3.11	(0.97, 10.04)	3.62	0.06
	Ethnicity (Non-Caucasian)	2.51	(1.96, 3.22)	53.28	<.001
	Financial status (non-secure)	1.44	(1.08, 1.92)	5.99	0.01
	Referral-Substance Misuse	1.55	(1.04, 2.33)	4.54	0.03
	Referral-Antidepressant Casefinder	1.52	(1.01, 2.29)	3.95	0.05
	Referral-Depression	1.30	(0.92, 1.84)	2.19	0.14
	Referral-PTSD	1.30	(0.92, 1.84)	2.24	0.13
<i>BOMC Score ≥ 17</i>					
	Age	1.13	(1.10, 1.15)	117.96	<.001
	Marital status (married)	1.03	(0.74, 1.45)	0.04	0.84
	Gender (male)	1.46	(0.44, 4.81)	0.39	0.53
	Ethnicity (Non-Caucasian)	2.93	(2.05, 4.19)	34.52	<.001
	Financial status (non-secure)	1.53	(1.00, 2.33)	3.89	0.05
	Referral-Substance Misuse	1.31	(0.69, 2.49)	0.69	0.41
	Referral-Antidepressant Casefinder	1.52	(0.84, 2.75)	1.93	0.16

BOMC Category ^a	Variable	OR	95% CI	Wald χ^2 (df=1)	p
	Referral-Depression	1.46	(0.87, 2.47)	2.04	0.15
	Referral-PTSD	1.43	(0.85, 2.41)	1.85	0.17

^aReference category = "Within Normal Limits". OR=odds ratio, 95% CI=95% confidence interval. Reference groups for each variable included in the model were: gender = female; marital status = unmarried; ethnicity = non-Caucasian; financial status = secure. One observation omitted from model due to missing data on an explanatory variable.

Table 3a

Total BOMC score as a function of sociodemographic characteristics and reason for referral (n=4324).

Variable	Model 1			Model 2		
	b (SE)	t	p	b (SE)	t	p
Constant	-8.39 (0.78)	-10.73	<.001	-9.12 (0.84)	-10.84	<.001
Age	0.17 (0.01)	18.38	<.001	0.17 (0.01)	17.70	<.001
Marital status (married)	0.07 (0.15)	0.50	0.62	0.07 (0.15)	0.48	0.63
Gender (male)	0.97 (0.46)	2.13	0.03	0.93 (0.46)	2.04	0.04
Ethnicity (Non-Caucasian)	1.63 (0.15)	10.57	<.001	1.63 (0.16)	10.47	<.001
Financial status (non-secure)	0.66 (0.19)	3.53	<.001	0.63 (0.19)	3.38	0.001
Referral-Substance Misuse	--	--	--	0.51 (0.26)	1.98	0.05
Referral-Anitidepressant Casefinder	--	--	--	0.76 (0.27)	2.78	0.01
Referral-Depression	--	--	--	0.53 (0.22)	2.38	0.02
Referral-PTSD	--	--	--	0.53 (0.21)	2.46	0.01
R ² Change, F(df), p	$\Delta R^2 = 0.002, F(4, 4314) = 6.13, p = 0.05$					

Note. Cell values represent unadjusted regression coefficients (standard errors). Reference groups for each variable included in the model were: gender = female; marital status = unmarried; ethnicity = Caucasian; financial status = secure. One observation omitted from model due to missing data on an explanatory variable. R² change (and associated F- and p-value) reflects significance of model fit change from Model 1 to Model 2.

Table 4

Odds of BOMC category as a function of sociodemographic characteristics and MH/SA assessment outcomes (n=4165).

<i>BOMC Category^a</i>	<i>Variable</i>	<i>OR</i>	<i>95% CI</i>	<i>Wald χ^2 (df=1)</i>	<i>p</i>
<i>Possible Cognitive Impairment</i>					
	Age	1.05	(1.04, 1.06)	94.95	<.001
	Marital status (married)	0.98	(0.85, 1.14)	0.05	0.83
	Gender (male)	1.28	(0.80, 2.03)	1.06	0.30
	Ethnicity (Non-Caucasian)	1.65	(1.42, 1.93)	41.23	<.001
	Financial status (non-secure)	1.09	(0.90, 1.31)	0.81	0.37
	Major Depression	1.22	(1.02, 1.45)	4.90	0.03
	PTSD	1.20	(0.98, 1.45)	3.18	0.07
	Psychosis	1.38	(1.00, 1.90)	3.82	0.05
	Mania	1.02	(0.71, 1.49)	0.01	0.90
	Substance Misuse	0.89	(0.69, 1.15)	0.84	0.36
	GAD and/or Panic	1.08	(0.89, 1.31)	0.62	0.43
<i>Possible Dementia</i>					
	Age	1.10	(1.08, 1.11)	139.77	<.001
	Marital status (married)	1.20	(0.95, 1.52)	2.24	0.13
	Gender (male)	3.14	(0.98, 10.14)	3.67	0.06
	Ethnicity (Non-Caucasian)	2.47	(1.93, 3.15)	51.60	<.001
	Financial status (non-secure)	1.29	(0.96, 1.74)	2.88	0.09
	Major Depression	1.52	(1.15, 2.00)	8.59	0.003
	PTSD	1.26	(0.91, 1.73)	1.94	0.16
	Psychosis	1.22	(0.73, 2.05)	0.57	0.45
	Mania	0.87	(0.46, 1.65)	0.18	0.67
	Substance Misuse	1.38	(0.94, 2.03)	2.63	0.11
	GAD and/or Panic	0.92	(0.67, 1.27)	0.26	0.61

^aReference category = "Within Normal Limits". OR=odds ratio, 95% CI=95% confidence interval. Reference groups for each variable included in the model were: gender = female; marital status = unmarried; ethnicity = non-Caucasian; financial status = secure. Substance misuse included veterans who met criteria for alcohol dependence and/or reported illicit drug use. Three cases omitted from model due to missing data on at least one of the response or explanatory variables.

Table 4a

Total BOMC score as a function of sociodemographic characteristics and MH/SA assessment outcomes (n=4165).

Variable	Model 1			Model 2		
	b (SE)	t	p	b (SE)	t	p
Constant	-5.15 (0.65)	-7.94	<.001	-5.99 (0.67)	-8.90	<.001
Age	0.12 (0.01)	15.29	<.002	0.13 (0.01)	15.82	<.001
Marital status (married)	0.05 (0.12)	0.39	0.70	0.03 (0.12)	0.25	0.80
Gender (male)	0.89 (0.37)	2.38	0.02	0.87 (0.37)	2.33	0.02
Ethnicity (Non-Caucasian)	1.26 (0.13)	9.89	<.001	1.21 (0.13)	9.45	<.001
Financial status (non-secure)	0.50 (0.15)	3.28	0.001	0.35 (0.16)	2.25	0.03
Major Depression	--	--	--	0.55 (0.15)	3.78	<.001
PTSD	--	--	--	0.30 (0.17)	1.74	0.08
Psychosis	--	--	--	0.74 (0.28)	2.62	0.01
Mania	--	--	--	-0.43 (0.32)	-1.34	0.18
Substance Misuse	--	--	--	0.09 (0.21)	0.42	0.68
GAD and/or Panic	--	--	--	-0.01 (0.16)	-0.07	0.94
R ² Change, F(df), p	$\Delta R^2 = 0.01$, $F(6, 4153) = 6.13$, $p < .001$					

Note. Cell values represent unadjusted regression coefficients (standard errors). Reference groups for each variable included in the model were: gender = female; marital status = unmarried; ethnicity = Caucasian; financial status = secure. Substance misuse included veterans who met criteria for alcohol dependence and/or reported illicit drug use. Three cases omitted from model due to missing data on at least one of the response or explanatory variables. R² change (and associated F- and p-value) reflects significance of model fit change from Model 1 to Model 2. Model 1 t-test df = 4159, Model 2 t-test df=4153.