

Original Research

Cite this article: Silveira SL, Beydoun H, and Tsai J (2024). Association of multiple sclerosis with psychiatric disorders and homelessness among veterans in the United States Department of Veterans Affairs healthcare system. *CNS Spectrums* 29(5), 433–440. <https://doi.org/10.1017/S1092852924002165>

Received: 03 May 2024

Accepted: 24 August 2024

Keywords:



mental health; substance use; homelessness; multiple sclerosis; veteran

Corresponding author:

Jack Tsai;

Email: Jack.Tsai@uth.tmc.edu

Association of multiple sclerosis with psychiatric disorders and homelessness among veterans in the United States Department of Veterans Affairs healthcare system

Stephanie L. Silveira¹ , Hind Beydoun^{1,2} and Jack Tsai^{1,2} 

¹Department of Management, Policy, and Community Health, University of Texas Health Science Center at Houston, Houston, TX, 77030, USA and ²National Center on Homelessness among Veterans, U.S. Department of Veterans Affairs, Homeless Programs Office, Washington, DC, 20420, USA

Abstract

Objective. To describe and compare the prevalence of psychosocial and psychiatric disorders among veterans with multiple sclerosis (MS) and a propensity-score-matched group of veterans without MS, and to identify sociodemographic and clinical characteristics associated with comorbid psychosocial and psychiatric problems among veterans with MS.

Methods. Data were linked and extracted from the Veterans Affairs (VA) Homeless Operations Management and Evaluation System and the Corporate Data Warehouse. The total sample comprised 27,342 veterans in the VA healthcare system between January 1, 2022, and June 30, 2023, who met eligibility criteria for an MS diagnosis (n=13,671) and 1:1 propensity-score-matched sample of veterans who did not have MS (n=13,671). MS diagnosis, substance use disorder (SUD), mental illness, and homelessness were defined using standard ICD-10 codes. Covariates included sex, age, Charlson Comorbidity Index (CCI), and VA service-connected disability rating.

Results. A higher prevalence of mental illness among veterans with MS (33%) was found compared with those without MS (31%). Multivariable logistic regression models indicated MS was negatively associated with diagnoses of alcohol use disorder, stimulant use disorders, posttraumatic stress disorder, and schizophrenia/schizoaffective disorder but positively associated with diagnoses of cannabis use disorder and major depressive disorder. MS was not significantly related to homelessness. Disparities in psychosocial and psychiatric disorders among veterans with MS are described.

Conclusion. This study provides novel insights regarding rates of homelessness, SUD, and mental illnesses among veterans with MS. Interdisciplinary approaches to identification and management of mental illness, SUD, and homelessness among veterans with MS are critically needed.

Introduction

Multiple sclerosis (MS) is an autoimmune disease of the central nervous system (CNS) with multifactorial etiology and is the most prevalent chronic, lifelong, progressive, neurological disease affecting young adults.^{1–4} There are an estimated 1 million persons with MS living in the United States (U.S.), and higher rates are observed among women compared to men.⁵ MS has the potential to cause disability in all major domains of the CNS, with alterations in strength, sensation, cognition, vision, and coordination.^{1–3,6,7} An MS diagnosis is associated with adverse consequences to quality of life, including physical, cognitive, psychological, and social functioning.⁸ With > 20 partially effective FDA-approved disease-modifying therapies (DMTs), managing MS has grown more complicated over the past 20 years, needing specialty neurology and an interdisciplinary team in addition to a wide range of healthcare providers, including neurologists, nurses, therapists, and social workers.^{1,9}

The U.S. Department of Veterans Affairs (VA) has been at the forefront of research activities focused on persons with MS, with approximately 16,000 veterans treated within the VA healthcare system per annum.¹⁰ For instance, the VA Cooperative Study was the first class 1 therapy trial for MS, investigating military veteran communities in the U.S., including men hospitalized during World War II, Korean Conflict veterans, and later service veterans.¹¹ A study analyzing data from the North American Research Committee on Multiple Sclerosis (NARCOMS) registry found that the Veteran Healthcare Administration (VHA) system provides better multidisciplinary care, particularly in social work, physical therapy, and urology, whereas treatment patterns for symptomatic therapies follow similar patterns across veterans and nonveterans groups, and veterans within VHA used immunomodulatory agents less

© U.S. Department of Veterans Affairs, 2024. This is a work of the US Government and is not subject to copyright protection within the United States. Published by Cambridge University Press.

frequently than their nonveteran counterparts.⁹ A study comparing primary survey data for male veterans with MS with secondary data from the 2003 Behavioral Risk Factor Surveillance System (BRFSS) found a higher prevalence of hypercholesterolemia, hypertension, diabetes, coronary heart disease, and stroke among male veterans than nonveterans with MS, and that correlation of chronic diseases among male veterans with MS were similar to general population literature.¹² Despite its established impact on quality of life, few studies have examined substance use and mental health implications of MS among veteran and nonveteran populations,^{2,13–19} and only one study highlighted homelessness as a stressful life event that may be linked to MS.²

Mental illness and substance use disorders (SUDs) are major health research areas in the general U.S. veteran population given these modifiable factors pose the greatest risk for social dysfunction and homelessness among other important functional outcomes.^{20–22} It is well established that veterans with disabilities, such as MS, are at a higher risk of homelessness.^{23,24} The specific mechanism relating mental illness, SUDs, and homelessness has not been elucidated; however, there is a pressing need to investigate these interactions in subpopulations of veterans who may be at higher risk of homelessness and experience greater rates of mental illness and SUDs. The current study aimed to perform analyses of contemporary national VA administrative data in 2023 to (1) examine the prevalence of homelessness, SUDs, and mental illnesses, among veterans with MS; (2) compare rates of homelessness, SUDs, and mental illnesses among veterans with MS and propensity-score-matched veterans without MS; and (3) identify sociodemographic and clinical characteristics associated with homelessness, SUDs, and mental illnesses among veterans with MS. This information is expected to contribute to epidemiological understanding of how behavioral health disorders are related to MS.

Methods

Study design, data, and participants

Cross-sectional data were extracted from two VA databases, namely, the Homeless Operations Management and Evaluation System (HOMES) and the VA Corporate Data Warehouse (CDW). HOMES is an online data collection system that facilitates the identification of veterans in various states of housing instability and homelessness,²⁵ and the CDW is a national repository of electronic health records comprising data on all inpatient and outpatient encounters from the VHA administrative and clinical systems.^{26, 27} Data extracted from the CDW and HOMES databases consist of patient demographics, medications, diagnoses, procedures, clinical notes, and billing information, including dates and settings of healthcare use.^{26,28–32} Data management and analyses were performed using Microsoft's Structured Query Language (SQL) Management Studio (SSMS) version 18 (Redmond, WA), and the SAS Enterprise Guide version 8.3 (SAS Institute, Cary, NC).

The study sample comprised all veterans in the VA healthcare system who were alive between January 1, 2022, and June 30, 2023, and met eligibility criteria defining an MS diagnosis (Cohort 1) and a propensity-score-matched sample of veterans in the VA healthcare system who were alive between January 1, 2022, and June 30, 2023, and did not meet eligibility criteria defining an MS diagnosis (Cohort 2). Propensity-score matching based on sex (Male vs. Female), and age (years), was performed

using PSMATCH in SAS. The date of the first VA healthcare system visit identified through linked HOMES and CDW data or first homelessness screen response identified through CDW data, within the study period, was considered the index date. Because veterans may have made multiple contacts with the VHA, we retained the date of their first encounter between January 1, 2022, and December 31, 2022, through HOMES or CDW databases. Using linked HOMES and CDW data, the occurrence of homelessness, SUDs, and mental illnesses within 6 months of a veteran's index date (*i.e.*, the time period between the index date and 6 months afterward) and within a prespecified period of time (January 1, 2022–June 30, 2023) were defined as the main correlates of MS. Veterans were included in the study if they met the following criteria: 1) utilized the VHA for healthcare; 2) had an index encounter date between January 1, 2022, and December 31, 2022; and 3) were aged between 18 and 99 at their index date. Furthermore, veterans were excluded from the study if they met the following criteria: 1) died prior to June 30, 2023 or 2) had missing data on the measures described below. This project was conducted as part of quality improvement efforts initiated by the National Center on Homelessness among Veterans in VA Central Office and was therefore exempt from the VA institutional review board.

Measures

Multiple sclerosis. We generated two cohorts of veterans with and without MS, by applying a prespecified definition for MS based on multiple sources within the CDW database. If a patient satisfied any of the following criteria, they were considered confirmed cases of MS: 1) had evidence of at least 1 MS ICD-10-CM diagnostic code (multiple sclerosis [G35], other specified demyelinating diseases of the CNS [G37.8], and/or demyelinating diseases of the CNS [G37.9]) identified in the context of an inpatient or an outpatient visit, between January 1, 2022, and June 30, 2023, and within 6 months of their index date; 2) had at least 1 treatment with DMTs for MS from CDW inception date until 6 months of their index date; and/or 3) was service-connected for MS from CDW inception date until 6 months of their index date. This definition was selected based on standard practice at the VHA while taking the published literature into consideration.^{1,7,9–13,33–41}

SUDs. A veteran was identified as having an SUD if they had at least one ICD-10-CM diagnostic code in the context of an inpatient or an outpatient visit that corresponds to alcohol use disorder, opioid use disorder, cannabis use disorder, stimulant use disorder, sedative/hypnotic/anxiolytic use disorder, and hallucinogen use disorder, occurring between January 1, 2022, and June 30, 2023, and within 6 months of their index date (list of ICD-10-CM codes used are listed in [Supplement 1](#)).

Mental illness. A veteran was identified as having a mental illness if they had at least one ICD-10-CM diagnostic code in the context of an inpatient or an outpatient visit that corresponds to major depressive disorder (MDD), posttraumatic stress disorder (PTSD), generalized anxiety disorder, bipolar disorder, and schizophrenia/schizoaffective disorder, occurring between January 1, 2022, and June 30, 2023, and within 6 months of their index date (list of ICD-10-CM codes used are listed in [Supplement 2](#)).

Homelessness. We identified a record as belonging to a veteran who had experienced homelessness during the time period between January 1, 2022, and June 30, 2023, using linked HOMES and CDW data, using VHA's operational definition as described elsewhere.⁴² Specifically, homelessness was identified among outpatient and

inpatient records with ICD-10-CM diagnostic code that is descriptive of homelessness (Z59.0), in the presence of outpatient stop codes indicating clinical encounters with outpatient staff in the Grant and Per Diem (GPD) program, the Health Care for Homeless Veterans (HCHV)/Homeless Chronically Mentally Ill (HCMI) program, and/or inpatient stop codes indicating clinical encounters with inpatient staff including the Domiciliary Care for Homeless Veterans (DCHV) program and the Compensated Work Therapy/Transitional Residence (CWT/TR) program, if the veteran had a positive screen on an annual homeless screening clinical reminder (HSCR)—responded “no” to “In the past 2 months, have you been living in stable housing that you own, rent, or stay in as part of a household?” based on CDW data, and/or had evidence of participation in GPD, HCHV/HCMI, DCHV, or CWT/TR based on HOMES data, between January 1, 2022, and June 30, 2023, and within 6 months of their index date.

Covariates. Besides sex (male vs. female), age (years), Charlson Comorbidity Index (CCI), and percent service-connected disability rating, which were considered as candidate variables in propensity-score matching, we also examined the following potential confounders for the hypothesized relationships: race, marital status, combat service, as defined at baseline (*i.e.* index date). The CCI score was calculated using 17 ICD-10-CM diagnostic codes, as described elsewhere,⁴³ reflecting the cumulative increase in the likelihood of 1-year mortality due to severity of the selected comorbidities.

Statistical analysis

All statistical analyses were performed using the SAS Enterprise Guide version 8.3 (SAS Institute, Cary, NC), whereby MS status was considered the exposure variable to be examined in relation to multiple outcome variables of interest, namely, homelessness, SUDs, and mental illnesses. First, the prevalence rates of any homelessness, SUD, and mental illness were calculated with their 95% confidence intervals (CIs) among veterans with MS. Second, a propensity-score-matched group of veterans without MS was created to be matched on sex and age with the sample of veterans with MS. Third, bivariate analyses were conducted comparing veterans with MS to propensity-score-matched comparison group of veterans without MS on rates of homelessness, SUDs, and mental illnesses. Fourth, these bivariate analyses were then followed with multivariable logistic regression analyses to examine whether veterans with MS had higher rates of homelessness, SUDs, and mental illnesses than other veterans without MS after adjusting for confounders. Fifth, among the sample of veterans with MS, a series of multivariable logistic regression models were constructed to identify sociodemographic and clinical characteristics associated with any homelessness, SUDs, and mental illness. We calculated propensity scores or predicted probabilities of MS vs. No MS for each veteran based on a set of relevant characteristics using a two-step procedure: (1) MS vs. no MS was modeled as the outcome variable in a multiple logistic regression model including as predictor variables a selected group of covariates that were identified as key confounders of the exposure-outcome association; (2) predicted probabilities of MS vs. No MS (“propensity scores”) were used for the purpose of matching MS and non-MS exposure groups and these matched subjects were later used within regression models that examined the relationship of MS vs. no MS status with homelessness, SUDs, and mental illnesses, whereby covariates were added if needed. The PSMATCH procedure was applied for the purpose of 1:1 matching, using the greedy nearest neighbor method

with caliper specified at 0.50. Two-sided statistical tests were performed at $\alpha=0.05$.

Results

A total of 6,861,414 (18,569 MS and 6,842,845 non-MS) veterans sought VHA services between January 1, 2022, and December 31, 2022, of which 4,212,580 (13,671 MS and 4,198,909 non-MS) remained in the study sample after all eligibility criteria were applied. Using propensity scores generated through propensity-score matching on sex and age, each veteran with MS was 1:1 matched to another veteran from the pool of non-MS veterans, resulting in a total sample of 27,342 veterans, that is, 13,671 MS and 13,671 non-MS veterans (Figure 1). The sociodemographic and clinical characteristics of veterans diagnosed with MS and propensity-score-matched veterans not diagnosed with MS are displayed in Table 1. As expected, the distribution by sex and age was similar among the propensity-score-matched groups. By contrast, MS and non-MS groups of veterans differed with more non-Hispanic white individuals, more married individuals, higher

Table 1. Sociodemographic and Clinical Characteristics of U.S. Veterans Diagnosed with Multiple Sclerosis (MS) and Propensity-Score-Matched U.S. Veterans Not Diagnosed with MS—Veterans Health Administration (January 1, 2022–December 31, 2022)

	Total N = 27342	MS N = 13671	No MS N = 13671
Total	n (%)	n (%)	n (%)
Sociodemographic:			
Sex: P = 1.00			
Male	19436 (71.08%)	9718 (71.08%)	9718 (71.08%)
Female	7906 (28.92%)	3953 (28.92%)	3953 (28.92%)
Age (years): P = 1.00			
18–39	3790 (13.86%)	1895 (13.86%)	1895 (13.86%)
40–49	5244 (19.18%)	2622 (19.18%)	2622 (19.18%)
50–59	7004 (25.62%)	3502 (25.62%)	3502 (25.62%)
60–69	5868 (21.46%)	2934 (21.46%)	2934 (21.46%)
70+	5436 (19.88%)	2718 (19.88%)	2718 (19.88%)
Mean ± standard deviation P = 1.00			
Mean ± standard deviation	56.34±13.58	56.34±13.58	56.34±13.58
Race: P < 0.0001			
Non-Hispanic White	16189 (59.21%)	8679 (63.48%)	7510 (54.93%)
Non-Hispanic Black	5884 (21.52%)	2785 (20.37%)	3099 (22.67%)
Hispanic	1406 (5.14%)	586 (4.29%)	820 (6.00%)
Mixed race/other	789 (2.89%)	247 (1.81%)	542 (3.96%)
Missing	3074 (11.24%)	1374 (10.05%)	1700 (12.44%)
Marital status: P < 0.0001			
Married	15727 (57.52%)	8155 (59.65%)	7572 (55.39%)
Single/never married	4009 (14.66%)	1942 (14.21%)	2067 (15.12%)
Separated/divorced	6451 (23.59%)	3125 (22.86%)	3326 (24.33%)
Widowed	542 (1.98%)	259 (1.89%)	283 (2.07%)

Table 1. Continued

	Total	MS	No MS
	N = 27342	N = 13671	N = 13671
Total	n (%)	n (%)	n (%)
Missing	613 (2.24%)	190 (1.39%)	423 (3.09%)
<i>Combat service:</i>			P = 0.003
Yes	2087 (7.63%)	979 (7.16%)	1108 (8.10%)
<i>Clinical:</i>			
<i>Percent service-connected disability rating:</i>			P < 0.0001
10%–40%	5606 (20.50%)	1966 (35.07%)	3640 (64.93%)
50%–100%	21736 (79.50%)	11705 (53.85%)	10031 (46.15%)
<i>Charlson's comorbidity index:</i>			P < 0.0001
0	19472 (71.22%)	9552 (69.87%)	9920 (72.56%)
1	3732 (13.65%)	1827 (13.36%)	1905 (13.93%)
2	1965 (7.19%)	1102 (8.06%)	863 (6.31%)
3+	2173 (7.95%)	1190 (8.70%)	983 (7.19%)
			P < 0.0001
Mean ± standard deviation		0.65 ± 1.29	0.55 ± 1.19

disability ratings and CCI, and fewer individuals with combat service exposure among the MS group.

Differences in prevalence rates of homelessness, diagnosed SUD, and mental illnesses between veterans diagnosed with MS and propensity-score-matched veterans not diagnosed with MS are shown in Table 2 and depicted in Figure 2. Specifically, there was a higher prevalence of mental illness among veterans with MS (32.8%) compared with propensity-score-matched veterans without MS (30.5%). There was a higher prevalence of both homelessness and SUDs among propensity-score-matched veterans without MS (3.1% and 5.7%, respectively) compared with veterans with MS (2.7% and 4.5%, respectively).

Multivariable logistic regression models were constructed separately for each of the selected outcome variables in relation to MS status as the exposure variable, after adjustment for race, marital status, combat service, percent service-connected disability rating, and CCI. These multivariable analyses suggested that MS was negatively associated with SUD (OR=0.77, 95% CI: 0.69, 0.87), with variation according to type of substance. Specifically, MS was negatively associated with alcohol use (OR=0.59, 95% CI: 0.52, 0.68) and stimulant use (OR=0.57, 95% CI: 0.43, 0.78) disorders but positively associated with cannabis use disorder (OR=1.20, 95% CI: 0.99, 1.45). Similarly, MS was positively associated with MDD (OR=1.29, 95% CI: 1.22, 1.38) but negatively associated with PTSD (OR=0.69, 95% CI: 0.65, 0.74) and schizophrenia/schizoaffective disorder (OR=0.61, 95% CI: (0.49, 0.77). Conversely, MS was not significantly related to homelessness, after adjustment for covariates.

Table 3 presents multiple logistic regression models for socio-demographic and clinical correlates of the prevalence of homelessness, SUD, and mental illnesses among veterans with MS. Results of these multivariable analyses suggested no sex differences in homelessness among veterans with MS, whereas SUDs were more

Table 2. Differences in Prevalence of Homelessness, Substance Use Disorders, and Mental Illnesses between U.S. Veterans Diagnosed with Multiple Sclerosis (MS) and Propensity-Score-Matched U.S. Veterans Not Diagnosed with MS—Veterans Health Administration (January 1, 2022–December 31, 2022)

	Prevalence n (%)		Odds ratio (95% confidence interval)*
	MS	No MS	
Homelessness:	364 (2.66%)	421 (3.08%)	0.91 (0.79, 1.06)
<i>Substance use disorder:</i>			
Any	616 (4.51%)	777 (5.68%)	0.77 (0.69, 0.87)
Alcohol	344 (2.52%)	544 (3.98%)	0.59 (0.52, 0.68)
Opioids	84 (0.61%)	99 (0.72%)	0.83 (0.62, 1.13)
Cannabis	254 (1.86%)	233 (1.70%)	1.20 (0.99, 1.45)
Stimulant	68 (0.50%)	116 (0.85%)	0.57 (0.43, 0.78)
Sedative/hypnotic/anxiolytic	17 (0.12%)	19 (0.14%)	1.43 (0.66, 3.09)
Hallucinogen	1 (0.01%)	2 (0.01%)	0.44 (0.04, 4.97)
<i>Mental illness:</i>			
Any	4482 (32.78%)	4180 (30.58%)	0.98 (0.93, 1.03)
Major depressive disorder	2707 (19.80%)	2016 (14.75%)	1.29 (1.22, 1.38)
Posttraumatic stress disorder	2311 (16.90%)	2779 (20.33%)	0.69 (0.65, 0.74)
Generalized anxiety disorder	576 (4.21%)	566 (4.14%)	1.02 (0.90, 1.15)
Bipolar disorder	366 (2.68%)	350 (2.56%)	0.99 (0.85, 1.16)
Schizophrenia/schizoaffective disorder	129 (0.94%)	168 (1.23%)	0.61 (0.49, 0.77)

*Based on propensity-score-matched samples whereby logistic regression models were constructed separately for each of the selected outcome variables in relation to multiple sclerosis status as the exposure variable, controlling for covariates (race, marital status, combat service, percent service-connected disability rating, and Charlson's comorbidity index).

frequent among male veterans, and mental illnesses were more frequent among female veterans. Furthermore, homelessness, SUDs, and mental illnesses were inversely related to age. Compared to non-Hispanic white veterans, those who identified themselves as non-Hispanic black or had missing data on race were more likely to have experienced homelessness, while those who identified themselves as Hispanic, mixed/other race, were more likely to be diagnosed with mental illnesses. Homelessness, SUDs, and mental illnesses were more frequently observed among single/never married and separated/divorced veterans as compared to married veterans, whereas widowed veterans were more likely than married veterans to be diagnosed with mental illnesses. A positive association was observed between combat service, disability rating, and mental illnesses, whereas the CCI score was positively associated with both SUDs and mental illnesses, among veterans with MS.

Discussion

Results from this study provide new data and novel insights regarding homelessness, SUDs, and mental illnesses, among

Table 3. Multiple Logistic Regression Models for Sociodemographic and Clinical Correlates of Prevalent Homelessness, Substance Use Disorder, and Mental Illness, among U.S. Veterans Diagnosed with Multiple Sclerosis (MS)—Veterans Health Administration (January 1, 2022–December 31, 2022)

	Odds ratio (95% confidence interval)		
	Homelessness	Substance use	Mental illness
Sociodemographic:			
<i>Sex:</i>			
Male	Ref.	Ref.	Ref.
Female	0.85 (0.67, 1.07)	0.61 (0.51, 0.75)	1.38 (1.27, 1.50)
<i>Age (years):</i>			
18–39	Ref.	Ref.	Ref.
40–49	0.80 (0.58, 1.11)	0.67 (0.53, 0.86)	0.81 (0.72, 0.92)
50–59	0.74 (0.53, 1.01)	0.44 (0.34, 0.57)	0.68 (0.60, 0.77)
60–69	0.60 (0.42, 0.86)	0.38 (0.29, 0.50)	0.49 (0.43, 0.56)
70+	0.28 (0.17, 0.46)	0.18 (0.13, 0.26)	0.45 (0.39, 0.52)
<i>Race:</i>			
Non-Hispanic White	Ref.	Ref.	Ref.
Non-Hispanic Black	1.99 (1.56, 2.55)	1.08 (0.88, 1.32)	0.99 (0.90, 1.09)
Hispanic	1.42 (0.86, 2.35)	0.87 (0.58, 1.31)	1.43 (1.19, 1.70)
Mixed race/other	1.71 (0.86, 3.43)	1.22 (0.72, 2.11)	1.52 (1.17, 1.97)
Missing	1.94 (1.40, 2.70)	1.04 (0.78, 1.37)	0.89 (0.79, 1.02)
<i>Marital status:</i>			
Married	Ref.	Ref.	Ref.
Single/never married	2.70 (2.00, 3.65)	1.54 (1.21, 1.94)	1.16 (1.03, 1.29)
Separated/divorced	3.58 (2.78, 4.61)	2.07 (1.71, 2.51)	1.45 (1.33, 1.59)
Widowed	2.70 (1.23, 5.93)	2.73 (1.63, 4.58)	1.04 (0.78, 1.38)
Missing	0.88 (0.28, 2.86)	0.70 (0.28, 1.74)	0.69 (0.49, 0.99)
<i>Combat service:</i>			
Yes	0.66 (0.40, 1.08)	1.14 (0.85, 1.55)	1.64 (1.43, 1.88)
<i>Clinical:</i>			
<i>Percent service-connected disability rating:</i>			
10%–40%	Ref.	Ref.	Ref.
50%–100%	0.80 (0.60, 1.08)	1.02 (0.79, 1.30)	2.20 (1.95, 2.49)
<i>Charlson's comorbidity index:</i>			
0	Ref.	Ref.	Ref.
1	1.10 (0.79, 1.53)	1.88 (1.49, 2.37)	1.60 (1.43, 1.79)
2	1.23 (0.83, 1.84)	1.76 (1.31, 2.36)	1.54 (1.34, 1.77)
3+	1.45 (0.98, 2.16)	2.27 (1.70, 3.03)	2.35 (2.05, 2.68)

veterans with MS, which have been rarely explored in the literature. Perhaps, the most notable finding was the higher prevalence of mental illness among veterans with MS compared with veterans without MS. Characteristics associated with higher rates of mental illnesses among veterans with MS included younger age, unmarried status, Hispanic ethnicity or mixed/other race, combat service, and disability status. These findings highlight an important consideration for clinical teams within the VHA, specifically the need to conduct appropriate screening and referrals among veterans with

MS based on nonmodifiable sociodemographic characteristics (i.e., age, marital status, sex, race, combat service, and disability).

There is a strong body of evidence indicating a higher prevalence of psychiatric comorbidity among persons with MS as other studies have found rates of depression 2–5-folds higher than the general population.^{44,45} Our findings align with the ongoing concern about the prevalence of MDD in the MS population that has been associated with greater health services use.⁴⁶ Results from a recent systematic review highlighted the high prevalence of anxiety and depression in particular (more than 20%), but noted a significant gap in the literature regarding studies devoted to other psychiatric comorbidities such as bipolar and SUDs that are of significant clinical relevance.⁴⁴ The current study addresses this gap in the literature, particularly among veterans with MS, who may be at greater risk of mental illnesses. There are various theorized mechanisms for higher prevalence of psychiatric comorbidities including the impact of MS diagnosis and MS symptoms (e.g., disability status); however, the inflammatory and neurogenerative processes of MS have been strongly associated with depression and bipolar mood disorders.⁴⁵ One key takeaway from the evidence regarding mental illness among veterans with MS is a critical need for multidisciplinary diagnosis and treatment approaches.

There was a lower prevalence of alcohol and stimulant use disorders among veterans with MS, but higher rates of cannabis use disorders compared to veterans without MS. Over the past 10 years there has been great interest in the use of cannabis as a second-line symptom management strategy for pain.⁴⁷ Results from this study are related to other recent research comparing general cannabis use between adults with MS and controls wherein persons with MS are more likely to report recent cannabis use.⁴⁷ Further research is needed to examine the rates of general cannabis use versus cannabis use disorders in persons with MS. Another pain management treatment of interest among veterans globally is opioids.⁴⁸ One previous study among veterans with MS indicated over a 3-year period (2015–2017) chronic opioid use declined.¹⁸ Low rates of opioid use in the current cohort are a positive indication; however, there is a need for widely available and effective treatment strategies for chronic pain among persons with MS given the limited research on cannabis.

There was no significant difference in the prevalence of homelessness between veterans with and without MS. However, there was an indication of non-Hispanic black veterans, regardless of MS diagnosis, being at high risk for homelessness which has been well-documented in both the general and veteran populations.^{22,49,50} Among veterans, race is associated with greater housing instability in general and the use of VHA homeless programs in particular.^{22,50} Additionally, there are well-documented health disparities among minority populations with MS, particularly non-Hispanic blacks, which lead to disproportionate access to first-line DMTs and specialty care.⁵¹ Such compounding disparities can have significant implications for patient outcomes and quality of life that must be addressed within the VHA system through rigorous screening and referral mechanisms to support marginalized persons with MS.

The current study has several notable limitations. There are likely distinct differences between veterans with MS and the general MS population; as such, results from the current study may not be generalizable to all persons with MS. This study highlights the pressing need for further research among black and ethnic-minority populations with MS in general in the U.S. and globally given health disparities associated with social determinants of health.⁵¹ Specifically, culturally tailored resources may be needed

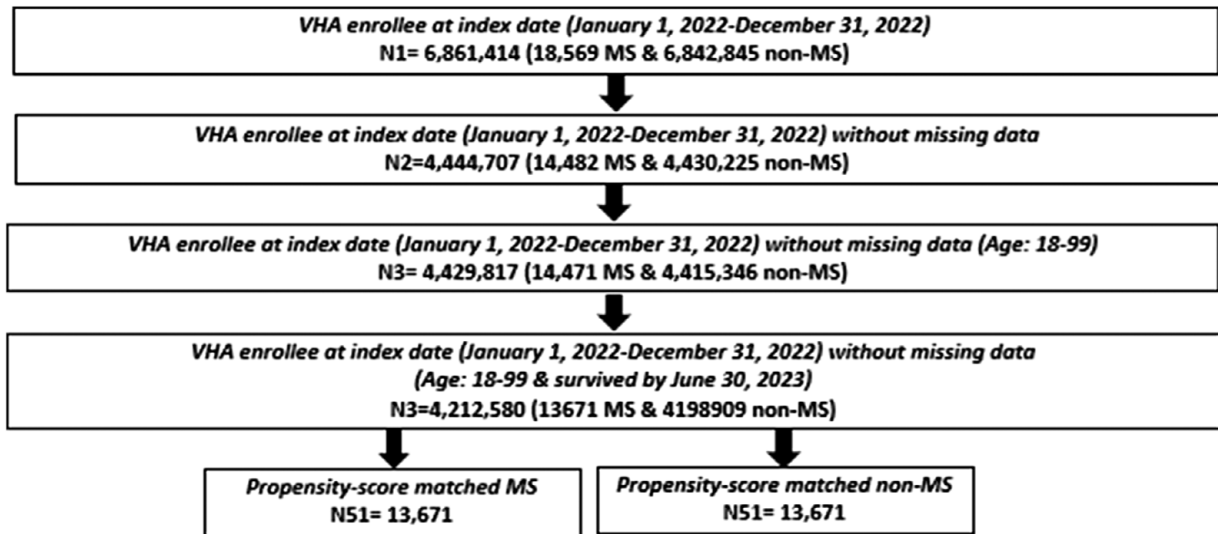


Figure 1. Study flowchart.

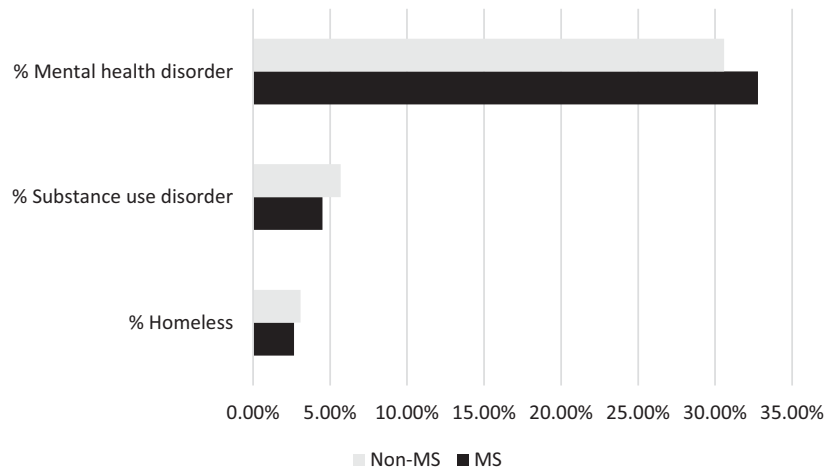


Figure 2. Prevalence (95% confidence interval) of homelessness, substance use disorders, and mental illness, among U.S. veterans diagnosed with multiple sclerosis and propensity-score-matched U.S. veterans not diagnosed with multiple sclerosis—Veterans Health Administration (January 1, 2022–December 22, 2022)

to mitigate the risk of psychiatric disorders and homelessness. The cross-sectional nature of data collection limits the assessment of directionality of associations examined in the current study. Additionally, there was a low prevalence of homelessness in the current sample; however, there are many veterans with MS who experience homelessness and housing instability that warrant focal research on their needs to guide appropriate healthcare resources and interventions.

Conclusion

In conclusion, veterans with MS were more likely to have some psychiatric disorders than veterans without MS but there was no difference in rates of homelessness. Certain veterans with MS such as those who were younger, unmarried, race/ethnic minorities, with combat exposure and disabilities were at greater risk for a host of psychosocial problems, such as homelessness, SUDs, and mental illness. Veterans in these categories may require particular attention to address health disparities within the clinical population of veterans with MS.

Supplementary material. The supplementary material for this article can be found at <http://doi.org/10.1017/S1092852924002165>.

Author contribution. Conceptualization: J.T., S.L.S.; Funding acquisition: J.T.; Methodology: J.T., H.B., S.L.S.; Resources: J.T.; Writing – review & editing: J.T., H.B.; Data curation: H.B.; Formal analysis: H.B.; Investigation: H.B.; Writing – original draft: S.L.S.

Competing interest. S. Silveira, H. Beydoun, and J. Tsai report no conflicts of interest with this work.

Funding. There was no specific funding for this work, but this work was supported by the U.S. Department of Veterans Affairs National Center on Homelessness among Veterans.

References

1. Abdel Magid HS, Jin S, Culpepper WJ, Nelson LM, Wallin M. Telemedicine utilization among patients with multiple sclerosis in the US veterans health administration, 2010–2020. *Neurol Clin Pract.* 2022;12(6):e133–e142. doi: 10.1212/cpj.0000000000200078

2. Abdollahpour I, Nedjat S, Mansournia MA, Eckert S, Weinstock-Guttman B. Stress-full life events and multiple sclerosis: A population-based incident case-control study. *Mult Scler Relat Disord*. 2018;**26**:168–172. doi:10.1016/j.msard.2018.09.026
3. Hoang PD, Cameron MH, Gandevia SC, Lord SR. Neuropsychological, balance, and mobility risk factors for falls in people with multiple sclerosis: a prospective cohort study. *Arch Phys Med Rehabil*. 2014;**95**(3):480–486. doi:10.1016/j.apmr.2013.09.017
4. Hong Y, Tang HR, Ma M, Chen N, Xie X, He L. Multiple sclerosis and stroke: a systematic review and meta-analysis. *BMC Neurol*. 2019;**19**(1):139. doi:10.1186/s12883-019-1366-7
5. Wallin MT, Culpepper WJ, Campbell JD, et al. The prevalence of MS in the United States: a population-based estimate using health claims data. *Neurology*. 2019;**92**(10):e1029–e1040.
6. LaVela SL, Prohaska TR, Furner S, Weaver FM. Preventive healthcare use among males with multiple sclerosis. *Public Health*. 2012;**126**(10):896–903. doi:10.1016/j.puhe.2012.06.002
7. Mazumder R, Murchison C, Bourdette D, Cameron M. Falls in people with multiple sclerosis compared with falls in healthy controls. *PLoS One*. 2014;**9**(9):e107620. doi:10.1371/journal.pone.0107620
8. Bergmann C, Becker S, Watts A, et al. Multiple sclerosis and quality of life: the role of cognitive impairment on quality of life in people with multiple sclerosis. *Mult Scler Relat Disord*. 2023;**79**:104966. doi:10.1016/j.msard.2023.104966
9. Lo AC, Hadjimichael O, Vollmer TL. Treatment patterns of multiple sclerosis patients: a comparison of veterans and non-veterans using the NARCOMS registry. *Mult Scler*. 2005;**11**(1):33–40. doi:10.1191/1352458505ms11360a
10. Nelson RE, Xie Y, DuVall SL, et al. Multiple sclerosis and risk of infection-related hospitalization and death in US veterans. *Int J MS Care*. 2015;**17**(5):221–230. doi:10.7224/1537-2073.2014-035
11. Kurtzke JF. Some contributions of the department of veterans affairs to the epidemiology of multiple sclerosis. *Mult Scler*. 2008;**14**(8):1007–1012. doi:10.1177/1352458508096005
12. Lavela SL, Prohaska TR, Furner S, Weaver FM. Chronic diseases in male veterans with multiple sclerosis. *Prev Chronic Dis*. 2012;**9**:E55.
13. Bambara JK, Turner AP, Williams RM, Haselkorn JK. Social support and depressive symptoms among caregivers of veterans with multiple sclerosis. *Rehabil Psychol*. 2014;**59**(2):230–235. doi:10.1037/a0036312
14. Coughlin SS, Sher L. Suicidal behavior and neurological illnesses. *J Depress Anxiety*. 2013;**9**(1):12443. doi:10.4172/2167-1044.S9-001
15. Howard I, Turner R, Olkin R, Mohr DC. Therapeutic alliance mediates the relationship between interpersonal problems and depression outcome in a cohort of multiple sclerosis patients. *J Clin Psychol*. 2006;**62**(9):1197–1204. doi:10.1002/jclp.20274
16. Kojima G, Tamai A, Karino S, et al. Bupropion-related visual hallucinations in a veteran with posttraumatic stress disorder and multiple sclerosis. *J Clin Psychopharmacol*. 2013;**33**(5):717–719. doi:10.1097/JCP.0b013e3182a11622
17. Lee A, Nathan KI. Understanding psychosis in a veteran with a history of combat and multiple sclerosis. *Fed Pract*. 2019;**36**(Suppl 4):S32–S35.
18. Turner AP, Arewasikporn A, Hawkins EJ, et al. Risk factors for chronic prescription opioid use in multiple sclerosis. *Arch Phys Med Rehabil*. 2023;**104**(11):1850–1856. doi:10.1016/j.apmr.2023.04.012
19. Turner AP, Williams RM, Bowen JD, Kivlahan DR, Haselkorn JK. Suicidal ideation in multiple sclerosis. *Arch Phys Med Rehabil*. 2006;**87**(8):1073–1078. doi:10.1016/j.apmr.2006.04.021
20. Edens EL, Kaspro W, Tsai J, Rosenheck RA. Association of substance use and VA service-connected disability benefits with risk of homelessness among veterans. *Am J Addict*. 2011;**20**(5):412–419.
21. Tsai J, Rosenheck RA, Kane V. Homeless female U.S. veterans in a national supported housing program: comparison of individual characteristics and outcomes with male veterans. *Psychol Serv*. 2014;**11**(3):309–316. doi:10.1037/a0036323
22. Tsai J, Pietrzak RH, Szymkowiak D. The problem of veteran homelessness: an update for the new decade. *Am J Prev Med*. 2021;**60**(6):774–780. doi:10.1016/j.amepre.2020.12.012
23. Fargo JD, Brignone E, Metraux S, et al. Homelessness following disability-related discharges from active duty military service in Afghanistan and Iraq. *Disability and Health Journal*. 2017;**10**(4):592–599. doi:https://doi.org/10.1016/j.dhjo.2017.03.003
24. Tsai J, Rosenheck RA. Risk factors for homelessness among US veterans. *Epidemiol Rev*. 2015;**37**(1):177–195. doi:10.1093/epirev/mxu004
25. Tsai J, Kaspro WJ, Rosenheck RA. Latent homeless risk profiles of a national sample of homeless veterans and their relation to program referral and admission patterns. *Am J Public Health*. 2013;**103**(Suppl 2):S239–S247. doi:10.2105/ajph.2013.301322
26. Ferguson JM, Wray CM, Jacobs J, et al. Variation in initial and continued use of primary, mental health, and specialty video care among veterans. *Health Serv Res*. 2023;**58**(2):402–414. doi:10.1111/1475-6773.14098
27. Jones AL, Gordon AJ, Gabrielian SE, et al. Perceptions of care coordination among homeless veterans receiving medical care in the veterans health administration and community care settings: results from a national survey. *Med Care*. 2021;**59**(6):504–512. doi:10.1097/MLR.0000000000001547
28. Swankoski KE, Reddy A, Grembowski D, Chang ET, Wong ES. Intensive care management for high-risk veterans in a patient-centered medical home - do some veterans benefit more than others? *Healthc (Amst)*. 2023;**11**(2):100677. doi:10.1016/j.hjdsi.2023.100677
29. Mitra A, Pradhan R, Melamed RD, et al. Associations between natural language processing-enriched social determinants of health and suicide death among US veterans. *JAMA Netw Open*. 2023;**6**(3):e233079. doi:10.1001/jamanetworkopen.2023.3079
30. Laliberte AZ, Salvi A, Hooker E, et al. Factors associated with a lack of health care utilization among veterans after a positive suicide screen in the emergency department. *Acad Emerg Med*. 2023;**30**(4):321–330. doi:10.1111/acem.14695
31. Kamdar N, Hundt NE, Ramsey DJ, et al. Characteristics associated with persistent versus transient food insecurity among US veterans screened in the veterans health administration. *J Acad Nutr Diet*. 2023;**123**(7):1044–1052 e5. doi:10.1016/j.jand.2023.03.006
32. Holliday R, Smith AA, Kinney AR, et al. Research letter: traumatic brain injury among veterans accessing VA justice-related services. *J Head Trauma Rehabil*. 2023;**38**(2):184–190. doi:10.1097/HTR.0000000000000822
33. Bagnato F, Wallin M. COVID-19 vaccine in veterans with multiple sclerosis: protect the vulnerable. *Fed Pract*. 2021;**38**(Suppl 1):S28–S32. doi:10.12788/fp.0113
34. Barth SK, Kang HK, Bullman TA, Wallin MT. Neurological mortality among U.S. veterans of the Persian gulf war: 13-year follow-up. *Am J Ind Med*. 2009;**52**(9):663–670. doi:10.1002/ajim.20718
35. Finkelstein J, Cha E, Wood J, Wallin MT. Predictors of successful acceptance of home telemanagement in veterans with multiple sclerosis. *Annu Int Conf IEEE Eng Med Biol Soc*. 2013;**2013**:7314–7317. doi:10.1109/embc.2013.6611247
36. Fuchs TA, Wattengel BA, Carter MT, El-Solh AA, Lesse AJ, Mergenhagen KA. Outcomes of multiple sclerosis patients admitted with COVID-19 in a large veteran cohort. *Mult Scler Relat Disord*. 2022;**64**:103964. doi:10.1016/j.msard.2022.103964
37. Keszler P, Maloni H, Miles Z, Jin S, Wallin M. Telemedicine and multiple sclerosis: a survey of health care providers before and during the COVID-19 pandemic. *Int J MS Care*. 2022;**24**(6):266–270. doi:10.7224/1537-2073.2021-103
38. Khurana SR, Bamer AM, Turner AP, et al. The prevalence of overweight and obesity in veterans with multiple sclerosis. *Am J Phys Med Rehabil*. 2009;**88**(2):83–91. doi:10.1097/PHM.0b013e318194f8b5
39. Rinker JR, 2nd, Cossey TC, Cutter GR, Culpepper WJ. A retrospective review of lithium usage in veterans with multiple sclerosis. *Mult Scler Relat Disord*. 2013;**2**(4):327–333. doi:10.1016/j.msard.2013.03.004
40. Titcomb TJ, Bao W, Du Y, Liu B, Snetelaar LG, Wahls TL. Association of multiple sclerosis with risk of mortality among a nationally representative sample of adults in the United States. *Mult Scler J Exp Transl Clin*. 2022;**8**(2):20552173221104009. doi:10.1177/20552173221104009
41. Wallin MT, Culpepper WJ, Coffman P, et al. The Gulf War era multiple sclerosis cohort: age and incidence rates by race, sex and service. *Brain*. 2012;**135**(Pt 6):1778–1785. doi:10.1093/brain/aws099
42. Tsai J, Szymkowiak D, Jutkowitz E. Developing an operational definition of housing instability and homelessness in Veterans Health Administration's medical records. *PLoS One*. 2022;**17**(12):e0279973. doi:10.1371/journal.pone.0279973

43. Sundararajan V, Henderson T, Perry C, Muggivan A, Quan H, Ghali WA. New ICD-10 version of the Charlson comorbidity index predicted in-hospital mortality. *J Clin Epidemiol.* 2004;57(12):1288–1294. doi:10.1016/j.jclinepi.2004.03.012
44. Marrie RA, Reingold S, Cohen J, et al. The incidence and prevalence of psychiatric disorders in multiple sclerosis: A systematic review. *Mult Scler J.* 2015;21(3):305–317. doi:10.1177/1352458514564487
45. Inanc Y, Kaya T. Psychiatric disorders in multiple sclerosis. *J Mult Scler Res.* 2022;2(2):31–35. doi:10.4274/jmsr.galenos.2022.2022-8-1
46. Marrie RA, Walld R, Bolton JM, et al. Effect of mood and anxiety disorders on health care utilization in multiple sclerosis. *Mult Scler J.* 2021;27(9):1411–1420. doi:10.1177/1352458520963880
47. Gupta S, Fellows K, Weinstock-Guttman B, Hagemeyer J, Zivadinov R, Ramanathan M. Marijuana use by patients with multiple sclerosis. *Int J MS Care.* 2019;21(2):57–62. doi:10.7224/1537-2073.2017-112
48. Sandbrink F, Murphy JL, Johansson M, et al. The use of opioids in the management of chronic pain: synopsis of the 2022 updated U.S. Department of Veterans Affairs and U.S. Department of Defense Clinical Practice Guideline. *Ann Intern Med.* 2023;176(3):388–397. doi:10.7326/m22-2917
49. Fusaro VA, Levy HG, Shaefer HL. Racial and ethnic disparities in the lifetime prevalence of homelessness in the United States. *Demography.* 2018;55(6):2119–2128. doi:10.1007/s13524-018-0717-0
50. Montgomery AE, Szymkowiak D, Tsai J. Housing instability and homeless program use among veterans: the intersection of race, sex, and homelessness. *Hous Policy Debate.* 2020;30(3):396–408. doi:10.1080/10511482.2020.1712613
51. Amezcua L, Rivera VM, Vazquez TC, Baezconde-Garbanati L, Langer-Gould A. Health disparities, inequities, and social determinants of health in multiple sclerosis and related disorders in the US: a review. *JAMA Neurol.* 2021;78(12):1515–1524.