Acquired Stuttering in Veterans of the Wars in Iraq and Afghanistan: The Role of Traumatic Brain Injury, Post-Traumatic Stress Disorder, and Medications

Rocío S. Norman, PhD; Carlos A. Jaramillo, MD PhD†; Blessen C. Eapen, MD†; Megan E. Amuan, MPH‡; CAPT USAF (Ret) Mary Jo Pugh, PhD†§*

ABSTRACT Introduction: Determine the association between acquired stuttering (AS), traumatic brain injury (TBI), and post-traumatic stress disorder (PTSD) in a cohort of 309,675 U.S. Iraq and Afghanistan veterans. The secondary aim was to determine the association between AS and medication patterns for veterans in the sample. Materials and Methods: Retrospective study using data from the Veterans Health Administration National Repository for veterans deployed in support of combat operations in Iraq and Afghanistan and who received Veterans Health Administration care in 2010 and 2011. We identified stuttering using ICD-9 codes to establish the association between AS, TBI, and PTSD, controlling for demographic characteristics and other comorbidities. Multivariable logistic regression was used to determine the association between comorbid conditions and potentially problematic medications associated with stuttering. Results: Two hundred thirty-five veterans (0.08%) were diagnosed with AS in the cohort. There was the greater likelihood of an AS diagnosis for veterans with concomitant TBI and PTSD when compared with veterans without these diagnoses. Over 66% of those with stuttering were prescribed at least one medication that affected speech fluency (antidepressants, anxiolytics, and antiepileptic drugs) compared with 35% of those without AS. Conclusion: Veterans with a comorbid diagnosis of TBI and PTSD were more likely to be diagnosed with AS AOR: 9.77 (95% CI = 6.93–13.78, $p < 0.05$) and more likely to have been prescribed medications known to affect speech production OR: 3.68 (95% CI = 2.81–4.82, $p < 0.05$). Clinicians treating veterans with these complex comorbid conditions should consider the impact of medications on speech fluency.

INTRODUCTION

Stuttering, a disorder which affects speech fluency,[1] has been linked to a variety of negative outcomes including reduced self-esteem and self-image[2], low rates of employment,[3–5] reduced quality of life and difficulties with social and emotional functioning.[2,6,7] While the medical community currently lacks a standardized approach for the assessment and treatment of stuttering, it is a treatable disorder and favorable outcomes have been reported using a combination of behavioral modification techniques and supportive therapy.[8–11]

Stuttering is predominantly a developmental speech disorder with a typical onset at three years of age[12]; however, there are numerous reports of acquired adult stuttering (AS).[13] Studies[14,15] of AS typically distinguish stuttering as being neurogenic or psychogenic in nature. Neurogenic stuttering coincides with the progression of neurological disease such as Alzheimer's disease or with the onset of a neurological event, such as traumatic brain injury (TBI)[16] Psychogenic stuttering has been associated with a somatic or psychiatric diseases.[17–21] There are also reports of drug-induced stuttering, where stuttering symptoms resolve after the medication in question is discontinued.[22,23] Although factors such as sex and family history have been linked to developmental stuttering and research has linked AS to brain damage, a definitive basis of stuttering remains elusive.[24]

Stuttering and TBI

TBI is "an alteration in brain function, or other evidence of brain pathology, caused by an external force"[25] and is a risk factor for speech disorders.[26] A 1990 survey reported that over 38% of participants in treatment for AS attributed "head trauma" as the etiology[21] with respondents in the 16–30 age category having a greater likelihood of attributing "head trauma" as the cause of their AS compared with older respondents. However, there is a clinical challenge in reporting the prevalence of stuttering in individuals with brain injuries.[27] Indeed, in the absence of a detailed assessment, AS is difficult to distinguish from related speech-language disorders such as dysarthria or aphasia.[28] Assessment guidelines have

*Speech-Language Pathology Program, School of Health Professions, University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, TX 78229.

†South Texas Veterans Health Care System, Polytrauma Rehabilitation Center, 7400 Merton Miner Dr. San Antonio, TX 78229.

‡Bedford Center for Health Quality, Outcomes and Economic Research, Edith Nourse Rogers Memorial Veterans Hospital, 200 Springs Rd. Bedford, MA 01730.

§Department of Epidemiology & Biostatistics, University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, TX 78229.

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been developed to differentiate between AS and language-based deficits[29] but these methods have yet to be incorporated into standard clinical practice.

Stuttering and Mental Health Conditions

Distinguishing neurogenic versus psychogenic stuttering is challenging, as many cases of AS have a psychological component. The link between anxiety and stuttering has been well established in the literature for both children and adults who stutter.[30,31] The relationship between stuttering and social anxiety specifically is well documented.[6,7,32–35] The research on stuttering and social anxiety has demonstrated a robust association between the two, however, the relationship between stuttering and post-traumatic stress disorder (PTSD), which shares symptoms with anxiety disorders, has remained relatively unexplored. Given that developmental and AS are associated with anxiety disorders, which share clinical and biological features with PTSD, and that cases of PTSD, much like cases of psychogenic stuttering reported in the literature are consistent with a sudden event, it is clinically relevant to determine if an association between PTSD and stuttering exists. This is particularly relevant for patient populations with high incidence/prevalence rates of PTSD such as combat veterans.

Drug-Induced Stuttering

Drug-induced stuttering, while not as prevalent as neurogenic or psychogenic stuttering, has been defined as a side effect related to a change in a patient's medication regimen.[22,36,37] Drug-induced stuttering has been described in association with several medication classes, specifically antidepressants, antiepileptic medications, and neuroleptics.[38,39] Research in this area has predominantly used the case series design, in which speech symptoms are tracked per clinical case. A study by Bar et al[40] described six cases of individuals between the ages of 37–57 who were acutely treated with low potency neuroleptics such as sertraline, olanzapine and zoplicone and stuttering symptoms (characterized by repetitions, blocking, and prolongations) appeared and persisted until the medications were discontinued. In all six cases, the patients affected had no history of developmental stuttering prior to the documented event, leading the authors to attribute their stuttering symptoms to individual biological predisposition, perhaps exacerbated by the common properties of the drugs in question.

Veterans with TBI and PTSD and Stuttering

U.S. Iraq and Afghanistan veterans (IAV) are at risk for developing communication disorders such as AS.[41] In a study of U.S. veterans deployed to the wars of Iraq and Afghanistan during the years 2010–2011, individuals with mild TBI (mTBI) had an increased risk of being diagnosed with AS when compared with individuals with no diagnosis of TBI.[42] However, the rate of communication disorders in individuals with both TBI and PTSD remains to be determined in light of the frequent comorbidity of mTBI and PTSD in IAV.

TBI and PTSD occur in clinical and nonclinical samples of veterans.[43–45] These disorders are not always easily distinguishable[46], they frequently co-occur, and often share secondary symptoms such headache, insomnia, fatigue, irritability, cognitive dysfunction, and chronic pain.[47] PTSD is strongly associated with long-term somatic complaints and reduced health-related quality of life.[48–50] AS was identified as an area of concern by a panel of experts in the development of clinical practice guidelines for speech-language pathologists (SLPs) providing care to U.S. Service Members (SM) and IAV.[41] These guidelines state that determining the cause of stuttering in SMs and IAV is complex and likely due to the interaction of neurological changes, emotional trauma, individual reaction to stress and medication use. Despite the clinical need, research studies of AS in U.S. service members with TBI and PTSD have been limited to case studies.[51] In Mattingly's (2015) study, the SM's speech demonstrated stuttering-type dysfluencies; first syllable repetition of words. The SM also reported psychological distress and subjective attention problems, which was consistent with diagnoses of mTBI and PTSD. Although the SM's medication regimen is briefly mentioned in the report, the lack of statistical analysis makes interpreting causation or even an association between his medications and speech fluency infeasible. That same year, Roth and colleagues described two cases of Marine Corps SMs with post-deployment stuttering to discuss the theoretical bases of the AS (i.e., neurogenic vs. psychogenic origins). The cases, which include both assessment and treatment examples, serve as a clinical guide for SLPs treating AS for SMs with protracted recovery after mTBI. Although the authors rule out neurogenic stuttering in both cases, they advocate for a multidisciplinary approach to managing stuttering in this unique population; they warn against the oversimplification of assessment and treatment. To our knowledge, no prior study has explored AS in IAV with comorbid TBI and PTSD.

Aims of Current Study

The aim of this study was to examine the epidemiology of AS in a cohort of U.S. veterans who sought care in the Veterans Health Administration system between 2010 and 2011. We first identified the associations between AS, TBI, and PTSD controlling for demographic characteristics and other comorbidities. Next, we examined the association of potentially problematic medications with AS, while controlling for comorbid conditions.

MATERIALS AND METHODS

Data Sources and Population

After obtaining Institutional Review Board (IRB) approvals from the University of Texas Health Science Center, San Antonio and the Bedford Veteran's Affairs (VA) Hospital,

we obtained identifiers from the OEF/OIF/OND (Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn) Roster File. We then gathered data for these individuals from the national VA inpatient and outpatient medical Statistical Analysis Software (SAS) files from the VA National Repository in Austin, Texas. We included individuals who received inpatient or outpatient VA care annually in both Fiscal Year 2010 (FY10: October 1, 2009–September 30, 2010) and Fiscal Year 2011 (October 1, 2010–September 30, 2011) who received a ICD-9 code identifying AS. Those with additional speech disorders not related to primary stuttering were excluded from the analysis (n = 1,725). Finally, we obtained data on medications received from the VA from the Pharmacy Benefits Management Strategic Health Group and linked data from all files using an encrypted identifier that is consistent for each patient across all datasets. Inpatient and outpatient datasets included demographic characteristics of patients, diagnoses received in the course of clinical care, and the type of care received. Pharmacy data included the generic medication name.

Measures

Dependent Variable: Stuttering

We identified AS, the primary dependent variable, using International Classification of Diseases, Ninth Revision (ICD-9) codes indicative of adult-onset stuttering from inpatient and outpatient data: 307.0 (Adults-onset fluency disorder), 784.52 (fluency conditions identified elsewhere) and 784.59 (other speech disturbance). The codes selected for inclusion in our analysis were informed by the release of new (ICD-9) fluency codes in October, 2010, which were developed for the purpose of "better capturing the nature and description of fluency disorders".[52] Code 307.0 (Adult-onset fluency disorder) was chosen because prior to October 2010, this code was the "default code" for stuttering of adult-onset and after this date, it was revised to capture stuttering not related to organic conditions (i.e., stuttering that is psychogenic in origin) and both of these types of stuttering were of interest in our study. Code 784.52 was selected based on coding guidelines from the American Speech-Hearing Association (ASHA) stating this code should be used "when stuttering appears as a symptom of another condition" therefore, this code is essential for capturing stuttering related to TBI in our analysis. Code 784.59 was included in the analysis because it is considered a fluency code by ASHA, it includes "symptoms involving the head" and it excludes childhood stuttering. To ensure that our analysis was not confounded by other speech-language disorders, individuals with diagnostic codes representing other speech disorders, including aphasia, apraxia of speech, dysarthria, and voice disorders were excluded from the analysis. Given our primary interest in TBI-related stuttering, codes 315.35 (Developmental stuttering) and 438.14 (cerebrovascular accident-related stuttering) were excluded. Those with additional speech disorders not related to primary stuttering were excluded from the analysis (n = 1,725). Following guidelines recommended by previous studies[53] examining VA and Medicare diagnostic data, we classified individuals diagnosed two or more times by a clinician providing care at the VA at least 7 d apart with the aforementioned codes as having a valid stuttering diagnosis.

Dependent Variable: Demographic Characteristics

We obtained descriptive characteristics for this cohort of veterans from the OEF/OIF/OND Roster File, and the inpatient and outpatient Medical SAS datasets. Demographic characteristics included age, race/ ethnicity (White, Black, Hispanic, Other, Unknown), military rank (enlisted and officer/warrant officer). We excluded branch of service and education from the final analysis in order to limit the number of variables for multivariable analyses and to also avoid collinearity with other variables such as military rank.

Independent Variable: TBI Status

TBI status was obtained using an algorithm generated by the Department of Defense (DoD) Armed Forces Health Surveillance Center to first identify ICD-9 codes indicative of TBI (see Table I).

Independent Variable: PTSD Status

PTSD status was identified using ICD-9 code 309.81 (PTSD) from inpatient and outpatient data.

Independent Variable: Comorbid Conditions

We used ICD-9-CM codes in outpatient and inpatient data in FY10-11 to identify comorbid physical and mental health conditions that are common among IAV and to determine if they were positively associated with AS. Comorbid conditions were chosen based on prior studies identifying these comorbidities as common in this cohort[54–59] and based on

TABLE I. ICD-9 Codes for TBI

Code	Description
800–804	Fracture of the skull
850	Concussion
851	Cerebral laceration and contusion
852	Subarachnoid, subdural, and extradural hemorrhage, following injury
853	Other and unspecified intracranial hemorrhage following injury
854	Intracranial injury of other and unspecified nature
905	Late effect of fracture of skull and face bones
907.0	Late effect of intracranial injury without mention of skull fracture
950.1	Injury to optic chiasm
950.2	Injury to optic pathways
950.3	Injury to visual cortex
959.01	Head injury, unspecified
959.9	Unspecified site
310.2	Postconcussion syndrome
V15.52	History of traumatic brain injury

the clinical experience of the authors. The following comorbid conditions were selected in the final analysis: insomnia, pain, headache, substance abuse, anxiety, and depression.

Independent Variable: Medications

Our analysis of medication patterns for veterans diagnosed with AS was based on identifying medications prescribed to each patient during FY 11 using the VA product name. The drugs chosen for our analysis had been previously reported in the literature as being associated with stuttering in adults (alprazolam, methylphenidate, haloperidol, sertraline, fluoxetine, carbamazepine, fluoxetine)[60] and also included those commonly prescribed to post-deployment IAV.[61–65] Of particular interest were medications related to neurological and mental health conditions. Drugs belonging to these classes are known to affect central nervous system function via neurotransmitter function and have an impact on speech motor control and tone, which may contribute to speech fluency.[36,66] Table II includes the classes of drugs that were analyzed.

Data Analysis

We used the chi-square statistic to examine bivariate relationships between AS and demographic characteristics, comorbid conditions and medication use and multivariate logistic regression analyses to determine associations of these characteristics with AS. We next used a multivariable regression analysis to compare those IAV with and without AS and determine if potentially problematic medications were associated with AS. We then used logistic regression analyses to identify comorbid conditions significantly associated with AS and medications which were most frequently prescribed to those with stuttering, controlling for comorbid conditions. All analyses were conducted using SAS software ® version 9.2 (Cary, NC, USA), and used $p < 0.05$ as the level of statistical significance.

TABLE II. Drug Classes and Medications Included in Analysis

Class	Drugs
Antiepileptic	Gabapentin, valproate, levitaracetam, lamotragine, carbamazepine
Atypical antipsychotics	Risperidone, clozapine, quetiapine, ziprasidone, aripiprazole, olanzapine
Typical antipsychotics	Haloperidol, chlorpromazine, thioridazine
Antidepressants	(a) *Selective serotonin uptake inhibitors*: citalopram, escitalopram, fluoxetine, paroxetine, sertraline (b)*Serotonin norepinephrine reuptake inhibitors*: venlafaxine, duloxetine (c)*Tricyclic antidepressants*: mirtazapine and (d) *Other antidepressants*: bupropion
Anxiolytics	Clonazepam and alprazolam
Neurostimulants	Methylphenidate, pemoline

RESULTS

Demographic and Clinical Characteristics Associated with Stuttering

Of the 309,675 veterans who met inclusion criteria, 0.08 % (n = 235) were diagnosed with adult-onset stuttering. Table III shows characteristics of those with and without stuttering. Those diagnosed with stuttering were more likely to be male and between the ages of 20–49.

TBI and PTSD

Of the 235 veterans with an AS diagnosis, 5.6% of them had TBI only as a diagnosis, the majority of which were mild in severity. Seventy-two individuals (30.6%) had PTSD only as a diagnosis and 102 individuals (43.4%) had both PTSD and TBI as a diagnosis and 48 (20.4%) individuals in the sample had neither PTSD nor TBI as a diagnosis. Most individuals with both TBI and PTSD who were diagnosed with AS had TBI of mild severity (n = 50). Because results for chi-square analysis were consistent with the multivariable model, we report only multivariable model results. The multivariable logistic regression model predicting AS found that, after controlling for demographic characteristics, individuals with any combination of TBI and PTSD were more likely to have AS than those with neither TBI nor PTSD. We compared 95% confidence intervals in order to determine differences in effect size between TBI × PTSD and AS status. Because of the large size of our study groups, our study was overpowered, likely allowing small differences to reach statistical significance. Because of this potential confounder, we focused on moderate (OR >1.5 or <0.67) to large (OR > 2.0 or <0.5) effect sizes and used conservative criteria of nonoverlapping confidence intervals.[67] Examination of odds ratios and confidence intervals indicated that the odds for AS in those with TBI only (AOR: 4.14, 95% CI: 2.24–7.65) were not significantly different from those with PTSD only (AOR: 3.07, 95% CI: 2.13–4.43) or any TBI and PTSD combined (AOR: 9.77, 95% CI: 6.93–13.78), given that confidence limits overlapped in these categories. Odds for those with PTSD only were significantly lower than odds for those with TBI and PTSD (confidence limits did not overlap).

Comorbid Conditions

Our multivariable analysis indicated that even after controlling for demographics and PTSD and TBI status, those in our cohort with AS were more likely to have any of the comorbid conditions examined; however, AOR were the highest for those with headache (AOR: 3.88, 95% CI: 3.0–5.02), anxiety (OR: 2.49, 95% CI: 1.91–3.26), and depression (OR: 2.72, 95% CI: 2.10–3.51) (Table III).

Medications and Stuttering

Table IV shows the proportion of those with and without AS who received each potentially problematic medication. The drug groups that were most commonly prescribed were

TABLE III. Demographic and Clinical Characteristics of Iraq/Afghanistan Veterans with Stuttering

	Stuttering	No Stuttering	AOR 95% (CI)
N (%)	235 (0.08)	309,440 (99.9)	
Race/ethnicity			
White	153 (65.1)	196,238 (63.4)	Reference
Black	47 (20)	52,863 (17.1)	1.14 (0.82–1.58)
Hispanic	24 (10.2)	36,376 (11.8)	0.84 (0.55–1.30)
Other	** (<4.0)	12,429 (4.0)	0.83 (0.41–1.68)
Unknown	** (<2.0)	11,534 (3.7)	0.33 (0.11–1.05)
Male	222 (94.5)	268,726 (86.8)	2.59 (1.48–4.53)
Age			
20–49	219 (93.2)	274,349 (88.67)	Reference
50–65	16 (6.8)	34,612 (11.2)	0.58 (0.35–0.96)
66+	**	479 (0.2)	NA
Enlisted	223 (94.9)	289,100 (93.4)	1.31 (0.73–2.34)
TBI × PTSD			
No TBI or PTSD	48 (20.4)	174,752 (56.5)	Reference
mTBI only	** (<3.0)	6,556 (2.1)	3.33 (1.42–7.79)
PTSD only	72 (30.6)	85,265 (27.6)	3.07 (2.13–4.43)
mTBI + PTSD	50 (21.3)	21,059 (6.8)	8.64 (5.81–12.85)
Moderate TBI only	** (2.1)	2,881 (0.9)	6.32 (2.51–15.88)
Moderate TBI + PTSD	31 (13.1)	10,896 (3.5)	10.36 (6.60–16.28)
Unclassified TBI only	** (<1.0)	1,850 (0.6)	3.94 (0.96–16.20)
Unclassified TBI + PTSD	19 (8.1)	5,722 (1.9)	12.09 (7.10–20.58)
Penetrating or severe TBI only	**	137 (0.04)	—
Penetrating or severe TBI + PTSD	** (<1.0)	322 (0.1)	22.61 (5.48–93.43)
Any TBI + PTSD	102 (43.4)	37,999 (12.3)	9.77 (6.93–13.78)
Insomnia	77 (32.8)	62,766 (20.3)	1.92 (1.46–2.52)
Pain	145 (61.7)	149,490 (48.3)	1.72 (1.33–2.24)
Headache	117 (49.8)	63,852 (20.6)	3.81 (2.95–4.93)
Substance use	55 (23.4)	49,274 (15.9)	1.61 (1.19–2.18)
Anxiety	82 (34.9)	54,720 (17.7)	2.49 (1.91–3.26)
Depression	130 (55.3)	96,857 (31.3)	2.72 (2.10–3.51)

*All results were significant at less than $p < 0.05$. **Frequency less than $n = 11$.

antiepileptic drugs (AED's) (25% of those with stuttering vs. 42% without stuttering), antidepressants (47% of those with stuttering vs. 25% without stuttering), and anxiolytics (31% vs. 11% without stuttering). Roughly, 66% of veterans with an AS diagnosis were prescribed at least one of these medications from the potentially problematic classes for speech fluency. Chi-square analysis results were significant and similar to the multivariable model so we present results from the multivariable model. Table IV also shows the association (OR) between AS and receiving any one or more of the medication classes, in addition to specific medication classes. Those diagnosed with AS were all more likely to be prescribed any of the studied medications (OR: 3.68, 95% CI: 2.81–4.82). All medication classes examined in our analysis had OR greater than 2.5 with the exception of the typical antipsychotics (see Discussion), with the highest being anxiolytics (OR: 3.48, 95% CI:2.64–4.59).

Adjusted Medication Effects

Next we used a logistic regression analysis to determine if individuals diagnosed with AS were more likely to receive potentially problematic medication classes after controlling for comorbid conditions for which medication is indicated. Table V indicates that after controlling for demographic variables and comorbid conditions, only anxiolytics were significantly associated with AS (AOR: 1.64, 95% CI: 1.20–2.25.)

DISCUSSION

Findings from our study support the idea that AS is a complex disorder with a potentially multi-factorial etiology. Our data demonstrate a unique relationship between AS, TBI, and PTSD status in a cohort of IAV. It is also one of the first studies to describe associations between these conditions within the context of potentially problematic medications, which are commonly prescribed to IAV. To our knowledge, these factors have not been previously analyzed, as prior studies of AS have predominantly focused on relationships with a single disease or cause, with the exception of one study team[14] who found psychogenic stuttering in their sample of middle-aged adults with central nervous system disease. While the single disease approach to examining stuttering will elicit some information, it might not adequately assess patient populations with complex comorbidity such as IAV.

Demographics

Our study results establish an incidence rate for AS in IAV which has not been reported previously. While the general

TABLE IV. Multivariable Regression Analysis Comparing of Iraq/Afghanistan Veterans with and without Stuttering Taking Potentially Problematic Medications in Study Sample

	Stuttering	No Stuttering	OR* (CI)
N %	235 (0.1)	309,440 (99.9)	
AED	60 (25.5)	31,614 (10.2)	3.01 (2.25–4.04)
AA	36 (15.3)	17,856 (5.8)	2.95 (2.07–4.21)
TA	** (<1)	1,821 (0.6)	0.72 (0.10–5.15)
ATD	111 (47.2)	76,405 (24.7)	2.73 (2.11–3.53)
ANX	73 (31.1)	35,507 (11.5)	3.48 (2.64–4.59)
NEU	** (<4)	3,984 (1.3)	3.05 (1.57–5.95)
Any	155 (66.0)	106,775 (34.5)	3.68 (2.81–4.82)

*95% confidence intervals. All results were significant at less than $p < 0.05$.
** Frequency less than $n = 11$.

OR, odds ratio; CI, confidence interval; AED, antiepileptic drug (gabapentin, valproate, levitaracetam, lamotragine, carbamazepine); AA, atypical antipsychotic (risperidone, clozapine, quetiapine, ziprasidone, aripiprazole, olanzapine); TA, typical antipsychotic (haloperidol, chlorpromazine, thioridazine); ATD, antidepressants (TCA, tricyclic antidepressants, mirtazapine); SSRI, selective serotonin reuptake inhibitor (citalopram, escitalopram, fluoxetine, paroxetine, sertraline); SNRI, serotonin and norepinephrine reuptake inhibitor (venlafaxine, duloxetine); Other (bupropion); ANX, anxiolytic (clonazepam, alprazolam); NEU, neurostimulant (methylphenidate, pemoline); Any, any of above medications.

TABLE V. Adjusted Medication Effects for Veterans with Stuttering Diagnosis ($N = 235$)

	Adjusted OR	95% CI
AED	1.33	0.97–1.83
AA	1.15	0.78–1.69
TA	0.31	0.04–2.22
ATD	1.22	0.92–1.63
ANX	1.63	1.20–2.23
NEU	1.67	0.85–3.28

All results were significant at less than $p < 0.05$.

OR, odds ratio; CI, confidence interval; AED, antiepileptic drug; AA, atypical antipsychotic; TA, typical antipsychotic; ATD, antidepressants; SSRI, selective serotonin reuptake inhibitor; SNRI, serotonin and norepinephrine reuptake inhibitor; ANX, anxiolytic; NEU, neurostimulant.

prevalence of stuttering in our cohort of U.S. veterans (0.08%) is less than that of the general population (0.08% vs. roughly 0.97%),[68] as it is worthwhile to note the differences in methodology in this area of study. The prevalence rate for the general population has been based on estimates of stuttering acquired on U.S. children.[13] Studies of individuals with neurological disorders report a higher rate and use more rigorous criteria, which strongly limit false negatives. A study of adults with ischemic stroke with a mean age of 70 by Theys et al[69] found a 1-year incidence rate of 2.5% (95% CI, 1.1–4.7), confirmed via "in-depth" speech and language testing, cognitive testing and neuroimaging, (p. 683). Our study, which examined diagnoses over the course of a year, using diagnostic codes, is therefore not comparable. We examined a narrow and specific population over a short period of time and it is likely that our cohort demonstrates a "healthy soldier effect" whereby those individuals who enter the military tend to be healthier and may have reduced likelihood of AS even after incurring TBI and PTSD. Veterans with an AS diagnosis in our current study are representative of the general IAV population, the majority (48.5%) of these veterans were born between 1980 and 1989.[70]

It is possible that our estimation of AS prevalence was overly conservative; in the process of routine medical care, other physical and psychological symptoms may have taken priority. The low prevalence number may be explained by a lack of vigilance to the issue of AS in this cohort and a need to clinically prioritize life-endangering conditions such as epilepsy, suicide-risk behavior, depression, PTSD, or physically disabling conditions such as headaches. Indeed, Jaramillo et al[47] showed that in this same cohort of veterans, those with mental health and pain symptoms tended to have complex combinations of medical diagnoses and the management and identification of symptoms causing the most distress were likely to be prioritized in clinical settings.

TBI and PTSD

This study revealed a significant relationship between AS, TBI, and PTSD. Results indicate that PTSD and TBI have the capacity to contribute to AS. Our findings establish a new link between speech fluency disorders and PTSD. One notable finding was the greater likelihood of an AS diagnosis for veterans with concomitant TBI and PTSD when compared with veterans without these disorders. It is well known that both neurological and psychological conditions may contribute to AS but these two disease categories have not previously been analyzed together. Whether the result of having both TBI and PTSD is synergistic is beyond the scope of this study but a potential line for future research. Our results suggest that perhaps individuals with AS, PTSD, and TBI experience dysfluencies as a result of both physical changes related to TBI and/or increases in stress related to PTSD. Dysfluencies may be further complicated by the use of central nervous system acting medications prescribed to treat the symptoms related to TBI and PTSD.

Comorbid Conditions and Medications

The comorbid conditions most significantly associated with AS in our cohort included pain (~62% of veterans with stuttering), depression (~55%), and headache (~4%). Our discussion of comorbid symptomology is strongly linked with our discussion on the medication patterns observed in our cohort of veterans. Our study indicates that the individuals diagnosed with AS in our sample likely suffered from comorbid conditions, which are often treated with medications that are potentially problematic for speech.

Results of our medication pattern analysis revealed that the association of AS and medications might have an iatrogenic basis. Perhaps medications routinely used to manage physical and mental health comorbid conditions in the VA

system contribute to stuttering symptoms. Of special interest are those medications whose mechanism of action includes increases in dopamine levels, reduction in GABA, or those with anticholinergic properties, factors known to contribute to stuttering symptoms. Morgan et al[71] found that veterans with both TBI and PTSD were more likely to be prescribed antipsychotic medications when compared with individuals with PTSD alone. Furthermore, IAV are at risk of receiving multiple medications (polypharmacy) in the process of routine medical care.[72] The clinical implications of our medication analysis illustrate the importance of treating veterans with comorbid conditions holistically, as medications prescribed to treat one condition may exacerbate or even contribute to another condition. However, additional research is needed to examine this issue.

Limitations

A limitation in our study includes the diagnostic method employed; the use of ICD-9 codes limits the specificity of the diagnosis. In order to address possible misclassification, we ensured that at least two AS diagnostic codes were entered at least 7 d apart, a method consistent with prior studies.[53] While we can be certain that the diagnoses were assigned setting by a clinician providing medical care, we acknowledge that a limitation lies in knowing whether the individual providing care was trained in the diagnosing of AS. However, the goal of our study was to determine whether or not stuttering was present, not to differentially diagnose or classify said stuttering and we are confident that licensed clinical providers in the VA system are able to determine if stuttering conditions are present or not. In addition, our sampling method, which excludes patients who sought care at non-VA facilities, limits our ability to detect AS in the entire IAV population. However, given that SLPs, medical professionals especially trained to assess and treat AS, are a mandated component of post-deployment rehabilitation teams, it is unlikely that many IAV sought care elsewhere. For IAV residing in remote areas who seek "fee-basis" care (a process by which non-VA providers are authorized to provide care) typically these "fee-basis" requests are accompanied by a VA diagnosis for the specific condition for which the referral is made, in this case, AS.

CONCLUSIONS

TBI and PTSD are often labeled "the invisible wounds" of war[73] with TBI frequently cited as the "signature injury" of the conflicts in Iraq and Afghanistan.[74,75] Veterans with comorbid TBI and PTSD often display a constellation of chronic physical and mental health problems.[58] These conditions likely play a role in their successful reentry into the workplace and their ability to maintain gainful employment after deployment.

Communication skills are necessary in the current U.S. job market.[76] Veterans with AS are especially at risk for lower rates of employment and thus more difficulties with community reintegration. Identifying individuals at risk for this disorder could positively impact the long-term outcome of this generation of veterans. Future research should include longitudinal studies to characterize veterans at risk for AS and identify factors associated with recovery. Lastly, studies exploring treatment options, both behavioral and pharmacological, and which consider the needs of veterans with comorbid PTSD and TBI are also critically needed.

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PREVIOUS PRESENTATION

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