



The impact of military service and traumatic brain injury on the substance use norms of Army Reserve and National Guard Soldiers and their spouses



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ABSTRACT

Introduction: Traumatic brain injury (TBI) and substance use are highly prevalent conditions among military populations. There is a significant body of evidence that suggests greater approval of substance use (i.e., norms) is related to increased substance use. The objective of this work is to understand the impact of TBI and military service on substance use norms of soldiers and their partners. Data are from the baseline assessment of Operation: SAFETY, an ongoing, longitudinal study of US Army Reserve/National Guard (USAR/NG) soldiers and their partners.

Methods: Multiple regression models examined associations between alcohol, tobacco, illicit drug use, and non-medical use of prescription drug (NMUPD) norms within and across partners based on current military status (CMS) and TBI.

Results: Male USAR/NG soldiers disapproved of NMUPD, illicit drug use and tobacco use. There was no relation between military status and alcohol use. Among females, there was no relation between CMS and norms. The NMUPD norms of wives were more likely to be approving if their husbands reported TBI symptoms and had separated from the military. Husbands of soldiers who separated from the military with TBI had greater approval of the use of tobacco, NMUPD, and illicit drugs.

Conclusion: Overall, there is evidence to suggest that, while generally disapproving of substance use, soldiers and partners become more accepting of use if they also experience TBI and separate from the military. Future research should examine the longitudinal influence of TBI on substance use norms and subsequent changes in substance use over time.

1. Introduction

Substance use within the workplace is associated with detrimental effects that reaches beyond impairments in productivity to include negative health consequences (DeFulio et al., 2009; DM, 2008; Hourani et al., 2006; Normand et al., 1994; Phillips et al., 2015). Military workforces are not impervious to problematic substance use and its associated negative effects (Bray & Hourani, 2007; Department of Defense Directives 1010.4, 2014). When compared to the general population, service members have higher rates of substance use (Eisen et al., 2004; Thomas et al., 2010). In fact, substance abuse is one of the most commonly reported health problems among soldiers returning from Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) (Bennett et al., 2013; Bray et al., 2009; Kulesza et al., 2015; Seal et al., 2007). The use of tobacco is higher among service members than in the general population (Bray & Hourani, 2007) and a

long history of alcohol misuse has been chronicled (Bennett et al., 2013; Bray & Hourani, 2007; Bray et al., 1991). Prescription drug misuse is also a concern (Bennett et al., 2013; Bray et al., 1991). High rates of health problems in veterans of OEF/OIF exacerbates potentials for misuse. For instance, traumatic brain injury increases the likelihood of pain management plans involving opioids (Seal et al., 2012). Examination of health related behaviors in active duty personnel found the lifetime, past year, and past month use of illicit and prohibited drugs in those 18–65 years of age to be 28.2%, 1.4%, and 0.3% respectively (Institute of Medicine, 2009). A cross-sectional study in veterans using the Department of Veterans Affairs (VA) healthcare system, found that 7% of OEF/OIF veterans screened positive for cocaine and marijuana use disorders (Hawkins et al., 2010).

Among military personnel, a number of factors may influence substance use. Demographic factors related to an increased likelihood of substance misuse include male gender, age < 25 years, and being

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single (i.e., never married, widowed, or divorced) (Seal et al., 2011). Combat exposure and a history of deployment are associated with increased substance use/misuse, though the specific branch of the military also influences different patterns of substance use (Seal et al., 2011). Following deployment, United States Army Reserve/National Guard (USAR/NG) soldiers report higher rates of mental health problems and treatment needs for new-PTSD, depression, and substance abuse than their active duty counterparts (Jacobson et al., 2008; Milliken et al., 2007; Riddle et al., 2007; Smith et al., 2008).

Substance use norms are another influential factor associated with substance use (Bailey et al., 2016; Measham et al., 1994). In particular, greater approval substance use is related to higher levels of use, while decreasing approval is related to lower levels of use (Andrews et al., 2002; Delucchi et al., 2008; Leonard et al., 2000). For example, in civilians, peer alcohol use is a strong predictor of individual alcohol use (Andrews et al., 2002; Delucchi et al., 2008; Homish & Leonard, 2008a; Leonard et al., 2000). Tobacco use is associated with self-identification as a smoker, tobacco outlets close to home, and perceptions that smoking is more prevalent than actual use (Ilakkuvan et al., 2016; Lipperman-Kreda et al., 2014; McLaughlin, 2010; Schleicher et al., 2016). Parental substance use, childhood perceptions of parental norms, and individual and friends' norms all contribute to an increased likelihood of marijuana and alcohol use (Bailey et al., 2016). Research on prescription drug norms has found individuals to overestimate peers' misuse (Kilmer et al., 2015).

Information concerning substance use norms is much more limited in the military than in civilian populations. However, given the higher rates of alcohol and tobacco use in the military as compared to the general population, it is possible that their underlying norms may differ. When asked about the alcohol consumption of their coworkers, military personnel overestimated the actual amount of alcohol consumed by their coworkers as well as the percentage of their coworkers who engaged in episodes of heavy drinking (Neighbors et al., 2014). The more often that military personnel believed their coworkers drank, the frequency of their own alcohol use also increased (Neighbors et al., 2014; Williams et al., 2009). Soldiers' norms may be subject to change over time as a result of exposure to a number of service conditions or changes in social, environmental, or health related factors that influence their substance use (Jacobson et al., 2008; Milliken et al., 2007; Seal et al., 2012; Smith et al., 2008). One such influence is that of an intimate partner. Partner influences have been observed on each other's physical health, mental health, and risk related behavior (Derrick et al., 2013; Homish & Leonard, 2008b). Previous work with civilians found that one partner's actual use of a given substance (e.g., alcohol, tobacco, illicit drugs, and nonmedical use of prescription drugs (NMUPD)) is predictive of their spouse's use of the same substance (Dollar et al., 2009; Homish & Leonard, 2005a; Homish et al., 2007; Homish et al., 2010; Leonard & Homish, 2005; Smith et al., 2012). Further, there is evidence in civilian populations that a partner's expectations about substance use are related to their own substance use (Homish & Leonard, 2005b; Leonard & Homish, 2008). Given the high proportion of service members who are married, there is a potential for partners to impact each other's health behaviors (Department of Defense, 2012). As such, it is important to understand within (i.e., how one person's behaviors impact his/her own behaviors) and cross-spouse (i.e., how one partner's behaviors impact his/her partner's behaviors) influences among soldiers and partners.

Another factor that may relate to changing substance use norms is separation from the military. Norman et al. (Norman et al., 2014) investigated the predictors of problematic substance use following discharge from the military and found that the majority of soldiers who screened positive for problematic substance use during active duty no longer screened positive during the year after separation from the military; however 42% of the sample continued to have problematic substance use.

Appreciating other factors that negatively impact soldier wellbeing

is also necessary as these factors may precipitate departure from the military or further influence substance use. One such vulnerability factor is stress. Common stressors in the military are related to injuries and deployment (Milliken et al., 2007; Hoge et al., 2008; Hoge et al., 2004; Hoge et al., 2006; Mental Health Advisory Team (MHAT-V), 2008; Grieger et al., 2006). Combat-related traumatic brain injuries (TBI) and their detrimental aftereffects have been a major longstanding concern (Institute of Medicine, 2008). It is possible that health conditions, such as TBI, can impact substance use norms.

1.1. Purpose of the present study

Given the high percentage of married soldiers coupled with a higher prevalence of substance abuse among USAR/NG than active duty soldiers, the primary objective of this study was to explore how TBI and current military status (CMS) relate to the couples' substance use related norms. Importantly, we examined within spouse effects (e.g., his behaviors impacting his norms) and cross spouse (e.g., his behaviors impacting her norms) effects.

2. Methods

The Operation: SAFETY (Soldiers and Families Excelling Through the Years) study protocol was approved by The State University of New York (SUNY) at Buffalo's Institutional Review Board and also vetted by the Army Human Research Protections Office, Office of the Chief, Army Reserve as well as the Adjutant General of the National Guard.

2.1. Recruitment

After coordinating with unit commanders, Operation SAFETY staffs were able to attend unit drills to present a brief project overview to soldiers and distribute study information packets to soldiers to take home to share with their partners. The 10-min briefing detailed study objectives and protocols, what participation would involve, topics covered in the questionnaire, and confidentiality. Soldiers and their partners each received \$60 for baseline and \$70 for each of the yearly follow-ups (\$200 per person/\$400 couple over the study period). Soldiers were told that investigators had obtained a certificate of confidentiality from the US Department of Health and Human Services that prevents disclosure of their information in response to legal orders. Assurances were made that not only would the military not know of their participation, but partners would not learn of each other's responses. To conclude, soldiers were invited to complete a one-page screening form.

Inclusion criteria were as follows: (1) the couple is married or living as if married; (2) one member of the dyad is a current USAR/NG Soldier; (3) the soldier is 18–45 years of age; (4) both partners are able to speak and understand English; (5) both partners are willing and able to participate; and (6) both partners have had at least one alcoholic beverage in the past year. Assessment surveys were scheduled for eligible couples who verbalized their willingness to participate.

Over 15-months, we attended 47 recruitment events at units across New York State. We received 1653 completed screening forms; 922 were ineligible (579 were single, 329 failed ≥ 1 screening items ($M = 1.5$ (SD: 0.09)). Of the 731 eligible, 572 (78%) agreed to participate and 83% of couples ($N = 472$) completed at least part of the survey. Among males, 435 completed the entire survey, while 7 started but did not finish. Female participants completed 440 surveys and 14 additional surveys were partially completed. There were 7 same sex couples. Only surveys where both partners completed the entire survey were included for follow-up ($N = 411$). We examined the differences between those that passed and enrolled vs those who passed and did not enroll after screening. When a civilian partner screened for the study ($n = 11$), these couples were less likely to enroll ($p < 0.001$). No differences existed within the soldiers' screening

Table 1
Demographic characteristics of male and female USAR/NG soldiers and their partners with combat experience.

Characteristic	Male Soldiers and Partners		Female Soldiers and Partners	
	Husbands (n = 248) % (n) or \bar{x} (sd)	Wives (n = 248) % (n) or \bar{x} (sd)	Wives (n = 34) % (n) or \bar{x} (sd)	Husbands (n = 34) % (n) or \bar{x} (sd)
Race/ethnicity				
Non-Hispanic White	81.1% (201)	88.7% (220)	76.5% (26)	70.6% (24)
Non-Hispanic Black	4.5% (11)	1.2% (3)	2.9% (1)	8.8% (3)
Hispanic	9.7% (24)	5.2% (13)	11.8% (4)	11.8% (4)
Other	3.2% (8)	3.6% (9)	5.8% (2)	5.9% (2)
Education				
< HS – HS grad	14.1% (35)	9.2% (23)	2.9% (1)	17.7% (6)
Some college	60.1% (149)	42.3% (105)	50.0% (17)	44.1% (15)
College +	25.8% (64)	48.4% (120)	47.1% (16)	38.2% (13)
Age	33.4 (6.2)	32.0 (6.49)	33.2 (4.7)	34.3 (5.9)
Married/cohabitating	75.4% (187)	24.6% (61)	76.5% (26)	23.5% (8)
Years served	11.9 (6.0)	8.0 (4.6)	11.3 (4.0)	11.8 (7.6)
Number of deployments	1.6 (0.9)	1.3 (0.49)	1.3 (0.5)	2.0 (1.2)

health variables between those who enrolled and completed compared to those who enrolled and did not complete. The data presented are from a subset of the main study based upon soldiers who were deployed and their partners.

2.2. Participants

The sample for this report is comprised of (248 male soldiers (MS) and 34 female soldiers (FS); Table 1) USAR/NG Soldiers and their partners. Both male and female soldiers served an average of 11 years (males (M(SD)): 11.9 (6.0); females 11.3 (4.0)) of military service. The sample is mostly non-Hispanic White (male soldiers and partners: 81% and 89% respectively; female soldiers and partners: 76% and 71% respectively). Both male and female soldiers had at least some college education (60% MS; 50% FS) or a college degree (26% MS; 47% FS). Male soldier partners (MSP) and female soldier partners (FSP) also had some college education (42% MSP; 50 FSP) or a college degree (48% MSP; 47%FSP). Average gross household income was \$60,000 to \$79,999. Soldiers and partners were in their early thirties (MS: Mean (SD) 33.4 (6.2) and their partners (32.0(6.5)); FS: 33.2 (4.7) and their partners (34.3 (5.9)) and mostly married (MS: 75.4%; FS: 76.5%).

2.3. Survey administration

After completing an informed consent, surveys were administered using secure HIPAA-compliant online survey programming software, StudyTrax™ which allowed for data encryption. The baseline survey took approximately 2½ hours to complete while follow-up surveys lasted 90-min.

2.4. Measures

2.4.1. Perceived approval of substance use (norms)

Participants were asked three questions on a seven-point Likert scale concerning the acceptability of alcohol, tobacco, NMUPD, and illicit drugs. These questions (“People who are important to me think I [should not-should use] [substance]”; “People who are important to me would [disapprove-approve] of my using [substance]”; and, “People who are important to me want me to use [substance] [unlikely—likely]”) are based on the work of Armitage and colleagues (Armitage et al., 1999). All three items were summed to create a substance use norms summary score. Lower scores are indicative of greater substance

use disapproval, while higher scores suggest greater approval. This scale had a reliability of 0.77 in husbands and 0.78 in wives.

2.4.2. Traumatic brain injury (TBI)

TBI was assessed using the three-item Brief Traumatic Brain Injury Scale (Schwab et al., 2007). Soldiers were asked if any of various types of injuries occurred while deployed (e.g., blast, fragment, vehicular, etc.), the severity of injury (e.g., being dazed, no memory, lost consciousness for various lengths, etc.), and if they were currently experiencing any injury-related problems. Symptoms resulting from a head injury or concussion was dichotomized into experiencing versus not experiencing TBI symptoms.

2.4.3. Current military status (CMS)

Participants' responses were dichotomized into yes or no based on reports of current versus completed military service status.

2.5. Analytic plan

Multiple linear regression models examined associations between substance use (alcohol, tobacco, NMUPD, and illicit drugs) norms both within and across couples based on CMS and TBI. Within spouse models examined the impact of a soldier's CMS and TBI on his/her own norms. Cross spouse models examined the impact of a soldier's CMS and TBI on his/her partner's norms. Subsequent models examined the interaction between CMS and TBI.

3. Results

3.1. Descriptive statistics

Among soldiers who were deployed, 24% (N = 60) of the males screened positive for TBI as did 24% (N = 8) of the females. Four percent of male soldiers and 18% of female soldiers separated from the military. Among male soldiers, the mean (standard deviation) scores for substance use norms were: alcohol (9.8 (4.4)), tobacco (5.3 (3.2)), NMUPD (4.2 (2.6)), and illicit drug use (4.2 (2.5)). For their partners, normative scores were: alcohol (9.3 (4.3)), tobacco (4.4 (2.3)), NMUPD (4.2 (2.3)), and illicit drug use (4.2 (2.4)). Among female soldiers, normative scores were: alcohol (9.3 (4.2)), tobacco (4.7 (2.8)), NMUPD (4.3 (2.5)), and illicit drug use (4.2 (2.5)). For their partners, normative scores were: alcohol (9.4 (4.2)), tobacco (4.4 (2.3)), NMUPD (4.3 (2.4)), and illicit drug use (4.2 (2.2)).

3.2. Main effects

3.2.1. Within spouse effects

To examine the within spouse effects, we used Ordinary Least Squares regression models to identify the impact of Current Military Status (CMS) and TBI on his or her own perceived normative beliefs (i.e., approval) regarding alcohol, tobacco, NMUPD, and illicit drug use.

3.2.1.1. Husbands' norms based on his CMS and TBI. Among men, CMS and TBI had no significant association with their alcohol-related norms. However, men in the military were less approving of other substance use. Specifically, being in the military was negatively associated with husbands' tobacco norms ($\beta = -2.55$, 95% Confidence Interval [CI]: $-4.82, -0.28$; $p < 0.05$). Additionally, husbands in the military had lower approval of both NMUPD ($\beta = -2.24$, 95% CI: $-4.04, -0.44$; $p < 0.05$) and illicit drug use ($\beta = -2.23$, 95% CI: $-4.02, -0.45$; $p < 0.05$). TBI was not significantly associated with tobacco, NMUPD, or illicit drug use.

3.2.1.2. Wives' norms based on her CMS and TBI. Wives' CMS was not related to any of the substance use norms. Women soldiers who screened positive for TBI had lower approval of alcohol use

($\beta = -3.48$, 95% CI: -6.87, -0.09; $p < 0.05$). Among women, TBI was not related to any other substance use norms.

3.2.2. Cross spouse effects

Similar regression models were used to identify cross-spouse effects, or the impact of Current Military Status and TBI on their spouses' perceived approval.

3.2.2.1. Husbands' norms based on her CMS and TBI. Wives' CMS was not associated with any of her husbands' substance use related norms. However, there was some evidence suggesting a relationship between wives' TBI symptoms and husbands' approval of alcohol use such that wives with TBI had husbands with lower perceived approval of alcohol ($\beta = -3.30$, 95% CI: -6.67, 0.06; $p = 0.05$).

3.2.2.2. Wives' norms based on his CMS and TBI. Husbands' CMS and TBI symptoms were only associated with wives' NMUPD related norms. Specifically, there was some evidence indicating a negative association between husbands' CMS and wives' NMUPD norms ($\beta = -1.49$, 95% CI: -3.11, 0.13, $p = 0.07$), suggesting wives whose husbands were in the military had lower approval of NMUPD. Husbands with TBI symptoms had wives with higher approval of NMUPD ($\beta = 0.73$, 95% CI: 0.06, 1.40; $p < 0.05$).

3.3. Interaction effects

To examine the potential effects of an interaction between CMS and TBI symptoms on norms, an interaction term was added to each regression model. Predictive margins were also calculated to determine the stratum-specific interactions between CMS and TBI on norms.

3.3.1. Within spouse effects

3.3.1.1. Husbands' norms based on his CMS and TBI. No significant interactions were found between husbands' CMS and TBI on his norms.

3.3.1.2. Wives' norms based on her CMS and TBI. No significant interactions were found between wives' CMS and TBI on her norms.

3.3.2. Cross spouse effects

3.3.2.1. Husbands' norms based on her CMS and TBI. TBI symptoms in wives had a significant interaction with her CMS on husbands' tobacco use norms ($\beta = -7.19$, 95% CI: -13.61, -0.77, $p < 0.05$), NMUPD norms ($\beta = -10.62$, 95% CI: -15.37, -5.86, $p < 0.001$), and illicit drug use norms ($\beta = -10.57$, 95% CI: -15.37, -5.77, $p < 0.001$). Predictive margins show that husbands were more likely to approve of tobacco use ($p = 0.002$), NMUPD ($p < 0.001$), and illicit drug use ($p < 0.001$) when their wives were no longer in the military and reported TBI symptoms (Figs. 1–3, respectively). There was no significant interaction for husbands' alcohol norms.

3.3.2.2. Wives' norms based on his CMS and TBI. TBI symptoms in husbands had a significant interaction with his CMS on wives' NMUPD norms ($\beta = -3.90$, 95% CI: -7.61, -0.18, $p < 0.05$). Predictive margins show that wives were most likely to approve of NMUPD ($p < 0.001$) when their husbands were no longer in the military and reported TBI symptoms (Fig. 4). There were no significant interaction effects for alcohol, tobacco, or illicit drug use.

4. Discussion

This study is among the first to report substance use norms in a sample of soldiers and their spouses. The current study was also the first to examine factors that may change substance use norms for soldiers and partners, in particular, TBI and current military status. Results

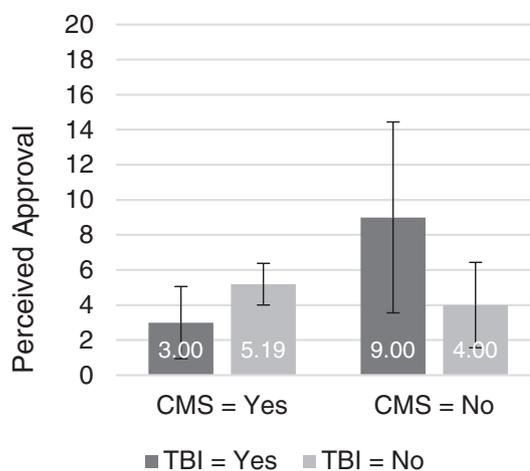


Fig. 1. Husbands' tobacco use perceived approval by wives' CMS and TBI status.

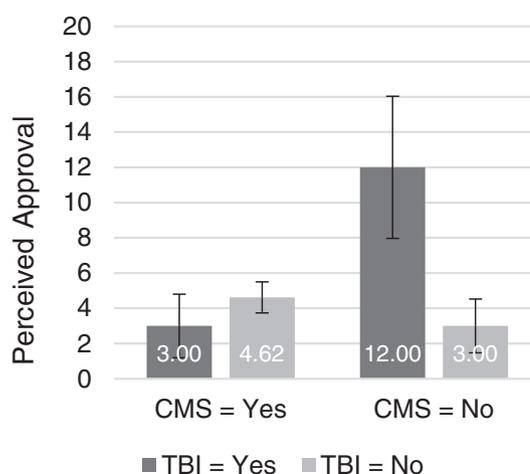


Fig. 2. Husbands' NMUPD perceived approval by wives' CMS and TBI status.

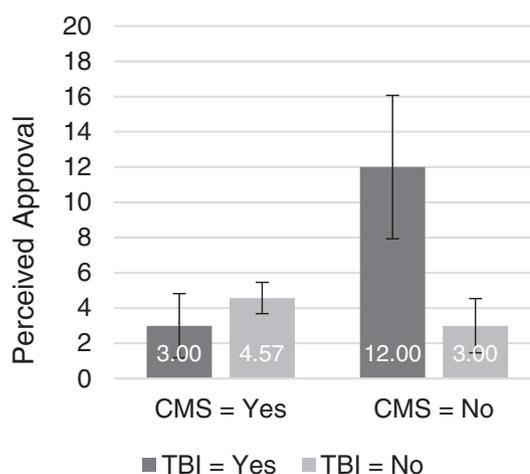


Fig. 3. Husband's illicit drug use perceived approval by wives' CMS and TBI status.

demonstrated that husbands currently in the military disapproved of the use of tobacco, NMUPD, and illicit drugs. Among women, military service was also not related to substance use norms. Our most noteworthy observations involved the interaction between current/separated military status and TBI which demonstrated significant cross spouse effects (that is, one person's circumstances impacted their partner's norms). More specifically, husbands were more likely to be

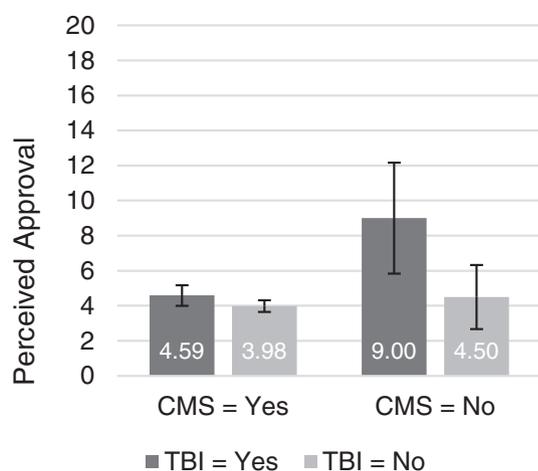


Fig. 4. Wives' NMUPD perceived approval by husbands' CMS and TBI status.

approving of NMUPD, tobacco use, and illicit drug use if their partners had TBI symptoms and had separated from the military. Similarly, wives had greater approval of NMUPD if their partners had TBI symptoms and separated from the military.

It is plausible that the spouses of reservists became more accepting of their husbands/wives use of NMUPD and in some cases other substances because, now acutely aware of partners' impairments, became open to possibilities that mitigate impairments. Essentially, the more amenable attitudes concerning their partners' use of substances after they have separated from the military likely originate from their expectations of symptom palliation and/or self-medication back to former levels of functioning.

Our findings that spouses' of USAR/NG soldiers shift to more approving substance use norms should partners report TBI symptoms after separating from the military is especially concerning considering reservists face a greater risk for substance abuse, mental health, and readjustment challenges than other soldiers. Susceptibility to these problems and the use of opioids for pain management certainly suggests that reservists may be at a high risk for worse outcomes, thus warranting targeted TBI intervention and management.

Irrespective of other influences on soldier wellbeing, simply returning to civilian life after separating from the military can be difficult for some individuals. Soldiers who report difficulty readjusting to civilian life are more likely to engage in problematic substance use (Bennett et al., 2013; Norman et al., 2014). Post-deployment this is especially a concern for USAR/NG soldiers as they report a greater psychiatric burden along with more difficulties readjusting to civilian life than active duty counterparts (Castenada et al., 2009; Thomas et al., 2010). The mental health and substance-related treatment needs of reservists are more substantial also (Jacobson et al., 2008; Milliken et al., 2007; Riddle et al., 2007; Smith et al., 2008). The most frequent reintegration challenges relate to problems accessing health care, family life and relationship difficulties, uncertainty of employment, expectations of a smooth readjustment, and rapid resumption of pre-deployment civilian roles (Castenada et al., 2009; Milliken et al., 2007; Thomas et al., 2010).

The environment to which soldiers are returning offers added complexity to reintegration. Often community norms and behavior are likely dissimilar to those found within the military, which have influenced soldier norms and behavior prior to separation. This is demonstrated by Golub and Bennett in their examination of substance use in veterans returning to low-income, predominantly minority communities (Golub & Bennett, 2014). Prior to military service, the majority of the sample reported marijuana as the only substance used. While serving, marijuana use was significantly lower, problematic alcohol use (binge and heavy drinking) became a concern, and misuse

of prescription drugs was newly initiated in 6% of the sample. After separating, marijuana use increased, problematic alcohol use decreased, and 7% of the sample continued to misuse prescription drugs. Initiations of NMUPD during deployment and a continuation of misuse is problematic and suggestive of prescription drug seeking activity after separation.

Because our results depict that reservists' spouses are at risk of developing more lenient substance norms when their partner is symptomatic and no longer in the military, there may be great value in including spouses in management plans. Future longitudinal research in reservists and their spouses is needed to examine influences of TBI on substance use norms and actual substance use changes over time in this population. Research documenting the efficacies of intervention and management strategies uniquely tailored to USAR/NG veterans that also incorporate spousal participation are also merited.

5. Limitations

This study has a few limitations. The data analyzed in this study were cross-sectional in nature. We acknowledge that our sample yielded comparatively few female soldiers with combat exposure. However, until recently, this was not uncommon as women were restricted from participating in many combat roles. Our TBI measure was analyzed as a dichotomous variable (i.e., symptoms versus no symptoms) leaving pertinent TBI related details such as mechanism and severity of injury, symptom specification, and objective assessments unaccounted for. Nonetheless, the results of analyses provided novel information about underlying substance use norms in an understudied population.

6. Conclusion

USAR/NG soldiers and their spouses generally disapprove of the use of substances. However, when soldiers report persisting TBI symptoms after separating from the military, spouses report greater approval of NMUPD and in certain cases tobacco and illicit drug use. Future work should examine how changing norms impact changes in actual substance use for both soldiers and their partners.

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Contributors

Author A designed the study, wrote the protocol, and conducted the statistical analyses. Author B conducted literature searches, provided summaries of previous research studies. Authors B and C wrote the first draft of the manuscript.

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Conflict of interest

All authors declare that they have no conflicts of interest.

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