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Determinants of intention to disclose concussion symptoms in a population of U.S. military cadets

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ABSTRACT

Objectives: Non-disclosure of concussion complicates concussion management, but almost nothing is known about non-disclosure in military settings. This study describes concussion disclosure-related knowledge, attitudes, perceived social norms, perceived control, and intention. Additionally, the study identifies determinants of high intention to disclose concussion symptoms.
Design: Cross sectional survey.
Methods: First-year service academy cadets completed a cross-sectional survey to assess perceptions of concussion disclosure. Independent variables included: gender, race, ethnicity, high school athlete status, NCAA athlete status, previous concussion history, previous concussion education, socioeconomic proxy, concussion-related knowledge, attitudes about concussion, perceived social norms (perceived peer/organizational support and actions), and perceived control over disclosure. Log-binomial regression was used to identify determinants of high intention to disclose concussion symptoms.
Results: A total of 972 first-year military service academy cadets completed the survey [85% response; age = 18.4 ± 0.9 y]. In the simple models, previous concussion history was associated with lower intention to disclose concussion symptoms. High perceived control over disclosure, higher concussion knowledge, more favorable attitudes and social norms about concussion were associated with high intention to disclose. In the multivariable model, a 10% shift towards more favorable perceived social norms (PR = 1.28; $p < 0.001$) and attitudes (PR = 1.07; $p = 0.05$) about concussion were associated with high intention to disclose concussion symptoms. High perceived control over disclosure was associated with high intention to disclose concussion symptoms (PR = 1.39; $p = 0.08$).
Conclusions: Concussion-related perceived social norms, attitudes, and perceived control are associated with intention to disclose. Organizationally appropriate intervention strategies can be developed from these data.

Practical implications

- Our analysis of knowledge, attitudes, and perceived social norms indicates that educational efforts should include more focus on emotional and social symptoms/consequences of concussion and ways to prevent these outcomes.
- Based on our identification of perceived social norms as the key factor associated with intention to disclose, military and organizational leaders at all levels should create physical and social environments that promote and model disclosure of concussion for service members and academy cadets.

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1. Introduction

Timely identification and disclosure of sport-related concussions (a type of traumatic brain injury-TBI) are critical to optimal concussion care and management. A growing body of literature focuses on concussion disclosure in athlete populations, such as collegiate student-athletes.[1–4] These studies suggest both better concussion knowledge and attitudes may improve disclosure and concussion identification.[1–4] Current evidence suggests better knowledge, although important, may not be as strongly associated with improved disclosure as other outcomes such as attitudes and intention to disclose concussion symptoms.[5]

Complexities that influence concussion disclosure in collegiate athletes are equally pervasive, if not more so, in the military setting. Military personnel, like athletes are also at high risk of concussion from physical activities during training and recreation. Estimates for the US military suggest prior to systematic screening for TBI in late 2006, over 80% of concussions and more severe TBIs in combat-deployed service members may have been undocumented;[6] it is unknown how many remain undocumented or unidentified due to non-disclosure. Despite this identification gap, no study has examined factors influencing concussion disclosure in military populations.

One framework for examining disclosure-related behaviors is the Theory of Planned Behavior (TPB).[7–9] While studies of various behaviors may question the use of the TPB, given a sometimes weak relationship between intention and behavior,[10–12] recent studies among high school and college athletes suggest an important relationship between intention and concussion disclosure behaviors.[3,5,13] However, no studies utilize this framework in the military setting. Given the unique environment for service academy cadets and military personnel, understanding unique and similar applications of the TPB may provide a stronger framework for interventions concerning concussion disclosure behaviors in this population.

The key TPB factors, in addition to concussion knowledge, include concussion-related *attitudes*, perceived social *norms*, perceived behavioral *control* over disclosure, and *intention* to disclose.[3–5] Concussion disclosure *attitudes* include beliefs and the weight of those beliefs around concussion overall and associated behaviors. Perceived social *norms* around concussion disclosure are perceptions of organizational and peer support and key individuals' actions within the sports environment.[7,14–17] Perceived behavioral *control* is the amount of control individuals believe they have over concussion disclosure. *Intention* is defined as the intention level towards concussion disclosure behaviors. Intention to disclose concussion symptoms is a key outcome to measure disclosure due to its association with behavior[18] and the potential ease of measurement. In addition to *attitudes, norms, and control,* other factors are also important in this context including knowledge and demographic/historical factors such as gender, ethnicity, race, sport status, concussion history, socioeconomic status, and concussion education.[18–21]

Attitudes and perceived social norms are a particular concern in a military context, such as a military service academy environment. A military service academy is a 4-year collegiate-level undergraduate program that provides rigorous academic, military, and physical training. Graduating cadets serve as commissioned military officers and many go on to pursue graduate level education. A five-year commitment to the military is typically required after graduation. Some demands and perceived social norms/pressures on the cadet population may be similar to student-athletes. Both populations tend to have strong goal and team orientations, and a commitment to physical excellence. Furthermore, there is population overlap, with approximately 25% of cadets being NCAA Division I student-athletes.

Military cadets experience unique environmental factors, due to their military commitment and the potential impact of injury on career opportunities and advancement. The chain of command (http://www.west-point.org/parent/wppc_michigan/index.php?option=com_content&task=view&id=153&Itemid=74) that drives decision-making is also unique to the academy environment. The academy is highly competitive and class ranking based on physical, academic, and military performance drives occupational selection (branching) and duty station assignments. There are medical standards for accession and commissioning. Long-term consequences of concussion/TBI may impact a cadet's career; however, it is rare that a cadet would not be commissioned following a non-complicated TBI/concussion. Beliefs, whether valid or not, about the impact of concussion disclosure on medical clearance for commissioning may influence disclosure intentions. Perceptions that concussion disclosure could impact performance scores may also make cadets and military service members less likely to disclose concussion symptoms.

Despite the importance of early identification and concussion disclosure, no studies have examined concussion disclosure intentions and associated factors among military trainees, such as service academy cadets, or military recruits. The study purpose was to: (1) describe knowledge, attitudes, perceived social norms, perceived control, and intention concerning concussion disclosure; (2) examine the influence of demographics and TPB components on intention to disclose concussion symptoms; and (3) examine the association between intention to disclose concussion symptoms and concussion disclosure behaviors among first-year military service academy cadets. We hypothesized our selected key demographic factors would be weak-moderately associated with concussion disclosure behaviors. Additionally, we hypothesized, based on previous TPB research and considerations in the military academy setting, the following associations with intention: knowledge (weak), attitudes (moderate-strong) perceived control (weak-moderate), and perceived social norms (moderate-strong). Lastly, we hypothesized there would be at least a moderate association between high intention to disclose and higher prevalence of concussion disclosure.

2. Methods

This study used a cross-sectional survey to assess intention to disclose concussive symptoms. The survey also included items designed to evaluate potential determinants of intention to disclose. Potential determinants included demographics (age, race, etc.), athlete status (current and high school), and concussion-specific behavioral factors (concussion-related knowledge, attitudes, perceived social norms, and perceived control). The study was approved by two institutional review boards prior to any human subject interaction. Participants provided consent as part of the survey. The research team administering the survey were researchers assisting with baseline concussion testing.

All first-year cadets (n = 1150) were eligible to participate. Potential participants were approached during concussion baseline testing, which occurred following their initial basic training, but prior to the start of the full academic year. Of the 1,150 who were invited, a total of 972 consented to participate (85%) and completed the survey at this time. The survey was completed via an online survey platform (Qualtrics, Inc, Provo, UT) in a classroom-style setting with the research team. Hard copies were available for completion in case of technical difficulty.

The survey was based on previously validated items.[3,22] The survey items included questions concerning basic demographics, concussion history, and sport participation. In addition, behavioral factors of interest included: scales related to knowledge

Table 1
Cadet concussion knowledge, attitudes, and perceived norm descriptive statistics.

Knowledge constructs	n	Frequency correct (%)
Signs & symptoms[a]		
Question: Do you consider the following to be a primary sign or symptom of concussion? (true = correct answer)		
- Headache (true)	958	814 (84.9)
- Pressure in head (true)	946	804 (84.9)
- Neck pain (true)	915	516 (56.4)
- Nausea or vomiting (true)	936	767 (81.9)
- Dizziness (true)	950	880 (92.6)
- Blurred vision (true)	947	874 (92.3)
- Balance problems (true)	942	869 (92.3)
- Sensitivity to light (true)	944	944 (89.3)
- Skin rash (false)	883	819 (92.7)
- Sensitivity to noise (true)	942	796 (84.5)
- Feeling slowed down (true)	937	812 (86.7)
- Feeling like in a fog (true)	941	838 (89.1)
- Don't feel right (true)	932	760 (81.6)
- Difficulty concentrating (true)	944	865 (91.6)
- Difficulty remembering (true)	942	871 (74.3)
- Fatigue or low energy (true)	927	689 (74.3)
- Confusion (true)	946	865 (91.4)
- Drowsiness (true)	930	728 (78.3)
- Joint pain (false)	886	748 (84.4)
- Trouble falling asleep (true)	918	560 (61.0)
- More emotional (true)	914	446 (50.9)
- Irritability (true)	917	599 (65.3)
- Sadness (true)	904	419 (45.4)
- Nervous or anxious (true)	911	462 (50.7)
Consequences of returning to play too soon[a]		
Question: What do you think can happen to someone returning to their sport or physical activity too soon after a concussion? (true = correct answer)		
- No bad things can ever happen (false)	962	958 (99.6)
- You may be more likely to get another concussion (true)	962	857 (89.1)
- Skin rash (false)	962	945 (98.2)
- Difficulty with everyday activities (true)	962	679 (70.1)
- Brain damage (true)	962	784 (81.5)
- Trouble with schoolwork or homework (true)	962	727 (75.6)
- I don't know what might happen (false)	962	931 (96.8)
Consequences of multiple concussions		
Question: What do you think can happen to someone as a result of suffering multiple concussions over their lifetime? (true = correct answer)		
- No bad things can ever happen (false)	962	958 (99.6)
- You may be more likely to get another concussion (true)	962	767 (70.3)
- Skin rash (false)	962	943 (98.0)
- Brain damage (true)	962	926 (96.3)
- Trouble with schoolwork or homework (true)	962	758 (78.8)
- Difficulty with everyday activities (true)	962	973 (90.1)
- Changes in social life (true)	962	786 (81.7)
- I don't know what might happen (false)	962	931 (96.8)

Attitude and perceived norm constructs	n	Mean ± SD
Attitudes (rated on a 1–7 scale with 7 being more favorable)		
Question: Reporting possible concussive symptoms to a medical professional or someone in authority during physical activity is:		
- Cowardly. . .brave	956	5.2 ± 1.5
- Shameful. . .prideful	954	4.6 ± 1.4
- Harmful. . .beneficial	956	6.4 ± 1.2
- Extremely difficult. . .extremely easy	956	4.9 ± 1.8
- Bad. . .good	956	6.2 ± 1.3
- Unimportant. . .important	959	6.5 ± 1.1
Perceived norms (rated on a 1–7 scale with 7 being more favorable)		
Question: Directly listed below as asked in the survey.		
- In my current activity or sporting environment, most people I know would report their possible concussive symptoms to a medical professional or someone in authority if they experience them.	951	5.1 ± 1.5
- Schools like mine provide appropriate care for individuals with a concussion.	950	6.5 ± 0.8
- If I suffered a concussion, I would feel supported by my school.	950	6.1 ± 1.2
- When I experience concussive symptoms, I am expected to report them to a medical professional or someone in authority.	946	6.4 ± 0.9
- When I experience possible concussive symptoms, people who are important to me would approve of me reporting them to a medical professional or someone in authority.	952	6.5 ± 0.9
- When other athletes I know experience possible concussive symptoms, they report them to a medical professional or someone in authority.	947	5.3 ± 1.4
- I should report possible concussive symptoms, when I experience them to a medical professional or someone in authority.	955	6.4 ± 0.9

(Cronbach's alpha = 0.89), attitudes (Cronbach's alpha = 0.81), and perceived social norms (Cronbach's alpha = 0.80); and single-item measures on perceived control and intention. Table 1 displays all scale items and response options for the scale items included in the survey.

Concussion knowledge questions included 39 yes-or-no items concerning symptom recognition, potential long-term effects of concussion and effects of premature return to play. Correct answers were scored 1 point. The resulting scale ranged from 0 to 39, with higher scores indicating better knowledge.

Attitude questions included six 7-point scale items on feelings towards concussion symptom disclosure and towards concussion overall. The resulting scale ranged from 6 to 42, with higher scores indicating more favorable attitudes.

Perceived social norm questions included seven 7-point scale items on perceptions of organization, social referent expectations, and actions concerning concussion. The resulting scale ranged from 7 to 49, with higher scores indicating favorable perceived social norms.

Perceived control was assessed using a single question about how much control cadets believed they had about concussion disclosure (I have control over reporting concussive symptoms to a medical professional or someone in authority). Responses on the 7-point scale were categorized with a higher score of 6 or 7, reflecting agreement or strong agreement with having control vs. a lower score of 1–5, reflecting strong disagreement through some agreement for having control. A higher score indicated stronger perceived control.

Intention to disclose concussive symptoms was assessed using a single question asking the cadet about intention to disclose concussion-related symptoms following injury (*When I experience possible concussive symptoms, I intend to report them to a medical professional or someone in authority*). Responses on the 7-point scale were grouped by higher score of 6 or 7, reflecting agree or strongly agree for intention to disclose vs. lower score of 1–5, reflecting strongly disagree through somewhat agree for intention to disclose. A higher score indicated stronger intention to disclose. Intention and control were dichotomized to provide a more applicable approach to understanding their influence in the context of the current study and given that there was a theoretical cut with those reporting 6 or 7 vs. those reporting lower agreement with these measures.

Concussion disclosure was assessed by first giving cadets a definition similar to previous studies[23] and asking: "Given the definition above, have you ever had a concussion related to sport or other activities (Yes/No)? The definition was as follows: 'A change in brain function following a force to the head, which may be accompanied by temporary loss of consciousness and is identified in awake individuals with measures of neurologic and cognitive dysfunction. Common concussion symptoms include: headache, feeling slowed down, difficulty concentrating or focusing, dizziness, balance problems/loss of balance, fatigue/loss of energy, feeling in a fog, irritability, drowsiness, nausea, memory loss, sensitivity to light/noise, and blurred vision. **IMPORTANT:** A concussion can occur without being "knocked out' or unconscious; getting your 'bell rung' or "clearing the cobwebs" is a concussion."

For those answering yes, they were then asked "How many concussions have you had?". This was followed by, "How many of these concussions did you report/disclose to a medical professional or someone in authority at the time of injury?" We then divided the number of disclosed concussions by the number of total concussions for each individual. We defined disclosure as individuals who disclosed all of their suspected concussions at time of injury (yes vs. no). This is consistent with other studies defining disclosure vs. non-disclosure.[24]

Descriptive statistics were computed for all continuous variables and outcomes of interest. Frequencies and proportions were calculated for all categorical variables of interest. The primary predictive factors for intention to disclose included: gender (female vs. male), high school contact sport participation (contact/collision vs. non-contact), NCAA athlete status (yes vs. no), ethnicity (Hispanic vs. non), race (Caucasian vs. non), proxy socioeconomic status (parents higher education vs. not), previous concussion education (yes vs. no), previous concussion history (yes vs. no), and four intermediate outcomes from the TPB framework (knowledge score, attitudes score, perceived norms score, and perceived control group[higher vs. lower]).

Simple univariable and multivariable log-binomial regression models (12) for each variable of interest were used to model the prevalence of high intention to disclose. A univariable log-binomial regression model was used to examine the association between intention to disclose and disclosure of suspected lifetime concussions. Regression models maximized the available sample for each model by excluding observations with missing data on an analysis-by-analysis basis. Estimated prevalence ratios (PR) and 95% confidence intervals (CI) associated with high intention to disclose were computed from the univariable and multivariable models. The PR is also a measure of effect size. For continuous variables, we computed a PR representing the change in reporting prevalence associated with a 10% increase in knowledge, attitude, or perceived social norm scores, based on the range on those scales observed in this population. This 10% increase corresponds to a shift of 3.9 points on the knowledge scale (possible range: 0–39), 4.2 points on the attitudes scale (range: 6–42), and 4.9 on the perceived norms scale (range: 7–49).

3. Results

A total of 972 first-year military service academy cadets completed the survey (85% response). In addition, age = 18.4 ± 0.9 y, 21.7% were female (201/925), 18.9% were previous high school contact sport athletes (172/911), 29.0% were NCAA athletes (281/970), 11.2% identified as Hispanic (103/917; 11.2%), 72.6% identified as Caucasian (667/919), and 85.1% indicated a high proxy socioeconomic status (one parent with at least a Bachelor's degree; 785/922). In the study sample, 71.7% reported previous concussion education (695/970) and 23.6% reported at least one previous concussion (229/969).

While symptom recognition was high, cadets were least familiar with emotional symptoms including sadness (419/904; 46.3%), nervousness/anxiousness (462/911; 50.7%), and feeling more emotional (446/914; 48.8%). In addition, 727/862 (84.3%) identified school-related issues as a result of returning to play too early. A lower proportion of the sample identified social life issues 786/962 (81.7%) and school-related issues 758/962 (78.8%) as potential complications of suffering multiple concussions (Table 1).

On averaged cadets answered 32.1 ± 6.2 out of 39 knowledge questions correctly. Attitudes toward concussion disclosure were 33.8 ± 5.9 (max = 42). Attitude items related to the importance and serious nature of concussion all had mean scores above 6; however, there was more variability among attitude items concerning the ease of concussion disclosure with these items averaging a rating of 5.2 (max = 7) or lower (Table 1). In addition, perceived social norms around organizational support were high with means on these questions above 6; however, perceived social norms around disclosure actions of peers were lower with means <5.5 (max = 7). Average perceived control over disclosure was 6.4 ± 0.9 (max = 7) and average intention to disclose was 5.9 ± 1.2 (max = 7) (Table 1).

High intention was reported by 77.0% of cadets in the sample (731/950). Means and standard deviations for key concussion-disclosure related variables in the high intention group vs. low intention group were as follows: knowledge: 32.5 ± 5.8 vs. 30.2 ± 7.4; attitudes: 35.1 ± 5.1 vs. 29.2 ± 6.5; perceived social norms: 43.7 ± 4.1 vs. 37.2 ± 5.4; and perceived control: 6.5 ± 0.8 vs. 5.8 ± 1.1.

In the univariable analysis, having a previous concussion history was associated with a lower intention to disclose (66.5% vs. 80.2%; $p < 0.001$). In comparison, being in the high perceived control group was associated higher intention to disclose (81.0% vs. 42.5%; $p < 0.001$). A 10% shift towards higher knowledge, more favorable

Table 2
Prevalence of high intention to disclose concussion symptoms.

	n	Proportion (%) with high intention
Gender		
Female	199	161 (81.0)
Male	720	548 (76.1)
High school athlete status		
Contact	734	554 (75.5)
Non-contact	170	146 (85.9)
NCAA athlete		
Yes	277	215 (77.6)
No	671	514 (76.6)
Ethnicity		
Hispanic	101	81 (80.2)
Non-Hispanic	810	625 (77.2)
Race		
Caucasian	662	508 (76.7)
Non-Caucasian	251	196 (78.1)
Socioeconomic status		
High	779	603 (77.4)
Low	137	105 (76.6)
Concussion education		
Yes	683	520 (76.1)
No	267	211 (79.0)
Concussion history		
Yes	227	151 (66.5)
No	722	579 (80.2)
Perceived control		
Higher perceived control	847	686 (81.0)
Lower perceived control	101	43 (42.5)

attitudes, and more favorable perceived social norms were each associated with higher intention to disclose (PRs of 1.05, 1.20, and 1.37, respectively) (Table 2).

Three key factors emerged as important predictors of intention to disclose in the multivariable model. A 10% shift towards more favorable perceived social norms around concussion disclosure were associated with substantially higher prevalence of high intention to disclose (PR = 1.28; $p < 0.001$). A 10% shift towards more favorable attitudes about concussion remained associated with a higher prevalence of high intention to disclose (PR = 1.07; $p = 0.05$), and greater perceived control also tended to be associated with a higher intention to disclose (PR = 1.39; $p = 0.08$) (Table 3).

There was a moderate effect (PR > 1.4) for the association between intention to disclose concussion symptoms and self-reported disclosure of suspected concussions at the time of injury (PR = 1.53; 95% CI: 1.16, 2.03; $p = 0.003$). In those with high intention, 69.9% disclosed all concussions at the time of injury vs. 45.6% in those with lower intention.

4. Discussion

High intention to disclose concussion symptoms was associated with improved disclosure prevalence at the time of injury, suggesting intention as an appropriate proxy to behavior and a measure that may be utilized to understand concussion disclosure among service academy cadets. Multiple factors were associated with intention to disclose concussion in our univariable models these factors included: previous concussion history, higher perceived control over disclosure, better knowledge, better attitudes, and more favorable perceived social norms. In the multivariable model, three key factors remained associated with intention to disclose concussion: (1) favorable perceived social norms about concussion disclosure and (2) attitudes about concussion and (3) control over disclosure. The strongest observed association was with favorable perceived social norms. These norms were reflective of perceived actions of key peers and perceived organizational and peer support. The current findings highlight the importance of addressing these perceived social norms around concussion disclosure among first-year service academy cadets. Specifically, the findings support addressing concussion disclosure at multiple levels of the academy environment (peer and organization), since environmental perceptions at multiple levels drive cadet intentions to engage in healthy concussion disclosure behaviors.

Key targets for concussion disclosure interventions are the social environment and chain of command (http://www.west-point.org/parent/wppc_michigan/index.php?option=com_content&task=view&id=153&Itemid=74). Specifically, peer stakeholders and those across the chain of command can encourage concussion disclosure and model healthy disclosure behaviors such as providing support to concussed cadets, encouraging individuals to take care of their brains and bodies following concussion, and should they experience a concussion seeking appropriate medical care.

Our findings also illustrate important knowledge gaps including the influence of concussion on school and emotional issues (over 20% did not recognize these as potential problems following concussion), as well as attitudes towards concussion disclosure that may be addressed through education, training, and leadership opportunities. While a high percentage of cadets recognized most signs and symptoms of concussion. Emotional symptoms were the least recognized (Table 1). Cadets may also not associate these symptoms with concussion, when in fact they may be the most burdensome when experienced long term.[25] Additionally, most educational materials and awareness campaigns largely address the physical concussion symptoms and place less focus on emotional and social consequences of both acute concussion and long

Table 3
Univariable and multivariable prevalence ratios (PR) for high intention to disclose concussion symptoms.

	n	Univariable			Multivariable (n = 803)		
		PR	95% CI	p-Value	PR[a]	95% CI	p-Value
Individual factors							
Gender (female vs. male)	919	1.06	0.90, 1.27	0.496	–	–	–
High school athletics (contact vs. non)	904	0.89	0.73, 1.05	0.165	–	–	–
NCAA athlete (yes vs. no)	948	1.01	0.86, 1.19	0.871	–	–	–
Ethnicity (Hispanic vs. non-Hispanic)	911	1.04	0.82, 1.31	0.743	–	–	–
Race (Caucasian vs. non)	913	0.98	0.83, 1.16	0.664	–	–	–
Socioeconomic status (high vs. low)	916	1.01	0.82, 1.24	0.925	–	–	–
Concussion education (yes vs. no)	950	0.96	0.82, 1.13	0.648	–	–	–
Concussion history (yes vs. no)	949	0.83	0.69, 0.99	0.041	0.92	0.75, 1.12	0.384
Perceived control group (high vs. lower)	948	1.90	1.40, 2.59	<0.001	1.39	0.92, 2.03	0.080
Knowledge[b]	841	1.05	1.01, 1.10	0.024	1.02	0.97, 1.07	0.528
Attitudes[b]	941	1.20	1.13, 1.37	<0.001	1.07	1.00, 1.16	0.045
Perceived norms[b]	922	1.37	1.27, 1.49	<0.001	1.28	1.16, 1.41	<0.001

[a] PRs are adjusted for all other factors in the model. Changes in sample size reflect missing data.
[b] Continuous scale. PR represents the effect of a 1-decile increase (change of +10%) on each scale in this population.

term sequelae.[13,26] These data support the inclusion of emotional symptoms when discussing concussion among service academy cadets and military recruits.

While attitudes about the seriousness and importance of concussion disclosure were high, attitudes about the difficulty and sense of pride or bravery around disclosure behaviors were lower. This supports the notion that understanding the serious nature of concussion and the need to disclose concussive injuries has improved with education efforts.[19] Less favorable attitudes about ease of disclosure and perceptions of pride/bravery suggest the need for changes to the social environment and unique messaging for cadets. Key educational messages should position concussion disclosure as a brave and accepted behavior for the betterment of one's health and an overall benefit to a cadet's unit or team. While this may seem contrary to key values of perseverance and commitment, it is aligned with the academy and military environments of protecting health, protecting team, and improving overall force readiness. Furthermore, it is aligned with the recent efforts to shift military culture to reduce stigma related to reporting and seeking treatment for mental health issues within the military population (http://www.apa.org/monitor/2009/06/stigma-war.aspx). These messages should also mitigate negative perceptions about the impacts of concussion disclosure on commissioning and branching to the extent possible.

Our analysis of perceived social norms yielded important findings. While cadets felt their environment and organization supported concussion disclosure, their perceptions of what they see and expect from peers highlight that the perceived behaviors being modeled are still those more aligned with non-disclosure. These data are similar to Kroshus et al.[13] that identified social norm perceptions as key targets for consideration concerning concussion disclosure among collegiate athletes. Additionally, perceived control over concussion disclosure was overall high, indicating cadets feel a strong sense of personal agency in disclosing concussions. These data are similar to data in both the high school[27] and collegiate athletic populations;[1] however, not everyone reports feelings of high control. Overall control over concussion disclosure may be influenced by various factors and may also be contextual in nature (when the injury occurs, who is around, etc.). While not empirically studied, it is reasonable to believe that presence of a medical professional is a key factor that may improve number of concussions reported and may improve perceived control over disclosure.

In our multivariable model, perceived social norms and perceived control over disclosure remained key influencers of disclosure intention. The finding concerning previous concussion experience is similar to recent findings suggesting those with a previous history of concussion have worse attitudes and are less likely to disclose subsequent injuries.[4] While previous concussion history is a non-modifiable factor, messaging can be tailored towards improving perceptions that may reflect previous experience with both concussion and sport. One example includes highlighting recent data suggesting delayed disclosure can lead to prolonged recovery compared to reporting at the time of concussion.[28] In addition, clearly outlining the organization's process for disclosure and care for concussion may improve expectations and lead to increased reporting. Concussion-related knowledge, attitudes, perceived social norms, and perceived control over disclosure behaviors are all modifiable factors that may be targeted in educational and prevention initiatives via messaging, educational materials, conversations with key social referents, and environmental cues. Previous studies related to behavior modification highlight improvements in attitudes and knowledge can be obtained from such intervention strategies.[24–26]

Military environments are characterized by a clearly-delineated chain-of-command structure. In the service academy environment, military officers, upper-level classmates (cadre) and fellow cadets all influence behavior. This hierarchical structure also provides a redundant system in which multiple individuals may make decisions and raise concerns about concussion and influence behaviors related to disclosure. As such, the chain-of-command plays a critical role in any behavioral or educational intervention targeting social norms around concussion disclosure. Recent efforts in the military to de-stigmatize behavioral and mental health issues suggest changing norms and culture is possible through widespread education, access to appropriate care, and chain of command involvement.[29] This suggests interventions to improve concussion disclosure behaviors should target all levels of leadership throughout the organization and emphasizes the importance of leadership support to the success of these interventions. As stated, leaders may promote disclosure by providing support to concussed cadets, encouraging individuals to take care of their brains and bodies following concussion, and should they experience a concussion seeking appropriate medical care. Given the close relationship of perceived social norms, perceived behavioral control, and intention to disclose, these factors are key targets for intervention among the cadet population. Addressing one of these factors, including the chain-of-command, will likely influence the others. These findings can help focus efforts of concussion-related interventions in the cadet population.

Finally, high intention to disclose concussion symptoms was associated with improved disclosure prevalence. While they are not the same construct, our findings support the use of intention as proxy to understand concussion disclosure behaviors in the cadet population. Intention is easily measure and can be used, as suggested by Kroshus et al.[5] as an outcome to understand the influence of concussion-related interventions and programs.

This study was cross-sectional and did not measure serial changes in disclosure. Sample size differed by outcome due to individuals with missing data. As with any survey, there is potential for response and recall bias. We believe response basis was minimized given all first-year cadets were approached with a response rate of 85%. Their perceptions will likely change over their time and during their military career. Additionally, participants completed the questionnaire in a classroom style setting, which may have influenced response. However, knowing key intervention targets when individuals begin their military career offers the opportunity for building a culture of disclosure throughout their time at the academy. Future work should examine disclosure-related factors and interventions across cadets' time at the academy. The current study did not separate disclosure behaviors for athletic vs. military training concussions or types of concussion education. Future work should consider how these contexts may influence disclosure. Finally, we assumed our main outcome of interest, intention to disclose, was a reasonable proxy for actual disclosure behavior based on previous research.

5. Conclusions

Intention to disclose was significantly associated with self-called disclosure of concussion in cadets. As such, intention may be an appropriate proxy to understand and study disclosure in this population. Our analyses identified perceived social norms as the factor most strongly associated with increased intention to disclose. Additionally, knowledge gaps concerning the emotional and social effects of concussion were identified. Our identification of perceived social norms as a key factor indicates interventions at all levels of the chain of command may be critical to address social influences on concussion disclosure in military service members and service academy cadets.

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