

Determinants of Intention to Disclose Concussion Symptoms in a Population of U.S.

Military Cadets

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Manuscript Word Count: 2952; Abstract Word Count: 250; Num. of Tables/Figures:

3

1 **Abstract**

2 **Objective:** Non-disclosure of concussion complicates concussion management, but almost
3 nothing is known about non-disclosure in military settings. This study describes concussion
4 disclosure-related knowledge, attitudes, perceived social norms, perceived control, and
5 intention. Additionally, the study identifies determinants of high intention to disclose concussion
6 symptoms.

7 **Design:** Cross sectional survey.

8 **Methods:** First-year service academy cadets completed a cross-sectional survey to assess
9 perceptions of concussion disclosure. Independent variables included: gender, race, ethnicity,
10 high school athlete status, NCAA athlete status, previous concussion history, previous
11 concussion education, socioeconomic proxy, concussion-related knowledge, attitudes about
12 concussion, perceived social norms (perceived peer/organizational support and actions), and
13 perceived control over disclosure. Log-binomial regression was used to identify determinants of
14 high intention to disclose concussion symptoms.

15 **Results:** A total of 972 first-year military service academy cadets completed the survey [85%
16 response; age=18.4±0.9y]. In the simple models, previous concussion history was associated
17 with lower intention to disclose concussion symptoms. High perceived control over disclosure,
18 higher concussion knowledge, more favorable attitudes and social norms about concussion
19 were associated with high intention to disclose. In the multivariable model, a 10% shift towards
20 more favorable perceived social norms (PR=1.28; p<0.001) and attitudes (PR=1.07; p=0.05)
21 about concussion were associated with high intention to disclose concussion symptoms. High
22 perceived control over disclosure was associated with high intention to disclose concussion
23 symptoms (PR=1.39; p=0.08).

24 **Conclusions:** Concussion-related perceived social norms, attitudes, and perceived control are
25 associated with intention to disclose. Organizationally appropriate intervention strategies can be
26 developed from these data.

27 **Key Words:** educational targets, traumatic brain injury, injury prevention, military cadets

28 **Introduction**

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

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

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

52 The key TPB factors, in addition to concussion knowledge, include concussion-related
53 *attitudes*, perceived social *norms*, perceived behavioral *control* over disclosure, and *intention* to

54 disclose.³⁻⁵ Concussion disclosure *attitudes* include beliefs and the weight of those beliefs
55 around concussion overall and associated behaviors. Perceived social *norms* around
56 concussion disclosure are perceptions of organizational and peer support and key individuals'
57 actions within the sports environment.^{7,14-17} Perceived behavioral *control* is the amount of
58 control individuals believe they have over concussion disclosure. *Intention* is defined as the
59 intention level towards concussion disclosure behaviors. Intention to disclose concussion
60 symptoms is a key outcome to measure disclosure due to its association with behavior¹⁸ and the
61 potential ease of measurement. In addition to *attitudes, norms, and control*, other factors are
62 also important in this context including knowledge and demographic/historical factors such as
63 gender, ethnicity, race, sport status, concussion history, socioeconomic status, and concussion
64 education.¹⁹⁻²²

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

74 Military cadets experience unique environmental factors, due to their military
75 commitment and the potential impact of injury on career opportunities and advancement. The
76 chain of command ([http://www.west-](http://www.west-point.org/parent/wppc_michigan/index.php?option=com_content&task=view&id=153&Itemid=7)
77 [point.org/parent/wppc_michigan/index.php?option=com_content&task=view&id=153&Itemid=7](http://www.west-point.org/parent/wppc_michigan/index.php?option=com_content&task=view&id=153&Itemid=7)
78 4) that drives decision-making is also unique to the academy environment. The academy is
79 highly competitive and class ranking based on physical, academic, and military performance

80 drives occupational selection (branching) and duty station assignments. There are medical
81 standards for accession and commissioning. Long-term consequences of concussion/TBI may
82 impact a cadet's career; however, it is rare that a cadet would not be commissioned following a
83 non-complicated TBI/concussion. Beliefs, whether valid or not, about the impact of concussion
84 disclosure on medical clearance for commissioning may influence disclosure intentions.
85 Perceptions that concussion disclosure could impact performance scores may also make
86 cadets and military service members less likely to disclose concussion symptoms.

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

101

102 **Methods**

103 This study used a cross-sectional survey to assess intention to disclose concussive
104 symptoms. The survey also included items designed to evaluate potential determinants of
105 intention to disclose. Potential determinants included demographics (age, race, etc.), athlete

106 status (current and high school), and concussion-specific behavioral factors (concussion-related
107 knowledge, attitudes, perceived social norms, and perceived control). The study was approved
108 by two institutional review boards prior to any human subject interaction. Participants provided
109 consent as part of the survey. The research team administering the survey were researchers
110 assisting with baseline concussion testing.

111 All first-year cadets (n=1150) were eligible to participate. Potential participants were
112 approached during concussion baseline testing, which occurred following their initial basic
113 training, but prior to the start of the full academic year. Of the 1,150 who were invited, a total of
114 972 consented to participate (85%) and completed the survey at this time. The survey was
115 completed via an online survey platform (Qualtrics, Inc, Provo, UT) in a classroom-style setting
116 with the research team. Hard copies were available for completion in case of technical difficulty.

117 The survey was based on previously validated items.^{3,23} The survey items included
118 questions concerning basic demographics, concussion history, and sport participation. In
119 addition, behavioral factors of interest included: scales related to knowledge (Cronbach's alpha
120 =0.89), attitudes (Cronbach's alpha=0.81), and perceived social norms (Cronbach's
121 alpha=0.80); and single-item measures on perceived control and intention. Table 1 displays all
122 scale items and response options for the scale items included in the survey.

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

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

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

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

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

149 Concussion disclosure was assessed by first giving cadets a definition similar to
150 previous studies²⁴ and asking: "Given the definition above, have you ever had a concussion
151 related to sport or other activities (Yes / No)? The definition was as follows: "A change in brain
152 function following a force to the head, which may be accompanied by temporary loss of
153 consciousness and is identified in awake individuals with measures of neurologic and cognitive
154 dysfunction. Common concussion symptoms include: headache, feeling slowed down, difficulty
155 concentrating or focusing, dizziness, balance problems/loss of balance, fatigue/loss of energy,

156 feeling in a fog, irritability, drowsiness, nausea, memory loss, sensitivity to light/noise, and
157 blurred vision. **IMPORTANT:** A concussion can occur without being “knocked out” or
158 unconscious; getting your “bell rung” or “clearing the cobwebs” is a concussion.”

159 For those answering yes, they were then asked “How many concussions have you
160 had?”. This was followed by, “How many of these concussions did you report/disclose to a
161 medical professional or someone in authority at the time of injury?” We then divided the number
162 of disclosed concussions by the number of total concussions for each individual. We defined
163 disclosure as individuals who disclosed all of their suspected concussions at time of injury (yes
164 vs. no). This is consistent with other studies defining disclosure vs. non-disclosure.²⁵

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

174 Simple univariable and multivariable log-binomial regression models (12) for each
175 variable of interest were used to model the prevalence of high intention to disclose. A
176 univariable log-binomial regression model was used to examine the association between
177 intention to disclose and disclosure of suspected lifetime concussions. Regression models
178 maximized the available sample for each model by excluding observations with missing data on
179 an analysis-by-analysis basis. Estimated prevalence ratios (PR) and 95% confidence intervals
180 (CI) associated with high intention to disclose were computed from the univariable and
181 multivariable models. The PR is also a measure of effect size. For continuous variables, we

182 computed a PR representing the change in reporting prevalence associated with a 10%
183 increase in knowledge, attitude, or perceived social norm scores, based on the range on those
184 scales observed in this population. This 10% increase corresponds to a shift of 3.9 points on the
185 knowledge scale (possible range: 0 to 39), 4.2 points on the attitudes scale (range: 6 to 42), and
186 4.9 on the perceived norms scale (range: 7 to 49).

187

188 **Results**

189 A total of 972 first-year military service academy cadets completed the survey (85%
190 response). In addition, age=18.4±0.9y, 21.7% were female (201/925), 18.9% were previous
191 high school contact sport athletes (172/911), 29.0% were NCAA athletes (281/970), 11.2%
192 identified as Hispanic (103/917; 11.2%), 72.6% identified as Caucasian (667/919), and 85.1%
193 indicated a high proxy socioeconomic status (one parent with at least a Bachelor's degree;
194 785/922). In the study sample, 71.7% reported previous concussion education (695/970) and
195 23.6% reported at least one previous concussion (229/969).

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

202 On averaged cadets answered 32.1±6.2 out of 39 knowledge questions correctly.
203 Attitudes toward concussion disclosure were 33.8±5.9 (max=42). Attitude items related to the
204 importance and serious nature of concussion all had mean scores above 6; however, there was
205 more variability among attitude items concerning the ease of concussion disclosure with these
206 items averaging a rating of 5.2 (max=7) or lower (Table 1). In addition, perceived social norms
207 around organizational support were high with means on these questions above 6; however,

208 perceived social norms around disclosure actions of peers were lower with means <5.5
209 (max=7). Average perceived control over disclosure was 6.4±0.9 (max=7) and average intention
210 to disclose was 5.9±1.2 (max=7) (Table 1).

211 High intention was reported by 77.0% of cadets in the sample (731/950). Means and
212 standard deviations for key concussion-disclosure related variables in the high intention group
213 vs. low intention group were as follows: knowledge: 32.5±5.8 vs. 30.2±7.4; attitudes: 35.1±5.1
214 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.
215 5.8±1.1.

216 In the univariable analysis, having a previous concussion history was associated with a
217 lower intention to disclose (66.5% vs. 80.2%; $p < 0.001$). In comparison, being in the high
218 perceived control group was associated higher intention to disclose (81.0% vs. 42.5%;
219 $p < 0.001$). A 10% shift towards higher knowledge, more favorable attitudes, and more favorable
220 perceived social norms were each associated with higher intention to disclose (PRs of 1.05,
221 1.20, and 1.37, respectively) (Table 2).

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

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

233

234 **Discussion**

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

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

258 Our findings also illustrate important knowledge gaps including the influence of
259 concussion on school and emotional issues (over 20% did not recognize these as potential

260 problems following concussion), as well as attitudes towards concussion disclosure that may be
261 addressed through education, training, and leadership opportunities. While a high percentage of
262 cadets recognized most signs and symptoms of concussion. Emotional symptoms were the
263 least recognized (Table 1). Cadets may also not associate these symptoms with concussion,
264 when in fact they may be the most burdensome when experienced long term.²⁶ Additionally,
265 most educational materials and awareness campaigns largely address the physical concussion
266 symptoms and place less focus on emotional and social consequences of both acute
267 concussion and long term sequelae.^{13,27} These data support the inclusion of emotional
268 symptoms when discussing concussion among service academy cadets and military recruits.

269 While attitudes about the seriousness and importance of concussion disclosure were
270 high, attitudes about the difficulty and sense of pride or bravery around disclosure behaviors
271 were lower. This supports the notion that understanding the serious nature of concussion and
272 the need to disclose concussive injuries has improved with education efforts.²⁰ Less favorable
273 attitudes about ease of disclosure and perceptions of pride/bravery suggest the need for
274 changes to the social environment and unique messaging for cadets. Key educational
275 messages should position concussion disclosure as a brave and accepted behavior for the
276 betterment of one's health and an overall benefit to a cadet's unit or team. While this may seem
277 contrary to key values of perseverance and commitment, it is aligned with the academy and
278 military environments of protecting health, protecting team, and improving overall force
279 readiness. Furthermore, it is aligned with the recent efforts to shift military culture to reduce
280 stigma related to reporting and seeking treatment for mental health issues within the military
281 population (<http://www.apa.org/monitor/2009/06/stigma-war.aspx>). These messages should also
282 mitigate negative perceptions about the impacts of concussion disclosure on commissioning
283 and branching to the extent possible.

284 Our analysis of perceived social norms yielded important findings. While cadets felt their
285 environment and organization supported concussion disclosure, their perceptions of what they

286 see and expect from peers highlight that the perceived behaviors being modeled are still those
287 more aligned with non-disclosure. These data are similar to Kroshus et al¹³ that identified social
288 norm perceptions as key targets for consideration concerning concussion disclosure among
289 collegiate athletes. Additionally, perceived control over concussion disclosure was overall high,
290 indicating cadets feel a strong sense of personal agency in disclosing concussions. These data
291 are similar to data in both the high school²⁸ and collegiate athletic populations;¹ however, not
292 everyone reports feelings of high control. Overall control over concussion disclosure may be
293 influenced by various factors and may also be contextual in nature (when the injury occurs, who
294 is around, etc.). While not empirically studied, it is reasonable to believe that presence of a
295 medical professional is a key factor that may improve number of concussions reported and may
296 improve perceived control over disclosure.

297 In our multivariable model, perceived social norms and perceived control over disclosure
298 remained key influencers of disclosure intention. The finding concerning previous concussion
299 experience is similar to recent findings suggesting those with a previous history of concussion
300 have worse attitudes and are less likely to disclose subsequent injuries.⁴ While previous
301 concussion history is a non-modifiable factor, messaging can be tailored towards improving
302 perceptions that may reflect previous experience with both concussion and sport. One example
303 includes highlighting recent data suggesting delayed disclosure can lead to prolonged recovery
304 compared to reporting at the time of concussion.²⁹ In addition, clearly outlining the
305 organization's process for disclosure and care for concussion may improve expectations and
306 lead to increased reporting. Concussion-related knowledge, attitudes, perceived social norms,
307 and perceived control over disclosure behaviors are all modifiable factors that may be targeted
308 in educational and prevention initiatives via messaging, educational materials, conversations
309 with key social referents, and environmental cues. Previous studies related to behavior
310 modification highlight improvements in attitudes and knowledge can be obtained from such
311 intervention strategies.²⁵⁻²⁷

312 Military environments are characterized by a clearly-delineated chain-of-command
313 structure. In the service academy environment, military officers, upper-level classmates (cadre)
314 and fellow cadets all influence behavior. This hierarchical structure also provides a redundant
315 system in which multiple individuals may make decisions and raise concerns about concussion
316 and influence behaviors related to disclosure. As such, the chain-of-command plays a critical
317 role in any behavioral or educational intervention targeting social norms around concussion
318 disclosure. Recent efforts in the military to de-stigmatize behavioral and mental health issues
319 suggest changing norms and culture is possible through widespread education, access to
320 appropriate care, and chain of command involvement.³³ This suggests interventions to improve
321 concussion disclosure behaviors should target all levels of leadership throughout the
322 organization and emphasizes the importance of leadership support to the success of these
323 interventions. As stated, leaders may promote disclosure by providing support to concussed
324 cadets, encouraging individuals to take care of their brains and bodies following concussion,
325 and should they experience a concussion seeking appropriate medical care. Given the close
326 relationship of perceived social norms, perceived behavioral control, and intention to disclose,
327 these factors are key targets for intervention among the cadet population. Addressing one of
328 these factors, including the chain-of-command, will likely influence the others. These findings
329 can help focus efforts of concussion-related interventions in the cadet population.

330 Finally, high intention to disclose concussion symptoms was associated with improved
331 disclosure prevalence. While they are not the same construct, our findings support the use of
332 intention as proxy to understand concussion disclosure behaviors in the cadet population.
333 Intention is easily measure and can be used, as suggested by Kroshus et al⁵ as an outcome to
334 understand the influence of concussion-related interventions and programs.

335 This study was cross-sectional and did not measure serial changes in disclosure.
336 Sample size differed by outcome due to individuals with missing data. As with any survey, there
337 is potential for response and recall bias. We believe response bias was minimized given all

338 first-year cadets were approached with a response rate of 85%. Their perceptions will likely
339 change over their time and during their military career. Additionally, participants completed the
340 questionnaire in a classroom style setting, which may have influenced response. However,
341 knowing key intervention targets when individuals begin their military career offers the
342 opportunity for building a culture of disclosure throughout their time at the academy. Future work
343 should examine disclosure-related factors and interventions across cadets' time at the
344 academy. The current study did not separate disclosure behaviors for athletic vs. military
345 training concussions or types of concussion education. Future work should consider how these
346 contexts may influence disclosure. Finally, we assumed our main outcome of interest, intention
347 to disclose, was a reasonable proxy for actual disclosure behavior based on previous research.

348

349 **Conclusions**

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

358 **Practical Implications**

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

366 **References**

- 367 1. Kroshus E, Garnett B, Hawrilenko M, Baugh CM, Calzo JP. Concussion under-
368 reporting and pressure from coaches, teammates, fans, and parents. *Soc Sci Med*
369 1982. 2015;134:66-75. doi:10.1016/j.socscimed.2015.04.011
- 370 2. Register-Mihalik JK, Baugh CM, Kroshus E, Kerr ZY, Valovich McLeod TC. A
371 multifactorial approach to sport-related concussion prevention and education:
372 application of the Socioecological Framework. *J Athl Train*. 2017;52(3):195-205.
- 373 3. Register-Mihalik JK, Guskiewicz KM, McLeod TCV, Linnan LA, Mueller FO,
374 Marshall SW. Knowledge, attitude, and concussion-reporting behaviors among
375 high school athletes: a preliminary study. *J Athl Train*. 2013;48(5):645-653.
376 doi:10.4085/1062-6050-48.3.20
- 377 4. Register-Mihalik JK, Valovich McLeod TC, Linnan LA, Guskiewicz KM, Marshall
378 SW. Relationship Between Concussion History and Concussion Knowledge,
379 Attitudes, and Disclosure Behavior in High School Athletes. *Clin J Sport Med Off J*
380 *Can Acad Sport Med*. July 2016. doi:10.1097/JSM.0000000000000349
- 381 5. Kroshus E, Baugh CM, Daneshvar DH, Viswanath K. Understanding concussion
382 reporting using a model based on the theory of planned behavior. *J Adolesc Health*
383 *Off Publ Soc Adolesc Med*. 2014;54(3):269-274.e2.
384 doi:10.1016/j.jadohealth.2013.11.011
- 385 6. Chase RP, Nevin RL. Population estimates of undocumented incident traumatic
386 brain injuries among combat-deployed US military personnel. *J Head Trauma*
387 *Rehabil*. 2015;30(1):E57-64.
- 388 7. Fishbein M, Ajzen I. *Predicting and Changing Behavior*. New York: Psychology
389 Press; 2010.
- 390 8. Ajzen I. Construction of a theory of planned behavior intervention. 2002.
391 <http://www-unix.oit.umass.edu/~aizen/pdf/tpb.intervention.pdf>. Accessed April 4,
392 2007.
- 393 9. Montano DE, Kasprzyk D. Chapter 6 Theory of Reasoned Action, Theory of
394 Planned Behavior, and the Integrated Behavior Model. In: Glanz K, Rimer BK,
395 Viswanath K, eds. *Health Behavior: Theory, Research, and Practice*. 5th ed. San
396 Francisco, CA: Jossey-Bass; 2015:95-124.
- 397 10. McEachan R, Taylor N, Harrison R, Lawton R, Gardner P, Conner M. Meta-
398 Analysis of the Reasoned Action Approach (RAA) to Understanding Health
399 Behaviors. *Ann Behav Med*. 2016;50(4):592-612. doi:10.1007/s12160-016-9798-4
- 400 11. Webb TL, Sheeran P. Does changing behavioral intentions engender behavior
401 change? A meta-analysis of the experimental evidence. *Psychol Bull*.
402 2006;132(2):249-268. doi:10.1037/0033-2909.132.2.249

- 403 12. Sniehotta FF, Penseau J, Araújo-Soares V. Time to retire the theory of planned
404 behaviour. *Health Psychol Rev.* 2014;8(1):1-7. doi:10.1080/17437199.2013.869710
- 405 13. Kroshus E, Kubzansky LD, Goldman RE, Austin SB. Norms, athletic identity, and
406 concussion symptom under-reporting among male collegiate ice hockey players: a
407 prospective cohort study. 2015;49(1):95-103.
- 408 14. Triandis HC. Values, attitudes, and interpersonal behavior. In: Howe HE, Page,
409 eds. *Nebraska Symposium on Motivation.* Lincoln: University of Nebraska Press;
410 1980:195-259.
- 411 15. Ravis A, Sheeran P. Descriptive norms as an additional predictor in the theory of
412 planned behaviour: A meta-analysis. *Curr Psych.* 2003;22(3):218-233.
- 413 16. Bagozzi RP, Lee KH. Multiple routes for social influence: The role of compliance,
414 internalization, and social identity. *Soc Psych Quart.* 2002;65(3):226-247.
- 415 17. Triandis HC, Bontempo R, Villareal MJ, Asai M, Lucca N. Individualism and
416 collectivism: Cross-cultural perspectives on self-ingroup relationships. *J Pers Soc*
417 *Psychol.* 1988;54(2):323-338.
- 418 18. Montano DE, Kasprzyk D. Chapter 6 Theory of Reasoned Action, Theory of
419 Planned Behavior, and the Integrated Behavioral Model. In: Glanz K, Rimer BK,
420 Viswanath K, eds. *Health Behavior: Theory, Research, and Practice, 5th Edition.*
421 5th ed. San Francisco, CA: Jossey-Bass; 2015:95-124.
- 422 19. Marar M, McIlvain NM, Fields SK, Comstock RD. Epidemiology of concussions
423 among United States high school athletes in 20 sports. *Am J Sports Med.*
424 2012;40(4):747-755.
- 425 20. Rosenthal JA, Foraker RE, Collins CL, et al. National high school athlete
426 concussion rates from 2005-2006 to 2011-2012. *Am J Sports Med.*
427 2014;42(7):710-715.
- 428 21. Beachy G, Rauh M. Middle school injuries: a 20-year (1988-2008) multisport
429 evaluation. *J Athl Train.* 2014;49(4):493-506.
- 430 22. Schulz MR, Marshall SW, Mueller FO. Incidence and risk factors for concussion in
431 high school athletes, North Carolina, 1996-1999. *Am J Epidemiol.* 2004;160:937-
432 944.
- 433 23. Kerr ZY, Register-Mihalik JK, Kroshus E, Baugh CM, Marshall SW. Motivations
434 associated with nondisclosure of self-reported concussions in former collegiate
435 athletes. *Am J Sports Med.* 2016;44(1):220-225.
- 436 24. McCrea M, Hammeke T, Olsen G, Leo P, Guskiewicz K. Unreported concussion in
437 high school football players: implications for prevention. *Clin J Sport Med Off J Can*
438 *Acad Sport Med.* 2004;14(1):13-17.

- 439 25. Kerr ZY, Register-Mihalik JK, Kay MC, DeFreese JD, Marshall SW, Guskiewicz
440 KM. Concussion Nondisclosure During Professional Career Among a Cohort of
441 Former National Football League Athletes. *Am J Sports Med.* 2018;46(1):22-29.
442 doi:10.1177/0363546517728264
- 443 26. Fedor A, Gunstad J. Limited knowledge of concussion symptoms in college
444 athletes. *Appl Neuropsychol Adult.* 2015;22(2):108-113.
- 445 27. Kroshus E, Baugh CM. Concussion education in U.S. collegiate sport: what is
446 happening and what do athletes want? *Health Educ Behav.* 2016;43(2):182-190.
- 447 28. Register-Mihalik JK, Linnan LA, Marshall SW, Valovich McLeod TC, Mueller FO,
448 Guskiewicz KM. Using theory to understand high school aged athletes' intentions
449 to report sport-related concussion: implications for concussion education initiatives.
450 *Brain Inj.* 2013;27(7-8):878-886. doi:10.3109/02699052.2013.775508
- 451 29. Asken BM, McCrea MA, Clugston JR, Snyder AR, Houck ZM, Bauer RM. "Playing
452 Through It": Delayed Reporting and Removal From Athletic Activity After
453 Concussion Predicts Prolonged Recovery. *J Athl Train.* 2016;51(4):329-335.
- 454 30. Hoge CW, Ivany CG, Brusher EA, et al. Transformation of Mental Health Care for
455 U.S. Soldiers and Families During the Iraq and Afghanistan Wars: Where Science
456 and Politics Intersect. *Am J Psychiatry.* 2016;173(4):334-343.

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Table 1. Cadet Concussion Knowledge, Attitudes, and Perceived Norm Descriptive Statistics

Knowledge Constructs	n	Frequency correct (%)
<i>Signs & symptoms^a</i>		
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)
<i>Consequences of returning to play too soon^a</i>		
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^a		
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		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

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)

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

	Univariable				Multivariable (n=803)		
	n	PR	95% CI	p-value	PR ¹	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 ²	841	1.05	1.01, 1.10	0.024	1.02	0.97, 1.07	0.528
Attitudes ²	941	1.20	1.13, 1.37	<0.001	1.07	1.00, 1.16	0.045
Perceived Norms ²	922	1.37	1.27, 1.49	<0.001	1.28	1.16, 1.41	<0.001

¹PRs are adjusted for all other factors in the model. Changes in sample size reflect missing data.

²Continuous Scale. PR represents the effect of a 1-decile increase (change of +10%) on each scale in this population.