Anxiety-Related Concussion Perceptions of Parents of Youth Athletes

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1 **Context:** Parents are key decisionmakers for the health and wellness of their children.

2 Despite the benefits of engaging in physical activity, parental concerns about

3 concussion may create hesitancy towards sport participation. The magnitude of

4 concussion-related anxiety perceptions and factors that influence these beliefs in

- 5 parents of youth athletes are largely unknown.
- 6 **Objective:** To determine the prevalence of concussion-related anxiety perceptions in
- 7 parents of youth athletes and establish the associations among concussion-related
- 8 anxiety and demographic variables (i.e., parent sex, parent concussion history, child

9 concussion history, parent concussion education).

10 **Design:** Cross-sectional paper survey.

11 **Setting:** Youth sports.

12 **Patients or Other Participants:** 452 parents (60% female; mean age = 40.4±13.0

13 years) of youth athletes (8-14 years old) who participated in soccer, ice hockey,

14 lacrosse, and football (i.e., higher concussion risk sports) in Pennsylvania and Michigan.

15 Main Outcome Measures: Survey items were adapted from the Perceptions of

16 Concussion Inventory for Athletes (PCI-A) to pertain to perceptions about their child.

17 Parents also completed a demographic survey regarding concussion-related topics.

18 **Results:** Overall, 73.2% of parents found the possibility of their child sustaining a

19 concussion to be upsetting, 61.5% were fearful of their child sustaining a concussion,

and 45.1% reported that the thought of their child having a concussion makes them feel

21 anxious. Only 4.6% of parents suggested that concussions do not worry them. The lack

of a personal concussion history and being female were associated with greater

23 concussion-related anxiety in parents.

25	about their child sustaining a concussion, while also contributing to the understanding of
26	what factors are related to such anxiety (i.e., female parent; no parent history of
27	concussion). Negative parental concussion beliefs may contribute to the reduction in
28	contact sport participation and should be directly addressed in concussion education
29	specific to youth sport participation.
30	Keywords: brain injury; sport; youth athletics; anxiety; injury beliefs
31	Abstract Word Count: 300
32	Manuscript Word Count: 4714
33	Key Points:
34	A significant proportion of parents of youth athletes in this study reported being
35	fearful, upset, worried, and anxious at the thought of their child sustaining a
36	concussion.
37	Greater parental concussion-related anxiety perceptions were significantly
38	associated with being female and lacking a personal history of concussion.
39	Athletic trainers should validate and address concussion-related anxiety
40	perceptions as part of their pre-injury awareness and post-injury management
41	approaches specific to youth sport participation.
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Conclusions: This study provides evidence that parents of youth athletes have anxiety

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46 Concussion has been recognized as a public health concern, particularly within 47 the youth sports community. Prior research shows that early participation in contact sports, such as football and ice hockey, result in greater risk of traumatic brain injuries 48 in young athletes.¹ Approximately 1 to 2 million concussions occur annually in children.² 49 though this is likely an underestimate due to the absence of sports medicine coverage 50 in youth sports and failure to seek outside care. Given the insufficient resources 51 52 available to this age group, the burden of injury identification and immediate management often falls onto parents. Although prior research suggests that parents 53 have moderate concussion knowledge,^{3,4} they may not be equipped to accurately 54 understand all of the nuances of this invisible injury.^{4,5} Despite the well-documented 55 physical and mental health benefits of playing a sport, parental concerns about the lack 56 of medical involvement, knowledge and misconceptions of concussion,⁶ and the 57 potential long-term effects of injury⁷ creates hesitancy towards youth sport participation. 58 Anxiety can be characterized as negative thoughts or emotions related to 59 potential, upcoming events.⁸ Both parent and child history of anxiety is linked to longer 60 recovery times for children with concussion.⁹ However, few studies have examined 61 parents' worry about the potential for future concussion, or what we characterize as 62 concussion-related anxiety. In a nationally representative sample of over 1,000 parents 63 from the general population, Kroshus and colleagues¹⁰ found that over half of parents 64 are worried (28%) or very worried (23%) about concussion. Parents of youth athletes, 65 however, may experience comparatively higher rates (>70%) of concussion-related 66 anxiety.¹¹ In fact, parents have expressed more concern about concussion than 67 smoking, drug use, depression, and unplanned pregnancy;¹⁰ thus, parents experience 68

70 future. Few studies have explored factors that may influence this preemptive concussion-related anxiety, particularly among youth athletes and their parents. 71 Kroshus and colleagues¹⁰ found that less education, lower socioeconomic status, 72 and identifying as either Hispanic or Black were independently related to greater 73 74 concern about concussions in parents. However, there may be additional factors to 75 consider when understanding parents' concerns and perceptions of concussion and concerns regarding the injury. The literature is split regarding sex differences in 76 concussion perceptions for parent and collegiate athlete samples.^{10,12} Further 77 investigation is needed as sex differences are commonly observed in relation to parent 78 anxiety in general. Mothers typically experience higher levels of parent anxiety than 79 fathers regardless of whether the child is experiencing illness or injury, or is in good 80 health.¹³ Another factor that may inform parent concussion-related anxiety is history of 81 concussion. Parental or child history of concussion is associated with improved parent 82 concussion knowledge and care seeking behaviors.^{14,15} Researchers have suggested 83 that concussion education may lessen concussion anxiety of parents.⁵ This assertion 84 would be consistent with existing health literature as educational programs have been 85 shown to effectively diminish parent anxiety related to fever¹⁶ and surgery,¹⁷ though 86 more research is needed in the context of pediatric concussion. 87

considerable worry about the potential for their child to sustain a concussion in the

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Collectively, prior work suggests there is limited understanding of concussionrelated anxiety in parents of youth athletes and an appreciation of factors influencing these perceptions is needed to create intentional awareness procedures. This information may be useful for athletic trainers who are frequently on the front line of

92 concussion education delivery, injury identification, and post-injury management for 93 young athletes within the communities they serve. The purpose of this study was to describe the prevalence of concussion-related anxiety perceptions in parents of youth 94 95 athletes. We hypothesized that a majority of parents would exhibit concussion-related 96 anxiety perceptions. Our secondary purpose was to establish the associations among 97 concussion-related anxiety and demographic variables including sex (male vs. female), personal concussion history, child concussion history, and previous concussion 98 education. We hypothesized that female sex, personal or child concussion history, and 99 no prior concussion education/training would be associated with perceptions of anxiety 100 regarding concussion. This investigation will provide athlete trainers with essential 101 knowledge regarding parents' feelings and perceptions of concussion that they can 102 103 leverage to advance their delivery of psychologically informed care for this invisible 104 injury.

105 Methods

106 Participants

We acquired the present data as part of a larger cross-sectional study¹⁸ 107 (CITATION BLINDED FOR REVIEW) investigating parent and youth athlete concussion 108 109 knowledge, perceptions, and reporting behaviors. The participants of this study included 110 a convenience sample of parents or legal guardians, hereafter referred to as "parents," 111 of male and female youth athletes 8 to 14 years of age. Participants were widely 112 recruited from youth football, ice hockey, lacrosse, and soccer teams and organizations within the western Pennsylvania and mid-Michigan regions. We specifically targeted 113 these sports due to their higher concussion injury rates.¹⁹ as well as their popularity 114

within the geographical locations proximal to the research team that supported thesuccessful implementation of our on-site data collection strategy.

117 Instrumentation

118 The larger investigation utilized parent and youth athlete surveys to capture outcomes, but only parental responses were considered for this study. The parent 119 survey included demographic items, such as respondent sex (male/female), their own 120 121 history of diagnosed sport-related concussion (yes/no), if any of their children had a history of diagnosed sport-related concussion (yes/no), and if the responding parent 122 previously had participated in formal concussion education (yes/no). We assessed 123 perceptions of parental anxiety regarding concussion through 26 items modified from 124 the Perceptions of Concussion Inventory for Athletes (PCI-A),²⁰ which is an injury-125 specific adaptation of the Illness Perceptions Questionnaire-Revised.²¹ The PCI-A was 126 previously administered to a collegiate athlete sample, which established six distinct 127 perception factors (i.e., Anxiety, Effects, Clarity, Treatment, Control, and Symptom 128 Variability).²⁰ For the parent version, we modified the PCI-A to frame items relative to 129 the prospect of their child sustaining a concussion. The parent PCI-A was evaluated for 130 face validity by three concussion content experts external to the research team and 131 construct validity and internal consistency were established. The modifications resulted 132 in a 7-factor structure which included Anxiety, Clarity, Treatment, Symptom Variability, 133 Permanent Injury, Affect Others, and Long-term Outcomes.²² The resulting Cronbach 134 alpha for the parent PCI-A was 0.75 for all items.²² 135

For this investigation the primary PCI-A outcomes of interest were the Anxiety
items, which included 1) The possibility of my child sustaining a concussion is *upsetting*,

2) I am *fearful* of my child sustaining a concussion, 3) The thought of my child having a
concussion makes me feel *anxious*, and 4) Concussions do not *worry* me (reverse
scored). Each item was scored on the same 5-point Likert scale from 1 (strongly
disagree) to 5 (strongly agree). In addition to considering each anxiety item individually,
we also computed an anxiety composite sum score (20 points possible) with a higher
score denoting increased anxiety concussion perceptions.²⁰

144 Data Collection Procedures

Institutional Review Board approval for the study was obtained from Duquesne 145 University. Data collection occurred from 2017 through 2019. We first conducted 146 general internet searches to identify youth football, ice hockey, lacrosse, and soccer 147 organizations and teams within the western Pennsylvania and mid-Michigan regions 148 149 that served youth athletes within the study's target age range of 8-14 years. We then broadly emailed or called the identified youth sport organizations and teams to inform 150 them of our study and solicit their interest in participating. After obtaining organizational 151 152 permission, we then coordinated with individual teams to attend practices or competitions to recruit participants and distribute the survey instrument. After acquiring 153 signed informed consent for participation from parents and child assent, members of the 154 research team implemented the data collection procedures. Parents and youth athletes 155 completed independent paper and pencil surveys to ensure separate completion of the 156 157 guestions, however, this investigation only included the parental survey responses. The survey took approximately 15 to 20 minutes to complete. Trained research assistants 158 159 entered all paper and pencil survey responses into Qualtrics (Provo, Utah, USA) by 160 participant code number to create a master data spreadsheet.

161 Statistical Analyses

162 We completed descriptive statistics to display participant demographics and 163 summarize the parent-modified PCI-A Anxiety items (i.e., upset, fearful, anxious, 164 worried). We tested internal consistency of the Anxiety items using Cronbach's alpha, 165 with scores closer to 1 indicating the included items measure a similar construct. A 166 dichotomous agreement variable was also created for the anxiety outcome measure. A categorical score of 1 was assigned when the participant agreed with the statement by 167 indicating agree or strongly agree for the item. A score of 0 was assigned for the item 168 when the participant did not select a response option that indicated agreement with the 169 statement (i.e., neither, disagree, strongly disagree). 170 Using the constructed dichotomous agreement variables for each item 171 172 (agreement: 1, no agreement: 0), we conducted separate univariate logistic regression to estimate odds ratios (ORs) the association between agreement relative to no 173 agreement with each of the four individual anxiety items and the anxiety composite and 174 1) female relative to male; 2) no personal concussion history relative to one or more 175 prior concussions; 3) no child with a concussion history any child with one or more prior 176 concussions; and 4) previous concussion education relative to no previous education. 177 Then, separate multivariable logistic regressions were performed to determine ORs 178 between significant univariate factors and agreement with each of the five anxiety items. 179 180 Significance of the logistic regressions was established by considering 95% confidence intervals for point estimates exclusive of 1. Separately, the association between the 181 182 composite anxiety score and significant factors was evaluated by completing a 183 multivariable linear regression using the significant variables determined in the

univariable logistic regressions, and report the R² and tested for multicollinearity using

the variance inflation factor. Significance for the multivariable model with 95%

186 confidence was established when the confidence intervals for point estimates excluded

187 0. All analyses were completed in STATA (Statacorp, version 17.0; College Station,

188 TX).

189 Results

190 Participant Characteristics

A total of 490 parents started the survey and, of those, 452 completed all items 191 necessary to answer the research questions indicating a 92.2% response completion 192 rate. The average age of parent participants was 40.4 ± 13.0 years (median: 43 years; 193 25th percentile: 38 years, 75th percentile: 47 years) with over half identifying as female 194 (60.3%, n = 272/451; see Table 1). Approximately 11.2% (n = 50/446) of parents 195 reported a personal diagnosed sport-related concussion history and 17.5% (n = 78/446) 196 reported that at least one of their children had a history of one or more diagnosed sport-197 related concussions. Additionally, 36.6% of parents (n = 164/448) indicated receiving 198 formal concussion education in the past. 199

200 PCI-A Anxiety Item Characteristics

Overall, 73.2% (n = 331) of parents agreed or strongly agreed that the possibility of their child sustaining a concussion is upsetting, 61.5% (n = 278) were fearful of their child sustaining a concussion, 45.1% (n = 204) reported that the thought of their child having a concussion makes them feel anxious. Only 4.6% (n = 21) agreed or strongly agreed that concussions do not worry them. The median anxiety composite score was 15 (interquartile range [IQR]: 13, 17) overall, 16 (IQR: 13, 28) for females, and 14 (IQR: 12, 16) for males. Table 2 presents descriptive information for each anxiety perception
item, and Figure 1 displays the sample's level of agreement for each item. The internal
consistency of the four anxiety items was alpha = 0.8457, suggesting the items similarly
measured the construct of anxiety.

211 Factors Associated with PCI-A Anxiety Item Agreement

212 Univariate logistic regressions revealed female parents relative to male parents 213 had greater odds of being upset (OR: 1.91, 95% CI: 1.25, 2.92), fearful (OR: 2.01, 95% CI: 1.36, 2.96), and anxious (OR: 2.19, 95% CI: 1.49, 3.25) perceptions of their child 214 sustaining a concussion. Separately, females (OR: 0.31, 95% CI: 0.12, 0.79) had lower 215 odds of expressing concussions "do not worry" them relative to males. Parents without a 216 personal diagnosed concussion history had greater odds of being upset (OR: 2.49, 95% 217 CI: 1.36, 4.56), fearful (OR: 2.08, 95% CI: 1.14, 3.76), or anxious (OR: 2.92, 95% CI: 218 1.48, 5.76) relative to parents that had sustained a concussion previously. Figure 2 219 displays univariate odds ratios for each anxiety item for each factor. Based on 220 221 independent associations, we included these significant factors in the separate multivariable models. The multivariable logistic regression models included all the 222 individual anxiety factors that were significant from the univariate logistic regressions 223 224 (Figure 3). In the final multivariable linear model for overall concussion anxiety perceptions, being female (1.26, 95% CI: 0.67, 1.84) and having no personal history of 225 226 concussion (1.35, 95% CI: 0.44, 2.26) were associated with a higher anxiety perception composite score (F(2, 422) = 15.32; $P \le .001$, R2 = 0.06). 227

228 Discussion

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229 Our study findings align with prior research that has documented parents of 230 youth athletes have significant concerns about concussion. Our hypothesis that at least 231 50% of our sample would have concussion anxiety perceptions was supported as the 232 majority of parents reported that they were upset, fearful, or worried by the thought of 233 their child sustaining a concussion. Results regarding our second aim revealed that 234 parents who were female and those who had not personally sustained a diagnosed 235 concussion had greater odds of experiencing concussion-related anxiety. Overall, these findings show the potential emotional burden that parents experience related to 236 concussion and their child even prior to the occurrence of an injury. The notable parent 237 concussion-related anxiety demonstrated in this study should be considered by athletic 238 trainers as part of their psychologically-informed concussion management practices for 239 240 youth athletics. This could include directly acknowledging and discussing common 241 parental concussion concerns during an educational session or intentionally asking parents if they are feeling concussion-related anxiety and what apprehensions they may 242 243 have regarding their child's concussion as part of post-injury communications. In both approaches, athletic trainers, neuropsychologists, researchers, and public health 244 officials should work collaboratively to lessen parent concussion-related anxiety by 245 246 discussing the multi-faceted benefits of sport participation as well as transparently 247 educating parents on the current state of research regarding persisting and long-term 248 issues related to concussions and head impacts.

At least one negative emotional perception regarding concussion was reported by approximately 75% of parents in our sample. The highest prevalence of agreement among the individual anxiety perception items was related to parents being upset or

252 worried about their child sustaining a concussion. The lowest prevalence of agreement, 253 while still substantial at 45%, was for the item related to feeling anxious. Our multi-sport findings align with and expand upon previous soccer-specific studies that found parents 254 believe a concussion is a serious injury that may lead to permanent damage⁶ and are 255 concerned about their child sustaining a concussion.¹¹ Additionally, the percentage of 256 parents of youth athletes who reported concussion concerns in our study was 257 258 approximately 25% greater than what was found in a previous investigation of parents from the general population.¹⁰ This difference could be due to a number of factors, such 259 as the numerous mainstream media stories specifically about sport-related 260 concussions, the inherent risk for sustaining an injury while participating in sports, or an 261 increased exposure to vicarious concussion occurrences and experiences through 262 individuals within athletic teams or youth sport environments. Overall, our study 263 expanded upon the earlier work in soccer to include additional sports (i.e., football, 264 lacrosse, ice hockey) and found similar results regarding the magnitude of negative 265 emotional perceptions related to concussions. Together, these findings suggest that 266 parents of youth athletes are likely to experience concussion-related anxiety which 267 warrants intervention. 268

This trend of concussion-related anxiety among parent of youth athletes may have major implications for youth sports. There has been a steady decrease in tackle football participation in recent years,²³ which experts attribute, in part, to the rise in concussion knowledge and spread of information via mainstream media.²⁴ Furthermore, approximately 45% of parents of youth soccer athletes have considered not allowing their children to play soccer due to fears their child may experience a concussion.⁶

275 Parents who had personally suffered a concussion were less likely to allow their children to participate in football and ice hockey,²⁵ which are sports that are notorious 276 for collisions and higher concussion incidence rates.²⁶ Although parental concerns 277 278 about concussion are understandable, the advantages of early and consistent 279 engagement in physical activity and organized sport must also be considered. For children, sport participation provides both physical (e.g., lower obesity risk, improved 280 281 motor skills, increased bone density) and psychological (e.g., better self-esteem, less depression, improved socialization skills) benefits. Youth sport participation even has 282 long-term benefits as it is known that adolescent sport involvement is related to a more 283 active lifestyle that acts as a protective mechanism against chronic diseases later in life 284 (e.g., cardiovascular disease, type-2 diabetes).²⁷ During athlete and parent concussion 285 education, athletic trainers should deliver a balanced message highlighting the above 286 benefits of sport participation while noting that there is inconsistent evidence at this time 287 regarding the relationship between contact sport participation and the development of 288 neurological diseases (e.g., chronic traumatic encephalopathy^{28,29}). Further, it may also 289 be helpful to identify sports with higher (i.e., rugby, ice hockey, football, lacrosse, 290 soccer, wrestling) versus lower (i.e., volleyball, field hockey, baseball, softball, 291 basketball) concussion incidence rates¹⁹ as part of concussion education. Providing this 292 293 information comprehensibly may aid families in choosing a sport for their child to engage in that aligns with their personal concussion risk tolerance and increase their 294 overall awareness that there is a greater inherent risk of sustaining an injury in sports 295 with more physical contact. 296

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297 In addition to sport participation decisions, concussion-related anxiety of parents 298 may also be related to post-injury outcomes. A previous study found that 4 in 10 parents 299 reported moderate to severe stress following their child's concussion and this heightened stress response was related to increased recovery time.³⁰ Children whose 300 parents experienced higher post-injury stress took approximately two weeks longer to 301 302 recover than children whose parents had low stress, even after controlling for initial post-injury symptom scores.³⁰ In contrast, Zemek and colleagues³¹ did not find that 303 parent anxiety measured during acute concussion presentation at an emergency 304 department was related to the persistence of symptoms following a concussion in 305 children. However, parent anxiety was higher in those whose children were still 306 experiencing symptoms at one-month post-injury compared to those whose children 307 had already reached symptom resolution. Future research is needed to better 308 understand the relationships among parental stress and anxiety and clinical outcomes 309 for the injured child. It remains possible bidirectional pathways may exist between 310 parent concussion-related anxiety and stress and child outcomes post-concussion. 311 Parents have reported during interview that their stress level was directly related to their 312 child's stress level, post-injury symptoms, and overall functioning.³⁰ These previous 313 studies focused on indicators of parental stress and anxiety post child,^{30,31} whereas our 314 315 study took a much broader approach to measuring the parental emotional burden of 316 concussion (e.g., upset, fearful, anxious, worried) in the absence of an injury. More 317 research is needed to learn how pre-morbid parent concussion-related anxiety versus post-injury parent concussion-related anxiety is related to post-concussion assessment 318

outcomes and recovery milestones in children, which may have important implicationsfor concussion education and management strategies.

321 In order to gain an appreciation for factors that may influence parental 322 concussion beliefs, our study explored the relationship between parent sex and 323 concussion-related anxiety. We found that parents who identified as female reported 324 more concussion-related anxiety. This result is congruent with extant literature 325 indicating that women have a greater lifetime prevalence of anxiety and mood disorders compared to men which may be attributed to a combination of various factors including 326 genetic, environmental, neurodevelopmental, and neurobiological differences.^{32,33} 327 Therefore, one might expect increased risk of anxiety to extend to a specific health-328 related construct, such as concussion. Evidence of this has been documented within the 329 330 concussion literature. Two previous investigations have reported higher general concussion anxiety in healthy female collegiate athletes compared to their male 331 counterparts.^{12,34} Additionally, following a concussion, adolescent female athletes have 332 reported greater anxiety- and emotion-related symptoms than male athletes.³⁵ Finally, 333 mothers of youth soccer players perceived concussion to be more harmful than did 334 fathers in one previous investigation,³⁶ which could be related to the parental male and 335 female injury anxiety differences we observed in this study. The sex-based findings 336 regarding concussion-related anxiety perceptions from this study can be used by 337 338 athletic trainers to tailor their injury education and communications based upon the gender identity of the target audience. Although emotions are highly individualized, our 339 findings suggest that female parents may need more concussion-related support. For 340 341 example, when notifying a mother that her child sustained a concussion, an athletic

trainer can proactively provide information that normalizes the presence of concussion
anxiety perceptions in parents and afford them the opportunity to express their own
concerns.

345 In addition to parent sex, we also considered whether child or personal 346 concussion history were related to concussion-related anxiety perceptions in parents. 347 Although we hypothesized that both child and parent concussion history, respectively, would be related to greater parental concussion-related anxiety, we found that parent 348 concussion history was related but child concussion history was not. Specifically, 349 parents who had not personally sustained a concussion in the past had greater odds of 350 reporting being upset, fearful, or anxious at the thought of their child sustaining a 351 concussion. This finding regarding parental personal concussion history may be 352 353 grounded in evolutionary psychology models regarding the fear of the unknown and the Uncertainty and Anticipation Model of Anxiety.³⁷ Individuals are inherently averse to 354 unknowns, and it is theorized that fear of the unknown is significant to the development 355 of neuroticism,³⁸ which is a personality trait characterized by anxiety, emotional 356 instability, and depression.³⁹ The Uncertainty and Anticipation Model of Anxiety goes 357 further to describe that negative reactions to uncertainty supports maladaptive 358 359 responses to unknowns, which may include "inflated estimates of threat cost improbability, hypervigilance, division safety learning, behavioral and cognitive 360 avoidance, and heightened reactivity to threat uncertainty."³⁷ Compared to 361 362 musculoskeletal injuries in sport that have external tissue damage that follows a 363 predictable process of healing, concussions tend to be more mysterious and 364 challenging to comprehend given their internal nature, uniqueness of clinical

presentation, and variation in recovery patterns. For someone who has never sustained this injury and experienced the recovery process before, it is understandable that the fear of the unknown and anticipatory anxiety may be present. Thus, parental personal concussion history is yet another factor that athletic trainers can inquire about to inform their post-injury education and management approaches for a youth athlete who sustained a concussion with the knowledge that those who have not personally experienced this injury before may require or benefit from additional injury counseling

and support.

373 Implications for Practice

Athletic trainers are an essential element in community-based healthcare for 374 adolescent athletes as they are allied healthcare professionals that provide on-site care 375 for emergent and non-emergent injuries and illnesses. Due to the nature of their 376 healthcare practice, athletic trainers are often the first individuals to directly identify or 377 be alerted by others that a concussion was sustained by an athlete, are a primary 378 source of healthcare information for their patients, and facilitate post-injury care in a 379 school-based setting. We did not focus on secondary school sports specifically in this 380 investigation. However, the results of this study may be helpful to athletic trainers 381 382 interacting with parents of athletes fitting within our target age range of 8-14 years old which corresponds to those in the 3rd through 9th grades. The recent emphasis on 383 psychologically-informed practices for sports injury management⁴⁰ encourages athletic 384 trainers to consider a broad range of factors within the biopsychosocial model⁴¹ 385 spanning multiple levels of the public health socioecological framework.⁴² These care 386

concepts are part of the central structure of the World Health Organization's
International Classification of Functioning, Disability, and Health.⁴³

389 Our findings regarding parental concussion anxiety perceptions can be 390 understood in the context of a social relationship (i.e., parent-child) that exists within the interpersonal level of the socioecological framework.⁴² Parents are a significant 391 interpersonal stakeholder in concussion management given their pivotal role in making 392 393 sport participation and healthcare decisions for their pediatric and adolescent dependents. As such, parental concussion education has been proposed as a primary 394 strategy for athletic trainers to address this level of the socioecological model.⁴² This 395 education must include accurate and specific health information provided in a format 396 that can be successfully received and easily interpreted by parents in order to support 397 the development of health literacy that facilitates their abilities to identify their child 398 sustained a concussion and seek care from a qualified healthcare provider. 399 Aligned with this guidance, we recommend that athletic trainers consider the 400 401 findings of this study in their delivery of preseason parent-team concussion education meetings and post-concussion anticipatory guidance to athletes and their families. As 402 part of their psychologically-informed concussion practices, athletic trainers should seek 403 to validate and normalize the presence of negative injury perceptions of parents, ask 404 follow-up questions to better understand these emotion-related perceptions, determine 405 406 the root mechanism(s) of these beliefs, and respond with scientifically-based information to address the specific concerns of the athletes and their family members. 407 Additionally, future concussion awareness campaigns for youth sports should include 408 409 more information regarding proper immediate management, advances in post-injury

410 treatment options, and the current state of research regarding long-term brain health, 411 concussion, and sport participation. Further, athletic trainer communications with youth 412 sport stakeholders should seek to magnify the positive health benefits associated with 413 sport engagement while also encouraging the proactive adoption of concussion injury 414 prevention and head impact mitigation strategies. Given the unique nature of parent-415 child relationships, it may be worth exploring the development of interactive familyfocused concussion education intervention programs that can be adapted and 416 implemented by athletic trainers to meet the unique needs of different youth sport 417 418 populations.

419 Limitations

This was a cross-sectional study limited to parents of healthy youth athletes from 420 two locations within the United States. Our findings do not fully capture the robust 421 nature of the lived experience of parents of youth athletes regarding this injury beyond a 422 single moment in time. Based upon the convenience sampling method used, we are 423 424 unable to accurately determine a study participation rate or how many individual sport organizations/teams participated. Further, the concussion-related anxiety perceptions 425 found in this study may not be generalizable to parents of non-contact sport athletes 426 427 and those whose children participating in youth sports in different geographical areas of the country and world. Due to the survey-based methodology we used, outcomes were 428 429 also subject to response and recall bias as we relied on participants to truthfully complete each perception item and accurately report previous concussion history for 430 431 themselves and their child. In addition, we did not account for child's sex was 432 unaccounted for in the analysis, which may influence the likelihood of allowing certain

433 sport participation (e.g., football is largely includes male athletes). Thus, parents with 434 only female child(ren) may not think football is an option for their child(ren) so their 435 perceptions of anxiety may be different than that of parents with a male child. Lastly, our 436 sample lacked diversity in respondents' racial and ethnic identity; therefore, there are 437 additional cultural and environmental factors that could impact injury beliefs that were 438 not considered in this investigation. Future research is also needed to assess 439 concussion-related anxiety perceptions in different populations and identify how parent injury beliefs relate to those of their child. Understanding the unique injury perceptions 440 of different groups of people and the mechanisms that underly their beliefs is central to 441 the development of future equitable, concussion practices that meet the needs of the 442 diverse patient populations that athletic trainers serve. Additionally, examining anxiety 443 444 perceptions following a concussion is also necessary to expand our understanding of the psychological response to this injury for both the patient and their key stakeholders. 445

446 Conclusions

Overall, the results of our study suggest that a significant portion of parents of 447 youth athletes exhibit feelings of being fearful, upset, worried, and anxious at the 448 thought of their child sustaining a concussion. Additionally, parental concussion-related 449 anxiety perceptions in our sample were significantly associated with being female and 450 451 lacking a personal history of concussion. These negative emotions regarding 452 concussion should be considered and addressed when developing and implementing awareness approaches specific to youth sport participation. Given their important role in 453 454 pre-injury and post-injury concussion education for youth athletes and their families, we 455 recommend that athletic trainers directly acknowledge that a concussion is a concerning

- 456 injury that may invoke a number of negative emotions while also providing scientifically-
- 457 based information regarding proper immediate management, post-injury care and
- 458 treatment options, and the potential protracted outcomes associated with concussion
- and sport participation. Further investigation into how parent concussion-related anxiety
- 460 perceptions relates to concussion recovery in youth athletes is warranted.

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Table	1.	Parent	Demog	yraphics

	n	%	
Sex (n = 451)			
Female	272	60.3	
Male	179	39.7	
Race/Ethnicity (n = 450)			
White, Non-Hispanic	418	92.9	
Black, Non-Hispanic	8	1.8	
Asian	13	2.9	
Hispanic Latino	8	1.8	
Other	3	0.7	
Parent/Personal Concussion History (n = 446)			
Yes	50	11.2	
No	396	88.8	
Child Concussion History (n =446)			
Yes	78	17.5	
No	368	82.5	
Received Concussion Education (n = 448)			
Yes	164	36.6	
No	284	63.4	

Table 2. Parent Prevalence of Perceptions of Concussion Inventory for Athletes (PCI-A) Anxiety Factor Structure Items

PCI-A Anxiety Items ^a		SD	Median	IQR	Agreement ^b	
					n	%
The possibility of my child sustaining a concussion is <i>upsetting</i> .	3.9	0.9	4	(3, 5)	331	73.2
I am <i>fearful</i> of my child sustaining a concussion.	3.6	1.0	4	(3, 4)	278	61.5
The thought of my child having a concussion makes me feel anxious.	3.3	1.0	3	(3, 4)	204	45.1
Concussions do not <i>worry</i> me. ^c	2.0	0.8	2	(1, 2.5)	5	4.7
Composite score ^d	14.9	3.1	15	(13, 17)		

Notes. SD, standard deviation; IQR, interquartile range

^a Each item was scored on the same 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

^b A dichotomous agreement variable was also created for each anxiety outcome measure. A categorical score for agreement was assigned when the participant agreed with the statement by indicating agree or strongly agree for the item.

^c Indicates negatively worded item reverse scored for composite score.

^d Computed an anxiety composite sum score (20 points possible) with a higher score denoting increased anxiety concussion perceptions.



Figure 1. Percent of parental agreement or disagreement with anxiety perception items. ^a Indicates negatively worded item (i.e., reverse scoring).



Figure 2. Univariate logistic regression displaying the odds ratio for each anxiety item by each factor. Females had greater odds of feeling upset, fearful, or anxious, and lower odds of worry. Parents without a concussion history had greater odds of feeling upset, fearful, or anxious. ^a No child concussion history was excluded from the figure for the "Concussions do not worry me" item due to large confidence intervals (CI) and should be interpreted with caution (OR: 4.19, 95% CI: (0.55, 37.79).

Figure 3. Multivariable logistic regression displaying odds ratio for each anxiety item informed by significant univariate factors. Females exhibited higher odds of feeling upset, fearful, or anxious when adjusting for personal concussion history relative to males. Females exhibited lower odds of concussion worry relative to males.

