

SOMATIZATION IN ADOLESCENTS WITH PERSISTENT POST-CONCUSSIVE
SYMPTOMS: A RETROSPECTIVE CHART REVIEW

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Somatization in adolescents with persistent post-concussive symptoms: a retrospective chart review

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ABSTRACT

Background: Approximately 30% of adolescents who sustain a concussion experience related symptoms that persist beyond one month post-injury, affecting everyday functioning, developmental achievements, and quality of life. Somatization, the process whereby psychological distress is expressed as unintentionally produced physical symptoms, may relate to and maintain persistent post-concussive symptoms in some adolescents. However, effectively identifying somatization in adolescents with persistent post-concussive symptoms is challenging due to ambiguity about factors that specifically characterize the issue, such as symptoms, impairment levels, premorbid experiences, mental health and medical service use.

Objective: To describe the characteristics of somatization in adolescents with persistent post-concussive symptoms and compare outcomes in adolescents with persistent post-concussive symptoms unaffected by somatization.

Methods: This study involved a review of medical records of adolescents referred to a tertiary care interdisciplinary concussion clinic between January 2016 and May 2018. Information on demographics and injury characteristics, post-concussive symptoms, mental health, medical service use, and school attendance was extracted from charts. Those with physician-identified somatization were compared to those without physician-identified somatization.

Results: Compared to those unaffected by somatization, adolescents with somatization reported more severe and unusual post-concussive symptoms, demonstrated that they had more post-injury impairment in school attendance, were more likely to have a history of premorbid chronic pain or medically unexplained symptoms, obtained more neuroimaging after injury, and obtained more health care after injury.

Conclusions: Adolescents with persistent post-concussive symptoms affected by somatization differed in their experience of post-concussive symptoms, illness behaviours, and pre-morbid history compared to those unaffected by somatization. These findings should help improve clinical identification of somatization in youth following a concussion, and subsequently the referral of affected youth to effective mental health services.

LAY SUMMARY

After a mild head injury, also known as concussion, symptoms usually last for a few weeks, but some teenagers have symptoms that last for months to years. Somatization, when emotions affect physical health, may increase how long symptoms last. Identifying and treating somatization is important because otherwise concussion symptoms might not go away, getting in the way of a teenager's activities, growth, and well-being. This study assessed teenagers seen at a concussion clinic at GF Strong Rehabilitation centre, and described how those with somatization differed from those without. Teens with somatization had more severe and unusual symptoms, were more likely to have a history of chronic pain or medically unexplained symptoms, and after their concussion, used more medical services, and were more likely to be out of school compared to those without somatization. This is the first step towards helping doctors better identify somatization in teenagers with long-lasting concussion symptoms.

PREFACE

This work was conducted at the GF Strong Rehabilitation Centre in Vancouver, BC, and was approved by the UBC Clinical Research Ethics Board (H17 – 03366). My supervisors, Dr. Amrit Dhariwal and Dr. Tim Oberlander, and my supervisory committee members, Dr. Andrea Chapman, Dr. Jacqueline Purtzki, and Dr. Noah Silverberg, and myself collaboratively developed the study design, based on an idea put forward by Dr. Purtzki. I developed a data extraction tool, extracted chart data, processed and analyzed the data, and am the primary author of this document. All supervisors and committee members provided valuable feedback on the interpretation of results, and on the written document. A manuscript based on this work is being prepared for submission for peer review.

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LIST OF ABBREVIATIONS

AC3	Adolescent Complex Concussion Clinic
ADHD	Attention Deficit Hyperactivity Disorder
KADS	Kutcher Adolescent Depression Scale
PROMIS	Patient Reported Outcomes Measurement Information System (PROMIS) Pediatric Anxiety Symptom Scale
RPQ	Rivermead Post-Concussion Symptom Questionnaire

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This work is dedicated to youth with confusing physical symptoms, in search of answers.

I. BACKGROUND

Concussion, a form of mild traumatic brain injury, is a prevalent health concern among adolescents.¹ While many adolescents fully recover from their concussion within the first two to four weeks, roughly 30% of adolescents experience symptoms that persist beyond one month post-injury.² These persistent post-concussive symptoms, which include symptoms such as headache, dizziness, and fatigue, can last for months to years, leading to decreased physical, emotional, and social functioning, and lower overall quality of life.^{3,4}

It remains unclear why some adolescents develop these persistent symptoms after concussion while others do not. A number of patient, injury, and environmental variables have been considered as possible risk factors for persistent post-concussive symptoms.⁴ Among these factors, pre-injury mental health concerns have emerged as some of the most robust predictors of prolonged recovery from concussion in both pediatric and adult populations.⁵ Until recently, research in this area has focused on mental health concerns such as anxiety, depression, and post-traumatic stress disorder, however, mounting evidence suggests that other mental health concerns, such as somatization, may also play a role in prolonged recovery from concussion.⁶⁻⁸

Somatization is the process whereby psychological stress is experienced in the form of unintentionally produced physical symptoms.⁹ These symptoms can occur in the absence of organic pathology, or in combination with a medical concern, exacerbating and prolonging pre-existing symptoms.¹⁰ Unlike anxiety or depression, in which emotional distress is usually acknowledged and articulated by the sufferer, with somatization adolescents may be more likely to experience and communicate physical discomfort instead of emotional distress.¹¹ If left

untreated, somatization can lead to chronic symptoms with negative long-term implications for an adolescent's academic and social functioning, quality of life, development, and mental health.^{12,13}

Due to the physical symptoms of somatization, affected adolescents often spend less time at school and in other social settings which help facilitate normal emotional and social development.^{13,14} At the same time, they often spend more time as a patient in medical settings, trying to make sense of their symptoms, during a developmental period characterized by identity exploration and formation.¹³ The search to find answers and relief from symptoms also puts affected individuals at risk for undergoing unnecessary medical investigations and procedures, which can have a negative impact on their health.¹⁵ Adolescents with somatization also experience higher rates of anxiety and depression, and report poorer perceived social relationships than their unaffected counterparts.^{16,17} If left unaddressed in adolescence, somatization can persist into adulthood, and is associated with increased rates of anxiety, hypochondriacal beliefs, such as greater concern that bodily symptoms represent undiagnosed illness, and poor social functioning later in life.¹⁸

In a prospective study of high school athletes, higher pre-injury scores on somatization symptom inventories were the strongest pre-morbid predictor of length of concussion recovery when compared to other pre-injury emotional, behavioural and demographic factors.⁶ In this study, the authors hypothesized that pre-injury somatization indirectly lengthened recovery from concussion via the effect of somatization on concussion symptom reporting. In pediatric populations, immediate post-injury scores on somatization symptom inventories were related to

delayed post-concussion symptom resolution.^{7,8} These findings suggest that somatization may be playing a role in the severity and duration of persistent post-concussive symptoms for some individuals. However, our understanding of which individuals are affected by somatization after a concussion, and how best to identify them in a clinical setting is limited, as research has yet to address the diagnosis and clinical characteristics of adolescents with persistent post-concussive symptoms affected by somatization.

Only one previous adult study assessing the prevalence of somatization in persistent post-concussive symptoms has touched on differences in patient characteristics between those clinically identified by a neuropsychologist as having post-concussive symptoms affected by somatization, based on ICD-10 diagnostic criteria, and those not identified as affected.¹⁹ These authors reported that patients with somatization had more severe ratings of concussion symptoms, were more likely to have previous psychiatric history, and on average had greater elapsed time between injury and clinic visit than patients unaffected by somatization.¹⁹ While these results provide some understanding of possible differences between patients with and without identified somatization in a population with persistent post-concussive symptoms, this study was done in a population of adults, and examined very few factors. The uniqueness of the developmental stage of adolescence requires a more thorough investigation into these and other factors in an adolescent population. Past research into somatization in the general adolescent population provides insight into patient characteristics which may help to identify adolescents with persistent post-concussive symptoms affected by somatization. In the general adolescent population, somatization affects girls more than boys – with prevalence in adolescents increasing in step with puberty; and is associated with anxiety and depression, high rates of medical service

use, and medical concerns such as chronic pain, medically unexplained symptoms, chronic fatigue syndrome, irritable bowel syndrome, and fibromyalgia.^{13,17,20–27}

Gaining a better understanding of the identifying characteristics of somatization in adolescents with persistent post-concussive symptoms, and how these adolescents differ from those unaffected by somatization in a real world clinical setting, is vital in order for clinicians to identify and connect their patients with the most appropriate treatment strategies for their needs. The current limited state of knowledge, and lack of awareness surrounding the role of somatization in persistent post-concussive symptoms is a critical barrier to the timely identification of somatization by health care providers treating adolescents for concussion, that impedes the subsequent referral of affected adolescents to appropriate mental health services. In order to address this issue, evaluating differences in characteristics between adolescents with and without clinically-identified somatization in a population of adolescents being seen in clinical care for persistent post-concussive symptoms, is necessary.

Aims

The purpose of this study was to describe a sample of adolescents with persistent post-concussive symptoms and somatization identified by a medical expert, and to evaluate differences in patient characteristics between these adolescents and those with persistent post-concussive symptoms without identified somatization. We expected that adolescents in this sample with identified somatization would have more severe post-concussion symptoms, more mental health symptoms, greater medical service use and poorer school attendance than those without.

II. METHODS

Design and Setting

This review of medical records was conducted at a tertiary care Adolescent Complex Concussion Clinic (AC3) at GF Strong Rehabilitation Centre in Vancouver, BC, and was approved by the institutional clinical review board at the University of British Columbia. The AC3 was chosen as an appropriate setting for this study, as adolescents are assessed and treated for persistent post-concussive symptoms by a multidisciplinary clinical team consisting of a pediatric physiatrist, occupational therapist, physiotherapist, and school teacher. Upon an adolescent's referral to the clinic, they receive and fill out a clinic intake package which includes demographic, concussion symptom and injury information, and mental health information. The adolescent then attends an intake evaluation, which may involve a consultation with the clinic physiatrist as indicated. The adolescent may then be referred to specialists outside of the clinic, most commonly a psychiatrist, if a mental health is a concern identified by the physiatrist. Data used in this study was collected from the intake package, the initial physiatry consultation report, and consultation report(s) from the external psychiatrist outside of the AC3 for the subset of adolescents with queried mental health concerns.

Participants and procedure

A flow diagram of patient inclusion/exclusion and group membership is shown in Figure 1. Records of all 199 patients referred to the AC3 between January 2016 and May 2018 were reviewed. Patients seen at the AC3 were between the ages of 11 and 19, had previously sustained a concussion, and had one or more of the following at the time of referral:

- Post-concussive symptoms lasting beyond four weeks post-injury
- One or more of the following risk factors for prolonged recovery: prior concussion(s), history of learning disability/Attention Deficit Hyperactivity Disorder (ADHD)/developmental disability, history of depression or anxiety, history of migraines/headaches, or a sleep disorder.

Records were excluded if the adolescent was less than one month post-injury at the time of referral to the clinic ($n = 41$ excluded), if the adolescent was not seen by the physiatrist ($n = 53$ excluded), or if the physiatry consultation report described the adolescent's head injury as a moderate or severe traumatic brain injury instead of concussion ($n = 3$ excluded). If an adolescent had been referred to the clinic more than once in the study timeframe, data from the first referral where the adolescent was seen by a physiatrist was used to avoid duplicate records in the sample ($n = 8$ excluded as duplicates). 94 records remained included in the sample.

Records were then assigned to outcome groups using the following criteria.

Patients with Identified Somatization ($n = 28$)

- The adolescent was referred to a child psychiatrist for their persistent post-concussive symptoms, and the diagnosis, impression, or formulation section of the psychiatrist's report confirmed any of the following words applied to the child's condition: "somatization," "somatic symptom disorder", "psychosomatic", "somatic component" or "somatoform."
- AND/OR in the treatment recommendations section of the psychiatrist's report the adolescent was referred to an intervention program specifically targeting somatization.

- AND/OR the adolescent did not attend a consultation with a child psychiatrist, but the physiatry report identified any of the following words as applicable to the child's condition: "somatization," "somatic symptom disorder", "psychosomatic", "somatic component" or "somatoform."
- AND/OR the adolescent did not attend a consultation with a child psychiatrist but in the treatment recommendations section of the psychiatrist's report, the adolescent was referred to an intervention program specifically targeting somatization.

Patients with No Identified Somatization (n = 66)

- All records in the sample that did not meet the criteria for the Patients with Identified Somatization group.

Data was sourced from AC3 charts accessed via the G. F. Strong Health Records Department. A detailed data extraction manual with guidelines and operationalized definitions was developed and used for standardized data extraction (Appendix 1). Using this manual, data was extracted by KG, following the recommendations by Gearing et al. (2006) for chart review collection in child and adolescent psychiatry.²⁸.

Measures

Demographic information, injury details, medical and mental health history, post-concussion symptoms, medical service use, and school attendance were extracted from the physiatry report (see Table 1). Complete operationalized definitions of variables are reported in Appendix 1.

Post-concussive symptoms were assessed with the Rivermead Post-Concussion Symptom Questionnaire (RPQ), a 16-item self-report questionnaire that takes inventory of physical (e.g. headache), emotional (e.g. feeling depressed or tearful), and cognitive symptoms (e.g. poor concentration) of concussion scored on a Likert scale from 0 (not experienced), to 4 (severe problem).²⁹ The RPQ has a maximum total score of 64, item ratings of '1' were not counted towards total scores as they denote "no more of a problem", in accordance with King et al., (1995).²⁹ The RPQ demonstrates high reliability in populations with persistent post-concussive symptoms, and has been validated in adolescent populations.^{29,30} In the current sample, the RPQ was found to be internally consistent ($\alpha = 0.88$) and showed a one-factor solution, using principal-axis factoring.

Depressive symptoms were assessed with the Kutcher Adolescent Depression Scale (KADS), a six-item self-report measure scored on a Likert scale from 0 (hardly ever) to 3 (all of the time), which takes inventory core physical (e.g. feeling fatigued, low in energy) and emotional symptoms (e.g. feeling worthless, hopeless) of depression.³¹ The Patient Reported Outcomes Measurement Information System (PROMIS) Pediatric Anxiety Symptom Scale, was used to evaluate symptoms of anxiety. The measure is an eight-item self-report scale which assesses fear, hyperarousal, worry and physical symptoms of anxiety, scored on a Likert scale from 0 (almost never to) to 4 (almost always).³² Both the KADS and PROMIS Pediatric Anxiety Symptom scales have been validated in pediatric and adolescent samples, and show good reliability and consistency.^{33,34} In the current sample, both the KADS and the PROMIS were found to be internally consistent ($\alpha = 0.86$ and $.88$, respectively) and each showed a one-factor solution using principal-axis factoring.

Plan of Analysis

First, descriptive information pertaining to central tendency and inter-correlations were calculated. Differences between groups (somatization and no somatization) were assessed using χ^2 tests for categorical variables and Mann-Whitney U tests for ordinal variables. Relationships among all variables of interest were analyzed using Spearman's rank-order tests. Second, binary logistic regression was used to determine the estimated odds of an adolescent falling into either the somatization or no somatization group, given a specific independent variable, and adjusting for other variables of interest. Log odds were converted into odds ratios for ease of interpretation. Data analysis was conducted using SPSS 25. A total of 14 records were missing one or more of the RPQ, PROMIS or KADS scales - 7 of the 14 records were missing complete RPQ scales, 10 of the 14 were missing PROMIS scales and 9 of the 14 were missing KADS scales. Adolescents missing entire scales were no more likely than those with completed scales to have identified somatization, and did not differ from those with completed scales on any demographic, injury, medical service use, or impairment variables. Because of this, when entire RPQ, PROMIS and KADS scales were missing, records were dropped from the correlation and regression analysis. When up to three items were missing on an RPQ scale (8% of records), and up to one item was missing on a KADS scale (2% of records), individual mean imputation was used to impute missing item scores, a reliable method of imputing data for missing item scores in the event that < 10% of total item responses in a sample are missing.³⁵ No data was imputed for PROMIS scales as no individual items for PROMIS scales were missing.

III. RESULTS

Differences between groups

Descriptive information about the groups with and without somatization is shown in Table 2.

Demographically, the groups were not different in age or sex. The groups did not differ significantly in whether they lost consciousness after injury, whether they visited the emergency department after injury, or the number of months since injury at time of AC3 consult. While the most common mechanism of injury was sport-related for adolescents in both groups, adolescents affected by somatization were more likely than those without, to have had an injury caused by a fall. Turning to post-concussive symptoms, those with somatization had higher Rivermead Post-Concussion Symptom Inventory (RPQ) total scores, and were more likely to have atypical post-concussive symptoms than those without. More specifically, those with somatization were more likely to have atypical neurological symptoms (e.g. limb numbness, loss of colour vision, aphasia) and other atypical symptoms (e.g. out of body experiences) than those without somatization, however the two groups did not differ in atypical pain symptoms. The two groups did not differ in their history of prior concussions, or their history of ADHD, anxiety and/or depression diagnoses. The two groups were not different on KADS depression or PROMIS anxiety symptom inventories, however, adolescents with somatization were more likely than those without to have a history of chronic pain or medically unexplained symptoms.

While most adolescents were referred to the AC3 clinic by a general practitioner, those with somatization were more likely to have been referred to the clinic by a specialist like a pediatrician or a neurologist than those without somatization. Furthermore, adolescents with somatization had seen more health care providers, and were more likely to have had an MRI or a CT scan for their injury than those without. The two groups did not differ in the number of

prescription medications at time of consult. Adolescents without somatization were more likely to be attending school at a pre-injury level than those with somatization, who were more likely to not be attending school. The likelihood of an adolescent attending school with accommodations was similar in both groups.

Links among somatization and patient characteristics

Spearman rank correlations amongst variables for the complete sample are reported in Table 3. Compatible with descriptive differences among groups noted above, somatization was correlated with: higher RPQ scores, the presence of atypical post-concussive symptoms, a history of chronic pain or medically unexplained symptoms, having seen a higher number of health care providers after injury, having neuroimaging done after injury, and not attending school at a pre-injury level. Positive associations were found among the scores on the RPQ, KADS depression, and PROMIS anxiety scales. Higher PROMIS anxiety scores were also associated with being female, and higher PROMIS anxiety and KADS depression scores were both associated with older age. Seeing more health care providers was correlated with having neuroimaging done after injury, a greater number of months since injury, and having a greater number of prescribed medications at the time of the physiatry consult. More prescriptions were also linked with not attending school at a pre-injury level.

Adjusted relationships between somatization and patient characteristics

A binary logistic regression was then conducted to address relationships between independent variables and somatization, while accounting for associations amongst independent variables detailed in the correlations in the section above. The regression was conducted using the following independent variables: RPQ total score, presence of atypical post-concussive

symptoms, PROMIS anxiety total score, KADS depression total score, presence of a history of chronic pain or medically unexplained symptoms, number of health care providers seen after injury, having neuroimaging done after injury, number of prescription medications, and attending school at a pre-injury level. The outcome was the presence vs. absence of identified somatization. The analysis also accounted for: age, sex, months since injury, and loss of consciousness. Inclusion of the history of chronic pain or medically unexplained symptoms variable in the regression produced implausibly large odds ratios and 95% confidence intervals. This is likely due to the small number of adolescents whose charts identified a history of chronic pain or medically unexplained symptoms, and therefore the variable was dropped from the regression analysis. No adolescents with somatization were attending school at a pre-injury level, therefore the odds of somatization given a pre-injury level of school attendance could not be calculated and the variable was also dropped from the analysis.

The results of the logistic regression are reported in Table 4 and represented visually in Figure 2. The presence of atypical post-concussive symptoms, having neuroimaging done after injury, and a greater number of health care providers seen for the injury were associated with increased odds of an adolescent having somatization, when adjusting for all other predictors. The KADS depression and PROMIS anxiety total scores, as well as the number of prescription medications at time of consult, sex, months since injury, and reported loss of consciousness were not significantly associated with having somatization when adjusting for other independent variables. The overall model was significant to the < 0.001 level, according to the model χ^2 statistic, and had a Nagelkerke pseudo- R^2 of 0.64, an approximation of the R^2 statistic constructed for logistic regressions.³⁶ Seen in the context of linear regression models, an R^2 of

this size would indicate that 64% of the variance in the dependent variable is explained by the model.³⁷

IV. DISCUSSION

This study sought to improve the understanding and diagnosis of somatization in a clinical sample of adolescents with persistent post-concussive symptoms by describing their characteristics and evaluating differences between these adolescents and those with persistent post-concussive symptoms unaffected by somatization. We found several key differences between adolescents with and without somatization that may aid in the clinical identification of this concern. Namely, adolescents with somatization had more severe and atypical persistent post-concussive symptoms, such as unexpected neurological symptoms, greater medical service use, for example seeing more health care providers post-injury, and poorer post-injury school attendance, and were more likely to have a history of chronic pain or medically unexplained symptoms than those without identified somatization in this sample. This study is the first to identify characteristics of diagnosed somatization in a population of adolescents with persistent post-concussive symptoms. Identifying and understanding these characteristics lays the groundwork for improving the clinical identification of somatization in this population, and connecting affected adolescents to effective mental health services sooner – stemming the long-term negative impacts of somatization on adolescent development and functioning.

Post-concussive symptoms

The experience of more severe post-concussive symptoms in those with identified somatization is in keeping with our understanding of how somatization may affect a medical condition by exacerbating the pre-existing symptoms of the medical concern.¹⁰ This is also consistent with the findings of previous studies in both pediatric and adult sample in which somatization was related to more persistent symptoms over time.^{6–8,19} It should be noted that in the logistic regression, while greater severity of post-concussive symptoms was associated with identified somatization,

these results fell just outside of the cut-offs for statistical significance. It is possible that this is because the initial relationship observed between severity of post-concussive symptoms and somatization may have been driven by another independent variable (or combination of variables). When independent variables were added to the logistic regression one at a time in varying orders, the addition of the number of health care providers most consistently drove the relationship between RPQ and somatization to reduced significance. This suggests that medical service use is related to the experience of having more severe post-concussive symptoms among adolescents with somatization in this sample. This could be because the experience of having more severe post-concussive symptoms leads adolescents to seek out more medical care for those symptoms. Alternatively, the greater number of health care providers seen, and the greater severity of post-concussive symptom scores in those with somatization may both be a reflection of health anxiety. Worry and distress about illness and symptoms is related to greater medical service use,³⁸ and in theory could also worsen physical symptoms based on our understanding of somatization as a physical expression of emotional distress.⁹

The process of emotional distress being expressed as physical symptoms could also play into the observed patterns in anxiety and depression symptom scores in this sample. Somatization has been consistently associated with anxiety and depression in adolescents.¹⁷ However, in this sample, neither the anxiety or depression measures were significantly related to identified somatization. This may be due to higher rates of anxiety and depression in the adolescent post-concussion population in general, as mood disturbances are well documented sequelae of concussion.⁴ Alternatively, this finding could be due to the effective expression and conversion of emotional distress into physical symptoms in adolescents with identified somatization. The experience of distress as physical symptoms instead of as explicit emotional symptoms could

produce anxiety and depression symptom self-reporting that does not reflect the extent of distress experienced by these adolescents. If this is the case, the experience of more severe post-concussion symptoms in adolescents with identified somatization may actually be a better reflection of increased emotional distress than self-report mental health symptom inventories in these adolescents.

In addition to worsening pre-existing post-concussive symptoms, the expression and conversion of emotional distress into physical symptoms could also produce novel symptoms. Adolescents with identified somatization in this sample were more likely to experience atypical post-concussive symptoms than their unaffected counterparts. These symptoms spanned multiple body systems, and could be broken down into the sub-categories of: neurological, pain, and other symptoms. Interestingly, atypical pain symptoms (any non-headache or non-neck pain) did not differ between the two groups. This could be because other bodily injuries incurred during the event that produced the concussion created pain symptoms in both those with and without identified somatization. Of these sub-categories, the most striking difference between those with and without identified somatization was in the experience of neurological symptoms. These symptoms included sensory and motor symptoms (e.g. limb numbness or weakness), visual symptoms (e.g. tunnel vision, loss of colour vision) and cognitive symptoms (e.g. aphasia, inability to recognize family members), and were present in half of the adolescents with identified somatization. These symptoms are not consistent with a concussive injury.²⁹ Instead, they may be more consistent with conversion disorder, a somatic symptom related disorder characterized by medically unexplained neurological symptoms.¹⁰ This suggests that somatization is likely playing a role in the etiology of the atypical neurological post-concussive symptoms present in this sample. Due to the distinctiveness of these symptoms, and the

compelling differences in the experience of these symptoms between those with and without somatization in this sample, atypical neurological post-concussive symptoms may serve as an effective clinical marker of somatization after concussion and should be further investigated as such.

The self-reported severity and persistence of post-concussive symptoms is a key method by which clinicians assess recovery from concussion after an injury. Differences in the severity and type of post-concussive symptoms between adolescents with identified somatization and those without in this sample suggest that emotional experiences may affect post-concussive symptoms for some individuals in a way that is identifiable in clinical symptom reporting. While past research has reported that higher post-concussive symptom scores are related to greater scores on somatization inventories, this is the first study to identify that symptoms are more severe in adolescents with clinically-identified somatization, and the first to identify atypical neurological symptoms as possible indicators of somatization in this population. These identifiable differences in symptom experience may provide useful clinical information that could help determine if somatization is affecting an adolescent's symptoms after a concussion.

Medical service use

Perhaps due to the more severe and distressing post-concussive symptoms experienced by those with identified somatization in this sample, as previously mentioned, this group also had greater medical service use than those unaffected by somatization. These findings offer unique information into post-injury patterns that may help to differentiate between adolescents with persistent post-concussive symptoms affected and unaffected by somatization.

The majority of the sample was referred to the Adolescent Complex Concussion Clinic by a general practitioner; however, adolescents with identified somatization were more likely to have been referred to the clinic by a specialist, such as a pediatrician or neurologist. This may reflect the more severe and unusual symptoms experienced by those with identified somatization, which could have led adolescents to seek more specialist care for their persistent symptoms.

Adolescents with identified somatization in this sample had also seen a greater number of health care providers, and were more likely to have had an MRI and/or CT scan after their injury than adolescents without identified somatization. These findings indicate that adolescents with somatization are seeking more care for their symptoms. This is in keeping with the literature on medical service use in individuals affected by somatization. In both the pediatric and adult literature, patients with somatization are more likely to be frequent users of medical care.^{13,39} As previously mentioned, these high levels of medical service use are associated with measures of health anxiety and may reflect an increased concern about physical symptoms in individuals with somatization.³⁸ Medical service use may also be higher in this population due to diagnostic barriers, that focus on a dichotomous biomedical model of physical symptoms by both patients and clinicians in which the role of emotional and psychosocial factors are not simultaneously considered and subsequently not treated with a unified approach. This may lead patients to see a number of physicians before finding any explanation or relief from their symptoms.⁴⁰ Because of this, high levels of medical service use may provide insight into the concern surrounding an adolescent's post-concussive symptoms, and potentially the persistence of these symptoms.

Interestingly, adolescents with and without somatization in this sample did not differ in the number of prescription medications an adolescent had at the time of the psychiatry consult. This may be because prescription medications are under the control of the prescribing physician, and

therefore not truly a measure of a patient seeking care. Exploring the relationship between over-the-counter and naturopathic medication use and somatization may be a better method of examining patient-directed management of symptoms.

While patients with somatization are widely understood to have high levels of medical service use, this is the first study to evaluate medical service use in adolescents with persistent post-concussive symptoms – a population that would in general be expected to have greater medical service use, due to their injury and subsequent symptoms. It is therefore striking that even in this population of adolescents seen at a tertiary care clinic for symptoms, those with identified somatization still had significantly greater medical service use than those without. This indicates that high levels of medical service may serve as clinical indicators that somatization should be further investigated in populations of adolescents with persistent post-concussive symptoms.

Post-injury school attendance

Differences in post-injury levels of school attendance in this sample indicate that those affected by somatization are experiencing greater levels of functional disability than those without.

Adolescents with identified somatization were more likely to not be attending school, and none had returned to attending school at a pre-injury level at the time of the psychiatry consult. This is likely related to the more severe and distressing symptoms experienced by adolescents with somatization, but may also be a reflection of psychosocial factors not evaluated in this study, such as family attitudes towards illness, care provider recommendations, and parental concern about symptoms. This study is the first to evaluate school attendance in adolescents with and without somatization in a population of adolescents with persistent post-concussive symptoms. School attendance and functioning is understandably affected by a concussion: adolescents with

active post-concussive symptoms report worse school functioning and adverse academic outcomes than recovered adolescents.^{3,41} The further reduced school attendance observed in adolescents with identified somatization in this sample speaks to the degree of functional impairment experienced by adolescents with somatization in this population, and emphasizes the need for the effective identification and treatment of somatization for improved functional recovery. Understanding the way that school attendance and functioning is impacted in adolescents with identified somatization compared to those without in this population is an important part of understanding and identifying somatization in clinical populations of adolescents with persistent post-concussive symptoms.

Pre-injury characteristics

In regards to pre-injury factors, adolescents with and without identified somatization did not differ with the exception of one key aspect: adolescents with somatization in this sample were more likely to have a history of chronic pain or medically unexplained symptoms, medical concerns commonly affected by somatization.^{21,23} Irritable bowel syndrome, chronic fatigue syndrome, and fibromyalgia are also conditions that are commonly affected by somatization, although no adolescents in this sample had any history of those conditions mentioned in the consult notes.^{20,22,24} These conditions are known to co-occur with each other in adult samples, suggesting a possible shared etiology.⁴² A history of conditions commonly affected by somatization may therefore be an indication that emotional and physical experiences are more closely linked for certain individuals, putting them at greater risk for developing a component of somatization along with a medical concern. Therefore, an adolescent with persistent post-concussive symptoms presenting with a history of such medical concerns could suggest the need for further investigation into somatization. However, it should be noted that a history of chronic

pain/medically unexplained symptoms was by no means universal to adolescents with somatization in this sample – only five adolescents had mentions of such a history in their chart (four of whom had somatization).

While female sex and adolescent age have been linked to somatization, adolescents in this sample with and without somatization did not differ in their demographics.^{26,27} This finding is unexpected as rates of somatization have repeatedly been related to pubertal development, and are usually seen to increase as adolescents age.²⁶ It is unclear if this finding may be explained by the characteristics of adolescents with persistent post-concussive symptoms in general: although adolescents are more likely than children or adults to develop persistent post-concussive symptoms, the differences between early and late adolescence have not been described.⁴ Sex was not related to outcomes in any analyses, which was also unexpected, as somatization is known to disproportionately affect females.²⁷ However, females are also more likely to develop persistent post-concussive symptoms after injury in the adult population, and well over half of both somatization and no somatization groups in our sample were female.^{1,5} This may indicate that conditional on an adolescent having persistent post-concussive symptoms, sex is not a good predictor of somatization.

Interestingly, the two groups also did not differ on risk-factors for persistent post-concussive symptoms identified in the referral criteria for the Adolescent Complex Concussion Clinic (AC3), namely prior concussions, a history of ADHD/developmental/learning disability, and a history of anxiety or depression. This may suggest that somatization is perhaps a unique contributing factor to persistent post-concussive symptoms in certain adolescents. It is also of note that the two groups do not differ in their history of mental health symptoms. This is not in

keeping with the findings of the previous adult study of somatization in persistent post-concussive symptoms, in which a history of mental health concerns was one of the identified differences between those with and without somatization in a clinic population of adults seen for persistent post-concussive symptoms.¹⁹ These differences in results could be due to the relatively high levels of anxiety and depression in our sample in general – as previously mentioned, those with and without somatization in this sample did not differ in their self-report anxiety or depression scales, with mean scores of both groups on both depression and anxiety symptom inventories greater than one standard deviation above zero (no symptoms). It should also be noted that although prior concussions and a history of ADHD are identified clinically as risk factors for persistent post-concussive symptoms, neither of them have been consistently linked to prolonged concussion recovery in adolescents or adults in the relevant literature.⁵

Limitations

This study has several limitations. First, it was a retrospective chart review and the variables and measures used in this study were therefore limited to what was available in patient charts. This method was chosen in order to reflect real world clinical practice, however, many of the independent variables of interest were extracted from the physiatrist's consult note, and were dependent on whether something was documented or not. While consult notes generally included comparable information, the exact formulation of these notes was not standardized and therefore could have been missing information, or have been biased by what the clinician believed was relevant to include. Because information was extracted primarily from the psychiatry consult note, psychosocial factors were not reliably mentioned, which meant that important intra and interindividual factors related to somatization in adolescents such as emotional regulation style, temperament, stressors, and parental attitudes could not be reliably extracted from the chart.⁴³

While the variables explored in this study are important in understanding somatization in adolescents with persistent post-concussive symptoms, it should be noted that psychosocial factors also represent an important piece of understanding somatization in adolescents that is missing from this study. However, using chart review as a method for examining this question allowed for the identification of somatization based on physician expertise. Previous studies of somatization in adolescents with persistent post-concussive symptoms have relied on somatization symptom inventories, which only evaluate physical symptoms. Using clinician identification of somatization allowed for a more holistic approach to identifying somatization in a true clinical population, providing the setting for real and clinically relevant comparisons to be made between adolescents with and without identified somatization in this sample. Second, this study had only one reviewer who extracted data from charts, and therefore this reviewer was not blinded to study hypotheses. While data extraction did follow standardized procedures, this is an additional source of bias that could have affected the data extracted from the charts. Third, records were sourced from a tertiary care clinic at a rehabilitation centre, and only patients who had seen a physiatrist were included in this study due to practical limitations. Patients in this study are therefore likely to have more severe persistent post-concussive symptoms when compared to the general population of adolescents with persistent post-concussive symptoms. Our understanding of the relationship between somatization and persistent post-concussive symptoms would be greatly aided by the addition of a third comparison group of adolescents who had sustained a concussion, but who had not developed persistent symptoms. This group would help to separate whether findings were a consequence of the concussion, the persistent symptoms, or somatization. However, for the purposes of this preliminary study, using adolescents from the Adolescent Complex Concussion Clinic provided a sample with clear

persistent post-concussive symptoms, which provided the foundation for comparing those with and without identified somatization.

Conclusions and Future Directions

This study provides important and clinically relevant information on the characteristics of somatization in adolescents with persistent post-concussive symptoms. A better understanding of these characteristics is the first step towards the improved identification and management of somatization in this population. It enables clinicians to better identify somatization and connect affected adolescents with effective treatment strategies, thus setting patients on a path to reduce suffering and the long-term harms of untreated somatization. Our findings suggest that adolescents with persistent post-concussive symptoms who are affected by somatization differ in their experience of their post-concussive symptoms, as well as in illness behaviour and history of medical concerns commonly affected by somatization. These findings are just the beginning of the work that needs to be done to better understand, identify and treat somatization in adolescents with persistent post-concussive symptoms. Prospective, longitudinal research that addresses the characteristics of somatization identified in this study, and evaluates their relationship with persistent symptoms and prolonged recovery is needed.

Somatization is a treatable clinical feature of persistent post-concussive symptoms in some adolescents. The need for early identification of somatization following concussion in youth is important, as unidentified, and subsequently untreated somatization has negative implications for adolescent development, functioning and mental health. This study provides a preliminary look at characteristics that may help to identify somatization in adolescents with persistent post-concussive symptoms.

V. TABLES

Table 1. Variables extracted from the psychiatry consult note, and their possible values.

<i>Variable name</i>	<i>Possible values</i>
<i>Demographics</i>	
Sex	Male (0); Female (1)
Age	11 - 19
<i>Injury details</i>	
Loss of consciousness	Loss of consciousness not mentioned (0) Loss of consciousness mentioned (1)
Visited Emergency Department (ED)	Visit(s) to the ED after injury not mentioned (0) Visit(s) to the ED after injury mentioned (1)
Mechanism of injury	Motor vehicle accident (MVA) (0, 1), Sports-related (0, 1) Fall (0, 1), Assault (0, 1), Other (0, 1)
<i>History</i>	
History of prior concussion(s)	Prior concussions not mentioned (0) Prior concussions mentioned (1)
History of ADHD	History of ADHD not mentioned (0) History of ADHD mentioned (1)
History of depression or anxiety	History of depression or anxiety not mentioned (0) History of depression or anxiety mentioned (1)
History of chronic pain or medically unexplained symptoms ¹	History of chronic pain and/or MUS not mentioned (0) History of chronic pain and/or MUS mentioned (1)
<i>Post-concussive symptoms</i>	
Atypical post-concussive symptoms	Symptoms not inventoried on the Rivermead post-concussion symptom questionnaire (RPQ) not mentioned (0) Mentions of any of the following symptoms not inventoried on the RPQ: neurological symptoms (sensory, motor, visual or cognitive), pain symptoms (excluding neck pain), other symptoms (1)
<i>Medical service use</i>	
Neuroimaging	CT scan and/or MRI done after injury not mentioned (0) CT scan and/or MRI done after injury mentioned (1)
Referring physician	General practitioner (0, 1), Pediatrician (0, 1), Neurologist (0, 1), Other (0, 1)
Number of health care providers	A count of the number of primary care providers, specialists, therapists, and alternative health care providers, mentioned as having been seen after the injury.
Number of prescription medications	A count of the number of prescription medications currently taken, mentioned in the consult note.
Months since injury at consult	The difference between the injury month and year, and the AC3 consult month and year.
<i>School attendance</i>	
School attendance post-injury	Attending school at a pre-injury level (0, 1); Attending school with accommodations, reduced hours or performance (0, 1); Not attending school (0, 1); Not mentioned (0, 1)

¹ This variable was collected as “History of conditions commonly affected by somatization”, which included chronic pain, medically unexplained symptoms, irritable bowel syndrome, fibromyalgia and chronic fatigue syndrome. However, adolescents in this sample only had chronic pain and medically unexplained symptoms, and the variable name was changed to reflect this.

Table 2. Descriptive statistics of the complete sample, No Identified Somatization group, and Identified Somatization group. Significant differences between groups are bolded.

		Complete Sample		No Identified Somatization		Identified Somatization		Group differences
<i>Categorical variables</i>		<i>Frequency (%)</i>	<i>n</i>	<i>Frequency (%)</i>	<i>n</i>	<i>Frequency (%)</i>	<i>n</i>	<i>Pearson's χ^2 (p)</i>
Sex (female)		63 (67.0%)	94	43 (65.3%)	66	20 (71.4%)	28	0.35 (0.55)
<i>Injury factors</i>								
Loss of consciousness		7 (7.4%)	94	4 (6.1%)	66	3 (10.7%)	28	0.62 (0.43)
Visited Emergency Dept.		42 (44.7%)	94	26 (39.4%)	66	16 (57.1%)	28	2.5 (0.11)
Mechanism of injury								
	Sport	59 (62.8%)	94	42 (63.6%)	66	17 (60.7%)	28	0.07 (0.79)
	MVA	17 (18.1%)	94	14 (21.2%)	66	3 (10.7%)	28	1.46 (0.23)
	Fall	8 (8.5%)	94	3 (4.5%)	66	5 (17.9%)	28	4.47 (0.03)
	Assault	1 (1.1%)	94	1 (1.5%)	66	0 (0%)	28	0.43 (0.51)
	Other	9 (9.6%)	94	6 (9.1%)	66	3 (10.7%)	28	0.25 (0.62)
<i>History</i>								
History of prior concussion(s)		45 (47.9%)	94	31 (47%)	66	14 (50.0%)	28	0.07 (0.79)
History of ADHD		9 (9.6%)	94	7 (10.6%)	66	2 (7.1%)	28	0.27 (0.60)
History of depression and/or anxiety		19 (20.2%)	94	12 (18.2%)	66	7 (25.0%)	28	0.57 (0.45)
History of chronic pain or medically unexplained symptoms		5 (5.3%)	94	1 (1.5%)	66	4 (14.3%)	28	6.37 (0.01)
<i>Post-concussive symptoms</i>								
Atypical post-concussive symptoms		44 (46.8%)	94	24 (36.4%)	66	20 (71.4%)	28	9.71 (0.00)
	Neurological	19 (20.2%)	94	5 (7.6%)	66	14 (50.0%)	28	21.94 (0.00)
	Pain	21 (22.3%)	94	15 (22.7%)	66	6 (21.4%)	28	0.02 (0.89)
	Other	16 (17.0%)	94	8 (12.1%)	66	8 (28.6%)	28	3.77 (0.05)
<i>Medical service use</i>								
Neuroimaging		30 (31.9%)	93	13 (19.7%)	65	17 (60.7%)	28	15.22 (0.00)
	MRI	13 (13.8%)	93	3 (4.5%)	65	10 (35.7%)	28	15.74 (0.00)
	CT	23 (24.5%)	93	11 (16.7%)	65	12 (42.9%)	28	7.07 (0.01)
Referring physician								
	GP	56 (59.6%)	82	49 (75.4%)	56	7 (25.0%)	26	19.79 (0.00)
	Pediatrician	15 (16.0%)	82	6 (9.2%)	56	9 (32.1%)	26	7.79 (0.01)
	Neurologist	8 (8.5%)	82	1 (1.5%)	56	7 (25.0%)	26	13.93 (0.00)
	Other	5 (5.3%)	82	2 (3.1%)	56	3 (10.7%)	26	2.31 (0.13)
<i>School attendance</i>								
At a pre-injury level		13 (13.8%)	93	13 (20%)	65	0 (0%)	28	6.40 (0.01)
With accommodations		52 (55.9%)	93	38 (58.5%)	65	14 (50.0%)	28	0.46 (0.50)
Not attending school		14 (14.9%)	93	7 (10.8%)	65	8 (28.6%)	28	4.73 (0.03)
Not mentioned		13 (13.8%)	93	7 (10.8%)	65	6 (21.4%)	28	1.93 (0.17)
<i>Continuous variables</i>		<i>Mean (SD)</i>	<i>n</i>	<i>Mean (SD)</i>	<i>n</i>	<i>Mean (SD)</i>	<i>n</i>	<i>Mann-Whitney U (p)</i>
Age		15.26 (1.78)	94	15.42 (1.61)	66	14.86 (2.10)	28	777.00 (0.22)
RPQ total score		33.07 (12.87)	87	31.09 (12.25)	62	37.97 (13.30)	25	535.00 (0.02)
PROMIS total score		14.38 (7.14)	84	13.75 (7.11)	60	15.96 (7.14)	24	599.00 (0.23)
KADS total score		5.86 (4.21)	85	5.66 (4.18)	62	6.39 (4.33)	23	626.00 (0.39)
Number of Health care providers		2.68 (2.49)	94	1.92 (1.76)	66	4.46 (3.05)	28	407.00 (0.00)
Number of rx medications		0.53 (1.02)	94	0.36 (0.69)	66	0.93 (1.50)	28	774.50 (0.13)
Months since injury at consult		6.62 (4.39)	93	6.36 (4.21)	66	7.24 (4.84)	27	842.50 (0.68)

Table 3. Bivariate correlations between independent variables and outcome group.

	Sex	LOC	Months since injury	RPQ	Atypical symptoms	PROMIS	KADS	Hx chronic pain or MUS	Number health care providers	Number rx meds	Neuro-imaging	School	Identified somatization group
Age	0.07	-.19	.11	.16	-.12	.23*	.23*	-.03	.12	.20*	-.15	-.15	-0.13
Sex (1 = female)	-	-.06	-.03	.27*	.08	.24*	.16	.07	-.06	-.10	-.10	.14	0.06
Loss of consciousness	-	-	-.03	.18	-.23*	.14	.11	-.07	-.00	.06	.15	.03	0.08
Months since injury	-	-	-	.01	.15	-.09	.08	-.02	.34**	.01	.24**	.25*	0.04
RPQ total	-	-	-	-	-.00	.57**	.63**	.03	.12	.17	.04	.01	0.24*
Presence of atypical post-concussive symptoms	-	-	-	-	-	.09	-.09	.16	.20	.03	.23*	.01	0.32**
PROMIS total	-	-	-	-	-	-	.66**	-.13	-.03	.13	-.07	-.19	0.13
KADS total	-	-	-	-	-	-	-	-.10	-.03	.16	-.05	.01	0.09
History of chronic pain or medically unexplained symptoms	-	-	-	-	-	-	-	-	.01	-.16	0.14	-0.10	0.26*
Number of health care providers	-	-	-	-	-	-	-	-	-	.27**	.37**	-0.01	0.45**
Number of prescription medications	-	-	-	-	-	-	-	-	-	-	0.11	-0.23*	0.16
Neuro-imaging	-	-	-	-	-	-	-	-	-	-	-	.10	0.40**
Attending school at a pre-injury level	-	-	-	-	-	-	-	-	-	-	-	-	-0.27*

* $p < 0.05$ ** $p < 0.01$

Test statistic reported is Spearman's Rho. LOC = Loss of Consciousness; School attendance: 1 = attending school at a pre-injury level, 0 = attending school with accommodations, or not attending school.

Table 4. Summary of logistic regression for variables predicting identified somatization.

Independent variable	<i>Unadjusted model</i>		<i>Adjusted model</i>				
	<i>Unadjusted Odds Ratio (95% CI)</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>Wald's X²</i>	<i>p</i>	<i>Adjusted Odds Ratio (95% CI)</i>
<i>Post-concussive symptoms</i>							
RPQ total score	1.046 (1.01 – 1.09)	0.03	0.09	0.05	3.71	0.05	1.09 (1.00 – 1.20)
Atypical post-concussive symptoms	4.38 (1.67 – 11.44)	0.00	2.88	1.28	5.03	0.03	17.83 (1.44– 221.05)
<i>Mental health</i>							
PROMIS total score	1.05 (0.98 – 1.12)	0.20	-0.02	0.07	0.06	0.81	0.98 (0.85 – 1.14)
KADS total score	1.04 (0.93 – 1.17)	0.48	0.22	0.17	1.67	0.20	1.24 (0.90 – 1.72)
<i>Medical service use</i>							
Number health care providers	1.65 (1.29 – 2.11)	0.00	0.98	0.37	7.09	0.01	2.67 (1.30 – 5.50)
Number prescription medications	1.69 (1.06 – 2.68)	0.03	-0.20	0.45	0.20	0.65	0.82 (0.34 – 1.96)
Neuroimaging	6.30 (2.39 – 16.64)	0.00	2.07	0.93	4.94	0.03	7.93 (1.28 – 49.29)
<i>Controls</i>							
Age	0.84 (0.65 – 1.07)	0.16	-0.54	0.30	3.40	0.07	0.58 (0.33 – 1.04)
Sex	1.34 (0.51 – 3.51)	0.55	-0.64	1.08	0.36	0.55	0.53 (0.06 – 4.33)
Months since injury	1.05 (0.95 – 1.15)	0.38	-0.30	0.19	2.54	0.11	0.74 (0.51 – 1.07)
Loss of Consciousness	1.86 (0.39 – 8.92)	0.44	1.73	1.61	1.16	0.28	5.65 (0.24 – 132.29)

Odds ratios describe increased odds of having somatization given a value of 1 vs. 0 for a binary independent variable, and for a one-unit increase in a continuous independent variable. *Adjusted* column reports odds ratios adjusting for all other independent and control variables, *Unadjusted* column reports odds ratios for a single independent variable. 14 records were excluded from the analysis due to missing variables, total n for this regression = 80 (No Identified Somatization = 59; Identified somatization = 21). Significant results are bolded.

VI. FIGURES

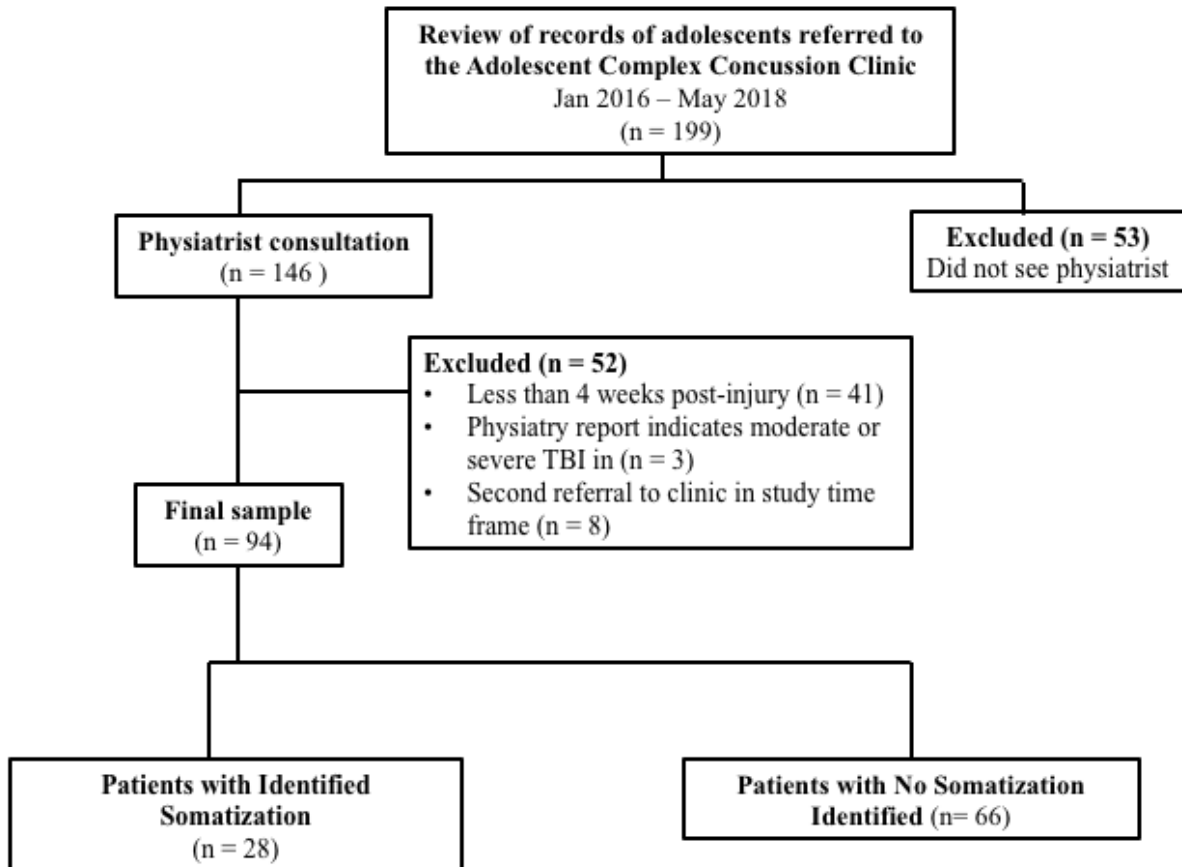


Figure 1. Flow diagram of study inclusion/exclusion and group membership based on STROBE guidelines.

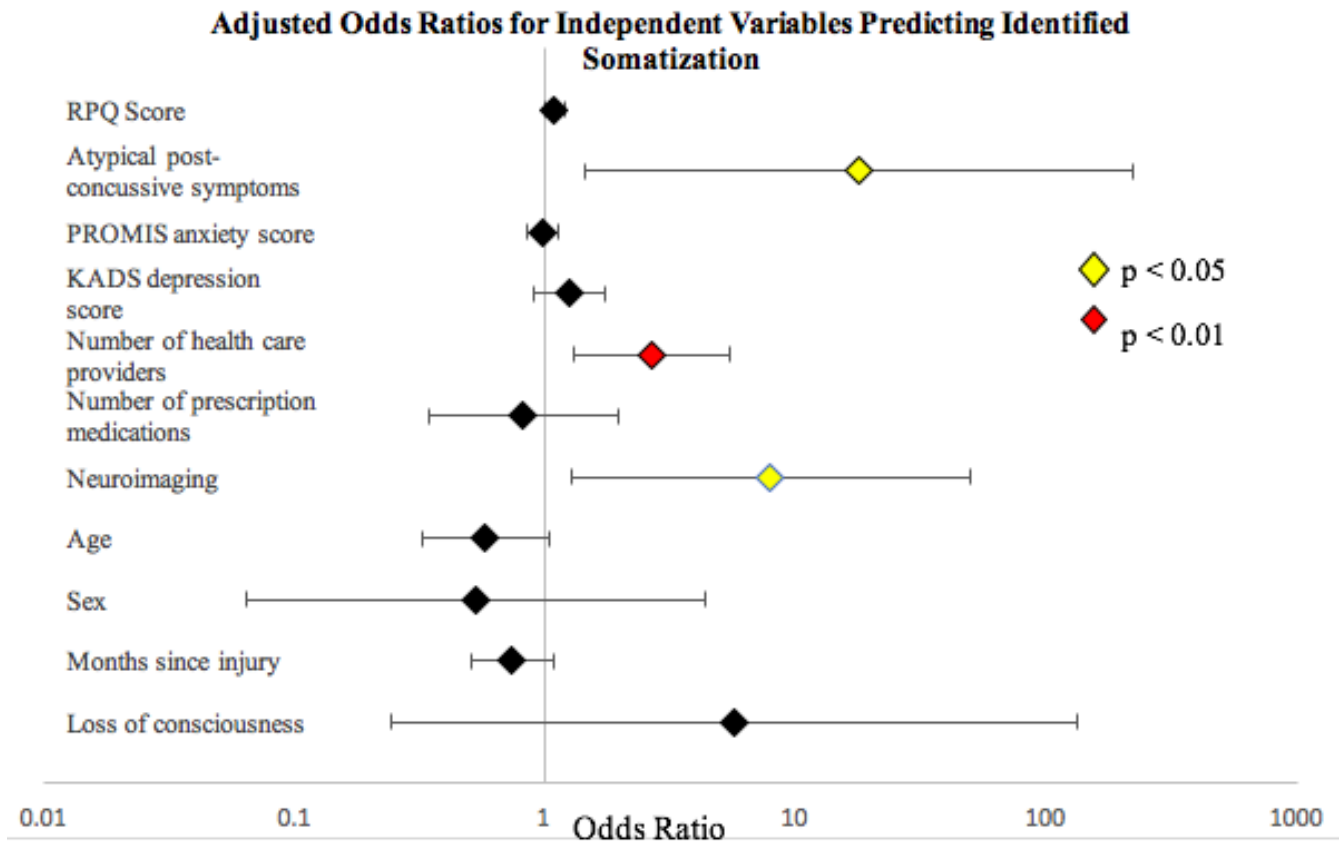


Figure 2. Forest plot of adjusted odds ratios for independent variables predicting identified somatization. Odds ratios describe increased odds of having somatization given a value of 1 vs. 0 for a binary independent variable, and for a one-unit increase in a continuous independent variable. 14 records were excluded from the analysis due to missing variables, total n for this figure = 80 (no identified somatization = 59; identified somatization = 21).

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APPENDIX: DATA EXTRACTION MANUAL

Referral Form

Variable Name	Possible Variable Values	Variable Units	Protocols for extraction
Referral Source	1 = neurologist, 2 = general practitioner, 3 = pediatrician, 4 = ophthalmologist, 5 = psychiatrist, 6 = ENT, 7 = other	n/a, categorical	Extract the referral source from the “Referred by:” open text box on the referral form. If a physician name is written, but no specialty is given, search the physician’s specialty on the internet. Choose the referral source’s specialty from the drop-down list.

ACCC Intake Package

Rivermead Post-Concussion Symptom Questionnaire (RPQ)			
Variable	Possible Variable Values	Variable Units	Protocols for extraction
Date of Intake PCSS	01-01-2015-30-06-2018	dd-mm-yyyy	Extract from the “date” response area at the top of the PCSS form whose date corresponds within a week with the intake package date. Convert date listed to the dd-mm-yyyy format.
Headaches	0; 1; 2; 3; 4	0 = not experienced at all 1 = no more of a problem 2 = a mild problem 3 = a moderate problem 4 = a severe problem	Extract from each corresponding item on the “Post-Concussion Symptom Questionnaire” in the intake package. Collect patient indicated value from 0 – 4 for each item.
Feelings of dizziness	0; 1; 2; 3; 4	“	
Nausea and/or vomiting	0; 1; 2; 3; 4	“	
Sleep disturbance	0; 1; 2; 3; 4	“	
Fatigue, tiring more easily	0; 1; 2; 3; 4	“	
Noise sensitivity (easily upset by loud noise)	0; 1; 2; 3; 4	“	
Light sensitivity (easily upset by bright light)	0; 1; 2; 3; 4	“	
Blurred vision	0; 1; 2; 3; 4	“	
Double vision	0; 1; 2; 3; 4	“	
Poor concentration	0; 1; 2; 3; 4	“	
Forgetfulness, poor memory	0; 1; 2; 3; 4	“	
Taking longer to think	0; 1; 2; 3; 4	“	
Being irritable, easily angered	0; 1; 2; 3; 4	“	
Feeling depressed or tearful	0; 1; 2; 3; 4	“	
Feeling frustrated or impatient	0; 1; 2; 3; 4	“	
Restless	0; 1; 2; 3; 4	“	
Other	Text box		Extract from corresponding open text-box on the PCSS. Extract what is written in the open space.

Other 1 severity	0; 1; 2; 3; 4	0 = not experienced at all 1 = no more of a problem 2 = a mild problem 3 = a moderate problem 4 = a severe problem	Extract from each corresponding item on the “Post-Concussion Symptom Questionnaire” in the intake package. Collect patient indicated value from 0 – 4 for each item.
Other	Text box		Extract from corresponding open text-box on the PCSS. Extract what is written in the open space
Other 2 severity	0; 1; 2; 3; 4	0 = not experienced at all 1 = no more of a problem 2 = a mild problem 3 = a moderate problem 4 = a severe problem	Extract from each corresponding item on the “Post-Concussion Symptom Questionnaire” in the intake package. Collect patient indicated value from 0 – 4 for each item.
Other	Text box		Extract from corresponding open text-box on the PCSS. Extract what is written in the open space
Other 3 severity	0; 1; 2; 3; 4	0 = not experienced at all 1 = no more of a problem 2 = a mild problem 3 = a moderate problem 4 = a severe problem	Extract from each corresponding item on the “Post-Concussion Symptom Questionnaire” in the intake package. Collect patient indicated value from 0 – 4 for each item.
Overall	0-80	Higher score indicates more severe concussive symptoms	No extraction needed. Total score will be calculated by adding scores from each question

6-item Kutcher Adolescent Depression Scale

Variable	Possible Variable Values	Variable Units	Protocols for extraction
Date of Intake Kutcher	01-01-2015-30-06-2018	dd-mm-yyyy	Extract from the “date” response area at the top of the Kutcher form whose date corresponds within a week with the intake package date. Convert date listed to the dd-mm-yyyy format. If date is not listed, but the scale is found either a) directly next to the PCSS/intake package, or b) in a clump with the intake PCSS, Kutcher and PROMIS, then indicate the date listed on the PCSS.
Low mood, sadness, feeling blah or down, depressed, or just can't be bothered	1; 2; 3; 4	1 = hardly ever 2 = much of the time 3 = most of the time 4 = all of the time	Extract from each corresponding item on the “6-item Kutcher Adolescent Depression Scale” in the intake package. Collect patient indicated value from 0 – 4 for each item.
Feelings of worthlessness, hopelessness, letting people down, not being a good person	1; 2; 3; 4	“ “	
Feeling tired, feeling fatigued, low in energy, hard to get motivated, have to push to get things done, want to rest or lie down a lot	1; 2; 3; 4	“ “	
Feeling that life is not very much fun, not feeling good when usually would feel good, not getting as much pleasure from fun things as usual	1; 2; 3; 4	“ “	
Feeling worried, nervous, panicky, tense, keyed up, anxious	1; 2; 3; 4	“ “	

Thoughts, plans or actions about suicide or self-harm	1; 2; 3; 4	“ “	
Overall	0 – 24	Higher score indicates more severe depressive symptoms	No extraction needed. Total score will be calculated by adding scores from each question.

PROMIS Pediatric Anxiety Symptom Scale			
Variable	Possible Variable Values	Variable Units	Protocols for extraction
Date of Intake PROMIS	01-01-2015-30-06-2018	dd-mm-yyyy	Extract from the “date” response area at the top of the PROMIS form whose date corresponds within a week with the intake package date. Convert date listed to the dd-mm-yyyy format. If date is not listed, but the scale is found either a) directly next to the PCSS/intake package, or b) in a clump with the intake PCSS, Kutcher and PROMIS, then indicate the date listed on the PCSS.
I felt like something awful might happen	0; 1; 2; 3; 4	0 = never 1 = almost never 2 = sometimes 3 = often 4 = almost always	Extract from each corresponding item on the “PROMIS Pediatric Item Bank v.1.0 - Anxiety – Short Form 1” in the intake package. Collect patient indicated value from 0 – 4 for each item.
I felt nervous	0; 1; 2; 3; 4	“ “	
I felt scared	0; 1; 2; 3; 4	“ “	
I felt worried	0; 1; 2; 3; 4	“ “	
I thought about scary things	0; 1; 2; 3; 4	“ “	
I was afraid that I would make mistakes	0; 1; 2; 3; 4	“ “	
I worried about what could happen to me	0; 1; 2; 3; 4	“ “	
I worried when I went to bed at night	0; 1; 2; 3; 4	“ “	
Overall	0-32	Higher score indicates more severe anxiety symptoms	No extraction needed. Total score will be calculated by adding scores from each question.

ACCC Physiatrist Consult Report			
Variable	Possible Variable Values	Variable Units	Protocols for extraction
Writer of report	1 = physiatrist, 2 = occupational therapist, 3 = school teacher, 4 = other	n/a, categorical	<p>IF there is an available physiatrist consult in the chart, then extract data for this form from that note, and indicate 1 = Physiatrist.</p> <p>IF NO physiatrist consult note is present in the chart:</p> <ol style="list-style-type: none"> 1. If chart/progress notes are available, check notes to determine whether the adolescent saw a physiatrist at the ACCC. If there are notes from a physiatrist consult, but the consult is not in the chart, indicate 1 = Physiatrist, make a note on the RID form to indicate that the consult note is missing from the chart, ask Jacqueline to send the physiatrist note to charts, and return to the chart in 2-4 weeks. 2. If chart/progress notes are available, check notes to determine whether the adolescent saw a physiatrist at the ACCC. If the notes indicate that the physiatrist was not seen, or that only the OT/school teacher was seen, use the OT's report to parents/child to extract information and indicated 2 = Occupational therapist. 3. If no chart/progress notes are available, and no physiatrist consult is present indicate 2 = Occupational therapist, extract information in the form below from the OT form AND make a note in the RID form to check with Kelsey/Jacqueline about whether or not the patient saw the physiatrist. <p>IF NO physiatrist OR Occupational therapist note are present in the chart:</p> <ol style="list-style-type: none"> 1. Chart notes are available and indicate that only the school teacher saw the student, then select 3 = School teacher, and extract information from form from that letter. 2. Chart notes are not available, indicate 3 = School teacher, extract information from the school teacher letter, AND make a note in the RID form to check with Kelsey/Jacqueline about whether or not the patient saw the physiatrist. <p>If somehow none of the above circumstances apply, indicate 4 = Other and do not intake information from whatever report exists.</p>
Date of ACCC Physiatrist consult	01-01-2016 – 31-07-2018	dd-mm-yyyy	Extract from the upper first page of the “ACCC Physiatrist Consult Report”, under the date of appointment.
Month and year of injury	Open text box		Extract from first page of the consult note – Extract month, year and day of injury (if available).
Months since injury	(date of ACCC physiatrist consult – date of injury)	months	No extraction needed, this will be automatically calculated when “date of ACCC physiatrist consult” and “date of injury” have been filled out.

Sex of adolescent	1 = male, 2 = female	n/a, categorical	Extract from the upper first page of the consult note.
Age of adolescent (at initial consult)	11 - 19	numeric	Extract from “Age” variable in the upper first page of consult note, OR from the introductory lines of the body of the consult note: “Thank you for referring this _____ year old boy”. Use the upper first page over the age listed in the consult note, but if no age listed at the top (e.g. OT report) use age given in note.
Mechanism of injury	1 = Motor vehicle accident, 2 = Sport, 3 = Assault, 4 = Fall, 5 = Other, 6 = Cause of injury not mentioned	n/a, categorical	Extract from the body of text of the ACCC Physiatrist Consult Report or OT report. 1 = Motor vehicle accident if the description of injury mentions a car/bus/motor bike/other motor vehicle collision/accident with other vehicles, bicycles or pedestrians. 2 = Sport if the description of the injury mentions a collision/head injury during an organized or non-organized sporting practice, event, game or activity. 3 = Assault if the description of the injury mentions head injury caused directly or indirectly by an intentional (non-accidental) act of another person/people. 4 = Fall if the description of the injury mentions head injury due to a fall either from a height or from standing. 5 = Other if the description of injury does not meet the description of any of the five options above. 6 = Cause of injury not mentioned if the mechanism of injury is not mentioned or discussed in the consult note.
Mentions of symptoms experienced post-injury (check all that apply)	1 = Headaches, 2 = dizziness, 3 = fatigue, 4 = nausea and/or vomiting, 5 = vision disturbances, 6 = perceptual sensitivity, 7 = cognitive disturbances, 8 = mood disturbances, 9 = sleep disturbances, 10 = other	n/a, categorical	Extract from the body of the ACCC consult note. Check all that apply. The variables listed below should be indicated IF in the description of the injury, the consult note reports that these symptoms occurred: <ol style="list-style-type: none"> 1. Immediately post injury (mentions of “right after impact, after ____ hit their head, after collision, immediately after”, subsequent, or any other synonyms indicating that symptoms were experienced right away) 2. The same day of their injury (mentions of “after the game, after school, after practice, later that evening, later that day, before bed that night”, or any other synonyms indicating that symptoms were experienced the day of the injury) 3. Within the first few days after injury (mentions of “a few days, in the days following, in the days after, in the first week after” or any other synonyms indicating that symptoms were experienced within the first few days after the injury. 4. Initially a symptom was experienced, X has had this symptom since their injury. If symptoms are listed but do are not described in this way DO NOT mark them in this variable. 1 = Headaches if head pain, headache(s), migraine(s), or other descriptions of pain in head are listed.

			<p>2 = Dizziness if feeling dizzy, faint, light-headed, or other iterations/synonyms of these words are listed.</p> <p>3 = Fatigue if sleepiness, tiredness, grogginess, fatigue, feeling wiped out, exhaustion, or other iterations/synonyms of these words are listed.</p> <p>4 = Nausea and/or vomiting if nausea, vomiting, feeling sick to stomach, feeling queasy, throwing up, or other iterations/synonyms of these words are listed.</p> <p>5 = Vision disturbances if blurred vision, double vision or other disturbances relating to vision are listed.</p> <p>6 = Perceptual sensitivity if sensitivity to light, sound or other stimulation is mentioned.</p> <p>7 = Cognitive disturbances if poor/reduced concentration, poor/reduced focus, distractedness, forgetfulness, poor/reduced memory, taking longer to think, slowed thinking or other iterations of these words/other concerns involving the term “memory” or “attention” are listed.</p> <p>8 = Mood disturbance if low/reduced mood, depressed, tearful, sad, worried, anxious, stressed, irritable, cranky, angry, mad, frustrated, impatient mood, any other iteration/synonyms for these words or any mentions of “mood” or “emotions” are listed.</p> <p>9 = Sleep disturbances if sleep duration (longer, shorter, more, less) or quality (worse, interrupted, wake up a lot) of sleep, any other iteration/synonyms for these words or any mention of “sleep” are listed.</p> <p>10 = Other if the problem listed does not fit into any of these above categories.</p>
<p>Mentions of symptoms experienced at time of ACCC consult (check all that apply)</p>	<p>1 = Headaches, 2 = dizziness, 3 = fatigue, 4 = nausea and/or vomiting, 5 = vision disturbances, 6 = perceptual sensitivity, 7 = cognitive disturbances, 8 = mood disturbances, 9 = sleep disturbances, 10 = other</p>	<p>n/a, categorical</p>	<p>Extract from the body of the ACCC consult note. Check all that apply. The variables listed below should be indicated IF the consult note:</p> <ol style="list-style-type: none"> 1. Mentions of the patient still experiencing a symptom, symptom continues to persist, X is a persistent symptom, still complains of a symptom, continues to experience, still a problem, has not gone away or any other iterations/synonyms which indicate that at the present time, a symptom is still be experienced. 2. Lists the current concerns of the patient, and a symptom is listed as one of the concerns. 3. Mentions that a symptom has developed since the injury, and does not specify that the symptom has gone away, no longer a problem, etc. <p>1 = Headaches if head pain, headache(s), migraine(s), or other descriptions of pain in head are listed.</p> <p>2 = Dizziness if feeling dizzy, faint, light-headed, or other iterations/synonyms of these words are listed.</p> <p>3 = Fatigue if sleepiness, tiredness, grogginess, fatigue, feeling wiped out, exhaustion, or other iterations/synonyms of these words are listed.</p> <p>4 = Nausea and/or vomiting if nausea, vomiting, feeling sick to stomach, feeling queasy, throwing up, or other iterations/synonyms of these words are listed.</p> <p>5 = Vision disturbances if blurred vision, double vision or other disturbances relating to vision are listed.</p>

			<p>6 = Perceptual sensitivity if sensitivity to light, sound or other stimulation is mentioned.</p> <p>7 = Cognitive disturbances if poor/reduced concentration, poor/reduced focus, distractedness, forgetfulness, poor/reduced memory, taking longer to think, slowed thinking or other iterations of these words/other concerns involving the term “memory” or “attention” are listed.</p> <p>8 = Mood disturbance if low/reduced mood, depressed, tearful, sad, worried, anxious, stressed, irritable, cranky, angry, mad, frustrated, impatient mood, any other iteration/synonyms for these words or any mentions of “mood” or “emotions” are listed.</p> <p>9 = Sleep disturbances if sleep duration (longer, shorter, more, less) or quality (worse, interrupted, wake up a lot) of sleep, any other iteration/synonyms for these words or any mention of “sleep” are listed.</p> <p>10 = Other if the problem listed does not fit into any of these above categories.</p>
Witnessed loss of consciousness after injury?	1 = mentions of witnessed loss of consciousness, 2 = mentions of no clear loss of consciousness, 3 = loss of consciousness not mentioned	n/a, categorical	<p>Extract from the body of text of the “ACCC Psychiatrist Consult Report”.</p> <p>1 = Mentions of witnessed loss of consciousness if loss of consciousness reported by a by-stander, parent, friend, other mentioned in consult report.</p> <p>2 = Mentions of no clear loss of consciousness if specific mentions of “no loss of consciousness”, “did not lose consciousness”, or variations thereof are reported.</p> <p>3 = Loss of consciousness not mentioned if the consult report contains no mentions of adolescent’s loss of consciousness after the injury.</p>
Alteration of mental status after injury?	1 = mentions of witnessed loss of consciousness, 2 = no witnessed LOC mentioned, but mentions of clear evidence of acutely altered mental status (e.g., confusion or amnesia from impact), 3 = mentions of no clear acute alteration in mental status or loss of consciousness, 4 = alteration of mental status not mentioned	n/a, categorical	<p>Extract from the body of text of the “ACCC Psychiatrist Consult Report”.</p> <p>1 = Mentions of alteration of mental status if mentions of the adolescent being dazed, confused, or having amnesia/memory loss for the event surrounding the impact (or any other iterations/synonyms of those terms) after injury.</p> <p>2 = No alteration of mental status if specific mentions of no clear loss of consciousness is included in the consult report.</p> <p>3 = Alternation of mental status not mentioned if the consult report contains no mentions of adolescent’s mental status after the injury.</p>
Seen at Emergency Department for injury?	1 = mentions of being seen at emergency department after injury 2 = no mention of being seen at emergency department after injury	n/a, categorical	<p>Extract from the body of text of the “ACCC Psychiatrist Consult Report”.</p> <p>1 = Mentions of being seen at emergency department after injury if went to/was taken/seen at the hospital/the emergency room/emergency department was mentioned in relation to the injury.</p> <p>2 = No mention of being seen at emergency department after injury if none of the above terms were mention OR it was explicitly stated that the adolescent was not seen at the emergency department for their injury.</p>
Onset of concussion symptoms	1 = mentions of symptom onset within 24 hours of injury, 2 =	n/a, categorical	<p>Extract from the body of text of the “ACCC Psychiatrist Consult Report”.</p>

	mentions of delayed onset of symptoms (> 24 hours after injury), 3 = onset of symptoms not mentioned		<p>1 = Mentions of symptom onset within 24 hours of injury if immediate symptom onset, right afterwards, later that day, onset within x hours (if $x < 24$) or other iterations/synonyms of these terms mentioned.</p> <p>2 = Mentions of delayed onset of symptoms (> 24 hours after injury) if delayed symptom onset, onset x hours after injury (if $x > 24$), began/onset any length of time > 1 day after the injury, the next day, or any other iterations/synonyms of these terms mentioned.</p> <p>3 = Onset of symptoms not mentioned if the consult report contains no mentions of symptom onset after the injury.</p>
Course of concussion symptoms	1 = mentions of symptoms improving since injury, 2 = mentions of symptoms worsening since injury, 3 = mentions of symptoms stable since injury, 4 = mentions of symptoms waxing/waning since injury, 5 = course of symptoms not mentioned	n/a, categorical	<p>Extract from the body of text of the “ACCC Physiatrist Consult Report”.</p> <p>1 = mentions of symptoms improving since injury if symptoms improving, getting better, less painful, less disruptive, or any iteration/synonyms of these words are mentioned.</p> <p>2 = mentions of symptoms worsening since injury, if symptoms worsening, more painful, more disruptive, deteriorating, becoming more severe, or any iteration/synonyms of these words mentioned.</p> <p>3 = mentions of symptoms stable since injury if symptoms stable, symptoms not getting better, not improving, or any other iteration/synonyms of these words are mentioned.</p> <p>4 = Mentions of symptoms waxing/waning since injury, if waxing/waning, symptom severity up and down, better some days and worse others, or any other iteration/synonyms of these words are mentioned.</p> <p>5 = Course of symptoms not mentioned if the consult report contains no mentions of symptom onset after the injury.</p>
Prolonged recovery medical risk factors mentioned (check all that apply)	1 = prior concussions, 2 = history of learning disability/ADHD/developmental disability, 3 = depression, mood &/or anxiety, 4 = history of migraines/headaches, 5 = sleep disorder	n/a, categorical	<p>Extract from the body of text of the “ACCC Physiatrist Consult Report”.</p> <p>1 = prior concussions if previous/prior concussions/mTBI are mentioned OR if a number of previous concussions are listed OR if when describing the current injury, it is described as their “nth concussion” or “not their first concussion”.</p> <p>2 = History of learning disability/ADHD/developmental disability, if learning disability (a specific one or just a global term), ADHD/ADD, or a developmental disability is mentioned.</p> <p>3 = Depression, mood &/or anxiety, if a history of depression, anxiety, low mood, being anxious, being depressed, or variations thereof are mentioned as being prior to the injury.</p> <p>4 = History of migraines/headaches, if headaches/migraines or any variation thereof are mentioned as occurring prior to the injury/having a history of/having had headaches from a young age.</p> <p>5 = Sleep disorder, if “sleep disorder” is mentioned in the consult note.</p>

If 2 = history of learning disability/ADHD/developmental disability in the above question is checked, which problem specifically:	1 = ADHD, 2 = learning disability, 3 = developmental disability	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. 1 = ADHD , if ADHD, ADD or attention deficit is mentioned as a confirmed diagnosis. 2 = learning disability , if any kind of learning disability, dyslexia, dyscalculia, is mentioned as a confirmed diagnosis 3 = developmental disability , if any kind of developmental disability is mentioned as a confirmed diagnosis.
Course of school involvement	1 = mentions of child attending school as pre-injury, 2 = mentions of child attending school with reduced hours, performance or additional assistance, 3 = mentions of child not attending school, 4 = not mentioned	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. ***if the child is seen in the summer, code on the last available information in the consult report*** 1 = Mentions of child attending school as pre-injury if attending school as pre-injury, no change in school attendance, no change in school hours, attending school full time, or other iterations/synonyms of these words AND no change in performance, grades are similar to pre-injury, or other iterations/synonyms of these words AND no additional assistance, no new accommodations, or any other iterations/synonyms of these words are mentioned. 2 = Mentions of child attending school with reduced hours, performance or additional assistance if ANY change is mentioned in hours at school (attending school part-time since injury, reduced hours, etc.), reduced performance (struggling with material, grades have dropped, etc.), or new accommodations at school (sees a counselor since injury, has ministry designation since injury, etc.) since injury. 3 = Mentions of child not attending school if not attending school, not in school, or other iterations/synonyms of these words mentioned. 4 = Not mentioned if school involvement (attendance, hours, performance, assistance) not mentioned.
Course of sport involvement	1 = mentions of child participating in sports as pre-injury, 2 = mentions of child participating in sports with reduced hours, performance or additional assistance since injury 3 = mentions of child not participating in pre-injury sports, 4 = not relevant (child does not play sports), 5 = not mentioned	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. 1 = Mentions of child participating in sports as pre-injury , if participating in sports normal, as pre-injury, no change in attendance, performance, additional assistance or any other iterations/synonyms of these words are mentioned. 2 = Mentions of child participating in sports with reduced hours, performance or additional assistance if ANY change is mentioned in hours playing sports, performance/ability, or new accommodations in sport since injury. 3 = Mentions of child not participating in pre-injury sports if not playing sports, not able to play sports, suspended for play or any other iterations/synonyms of these words are mentioned. 4 = Not relevant (child does not play sports) if it is mentioned that the adolescent does not play sports. 5 = Not mentioned if adolescent’s participation/involvement/hours/performance/assistance in sport is not mentioned in any capacity.

Mentions of sleep problems	1 = yes – mentioned, 2 = no – not mentioned	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. 1 = Yes if sleeping too much, not sleeping enough, problematic sleep cycle/schedule, sleep hygiene, disturbed, interrupted, irregular, sleep is listed as a concern or any other iterations/synonyms of these words are mentioned. 2 = No if sleep is either not mentioned at all OR if normal, regular, undisturbed sleep or any other iterations/synonyms of those words are mentioned.
Mentions of behavioural representation of symptoms	1 = yes – mentioned, 2 = no – not mentioned	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. 1 = Yes if any behavioural representations of symptoms are mentioned, including but not limited to: sunglasses indoors, a hat indoors (to shield light), a limp, walking aid (including using a wall), asking to turn the lights down, shading eyes from light, asking to decrease volume of conversation, or any other observable behaviour which relays or represents symptoms (NOT including actively discussing symptoms). 2 = No if none of the above are mentioned.
Mentions of physical complaints not inventoried on the Post-Concussion Symptom Scale	1 = yes – mentioned, 2 = no – not mentioned	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. 1 = Yes if physical post-concussive complaints are mentioned which are not inventoried on the Post-Concussion Symptom Scale. Physical symptoms on the PCSS are: headaches, dizziness, nausea and/or vomiting, sleep disturbance, fatigue, noise sensitivity, light sensitivity, blurred vision, double vision, restlessness. 2 = No if physical complaints are either not mentioned, or are mentioned but inventoried on the PCSS (see list of symptoms above).
If yes, what symptoms	Open text box	Open text box	Extract the words used in the ACCC consult that were used to describe the symptoms listed that are not present on the PCSS.
Mentions of pain (check all that apply)	1 = yes – pain in head, 2 = yes – other	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. Check all that apply. 1 = Yes – pain in head if head pain, headache, migraine, or any other iterations/synonyms are mentioned. 2 = Yes – other if pain (or any iterations/synonyms of this term) in any part of the body other than the head is mentioned.

Mentions of a history of any of the following mental health concerns and physical concerns commonly affected by somatization (check all that apply):	1 = Irritable Bowel Syndrome (IBS), 2 = Fibromyalgia, 3 = Chronic Fatigue Syndrome (CFS or ME), 4 = Insomnia, 5 = Medically unexplained symptoms, 6 = Complex Regional Pain Syndrome (CRPS), 7 = Other chronic pain syndrome or symptoms, 8 = Anxiety, 9 = Depression, 10 = Other mental health concerns	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. If any of the following are mentioned in relation to having been previously experienced by the adolescent (prior to the injury): 1 = Irritable Bowel Syndrome (IBS) , if irritable bowel syndrome or IBS is mentioned 2 = Fibromyalgia , if FM or fibromyalgia is mentioned 3 = Chronic Fatigue Syndrome (CFS or ME) , if chronic fatigue syndrome, CFS, myalgic encephalomyelitis or ME is mentioned, 4 = Insomnia , if insomnia is mentioned, 5 = Medically unexplained symptoms , if the term “medically unexplained symptoms” or “unexplained physical symptoms” is mentioned, 6 = Complex Regional Pain Syndrome (CRPS) , if specifically, complex regional pain syndrome or CRPS is mentioned 7 = Other chronic pain syndrome or symptoms , if any other kind of chronic pain is mentioned, but is not CRPS 8 = Anxiety , if anxiety, anxious, or any kind of anxiety disorder is mentioned 9 = Depression , if depressed, depression, major depressive disorder is mentioned 10 = Other mental health concerns , if any mental health concern other than anxiety and depression is mentioned.
Mentions of the following terms in regard to post-concussive symptoms (check all that apply):	1 = Disproportionate (with regards to injury), 2 = Distressing, 3 = Abnormal, 4 = Inconsistent (with injury), 5 = Atypical, 6 = Not explained by injury (either partially or completely), 7 = Excessive (severity or impairment with regards to injury), 8 = Incompatible with injury, 9 = Affected by stress, emotions, worry, anxiety or concern	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. If any of the following specific terms are mentioned in relation to an adolescent’s post-concussive symptoms: 1 = Disproportionate (with regards to injury) , 2 = Distressing , 3 = Abnormal , 4 = Inconsistent (with injury) , 5 = Atypical , 6 = Not explained by injury (either partially or completely) , 7 = Excessive (severity or impairment with regards to injury) , 8 = Incompatible with injury , 9 = Affected by stress, emotions, worry, anxiety or concern
Mentions of previous health care providers seen after injury (check all that apply)	1 = neurologist, 2 = general practitioner, 3 = pediatrician, 4 = ophthalmologist, 5 = psychiatrist, 6 = ENT, 7 = psychologist, 8 = concussion clinic, 9 = physiotherapist, 10 =	n/a, categorical	Extract from the body of text of the “ACCC Psychiatrist Consult Report”. If a specialist’s name is mentioned, but no specialty is given, search the specialist’s area on the internet. Check all health-care provider specialties listed.

	occupational therapist, 11 = other		
Number of previous health care providers mentioned	0 - 15	numeric	Extract from the body of text of the “ACCC Physiatrist Consult Report”. Count the number of health care providers mentioned in the consult note.
Mentions of CT scan for injury	1 = yes – mentioned, 2 = no – not mentioned	n/a, categorical	Extract from the body of text of the “ACCC Physiatrist Consult Report”. 1 = Yes if it is mentioned that the adolescent has received a CT scan or CAT scan. 2 = No if it is mentioned that the adolescent has received a CT/CAT scan or if CT/CAT scans are not mentioned.
Mentions of brain MRI for injury	1 = yes – mentioned, 2 = no – not mentioned	n/a, categorical	Extract from the body of text of the “ACCC Physiatrist Consult Report”. 1 = Yes if it is mentioned that the adolescent has received functional or structural MRI/magnetic resonance imaging. 2 = No if it is mentioned that the adolescent has not received a functional or structural MRI/magnetic resonance imaging scan or if functional or structural MRI/magnetic resonance imaging scans are not mentioned.
Mentions of other diagnostics tests for injury	1 = yes – mentioned, 2 = no – not mentioned	n/a, categorical	Extract from the body of text of the “ACCC Physiatrist Consult Report”. 1 = Yes if it is mentioned that the adolescent diagnostic tests other than CT scans and MRI scans. 2 = No if it is mentioned that the adolescent has not received any diagnostic tests other than CT or MRI, or if other diagnostic tests are not mentioned.
Mentions of medications at time of consult?	1 = yes 2 = no	n/a, categorical	Extract from the body of text of the “ACCC Physiatrist Consult Report”. 1 = Yes , if the name of any specific medication is listed, or if “current medications” are listed (followed by a list of medication names). 2 = No , if the chart contains no mentions of medications, or specifically states that the adolescent is not taking any medication.
If yes to the question above, which medications?	Open text box		Extract from the body of text of the “ACCC Physiatrist Consult Report”. List the names of the medications (prescription or otherwise) listed in the chart.
Mentions of the following terms, as contributing to symptoms, in the consult note: 'somatization', 'component of somatization', 'somatizing', 'somatic symptom', 'somatic component', 'psychosomatic'	1 = yes 2 = no	n/a, categorical	Extract from the body of text of the “ACCC Physiatrist Consult Report”. 1 = Yes , if any of the terms listed in the variable name were mentioned in the psychiatry consult note. 2 = No , if none of the terms listed in the variable name were mentioned

Physiatrist recommendations	Open text box		Extract from the end of the “ACCC Physiatrist Consult Report”. Record the list of instructions/recommendations/referrals given by the physiatrist.
Referred to mental health services after initial consult with ACCC physiatrist?	yes; no	n/a, categorical	Extract from the body or the end of the “ACCC Physiatrist Consult Report”. 1 = Yes if any mention of a referral to any mental health service (psychiatrist, mental health team, psychologist, counselor, etc.) is made either in the body of the consult report, or at the end of the consult report, in the referrals/next steps/recommendations section. 2 = No if no mention of a referral to any mental health services, or if the adolescent is explicitly not referred to any mental health services.
If yes to the above question, what for?	Open text box		Extract from the body or the end of the “ACCC Physiatrist Consult Report”. Record the reason listed in the chart for referral (if available).
If yes, which mental health services? (check all that apply)	1 = External child psychiatrist, 2 = community mental health team, 3 = other mental health service	n/a, categorical	Extract from the body of text of the “ACCC Physiatrist Consult Report”, if the answer to the previous question was 1 = Yes. Check all that apply. 1 = External child psychiatrist if referral to a child psychiatrist at BC Children’s hospital is mentioned. 2 = Community mental health team if community mental health team, or a specific name for a community mental health team is given. If a specific name is given, cross-check it with this list http://www.vch.ca/your-care/mental-health-substance-use/children-youth-mental-health-services of VCH community mental health teams. If a name is given not listed on this site, look up the name on the internet to determine if it is a community mental health team. 3 = Other mental health service if mentions of a referral to a mental health service other than the two listed above.
If “other” to the above question, which?	Open text box		Extract from the body of text of the “ACCC Physiatrist Consult Report”, if the answer to the previous question was 3 = other mental health. Record the name of the group/organization/type of specialist listed.

External Child Psychiatrist Consult Note

Variable	Possible Variable Values	Variable Units	Protocols for extraction
Number of BCCH Psychiatrist Reports	0 - 5	numeric	Count the number of available consult reports available in chart. If information is missing check with AC3 clinic administrator to inquire after further reports.
For each psychiatry report			
Date of psychiatry report	dd-mm-yyyy	numeric	Extract from the “date of consult” at the top of the psychiatry report.
Mentions of the following terms contributing to symptoms in the consult note: ‘somatization’, ‘component of somatization’, ‘somatizing’, ‘somatic symptom’, ‘somatic component’, ‘psychosomatic’ ‘emotional component’	1 = yes 2 = no	n/a, categorical	Extract from the body of the psychiatrist consult report. 1 = Yes if the consult report mentions any of the following terms contributing to symptoms: ‘somatization’, ‘component of somatization’, ‘somatizing’, ‘somatic symptom’, ‘somatic component’, ‘psychosomatic’ ‘emotional component to symptoms’. 2 = No if none of the above words are mentioned OR if they are mentioned, but it is explicitly stated that they have been ruled out/are not contributing to symptoms.

Mentions of degree of contribution of somatization to symptoms	1 = somatization not mentioned, 2 = somatization considered but ruled out, 3 = somatization judged to be an aggravating factor, 4 = somatization judged to be a significant clinical factor	n/a, categorical	<p>Extract from the body of the BCCH psychiatrist's consult note.</p> <p>1 = Somatization not mentioned if there is no mention of any of the terms 'somatization', 'component of somatization', 'somatizing', 'somatic symptom', 'somatic component', 'psychosomatic' 'emotional component to symptoms' in the chart.</p> <p>2 = Somatization considered but ruled out if any of the terms 'somatization', 'component of somatization', 'somatizing', 'somatic symptom', 'somatic component', 'psychosomatic' 'emotional component to symptoms' are mentioned BUT it is explicitly indicated that this has been ruled out/these are not contributing to symptoms.</p> <p>3 = Somatization judged to be an aggravating factor if the terms 'somatization', 'component of somatization', 'somatizing', 'somatic symptom', 'somatic component', 'psychosomatic' 'emotional component to symptoms' are mentioned, and are indicated to be exacerbating, prolonging, aggravating, provoking, worsening, extending, contributing to, making symptoms worse or any other iterations/synonyms of these words BUT are not indicated as the primary reason for symptoms (i.e. concussion symptoms are worsened by somatization)</p> <p>4 = Somatization judged to be a significant clinical factor if the terms 'somatization', 'component of somatization', 'somatizing', 'somatic symptom', 'somatic component', 'psychosomatic' 'emotional component to symptoms' are mentioned, and are indicated to be mostly responsible for symptoms, a major contributor to symptoms, or any other iterations/synonyms of these words indicating that somatization is the primary reason for symptoms.</p>
Referred to Mind Body Connection group?	1 = yes 2 = no	n/a, categorical	<p>Extract from the body or the end of the BCCH psychiatrist's consult note.</p> <p>1 = yes, if the adolescent is referred or recommended to attend the Mind Body Connection group/MBC group.</p> <p>2 = no, if the adolescent is not referred to the MBC group.</p>

Mentions of other mental health concerns identified (check all that apply)	1 = depression, 2 = anxiety, 3 = ADHD/ADD, 4 = trauma/stress related concern, 5 = other mental health concern	n/a, categorical	<p>Extract from the body of the BCCH psychiatrist's consult note. Check all that apply.</p> <p>1 = Depression if depression, depressed, depressive symptoms, low mood, major depressive disorder, depressive episode or other iterations of these words are mentioned.</p> <p>2 = Anxiety if anxiety, anxious, generalized anxiety, phobias, agoraphobia, panic disorder, social anxiety, separation anxiety, selective mutism or other iterations of these words are mentioned.</p> <p>3 = ADHD if attention deficit and hyperactivity disorder, attention deficit disorder, ADHD or ADD is mentioned.</p> <p>4 = Trauma/stress related concern if PTSD, post-traumatic stress disorder, post-traumatic stress component, acute stress disorder, adjustment disorders, reactive attachment disorder or disinhibited social engagement disorder is mentioned.</p> <p>5 = Other if a mental health concern is mentioned which does not fall under any of the categories listed above.</p>
Other mental health concerns	Text box	n/a	<p>Extract by writing as many other mental health concerns as listed in the body of the BCCH Psychiatry consult note.</p>