Individual Symptom Report Prevalence in Children and Adolescents With One, Two, and Three or More Persistent Symptoms After Concussion: A Brief Report

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Abstract

Objective: To examine differences in individual symptom report prevalence between children and adolescents experiencing 1 to 2 versus ≥3 persistent postconcussion symptoms. **Design:** A prospective cohort study. **Setting:** Three community practice concussion clinics within a family practice network. **Patients:** Children and adolescents aged 8 to 18 years presenting to clinics within 72 hours of a sport-related or recreation-related concussion. Those with complete symptom data from a 1-month follow-up time point (n = 236) were included in analyses. **Independent Variables:** One hundred thirty-six patients (n = 136) reported 0 symptoms as worse than preinjury at the 1-month time point. Participants reporting 1+ symptoms as worse than preinjury at 1 month were assigned to groups based on the number of symptoms endorsed: those with 1 to 2 (n = 38) compared with those experiencing ≥3 (n = 62). **Main Outcome Measures:** Fisher exact tests were used to compare symptom report prevalence for each item of the Rivermead Postconcussion Symptoms Questionnaire. This research question was formulated and examined after completion of data collection. **Results:** Across both groups, headache and fatigue were the most commonly reported persistent postconcussion symptoms. Several emotional symptoms (eg, irritability, depression) were primarily or only present in those reporting ≥3 persistent symptoms. **Conclusions:** Findings provide detail regarding the clinical manifestation of experiencing fewer versus more persistent postconcussion symptoms, underscoring the importance of developing individualized, multifaceted rehabilitation programs.

Key Words: mild traumatic brain injury, clinical presentation, youth, sport-related concussion

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INTRODUCTION

In youth, an estimated 1.1 to 1.9 million sport-related or recreation-related concussions occur in the United States each year.[1] Although many children recover relatively quickly, around 30% may experience symptom-related challenges for weeks or months after concussion.[2–4] In some cases, children or adolescents may be designated as experiencing "prolonged recovery," often defined as being symptomatic for greater than 4 weeks.[4,5] In other cases, a designation of "persistent postconcussion symptoms" or an official diagnosis of postconcussion syndrome (PCS) may be assigned, often defined as the presence of 3 or more concussion symptoms measured at least 1 month after injury.[3,6,7] However, many individuals experience just 1 or 2 lingering symptoms which can still cause considerable distress, dysfunction, and/or delayed return to sport or school.

Despite the relatively high prevalence of persistent symptoms after concussion, it is unclear which specific symptoms are most commonly reported in youth. In addition, it is unclear whether symptom reports differ between those who do and do not meet "official" criteria for persistent postconcussion symptoms or PCS—and the extent to which therapeutic interventions should be tailored to meet the needs of these groups. In other words, are certain symptoms being predominantly cited as the ones causing difficulties? And do the symptoms cited differ between those experiencing fewer versus more?

Thus, the purpose of this investigation was to determine symptom report prevalence in youth experiencing 1 to 2 versus ≥3 persistent symptoms 1 month after a sport-related

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concussion. Based on previous research,[8,9] it was hypothesized that for both groups, headache would be the most commonly reported symptom at the 1-month time point. Drawing on PCS research,[2] we also hypothesized that the "≥3 symptom" group would differ from the "1 to 2 symptom" group in endorsing persistent emotional symptoms.

METHODS

Subjects

Participants in this prospective cohort study were children/adolescents aged 8 to 18 years presenting to community practice clinics within 72 hours of sustaining a sport-related or recreation-related concussion. Two hundred forty-five children/adolescents participated in a follow-up period of 1 month after their initial injury, and those with valid symptom data from this time point were used for analysis: n = 236 (M_{age} = 14.3 ± 2.1 years; n = 97 female; n = 177 white).

Procedures

At an initial visit, participants completed informed consent and provided information about demographics, medical history, and the current injury (ie, severity, mechanism, and acute symptoms). One month later, persistent symptoms were assessed through a parent report of their child's symptoms on the Rivermead Postconcussion Symptoms Questionnaire (RPQ) (refer to Table 1 for complete list of items and response options).[10] A symptom was considered "endorsed" if it was rated with a score of 2 or higher, indicating that it was being experienced as worse than preinjury levels. Patients were assigned to groups based on the number of RPQ items endorsed: those with 1 to 2 versus those experiencing ≥3. Parents also reported/confirmed their child's history of anxiety, depression, and previous head injury at this follow-up time point.

Outcome Measures

The main outcome measure in this investigation was individual symptom report prevalence of each RPQ item. Parents were asked to compare their child's current (ie, over the past week) level of 18 symptoms compared with before the head injury. In addition, between-group differences in symptom reporting for each item were examined.

Analysis

Frequencies and proportions of RPQ item endorsement were calculated for the overall sample and each of the symptom groups (ie, 1-2 vs ≥3 symptoms rated as 2+ on the RPQ) 1 month after concussion. Between-group differences in symptom endorsement were computed for each individual item using the Fisher exact tests in R version 4.0.3 with $\alpha = 0.05$. Additional between-symptom group comparisons were conducted for history of anxiety, depression, and head injury.

Ethical Considerations

This study received institutional review board approval before data collection, and all patients and their parents/guardians provided informed assent/consent before enrollment.

RESULTS

In the overall sample (n = 236), an average of 2.2 of 18 symptoms (SD = 3.7, range = 0-16) on the RPQ were reported as being worse than preinjury (ie, scores ≥2) at 1 month. Slightly more than half (136/236, 57.6%) of patients reported zero RPQ items as worse than before their injury. Around 16% (38/236) of participants reported 1 to 2 RPQ symptoms as worse than before their injury. For these individuals, the most commonly reported items were headaches (16/38, 42.1%) and fatigue (11/38, 28.9%). Consistent with previous concussion research in children and adolescents, 26.3% of our sample (62/236) met commonly cited

TABLE 1. Items and Response Options Included in the Rivermead Postconcussion Symptoms Questionnaire (RPQ), Administered 1 Month After Injury

Symptom*	Response Options
Headaches	0 = Not experienced at all
Feelings of dizziness	1 = No more of a problem now than before the accident
Nausea and/or vomiting	2 = A mild problem now
Noise sensitivity, or easily upset by loud noise	3 = A moderate problem now
Sleep disturbance	4 = A severe problem now
Fatigue, tiring more easily	
Being irritable, easily angered	
Feeling depressed or tearful	
Feeling frustrated or impatient	
Forgetfulness, poor memory	
Poor concentration	
Taking longer to think	
Blurred vision	
Light sensitivity, or easily upset or irritated by bright light	
Double vision	
Restlessness	
Reduced tolerance to stress or emotional excitement	
Fear of permanent symptoms/brain damage	

** Parents reported their child's level of each symptom over the past week using the 5-item response scale indicated above.*

TABLE 2. Symptom Report Frequencies, Proportions, and Comparisons Between Those Rating 1 to 2 and ≥3 Symptoms as Worse Than Preinjury at 1-Month Follow-up

	1-2 Symptoms, n = 38	≥3 Symptoms, n = 62	
Symptom	Count (Proportion)	Count (Proportion)	Fisher Exact Test, *P*
Headaches	16 (42.1%)	44 (71.0%)	0.006*
Fatigue	11 (28.9%)	40 (64.5%)	0.001*
Frustrated	3 (7.9%)	38 (61.3%)	<0.001*
Irritability	3 (7.9%)	37 (59.7%)	<0.001*
Longer to think	1 (2.6%)	33 (53.2%)	<0.001*
Poor concentration	1 (2.6%)	33 (53.2%)	<0.001*
Forgetful	3 (7.9%)	30 (48.4%)	<0.001*
Emotional stress	0 (0%)	28 (45.2%)	<0.001*
Noise sensitivity	1 (2.6%)	28 (45.2%)	<0.001*
Dizziness	4 (10.5%)	27 (43.5%)	0.001*
Light sensitivity	2 (5.3%)	27 (43.5%)	<0.001*
Sleep disturbance	2 (5.3%)	23 (37.1%)	<0.001*
Fear	4 (10.5%)	17 (27.4%)	0.074
Restlessness	0 (0%)	17 (27.4%)	<0.001*
Depression	0 (0%)	16 (25.8%)	<0.001*
Blurred vision	0 (0%)	13 (21.0%)	0.001*
Nausea/vomiting	0 (0%)	7 (11.3%)	0.042†
Double vision	1 (2.6%)	6 (9.7%)	0.247

*P < *0.05*
†P < *0.01.*

criteria for PCS (ie, reporting ≥3 symptoms as worse than preinjury).[3,6] In these patients, headaches (44/62, 71%) and fatigue (40/62, 64.5%) were again the most common, followed by frustration (38/62, 61.3%) and irritability (37/62, 59.7%). Several symptoms were present only in the ≥3 group, including nausea/vomiting, depression, blurred vision, restlessness, and reduced tolerance to emotional stress. Individuals with ≥3 persistent symptoms were significantly more likely than those with 1 to 2 to report 16 of the 18 symptoms (*P* values < 0.05; Table 2 and Figure 1). History of anxiety (n = 27 total), depression (n = 6 total), or previous head injury (n = 70 total) did not differ across the 2 symptom groups (*P* values ≥ 0.124; Table 3).

DISCUSSION

Findings from this investigation provide detail regarding the symptoms experienced by those with fewer versus greater numbers of persistent postconcussion symptoms 1 month postinjury. Awareness of the high prevalence of headache and fatigue in both groups highlights a need for targeted interventions to address these symptoms. This study also highlighted that many items—notably, many that are emotional in nature—seem to be primarily or only present in those who meet commonly cited criteria for PCS. Appreciation of the high prevalence of mood/emotional symptoms in those with higher persistent symptom burden (despite a lack of difference in mental health history) underscores the importance of targeted active treatment considerations in this group.

A limitation of this study was that symptom reports were collected at just 2 time points: initially and 1 month after injury. Future work with more frequent data collection intervals could help identify specific trajectories of symptom onset, development, and eventual resolution. Regardless of whether athletes are experiencing several or even just 1 lingering symptom, findings from this investigation provide clinicians with valuable insights that can be used to design and implement targeted programs to alleviate postconcussion challenges in children and adolescents.

TABLE 3. History of Anxiety, Depression, and Previous Head Injury Compared Across Symptom Groups

	1-2 Symptoms, n = 38	≥3 Symptoms, n = 62	
History of:	Count (Proportion)	Count (Proportion)	Fisher Exact Test, *P*
Anxiety	2 (5.3%)	11 (17.7%)	0.124
Depression	0 (0.0%)	3 (4.8%)	0.296
Head injury	13 (34.2%)	16 (25.8%)	0.375

P < *0.05.*
P < *0.01.*

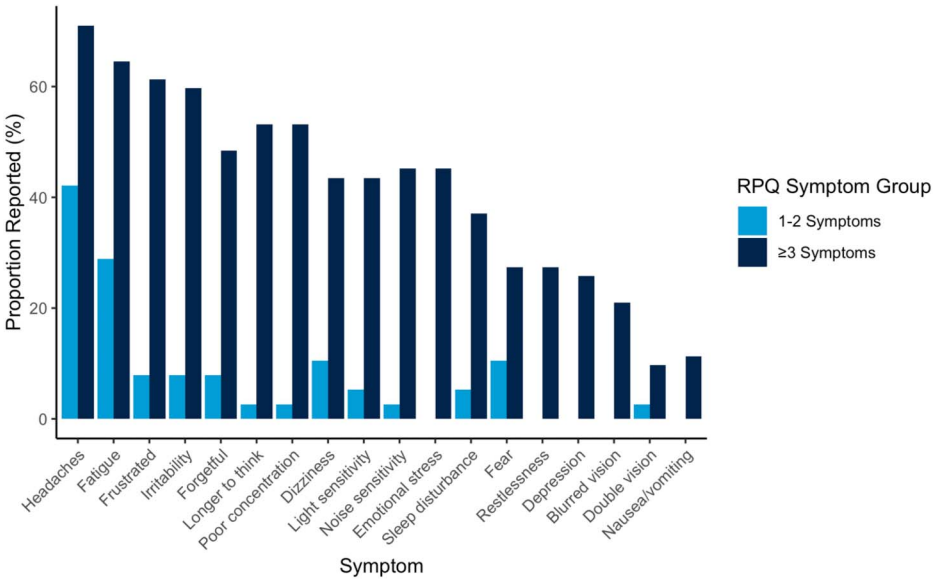

Figure 1. Individual item report prevalence in those experiencing 1 to 2 and ≥3 persistent postconcussion symptoms one month postinjury as measured by the Rivermead Postconcussion Symptoms Questionnaire (RPQ).

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