


School Attendance and Symptoms in Adolescents After Sport-Related Concussion

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Introduction

A recent retrospective study reported that 45% of a sample of elementary school, high school, and college students returned to school too soon after concussion with a recurrence or worsening of symptoms.¹ Another study found that 38% of high school student athletes reported symptoms and problems in school after concussion, although most students did not miss many days of school.² Further studies suggest that excessive mental exertion can aggravate concussion symptoms^{3,4} and perhaps prolong recovery.⁵ The 2012 Zurich Consensus Statement highlights modification of school attendance and activities to avoid provocation of symptoms.⁶ A gradual return to cognitive activity and to school has been recommended with “pacing” to stay below the cognitive symptom threshold.^{5,7}

One study showed that cognitive activity level reported by weekly recall was associated with duration of symptoms in adolescents sustaining sport-related concussion (SRC).⁸ While this study was prospective in nature, it relied on weekly recall by subjects and did not look at the specific number of school hours attended after injury. The hours spent in school may have a direct relationship with recovery time after SRC. This relationship requires further study. The purpose of this study was to prospectively evaluate the relationship of school attendance and symptoms after SRC. We specifically evaluated whether hours of school attended postconcussion was associated with increased concussion symptom severity scores and delayed recovery.

Methods

As part of a larger prospective study of concussion, 42 adolescent student-athletes (37 male, 15.4 ± 1.3 years, mean 5.0 ± 1.9 days after SRC) completed daily reports on symptoms (Post Concussion Symptom Scale)⁹ and hours spent in school for 14 days after the first study visit.

To be included, students had to have sustained SRC and been seen in a participating concussion clinic within 10 days of injury. Students had to be aged 14 to 19 years. Students were excluded who did not attend school because of the time of the year or because they were too symptomatic.

The relationship between hours of school attended and total reported symptoms was examined using a mixed modelling regression approach. The model included random effects of intercept, hours of school attended, and days (time). The model included a fixed covariate of days from injury and used an unstructured covariance structure. Days since injury were included as a covariate since patients generally are expected to improve over time.

In order to assess whether recovery speed group (fast [<3 days], moderate [3–14 days], or delayed [>14 days]) moderated the effect of school on symptoms, a group by school hours interaction was added in a second model. A third model was assessed after selecting out subjects that had a very low number of initial symptoms (<5) and/or only attended school on 1 out of the sampled days ($n = 39$). All models were run in SAS 9.3 Proc Mixed (Cary, NC).

Ethical Considerations

This study was approved by the University at Buffalo Institutional Review Board.

Results

The mean symptom severity score on clinic day 1 was 32.7 ± 23.3 . Symptom severity scores decreased with time, as expected ($\beta = -2.12$, $P < .0001$; see Figure 1).

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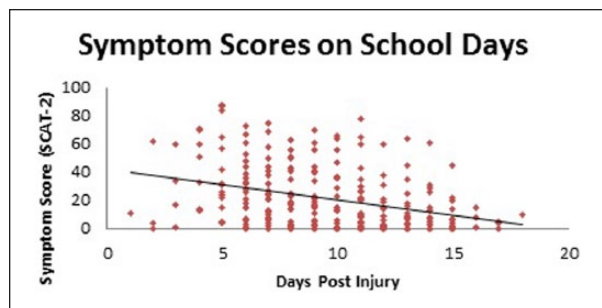


Figure 1. Sport Concussion Assessment Tool–2 (SCAT-2) Symptom Severity scores and days postinjury for concussed adolescents who attended school (holidays and weekends are not included).

Despite this, however, symptom severity score increased with hours of school ($\beta = 0.32$, $P < .0137$), with no significant effects of days from injury ($\beta = -2.12$, $P = .50$). Fast, moderate, or delayed recovery speed groups ($P = .44$) did not moderate the relationship between school hours and symptoms. When selecting out 3 students with low initial symptom scores and only one day of school, we observed similar effects for hours of school ($\beta = 0.37$, $P < .0101$) and time ($\beta = -2.24$, $P < .001$). Figure 2 shows that hours of school increased with days from injury.

Discussion

Our data show that, controlling for time from injury and speed of recovery, hours of school attendance exacerbated symptoms in adolescents after SRC. To our knowledge, this is the first prospective study that used daily symptom reports to show that school attendance exacerbated symptoms in adolescents after SRC. This has implications with respect to monitoring and modifying school hours after SRC in adolescents.

What do these findings mean for clinicians? Each case of SRC is individualized and unique. There are no evidence-based guidelines in place for return to school postconcussion. Clinicians currently rely on the history, physical examination, and other diagnostic studies to decide on an appropriate treatment plan after concussion. Some adolescents may be able to return to school immediately while others may require some time off. Our results suggest that too many hours of school initially after a concussion may be detrimental to recovery. At the same time, given that the relationship we found was a weak one, we cannot definitively say that it is good practice to keep students out of school for a long period of time. The decision to remove a student from school should be based on the level of symptoms

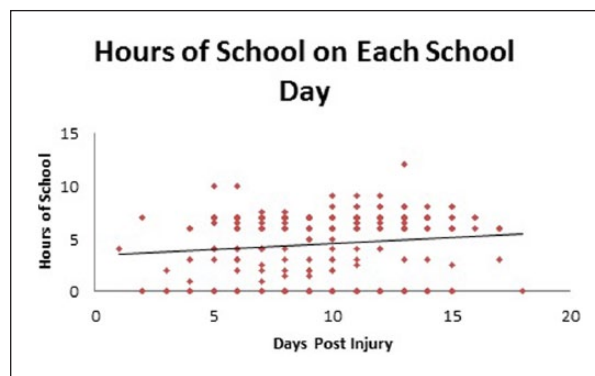


Figure 2. Hours of school attended and days postinjury for concussed adolescents who attended school (holidays and weekends are not included).

reported early after concussion² and whether there are physical examination findings such as significant vision dysfunction that would interfere with classroom performance and ability to read and use a computer.¹⁰

There were limitations to our study. For one, we did not include the subjects who did not attend school because the analysis required at least some school attendance. Those students may have been the most severely injured. We did not know specifically why students did not attend school or had decreased hours. Finally, we had no information about symptoms and time in school prior to the students' first clinic visit. Nevertheless, even though the complex nature of our data collection and analytic methods may have weakened our findings, there was still a direct relationship between hours of school attended and increased symptoms. These results point to the need for larger prospective studies that examine more closely which specific school activities exacerbate symptoms and potentially delay recovery after SRC.

Declaration of Conflicting Interests

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Author Contributions

AYM: Contributed to conception and design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

JL: Contributed to conception and design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

AH: Contributed to conception and design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

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