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Level of Agreement Between Child and Parent Reporting on the Child Sport Concussion Assessment Tool (SCAT5)

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Context: The Child Sport Concussion Assessment Tool, fifth edition (SCAT5), remains the consensus instrument for concussion evaluation in youth athletes. Both child and parent are recommended to complete the athlete background and symptom reporting.

Objective: To determine the level of agreement between child and parent medical history and symptom reporting and quantify their performance on the Child SCAT5 in male football athletes.

Design: Cross-sectional study.

Setting: National Collegiate Athletic Association Division I college football facility.

Patients or Other Participants: A total of 157 youth male football athletes (age = 10.7 ± 1.3 years) participating in a university-sanctioned youth football camp and their parent or legal guardian.

Main Outcome Measure(s): Youth athletes and their parent completed the athlete background (demographics, diagnosed medical history) and symptom evaluation (symptom items, total number of symptoms, and symptom severity score) of the Child SCAT5 and were instructed not to discuss reporting with each other during testing. Cronbach α tests were conducted to determine the internal consistency, and descriptive statistics determined the level of agreement between medical history, symptom reporting, and baseline performance.

Results: The internal consistency of the symptom items was high for both child (Cronbach $\alpha = 0.91$) and parent ($\alpha = 0.92$). Agreement on medical history ranged from 67% (learning disability or dyslexia) to 85% (attention-deficit/hyperactivity disorder), with 82% agreement on sustaining a previous concussion. Fourteen youth athletes reported having been hospitalized for a head injury, with zero matched parent confirmations. Individual symptom agreement ranged from 70.7% (*gets distracted easily*) to 94.9% (*going to faint*). Agreement was 35% on total number of symptoms and severity. Abnormal scoring ranged from 2% (*going to faint*) to 25% (*headache*) for child and 2% (*double vision*) to 28% (*gets distracted easily*) for parent reporting.

Conclusions: Fair agreement was shown between children and their parent on medical history and self-reported symptoms on the Child SCAT5 at baseline. When available, child and parent reporting should be used for concussion assessment and clinical decision-making.

Key Words: mild traumatic brain injuries, pediatrics, symptom reporting

Key Points

- Both child and parent reporting displayed high internal consistency for the 21-item symptom report on the Child Sport Concussion Assessment Tool, fifth edition (SCAT5).
- Agreement was 67% to 85% between children with diagnosed modifying factors and their parent.
- Commonly reported symptoms of concussion had good agreement between child and parent for headache (71%), dizziness (90%), nausea (81%), difficulty concentrating (77%) and remembering things (71%), and confusion (74%).

The Sport Concussion Assessment Tool (SCAT) has been the consensus recommended tool for the evaluation and management of sport-related concussion in athletes since 2004.[1–3] While the SCAT has undergone revisions and updates roughly every 4 years, the third edition[2] (SCAT3) and current fifth edition[4] (SCAT5) included a separate tool specific to children aged 5 to 12 years, called the Child SCAT.[5] Both the Child SCAT3 and Child SCAT5 were developed to be similar to the adult versions but with modified language to questions that are more appropriate for the child athlete, such as including a string of 2 digits for digits backward (eg, 6–2 instead of 4–9–3) and reciting the days of the week in reverse order (eg, Sunday-Saturday-Friday, etc), as opposed to the months of the year (eg, December-November-October, etc). Additionally, the Child SCAT3 and Child SCAT5 implemented a new validated symptom scale with modified child language and queried both the child (self) and parent on the symptoms being experienced by the child.[6] One main factor for this development of a child-specific version was that 12-year-old athletes demonstrated increased difficulty with the concentration tasks on the second version (SCAT2).[7] As athletes often

do not have access to athletic trainers and allied health care professionals to conduct baseline and postinjury assessments, limited literature exists regarding athletes younger than 12 years. It is imperative to understand performance on the Child SCAT, as age and developmental differences have been apparent in the SCAT2 concentration scores.[7]

One of the earliest explorations of the Child SCAT3, the first child version, quantified normative values for the entire assessment tool in 227 Canadian youth hockey athletes between 7 and 12 years[8] and provided the total number of symptoms and symptom severity scores for both the child and parent reports while also examining differences between the ratings. No differences were noted between child and parent total number of symptoms, but parents' severity scores were lower than the children's (9.8 versus 11.4), reflecting parents' well-documented underreporting of the number and severity of symptoms in comparison with their child.[9–11] Similar findings were observed in children within 21 days postconcussion,[12] specifically parents rating symptoms as lower than the child; however, strong correlations ($r_s = 0.88$) existed between the 2 reports. Liu and Hicks[13] found lower correlations between child and parent (r range = 0.27–0.70) on individual symptom items within 14 days postconcussion and worse correlations (r range = −0.11–0.73) at 4-week follow-up. Correlations for total number of symptoms and symptom severity were high ($r = 0.7$) at the initial visit but lower ($r = 0.4$) at follow-up, further suggesting that child and parent discrepancies may worsen over time.[14] At baseline, interrater reliability between child and parent symptom severity scores was 0.35 but was unexplored in individual symptom items and total number of symptoms.[15] To date, little is known about the level of agreement as opposed to correlations in baseline symptom reporting in children. Specifically, statistical tests of correlation would measure the strength of a relationship between child and parent reporting to determine if they are linearly changing at a constant rate. The level of agreement would provide better clarity into whether children and parents are reporting identical ratings and severity (eg, *never*, *a little*, *somewhat*, or *a lot*) on the 4-point Likert-scale instrument. Additionally, limited research exists on the agreement between the child and parent on other sections of the Child SCAT, including the athlete background and medical history. This information is pivotal in understanding if children and parents are reporting this information equally, as the subjectivity of their responses may alter clinical decision-making, especially if a parent is not present to provide responses postinjury.

Although the agreement between child and parent reporting on the Child SCAT5 remains unexplored, discrepancies were present between parents of 13 and 14 year olds recognizing signs and symptoms, from distractors, of concussion using the adult version of the SCAT.[16] Mothers accurately identified 21.25/25 symptoms, and fathers identified 20.41/25 symptoms of concussion, reflecting that parent knowledge and scoring may differ between the individual's parents. Additionally, medical history agreement has yet to be explored, but 16% of adolescent athletes between 13 and 18 years inconsistently described their concussion history.[17] Athletes with self-reported attention-deficit/hyperactivity disorder (ADD/ADHD) also provided more inconsistent concussion histories than those without, further jeopardizing the accuracy of child medical history reporting. Therefore, it is imperative to understand the agreement between the child and parent on the full medical history, as only 1 is asked to complete that section on the Child SCAT5, unlike symptom reporting.

Performances on the Child SCAT3[15,18] and SCAT5[19] have been provided but researchers often fail to report the full symptom assessment, including individual items, total symptoms, and severity scores for both the child and parent. The most recent values of Kelshaw et al[19] produced only child reporting on total number and severity scores, whereas an investigation of larger robust samples[18] did not include individual symptom item performance. Recently, researchers have published false-positive and abnormal scoring rates to better understand performance,[20,21] but none exist for the Child SCAT5. Therefore, the purpose of our study was to determine the level of agreement between child and parent medical history and symptom reporting and quantify both child and parent performance on the Child SCAT5 in youth male football athletes.

METHODS

Participants

A total of 157 youth male football athletes aged 8 to 12 (10.7 ± 1.3) years and their parent or legal guardian (59% male, age = 40.8 ± 8.1 years) volunteered to participate in the study while attending a university-sanctioned youth football camp in June 2022 open to youth football athletes from around the United States. Regarding relation to the child, 82% were the biological parents, with 5.1% being the legal guardian (Table 1). A prior single concussion was reported by 9 children. A total of 15 parents described a history of concussion, with 10 reporting 1, 3 reporting 2, and 2 reporting 3 or more concussions in themselves. Full demographics as supplied by both the child and parent are shown in Table 1. Athletics directors and football coaching staff provided a letter of support for the study to be conducted at the university-sanctioned youth football camp. Institutional review board approval from The University of Alabama was granted, and a parental permission form was given to the parent and child; proceeding with completion of the Child SCAT5 was considered agreement to participate.

Measures

The Child SCAT5[6] was implemented to capture demographic information, medical history, and symptom reporting from the child and parent. The child and parent completed Step 1: Athlete Background, which asks demographic information of the child, including age and gender (male, female, or other) as well as medical history (eg, ADD/ADHD, migraines), which serve as modifying[22,23] and risk factors[24] for concussion assessment and recovery, including concussion history (number of diagnosed concussions in the past, when the most recent occurred, and recovery time), hospitalization for a head injury (*yes* or *no*), and diagnosis (*yes* or *no*) of the following: treated for headache disorder or migraines; learning disability or dyslexia; ADD/ADHD; and depression, anxiety, or other psychiatric disorder. The child and parent also completed Step 2: Symptom Evaluation, a 21-item symptom questionnaire in which individuals rate their symptoms on a 4-point Likert scale of 0 (*not at all* or *never*), 1 (*a little* or *rarely*), 2 (*somewhat* or *sometimes*), or 3 (*a lot* or *often*) for how they typically

Table 1. Child and Parent Demographics as Reported for Themselves (N = 157)

Demographic	Child	Parent
	Mean ± SD	
Age, y	10.7 ± 1.3	40.8 ± 8.1
	No. (%)	
Range	8–12	27–69
8	13 (8.3%)	
9	17 (10.8%)	
10	32 (20.4%)	
11	27 (17.2%)	
12	68 (43.3%)	
Sex		
Male	157 (100.0%)	92 (58.6%)
Female		65 (41.4%)
Relation to child		
Biological parent		129 (82.2%)
Stepparent		6 (3.8%)
Adopting parent		5 (3.2%)
Legal guardian		8 (5.1%)
Other		9 (5.7%)
Concussion history	9 (5.7%)	15 (9.5%)
No. of prior concussions		
1	9 (100.0%)	10 (67.0%)
2		3 (20.0%)
3+		2 (13.0%)

feel. The child report uses first-person "I" statements (eg, "I have headaches," "I feel like I am going to faint"), and the parent uses third-person wording (eg, "has headaches," "feels faint"). Due to the need for specific language to be understandable to children, some symptom wording differs between the child and parent reports, but inquiries about the same symptom (eg, child = "my neck hurts" versus parent = "has a sore neck") are similar to the nonchild version of the SCAT5[4] for ages 13+ years (eg, symptom item = neck pain). Per the Child SCAT5 instructions, children rated their baseline symptoms for how they felt that day, while parents rated their perception of their child's symptoms over the previous week. The *total number of symptoms* (out of 21), defined as the number of items reported as a score of ≥1, and the *symptom severity score*, defined as the sum of all ratings (out of 63), were tallied for the child and parent reports by the research team at the time of data entry. We did not administer the cognitive screening (Step 3) of the Standardized Assessment of Concussion—Child Version,[6,25,26] neurologic screening (Step 4), or balance assessment using the modified Balance Error Scoring System.[4,27,28] The Child SCAT5 has been proven to be an accurate tool for differentiating concussed athletes from control individuals, with acceptable levels of between-groups discrimination (ie, area under the curve [AUC]) for both the total number of symptoms (AUC = 0.65 for child, 0.76 for parent) and symptom severity (AUC = 0.69 for child, 0.78 for parent).[29] Although internal consistency on the Child SCAT5 has not been published, the Child SCAT3 yielded Cronbach α values of 0.89 for the child symptom report and 0.93 for the parent report.[15] All testing was completed in a rested state before physical activity and training during the youth football camp.

Statistical Analysis

Two Cronbach α reliability analysis tests were conducted to determine the internal consistency of the child and parent reports. Descriptive statistics were used to determine the level of agreement between child and parent reporting on medical history and individual symptom items. Medical history was coded as binary data (*yes* or *no* to having diagnoses), so agreement was defined as the number of child and parent pairs who both reported the diagnosis, divided by the number and percentage of parents who reported, regardless of child agreement. We also provided the additional number of children who reported having the diagnosis, despite not being confirmed by the parent, which would indicate incorrect diagnoses by the child. The level of agreement was also calculated for individual symptom items, total number of symptoms, and symptom severity score. As symptoms were rated on a scale, agreement was defined as the number of cases in which the child and parent reported identical ratings by symptom item, divided by 157 total child and parent participant pairs. Means ± SDs and frequency distributions were computed for each individual symptom item for both child and parent reports. False-positive rates were determined to quantify *abnormal performance*, defined as the number of child and parent cases exceeding the upper 95% CIs.[20]

RESULTS

The Child SCAT5 had high internal consistency for both the child (Cronbach α = 0.916) and parent (α = 0.923) symptom reports. Agreement on medical and injury background ranged from 67% (6 child/9 parent reports), with 1 additional child indicating being diagnosed with a learning disability, to 85% (18 child/21 parent reports), with 2 additional children describing being diagnosed with ADD/ADHD (Table 2). Agreement on being hospitalized for a head injury was 0%, based on 14 children and 0 parents. The level of agreement for individual symptoms ranged from 70.7% (111/157) for *gets distracted easily*, *difficulty remembering what they're told*, and *forgets things* to 94.9% (149/157) for *going to faint* and *double vision*. The total number of symptoms yielded agreement of 35.0% (55/157), whereas agreement on symptom severity scores was 35.6% (56/157).

Mean scoring and frequency distributions for the child and parent reports are provided in Table 3. Between 75% (118/157 on *headaches*) and 98% (154/157 on *going to faint*) of children and 72% (113/157 on *gets distracted easily*) to 98% (154/157 on *double vision*) of parents supplied a symptom score of 0 (no symptoms). Interestingly, an individual item symptom score of ≥1 exceeded 95% upper CIs. Therefore, any nonzero symptom reporting was deemed abnormal. Abnormal child report symptom items ranged from 1.9% (3/157 on *going to faint*) to 25% (39/157 on *headaches*), whereas abnormal parent report symptom items ranged from 1.9% (3/157 on *double vision*) to 28% (44/157 on *gets distracted easily*), with an abnormal percentage of 27% (43/157) on headaches (Table 4). Children indicated an average of 2.80 symptoms; their parents rated 2.60 symptoms. Similar findings existed in symptom severity scores, with an average child severity of 3.73 and parent rating of 3.25. Abnormal scores were nearly identical for the total number of symptoms (29.9% [47/157] for the child and 28.6% [45/157] for the parent) and symptom severity scores (26.7% [42/157] for the child and 25.4% [40/157] for the parent).

Table 2. Parent and Child Reporting and Agreement on Medical and Injury Background

Background Item	Child	Parent	% Agreement	Additional No. of Children Reporting[a]
Sustained a diagnosed concussion	9	11	82	0
Hospitalized for a head injury	14	0	0	14
Diagnosed with headache disorder or migraines	6	8	75	6
Diagnosed with learning disability/dyslexia	6	9	67	1
Diagnosed with attention-deficit disorder or attention-deficit/hyperactivity disorder	18	21	85	2
Diagnosed with depression, anxiety, or psychiatric disorder	4	5	80	1

[a] The No. of other children who reported *yes* to a medical background item beyond those matched to their respective parent who reported *yes*.

DISCUSSION

The purpose of our study was to determine the level of agreement between child and parent medical history and symptom reporting and quantify their performance on the Child SCAT5 among male football athletes. As anticipated at baseline, children and their parents agreed fairly well on the diagnosed medical history. We believe we are the first to quantify the agreement between the child and parent on medical history, as only 1 individual must report that information on the Child SCAT5, unlike symptom reporting, for which both the child and parent (if available) do so. Additionally, it does not specify which individual should complete the medical history for the most accuracy. *Agreement*, defined as the percentage of matched correct diagnoses between child and parent, ranged from 67% (learning disability) to 85% (ADD/ADHD), with 75% agreement for headaches or migraines and 82% for a concussion history. Therefore, most children were able to accurately report their diagnosed modifying factor, with matched parent confirmation, and may be reliable to report this section if comfortable doing so. Interestingly, inconsistencies were noted with 14 additional children reporting a hospitalization for a head injury that was not a response match with the parent as well as 6 additional children providing a diagnosis of headaches or migraines that was not matched. These findings are similar to those of Wojtowicz et al,[17] who observed that 15.9% of boys 13 to 18 years old inaccurately described their concussion history. Although our results suggested 0 additional children who reported a history of concussion that was not confirmed by the parent, they reflected minor, general inaccuracies from younger athletes. It may be that the 14 athletes in our study had a misconception of hospitalization as opposed to seeing a pediatrician or family physician for an orthopaedic evaluation.

Previous researchers demonstrated low baseline correlations between child and parent reports for symptom severity scores.[15] These findings are likely due to the expectation that most athletes without diagnosed modifiers should be asymptomatic at baseline.[21–23] Postconcussion correlations were similar at a 4-week follow-up in athletes aged 7 to 21 years,[13] which may reflect a return to the earlier or a new baseline level. We attempted to show the level of agreement, rather than correlation, to further characterize the similar scoring across individual symptom Likert-scale ratings, the total number of symptoms, and the severity scores. It is clinically important to recognize the prevalence at which children and parents report identical symptom ratings rather than attempting to understand the linear relationship between them or the validity of the ratings to detect what the symptom evaluation is intended to do. Agreement was roughly 70% to 95% between individual symptom items, mostly reflecting that the child and parent both accurately identified 0 symptoms at baseline, given that 75% to 98% of both children and parents reported an individual symptom item of 0, which can also be seen in the previous literature on pretest symptoms during symptom provocation concussion tasks.[21] One group examined symptom reporting in children aged 9 to 12 years on the 17-item Post-Concussion Symptom Inventory, which rates symptoms on a 3-point Likert scale: 0 (*none*), 1 (*a little*), or 2 (*a lot*). Asymptomatic prevalences for boys ranged from 85.8% (hard to pay attention) to 97% (blurry vision) for similar symptom items.[30] Our rates were comparable with those of Hunt et al[30] for headache (75.2% versus 89.9%), nausea (82.8% versus 91.7%), dizziness (92.4% versus 94.1%), difficulty paying attention (83.4% versus 85.8%), difficulty remembering (78.3% versus 94.7%), and blurry vision (92.4% versus 97.0%).

Using the Child SCAT3 from 2015, earlier authors revealed that Canadian youth male ice hockey athletes between 9 and 12 years old described 7.9 total symptoms with a severity score of 11.4, while parent ratings indicated 7.2 symptoms and a 9.8 severity score.[8] Babl et al[29] noted similar child report symptom scores but lower parent reports (4.78 symptoms and 5.93 severity score). Our results suggest that youth males endorsed fewer symptoms and less severity, with approximately 2.5 total symptoms and a 3.5 severity score. Even when compared with male-only values, Kelshaw et al[19] determined that 12-year-old male children reported 7.5 symptoms and a severity score of 10.4 on the Child SCAT5, whereas Brooks et al[18] observed that 5- to 13-year-old boys described 9.9 symptoms and a 15.1 severity score on the Child SCAT3. With the release of the Child SCAT3 in 2012 and the SCAT5 in 2016, the only difference between the symptom inventories is the inclusion of neck pain as a symptom in the latest version.[6] Despite a difference of 1 additional symptom and 3 severity scores, our male youth football athletes reported fewer symptoms altogether. The difference in symptom reporting between children and parents may be due to geography (children and parents coming from around the country to a youth football camp rather than researchers going to specific youth sports organizations or associations), based on sport type. Additionally, Kelshaw et al[19] investigated only athletes as young as 11 years old, so younger ages, such as those between 8 and 10 years old, may not report as many symptoms due to development and maturation. Further, because the children and parents may not have had a connection to the research staff or university, they may have underreported or inaccurately reported their symptoms.[31–33]

Table 3. Symptom Reporting, Frequencies, and Agreement Between Child and Parent Reporting Continued on Next Page

	Child		Parent		
Symptom Item: "I Have/Feel"[a]	Mean ± SD	Frequency (%)	Mean ± SD	Frequency (%)	Agreement, No. (%)
Headaches	0.32 ± 0.6		0.32 ± 0.5		112 (71.3)
0		118 (75.2)		114 (72.6)	
1		28 (17.8)		35 (22.3)	
2		11 (7.0)		8 (5.1)	
Dizzy	0.08 ± 0.3		0.08 ± 0.2		141 (89.8)
0		145 (92.4)		145 (92.4)	
1		11 (7.0)		12 (7.6)	
2		1 (0.6)		NA	
Room is spinning	0.03 ± 0.1		0.03 ± 0.1		148 (94.2)
0		153 (97.5)		152 (96.8)	
1		4 (2.5)		5 (3.2)	
Going to faint	0.02 ± 0.1		0.03 ± 0.1		149 (94.9)
0		154 (98.1)		152 (96.8)	
1		3 (1.9)		5 (3.2)	
Blurry vision	0.08 ± 0.3		0.04 ± 0.2		144 (91.7)
0		145 (92.4)		151 (96.2)	
1		11 (7.0)		5 (3.2)	
2		1 (0.6)		1 (0.6)	
Double vision	0.04 ± 0.2		0.03 ± 0.2		149 (94.9)
0		151 (96.2)		154 (98.1)	
1		5 (3.2)		2 (1.3)	
2		1 (0.6)		1 (0.6)	
Sick to stomach/nausea	0.22 ± 0.5		0.05 ± 0.2		127 (80.8)
0		130 (82.8)		149 (94.9)	
1		19 (12.1)		8 (5.1)	
2		8 (5.1)		NA	
Neck pain/soreness	0.17 ± 0.4		0.08 ± 0.3		131 (83.4)
0		135 (86.0)		145 (92.4)	
1		18 (11.5)		11 (7.0)	
2		3 (1.9)		1 (0.6)	
3		1 (0.6)		NA	
Gets tired a lot	0.18 ± 0.5		0.13 ± 0.4		129 (82.1)
0		138 (87.9)		139 (88.5)	
1		12 (7.6)		15 (9.6)	
2		5 (3.2)		3 (1.9)	
3		2 (1.3)		NA	
Gets tired easily	0.18 ± 0.5		0.08 ± 0.3		138 (87.9)
0		139 (88.5)		145 (92.4)	
1		10 (6.4)		11 (7.0)	
2		5 (3.2)		1 (0.6)	
3		3 (1.9)		NA	
Trouble paying/sustaining attention	0.24 ± 0.6		0.24 ± 0.6		117 (74.5)
0		131 (83.5)		131 (83.5)	
1		18 (11.5)		17 (10.8)	
2		4 (2.5)		6 (3.8)	
3		4 (2.5)		3 (1.9)	
Gets distracted easily	0.36 ± 0.7		0.39 ± 0.7		111 (70.7)
0		120 (76.4)		113 (72.0)	
1		24 (15.3)		31 (19.7)	
2		7 (4.5)		8 (5.1)	
3		6 (3.8)		5 (3.2)	
Difficulty concentrating	0.21 ± 0.5		0.26 ± 0.6		121 (77.0)
0		133 (84.7)		127 (80.9)	
1		18 (11.5)		21 (13.3)	
2		3 (1.9)		7 (4.5)	
3		3 (1.9)		2 (1.3)	
Difficulty remembering what they're told	0.28 ± 0.6		0.27 ± 0.6		111 (70.7)
0		123 (78.3)		125 (79.7)	
1		27 (17.2)		22 (14.0)	
2		4 (2.5)		9 (5.7)	
3		3 (2.0)		1 (0.6)	
Problems following directions	0.15 ± 0.5		0.22 ± 0.5		124 (78.9)
0		141 (89.8)		129 (82.1)	
1		10 (6.4)		24 (15.3)	

Table 3. Continued From Previous Page

Symptom Item: "I Have/Feel"[a]	Child		Parent		Agreement, No. (%)
	Mean ± SD	Frequency (%)	Mean ± SD	Frequency (%)	
2		4 (2.5)		2 (1.3)	
3		2 (1.3)		2 (1.3)	
Daydream too much	0.14 ± 0.4		0.27 ± 0.5		116 (73.8)
0		141 (89.9)		121 (77.1)	
1		11 (7.0)		30 (19.1)	
2		4 (2.5)		5 (3.2)	
3		1 (0.6)		1 (0.6)	
Confusion	0.29 ± 0.6		0.10 ± 0.4		117 (74.5)
0		123 (78.3)		144 (91.7)	
1		26 (16.6)		11 (7.0)	
2		5 (3.2)		1 (0.6)	
3		3 (1.9)		1 (0.6)	
Forgets things	0.32 ± 0.6		0.24 ± 0.5		111 (70.7)
0		119 (75.8)		125 (79.6)	
1		28 (17.8)		27 (17.2)	
2		7 (4.5)		4 (2.5)	
3		3 (1.9)		1 (0.6)	
Problem finishing things/completing tasks	0.10 ± 0.3		0.15 ± 0.5		133 (84.7)
0		144 (91.7)		139 (88.5)	
1		11 (7.0)		14 (8.9)	
2		2 (1.3)		2 (1.3)	
3		NA		2 (1.3)	
Trouble figuring things out/problem solving	0.20 ± 0.4		0.12 ± 0.3		126 (80.2)
0		130 (82.8)		140 (89.2)	
1		22 (14.0)		15 (9.6)	
2		5 (3.2)		2 (1.3)	
Hard to learn new things/problems learning	0.10 ± 0.3		0.09 ± 0.3		142 (90.4)
0		144 (91.7)		147 (93.6)	
1		10 (6.4)		7 (4.5)	
2		3 (1.9)		2 (1.3)	
3		NA		1 (0.6)	
Total number of symptoms (out of 21)	2.80 ± 4.1		2.60 ± 3.7		55 (35.0)
0		77 (49.1)		71 (45.2)	
1–5		51 (32.5)		60 (38.2)	
6–10		17 (10.8)		15 (9.6)	
11–15		9 (5.7)		9 (5.7)	
16+		3 (1.9)		2 (1.3)	
Symptom severity score (out of 63)	3.73 ± 6.3		3.25 ± 5.8		56 (35.6)
0		77 (49.1)		71 (45.2)	
1–10		64 (40.8)		74 (47.2)	
11–20		10 (6.4)		10 (6.3)	
21–30		4 (2.5)		NA	
31–40		2 (1.2)		1 (0.6)	
41–50		NA		1 (0.6)	
50+		NA		NA	

Abbreviation: NA, not applicable.

[a] The items are reproduced in their original format. Symptoms are worded as "I" statements (eg, "I see double") for children and "has" statements (eg, "has double vision") for parents. Scoring: 0 = *not at all* or *never*, 1 = *a little* or *rarely*, 2 = *somewhat* or *sometimes*, 3 = *a lot* or *often*.

Our findings more closely relate to those of Glaviano et al,[7] who stated that 12-year-old male athletes in middle school indicated 1.4 symptoms with a severity score of 2.2 using the SCAT2 symptom scale despite using the nonchild version, which includes similarly themed individual symptoms but on a 7-point Likert scale, ranging from 0 (*none*) to 6 (*severe*). Thus, regardless of the number of Likert ratings, most youth athletes at 12 years of age reported few to no symptoms and minor severity of the items that they did select. We classified values exceeding the upper CIs only, as asymptomatic individuals at baseline would naturally fall below the lower threshold. According to our CIs, any reporting of an individual symptom item was considered abnormal, along with 4+ total symptoms and a 5+ severity score, as children and parents can only rate symptoms on a whole-digit scale. Roughly 3% to 40% of individual symptom items, 45% of the total number of symptoms, and 40% of severity scores were abnormal, warranting further research into modifying factors and comparisons with other baseline measures, such as balance and vestibular-ocular assessment. Youth athletes aged 8 to 14 years have shown an abnormal scoring rate of 9% to 13% on baseline vestibular-ocular motor screening, which may require more investigation for us to better understand why athletes 12 years of age and younger report symptoms during provocation and nonprovocation.[34]

Table 4. Confidence Intervals and Abnormal Scoring Between Child and Parent Reporting[a]

	Child Reporting		Parent Reporting	
Symptom Item: "I Have/Feel"[b]	95% CI	Abnormal, No. (%)	95% CI	Abnormal, No. (%)
Headaches	0.22, 0.41	39 (24.8)	0.24, 0.41	43 (27.3)
Dizzy	0.04, 0.13	12 (7.6)	0.03, 0.12	12 (7.6)
Room is spinning	0.00, 0.05	4 (2.5)	0.00, 0.06	5 (3.1)
Going to faint	0.00, 0.04	3 (1.9)	0.00, 0.06	5 (3.1)
Blurry vision	0.04, 0.13	12 (7.6)	0.01, 0.08	6 (3.8)
Double vision	0.01, 0.08	6 (3.8)	0.00, 0.06	3 (1.9)
Sick to stomach/nausea	0.14, 0.31	27 (17.2)	0.02, 0.09	8 (5.0)
Neck pain/soreness	0.10, 0.25	22 (14.0)	0.04, 0.13	12 (7.6)
Gets tired a lot	0.09, 0.26	19 (12.1)	0.07, 0.20	18 (11.4)
Gets tired easily	0.09, 0.28	18 (11.4)	0.04, 0.13	12 (7.6)
Trouble paying/sustaining attention	0.14, 0.34	26 (16.5)	0.15, 0.34	26 (16.5)
Gets distracted easily	0.24, 0.47	37 (23.5)	0.28, 0.51	44 (28.0)
Difficulty concentrating	0.12, 0.30	24 (15.2)	0.17, 0.36	30 (19.1)
Difficulty remembering what they're told	0.18, 0.38	34 (21.6)	0.18, 0.37	32 (20.3)
Problems following directions	0.07, 0.23	16 (10.2)	0.13, 0.30	28 (17.8)
Daydream too much	0.07, 0.21	16 (10.2)	0.19, 0.36	36 (22.9)
Confusion	0.19, 0.38	34 (21.6)	0.04, 0.16	13 (8.2)
Forgets things	0.22, 0.43	38 (24.2)	0.16, 0.32	32 (20.3)
Problem finishing things/completing tasks	0.04, 0.15	13 (8.2)	0.08, 0.23	18 (11.4)
Trouble figuring things out/problem solving	0.13, 0.28	27 (17.2)	0.06, 0.18	17 (10.9)
Hard to learn new things/problems learning	0.04, 0.16	13 (8.2)	0.03, 0.15	10 (6.3)
Total number of symptoms (out of 21)	2.15, 3.45	47 (29.9)	2.00, 3.19	45 (28.6)
Symptom severity score (out of 63)	2.72, 4.73	42 (26.7)	2.34, 4.17	40 (25.4)

[a] Values exceeding the upper 95% CI are considered abnormal.
[b] Items are reproduced in their original format.

This study was not without limitations. First, this was a 1-time assessment deployed at a university-sanctioned youth football camp in the southeastern United States. Although the camp was open to registration of youth athletes across the country, most athletes were likely from the region or state. We did not track residing location, which should be explored in future research to ensure geographic representation. Further, only youth males were included in this study, as no females who attended the youth camp participated. Additional research is needed to validate our findings in female athletes, as 12-year-old females have been noted to report more symptoms than their male counterparts at baseline.[7] We assumed that all participating youth athletes were cleared for full physical activity and sport without restrictions and that results might vary postinjury. Future researchers should examine the level of agreement between child and parent reports postconcussion and during recovery, especially given that parents rate their children's symptoms differently from baseline. On the day of injury, parents are to rate symptoms according to how their child appears now; on all subsequent days after injury, they must rate symptoms based on how they perceive the child to have felt over the past 24 hours. Participants who were diagnosed with a previous concussion only had 1 such injury. Future authors should address the effects of a dose response[35] (eg, 1, 2, 3+ prior concussions). Lastly, symptom factor structures have not been established for the symptom evaluation on the Child SCAT5 in children aged 5 to 12 years considering that affective or emotional symptoms (eg, sadness, nervousness, irritability) are not evaluated. Cross-comparison with the adult SCAT5 can help identify factors, yet investigators should conduct exploratory factor analytic methods to better understand cognitive-sensory, sleep-arousal, vestibular-somatic, and affective factor structures at baseline and postconcussion.

CONCLUSIONS

Our results indicated upward of 85% agreement between child and parent reporting on the medical history and 70% to 90% agreement on individual symptoms in male youth football athletes. Additionally, even though the Child SCAT5 symptom checklist displayed high internal consistency for both child and parent reports, abnormal scores in the range of approximately 3% to 30% existed at baseline. Mean scores were similar between child and parent reports, but agreement between symptoms ranged between 70% and 95%, suggesting that children and parents may report symptoms similarly, with the vast majority describing zero symptoms. Understanding that most child athletes do not endorse many symptoms at baseline is pivotal; thus, any symptom provocation and reporting on symptom assessment may provide valuable clinical information for athletic trainers, pediatricians, and other health care professionals.

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