Concussion Evaluation Methods Among Washington State High School Football Coaches and Athletic Trainers

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Objective: To evaluate awareness of concussion assessment methods and to determine whether there are differences among Washington State high school football coaches and athletic trainers in urban versus rural school districts.

Design: A Catalyst WebQ survey link was randomly sent by e-mail to varsity head football coaches, athletic trainers, and athletic directors in Washington State school districts.

Participants: Survey participants were high school varsity head football coaches and athletic trainers from a total of 106 Washington State high schools.

Methods: A 12-item questionnaire on Catalyst WebQ was distributed via e-mail. The survey inquired about use of the methods of concussion assessment, both on the field and for follow-up; participants' concussion education training; and familiarity with Washington State's Zackery Lystedt Law.

Main Outcome Measurements: The survey examined differences in concussion management practices between rural and urban school districts and also between coaches and athletic trainers in Washington State, specifically regarding the use of the Standardized Concussion Assessment Tool 2 (SCAT2) and neurocognitive testing (NCT).

Results: Twenty-seven of 48 respondents (56%) used the SCAT2 for on-the-field assessment; urban respondents were significantly more likely to use SCAT2 ($P < .05$). The difference between coaches and athletic trainers with respect to SCAT2 use was not significant ($P = .08$). NCT was used by 18 of 58 respondents (31%). This was more commonly used by those in urban districts ($P < .01$) and by athletic trainers ($P < .01$). Eleven of these 18 individuals (61%) reported that a neuropsychologist interpreted the results; the rest used other providers not specifically trained in neuropsychology. There was no statistically significant correlation between years of experience and use of the SCAT2, but those with more than 10 years of experience were less likely to use NCT ($P < .01$). All respondents reported being familiar with Washington State's Zackery Lystedt Law, but only 44.1% reported that the law changed their concussion management.

Conclusions: There were statistically significant differences between SCAT2 and NCT use for respondents from urban and rural districts, and also between coaches and athletic trainers, as well as NCT use among respondents with varying years of experience. Further understanding and identification of barriers that limit identification and management of concussions in high school athletes are crucial to prevent serious permanent injury. Additional education is necessary to ensure that athletic trainers and coaches are aware of current recommendations within the medical literature for the evaluation and management of concussions.

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INTRODUCTION

The Centers for Disease Control and Prevention estimates that, each year, U.S. emergency departments treat 135,000 children and adolescents aged 5-18 years with traumatic brain injuries (TBI) [1]. Concussions, a form of mild TBI, may account for as many as 8.9% of all high school sports injuries [2]. Although any athlete is susceptible to experiencing a concussion, football and girls' soccer players have the highest concussion rates in high

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school athletics [2]. Concussions are caused by force to the head or body, and result in a wide variety of symptoms.

The most common symptoms reported by high school athletes include headache, confusion, visual abnormalities, and dizziness [3]. Most high school athletes also report feeling fatigued and experiencing a pressure headache that worsens with physical or cognitive exertion [3]. Because much of adolescent life involves academic, educational, and social and/or interactive experiences, a concussion may affect the ability to acquire or integrate new knowledge and/or to perform other cognitive activities such as text messaging or video gaming [4]. Although proper on-the-field detection is imperative, athletes often experience memory decline and worsening self-reported symptoms 36 hours after injury, which makes proper management and follow-up vital for adequate recovery [5].

Proper recognition of concussions is crucial to prevent an untimely return to play and subsequent significant brain injury. High school and collegiate athletes who have experienced at least 1 previous concussion in the past 5 years were found to be 3-6 times more likely to sustain subsequent concussions than those without a history of prior concussions [6,7]. In addition, Boden et al [8] found that 59% of high school and college football players with a catastrophic head injury resulting in death or permanent neurologic injury, had had a previous mild head injury. Among those athletes, 71% of the previous injuries had occurred in the same season, and nearly 40% of those athletes were playing with residual symptoms from the prior injury when they experienced a second, catastrophic injury [8].

This second, catastrophic injury is known as second impact syndrome. The term is somewhat controversial because it suggests that the phenomenon is due to 2 separate injuries; however, it is believed to be a catastrophic worsening of an incompletely healed initial injury. Regardless of the terminology, injury occurs when an athlete receives a second, often minor, blow to the head or body before fully recovering from the first head injury. The athlete typically becomes semicomatose within 2-5 minutes of the second injury. Symptoms are thought to be caused by vascular engorgement and autoregulation malfunction of the brain's blood supply [9]. Symptoms also may result from a second injury that leads to a small subdural hematoma, followed by brain edema and catastrophic neurologic injury [10].

After a suspected concussion, athletes can be evaluated by using several different methods to assess various aspects of brain function and recovery. Traditional orientation questions have been suggested to not adequately assess for milder concussions. An alternative set of inquiries, the Maddocks questions, are questions related to the present athletic event and have been shown to give a better memory assessment after head injuries [4]. Ferrara et al [11] polled athletic trainers and found 84% who thought that the standardized methods of concussion assessment (SMCA), such as the Standardized Concussion Assessment Tool 2 (SCAT2) or the Standardized Assessment of Concussion (SAC), provided more diagnostic information than a clinical examination alone.

The SAC, developed to be used on the field in conjunction with other concussion evaluation methods, is a brief, 5-minute questionnaire that can be administered by someone without neuropsychological training and that assesses the athlete's orientation, immediate memory, concentration, and delayed recall [12]. These questions, plus a neurologic examination and observation of any loss of consciousness, retrograde amnesia, or posttraumatic amnesia, are scored to give a SAC score of a total of 30 points. A decline in SAC from preseason baseline scores was shown to be 95% sensitive and 76% specific in determining injured versus noninjured athletes on the sidelines [12].

More recently, the SCAT test was developed, which combined questions from the SAC and Maddocks questions to give a more comprehensive standardized method of concussion evaluation. By incorporating additional aspects of concussion evaluation, such as testing balance and coordination, the SCAT2 was developed to replace the SCAT. The SCAT2 is the most up-to-date SMCA tool for on-the-field evaluation for athletes over the age of 10 years and is the preferred method of on-the-field concussion assessment according to the Zurich Consensus Statement [4]. Similar to the SAC, a numerical score is recorded for the SCAT2 [13], and the SCAT2 should be repeated after a concussion to monitor changes in an athlete's scores over time. No numerical cut-off score for return to play or age-related norms is available, but it may be used to track progress or decline after a concussion.

Neurocognitive testing (NCT), such as the computer program ImPACT (Immediate Post-Concussion Assessment and Cognitive Testing), provides another tool to evaluate concussions. ImPACT recommends giving all athletes who participate in contact or collision sports baseline testing before their freshman and junior years of high school [14]. Although ImPACT is the most widely used computerized means of NCT [15], others, such as the Automated Neuropsychological Assessment Metric [16], CogState [17], or HeadMinder [18], also recommend baseline testing and reportedly determine declines in cognitive function after concussion. A survey of high school and collegiate athletic trainers indicated that 94.7% obtain baseline NCT, but only one-third of participants indicated that they retested baselines at least every 2 years [19].

On May 14, 2009, Washington State passed the Zackery Lystedt Law, which regulates youth athlete concussion management. According to the law, "a youth athlete who is suspected of sustaining a concussion or head injury in a practice or game shall be removed from competition at that time . . . [and] may not return to play until the athlete is evaluated by a licensed health care provider trained in the evaluation and management of concussion and receives writ-

ten clearance to return to play from that health care provider" [20]. With the enactment of this law, information is needed to determine what assessments and treatments are being used and how to develop best practice guidelines. This is especially important for high school coaches and athletic trainers because they are closely involved with these youth athletes. Although high school coaches are not "managing" the medical aspects of athletes with concussions, they certainly are involved and may, in fact, be the first to recognize that a player has sustained a concussion. By using this information, better protocols can be devised to guide safe return to play and to prevent catastrophic head injuries. Therefore, this study evaluates current practices in the management of youth concussion in football players throughout the state of Washington.

Results of previous studies have shown significant differences in TBI outcomes, depending on geographic location, with more functional impairment [21,22] and less access to health care [23] for patients with TBI who are living in rural areas. Based upon these previous studies, we hypothesized that there would be differences in concussion management practices in rural versus urban school districts in Washington State. Also, given the lack of standardized guidelines for concussion management and an ever-changing understanding of TBI, we hypothesized that the number of years of experience would also influence concussion practice management.

METHODS

Study Approval

Approval was obtained from the University of Washington Institutional Review Board.

Subjects

An alphabetical list of all 298 public school districts in Washington State was obtained [24]. Contact with every third school district was attempted, but this was not possible because of variation in school privacy policies and because not all schools had a varsity football program. Hence, school districts were randomly contacted to provide a sampling, for a total of 106 athletic departments contacted via telephone and asked to participate. We did not a priori choose 50% urban and 50% rural school districts.

Of those 106 school districts contacted, each had at least 1 high school varsity football program. Coaches were also included as study participants because it was expected that they may be responsible for recognizing, but not managing, concussions. Although coaches are not expected to be performing and/or administering specific testing such as NCT, it was presumed that they may be aware of which assessment methods are used at their school. Because privacy policies regarding e-mail distribution varied among school districts, some schools provided the athletic director's e-mail address, whereas others supplied varsity head football coaches' and/or athletic trainers' e-mail addresses. From these school districts, 41 athletic directors and 176 varsity head football coaches and/or athletic trainers were directly contacted, for a total of 217 survey links distributed via e-mail in June 2010. Athletic directors were asked to forward the survey to their varsity head football coaches and/or athletic trainers. Because the survey target audience was athletic trainers and head coaches, the survey responses from athletic directors who were neither coaches nor athletic trainers were eliminated from the study.

Survey

A 12-question Catalyst WebQ survey was devised to assess concussion evaluation methods within Washington State public high schools (Figure 1). The survey took 5-10 minutes to complete. Participation in the survey was voluntary and anonymous, and participants were not required to answer every question. The only identifying information recorded was school district, which was obtained only to ensure that an adequate sample of urban and rural schools was acquired and to be able to stratify data as urban or rural. The results were not reported by school district; instead, school districts were classified as either urban or rural from a map found on the Washington State Department of Health Web site [25]. Once each survey was classified as urban or rural, all identifying school district information was removed. The survey covered demographic information, number of concussions seen each season, familiarity with the Zackery Lystedt Law, and the impact of the Zackery Lystedt Law on concussion management. Information about assessment tools used, and use of NCT, including whether neuropsychologists were used to interpret the test, was also gathered. The survey inquired about formal concussion training and the desire for additional training.

Several clarifications regarding the survey questions need to be made. Question number 4 asks how many athletes with concussions are "overseen" by the coaches or athletic trainers in an average season. This wording may be confusing to some readers. The purpose of this question was to ascertain the number of athletes on the coaches' teams with concussions, not to imply that coaches should be acting in lieu of medical professionals in managing or "overseeing" the management of the concussion. Similarly, questions 6 and 7 ask about on-the-field evaluation, and question numbers 8-10 ask about NCT. We support the notion that the role of the high school football coach is to recognize that a student athlete might have sustained a concussion, rather than to manage the medical issues associated with concussions. If an athletic trainer or other medical professional is not available on the field, however, then the coaches may rely on these assessment tools to assist with evaluation. In addition, although

1. Which school district do you work for?	
2. What is your position? Please check all that apply.	☐ Coach ☐ Athletic Trainer ☐ Athletic Director
3. How many years of experience do you have as a coach, athletic trainer, and/or athletic director?	
4. On average, how many athletes do you oversee with concussions each football season?	
☐ 0-10 ☐ 11-20 ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 51+	
5. The Zackery Lystedt Law (WA House Bill 1824, Senate Bill 5763) regarding youth concussion management was passed in May 2009.	
Are you familiar with this law?	☐ Yes ☐ No
If you are familiar with this law, has it changed the way you manage concussions?	☐ Yes ☐ No
6. SCAT2: Sideline Concussion Assessment Tool 2. If you do NOT use SCAT2, please skip the second part of this question	
Do you use the SCAT2 test for on-the-field evaluation?	☐ Yes ☐ No
If you use SCAT2, do you perform repeat SCAT2 tests in the days following a concussion?	☐ Yes ☐ No
7. If you do NOT use SCAT2, what test(s) do you use for on-the-field evaluation? Please check all that apply. If you use SCAT2, please move on to question 8.	
☐ Mini-mental Status Exam ☐ Maddocks Questions ☐ Standardized Assessment of Concussion ☐ Other:	
8. Do you use computerized neurocognitive testing, such as ImPACT?	☐ Yes ☐ No
9. If you use computerized neurocognitive testing (ImPACT), please answer the following questions. If NOT, please move on to question 11.	
Do you obtain a pre-season baseline?	☐ Yes ☐ No
Is the baseline completed annually?	☐ Yes ☐ No
Is the computerized testing performed following a concussion?	☐ Yes ☐ No
10. If you use computerized neurocognitive testing (ImPACT), who interprets the test results? Please check all that apply.	
☐ Neuropsychologist ☐ Neurologist ☐ Psychiatrist ☐ Other:	
11. What type of formal training have you had in concussion management? Please check all that apply.	
☐ None ☐ School district ☐ WSATA ☐ Local conference ☐ National conference ☐ Other:	
12. Would you like additional training regarding concussion management, and if so, what type? Please check all that apply.	
☐ None ☐ School district ☐ WSATA ☐ Local conference ☐ National conference ☐ Other:	

Figure 1. Survey

coaches are not typically administering the NCT, our presumption was that they usually are aware of whether or not it is used at their school. Question number 8 asks about NCT and gives ImPACT as an example. Question number 9, however, asks about NCT and lists ImPACT as if NCT and ImPACT are the same thing. This is not the case. ImPACT is a commonly used form of computerized NCT; however, it is not the only program available. There are other programs, and it is certainly possible that this question was confusing. There were 19 affirmative answers to question number 8, however, and the same number of respondents to question number 9, despite the potentially confusing wording.

Analytic Approach

Dichotomous study variables (eg, yes/no, rural/urban) were tested for expected versus observed frequency disparities by using the Pearson χ^2 statistic. Continuous outcome variables (eg, years of experience) were evaluated by using either the *t*-test or 1-way analysis of variance procedures (depending on the number of levels of the predictor). *P* values $<.05$ were considered statistically significant. All analyses were conducted by using SPSS software, version 14.0 (SPSS Inc, Chicago, IL).

RESULTS

Descriptives

Sixty-five surveys were completed of the 217 survey links distributed, for a response rate of 30%. Of the surveys returned, 5 were submitted by athletic directors who were not head football coaches or athletic trainers, and one did not specify position; these were eliminated from the results. Two respondents reported being both a coach and an athletic trainer; these responses were not included in the coaches versus athletic trainer analyses (Table 1). The number of years of experience ranged from 2 to 43 years (average, 14.5 years); 2 respondents did not answer this question. Of 59 respondents, 56 (95%) reported seeing between 0 and 20 concussions each season. The 3 respondents who indicated that they observed more than 20 concussions were likely outliers; due to the anonymous nature of this study, however, we were unable to verify these results via telephone (Table 2).

Fifty-eight respondents reported being familiar with the Zackery Lystedt Law, and 1 participant did not respond. Of the replies, 32 reported that the law changed the way that they managed concussion, and 26 reported no change. All the participants reported receiving some form of formal concussion training (Table 3), and 42 respondents (65%) reported being interested in receiving additional training.

Table 1. *Respondent positions*

	Athletic Trainer	Head Coach	Athletic Trainer and Head Coach	Total
Urban	31	5	0	36
Rural	5	16	2	23
Total	36	21	2	59

Table 2. *The number of athletes seen with concussions for each football season*

	0-10	11-20	21-30	31-40	41-50	51+
Urban	28	6	1	1	0	0
Rural	21	1	0	0	0	1
Total	49	7	1	1	0	1

Use of SMCA and Computerized Testing

Twenty-seven respondents reported using the SCAT2. Of these, 22 reported that they repeated the test after a concussion (Table 4). For those who do not use SCAT2, 6 reported using the SAC, and 4 reported using the Mini-Mental Status Examination (Table 5). Eighteen of 58 respondents indicated that they used NCT. All 18 respondents reported obtaining baseline scores, and 17 reported using repeated NCT for postconcussion testing (Table 4). Eleven of 18 participants reported having a neuropsychologist interpret NCT results; the rest used providers not specifically trained in neuropsychology.

Urban Versus Rural School District

A χ^2 analysis indicated that there was a statistically significant difference between urban and rural SCAT2 use, with urban users being more likely to use SCAT2 ($P < .05$). More than three-fourths of respondents who used the SCAT2 were from urban districts. Of those who lived in rural districts, only 6 of 17 used the SCAT2 (35%) (Table 4), with the remaining respondents using other methods, including the SAC or various combinations of Mini-Mental Status Examination, and/or Maddocks questions (Table 5). Individuals in urban districts also were more likely to use NCT than those in rural districts ($P < .01$) (Table 4). With regard to training, rural respondents were more likely to receive training from school districts ($P < .01$), whereas urban respondents were more likely to be trained by the Washington State Athletic Trainers'

Table 3. *Completed concussion training by urban and rural respondents*

	Urban	Rural	χ^2	*P*
None	0	0	n/a	n/a
School district	11	15	7.3	.10
WSATA	21	6	5.9	<.05
Local conference	25	11	2.7	<.10
National conference	17	2	9.1	<.01
Other	16	5	3.2	.08

n/a = not available; WSATA = Washington State Athletic Trainers' Association.

Table 4. *SCAT2 and NCT usage by urban and rural respondents*

	Rural			Urban			Total				
	Yes	No	NR	Yes	No	NR	Yes	No	NR	χ^2	*P*
Use of SCAT2 on the field	6	11	6	21	10	5	27	21	11	4.7	<.05
Repeated after concussion	4	0	1	18	4	0	22	4	1	0.09	.92
Use of NCT	1	22	0	17	18	1	18	40	1	12.7	<.01
Baseline testing	1	0	0	17	0	0	18	0	0	0.0	.99
Repeated baseline annually	0	1	0	2	15	0	2	16	0	0.13	.72
Repeated postconcussion	1	0	0	16	1	0	17	1	0	0.06	.80

SCAT2 = Standardized Concussion Assessment Tool 2; NCT = neurocognitive testing; NR = no response.

Association ($P < .05$) or to attend national conferences ($P < .01$) (Table 3).

Coaches Versus Athletic Trainers

A χ^2 analysis showed that athletic trainers were statistically significantly more likely to use NCT ($P < .01$) and suggested a trend toward greater SCAT2 use in athletic trainers as opposed to coaches, but this did not reach statistical significance ($P = .08$) (Table 6). There were no significant differences between coaches and athletic trainers when comparing other methods of on-the-field evaluation, such as the Mini-Mental Status Examination ($P = .21$), Maddocks questions ($P = .12$), or the SAC ($P = .51$) (Table 7). In addition, the coaches were statistically significantly more likely to receive training from the school district ($P < .001$) than were the athletic trainers, who were more likely to get training from the Washington State Athletic Trainers' Association ($P < .001$) or national conferences ($P < .001$) (Table 8).

Effect of Years of Experience

Among coaches and athletic trainers with 10 or fewer years of experience, 12 of 22 used the SCAT2 (55%) and 13 of 27 used NCT testing (48%), whereas among those with more than 10 years of experience 14 of 28 used SCAT2 (50%) and 5 of 29 used NCT (17.2%) (Table 9). The difference by years of experience was not significant for the SCAT2 ($P = .8$) but was significant for NCT ($P < .05$). Similar results were obtained when years of experience were treated as a continuous variable. Those who used NCT reported fewer years of experience than those who did not use NCT (8.6 versus 16.8 years; $t = -2.96$; $P < .01$), but there were no differences among those who reported using the SCAT2 (13.6 versus 13.7 years; $t = -.01$; $P = .99$).

Table 5. *On-the-field evaluation methods for respondents who do not use SCAT2 by urban and rural respondents*

	Urban	Rural	χ^2	*P*
SAC	2	4	0.95	.31
MMSE	2	2	0.0	.99
Maddocks questions	0	2	2.2	.14
Other	7	3	3.2	.07

SCAT2 = Standardized Concussion Assessment Tool 2; SAC = Standardized Assessment of Concussion; MMSE = Mini-Mental Status Examination.

DISCUSSION

Our study found significant differences in concussion evaluation methods both on the field and through computerized testing that varied based upon several factors. Coaches and athletic trainers in urban schools were more likely than those in rural schools to use SCAT2. Both athletic trainers and respondents in urban districts used NCT more than coaches or rural respondents, respectively, and those with fewer years of experience were more likely to use NCT. Such results suggest variation in concussion management, but additional research is necessary to elicit information on why such variations exist and what changes need to be made to assist in better concussion management for youth athletes.

All respondents reported receiving some formal training in concussion, but 18 indicated that they did not wish to have further training. The passage of the Zackery Lystedt Law has undoubtedly increased concussion awareness in Washington State, and all respondents reported being familiar with the law. Interestingly, almost one-half of respondents reported that the law did not change their concussion management practices. Although it is possible that the schools did not change their protocols because they were already truly using proper assessment methods, it is also possible that they did not have the resources or knowledge to do so.

Football players are the most common high school athletes to experience a concussion, with 0.47 concussions occurring per 1000 athlete exposures [2] and representing as many as 63% of mild TBI in high school athletes [26]. In our study, the majority of respondents (56/59) reported seeing an average of 0-20 concussions per season. Three respondents reported seeing more than 20 concussions each season. Although theoretically possible, this seems unlikely and would be unfortunate. Retrospective recall may have overestimated the total numbers, and these results should be interpreted with caution. Because the survey was anonymous, we were unable to contact those participants to clarify the responses.

Our results found a significant difference between urban and rural SCAT2 use, with respondents in urban schools reporting more SCAT2 use. Interestingly, of all respondents,

Table 6. *SCAT2 and NCT usage by coaches and athletic trainers*

	Coaches			Athletic Trainers			Total				
	Yes	No	NR	Yes	No	NR	Yes	No	NR	χ^2	*P*
Use of SCAT2 on the field	7	10	4	20	10	6	27	20	10	2.88	.08
Repeated after concussion	5	1	1	16	4	0	21	5	1	0.033	.85
Use of NCT	1	19	1	17	19	0	18	38	1	10.51	<.01
Baseline testing	1	0	0	17	0	0	18	0	0	n/a	.99
Repeated baseline annually	1	0	0	1	16	0	2	16	0	8.47	<.01
Repeated postconcussion	0	1	0	17	0	0	17	1	0	18.0	<.01

SCAT2 = Standardized Concussion Assessment Tool 2; NCT = neurocognitive testing; n/a = not available; NR = no response.

only one-half reported using SCAT2, and nearly one-fifth of those did not perform repeated SCAT2 tests after a concussion. Although several SMCA tools exist, the Consensus Panel of the 2008 Zurich Conference recommends use of the SCAT2 [4]; however, further research is needed for validation of the SCAT2.

NCT, such as the computer program ImPACT, provides another tool to evaluate concussions. Our results indicated that only 31% of respondents used NCT and that respondents in urban districts were more likely to use NCT compared with respondents in rural districts ($P < .01$). It is unclear why such a discrepancy in practices between urban and rural districts exists; further research is necessary to gain a better understanding of this discrepancy. It is important to note that our study also found that respondents who were athletic trainers were more likely to be from urban school districts (31/36 [86.1%]), whereas coaches in our study were more likely to be from rural districts (16/21 [76.1%]).

Because high school athletes have a variety of levels of cognitive skills that are still developing, NCT appears to be more beneficial when compared with preinjury baseline scores [4]. Of the districts that used NCT, all of them performed baseline testing, but only 2 repeated baseline testing annually. Because high school students' brains continue to develop, baseline results may change from year to year; hence, it is important to update this baseline at an appropriate interval to prevent erroneous interpretation of results.

Notebaert and Guskiewicz [15] found that only 25% of athletic trainers with access to NCT also had regular access to a neuropsychologist to assist with interpreting the results. Because NCT is complex and there are subtleties in the results that may be misinterpreted by those not properly trained, we found it encouraging that more than half (61%) of those who used NCT relied on interpretation by a neuropsychologist. We did not, however, clarify whether respondents were aware of what constitutes a neuropsychologist (compared with a psychologist, for example), which may have affected reporting in this area.

Although there was no significant difference between years of experience and SCAT2 use, there was a decline in the use of NCT among respondents with more than 10 years of experience. The reasons for this are not clear; however, ongoing education and training are necessary to keep coaches and athletic trainers up to date and to ensure that youth athletes are properly evaluated after sustaining a concussion and are not prematurely returned to play.

There are several limitations of this study. First, because some schools provided athletic directors' e-mails only, we were unable to communicate directly with these head football coaches and athletic trainers, and had to rely on the athletic directors to distribute the survey. As such, we were unaware of whether surveys were distributed appropriately, and thus our response rate could have been decreased. In addition, the survey was sent out at the end of the school year, so it is possible that the response rate would have been higher if it had been sent out earlier. Because the survey was distributed via e-mail and school districts were contacted arbitrarily, it is unclear whether the respondents represented a truly random sample of high school athletic trainers and coaches throughout Washington State. The random manner of sampling may have created selection bias (volunteer and/or nonreferral bias). Another potential limitation of our

Table 7. *On-the-field evaluation methods for respondents who do not use SCAT2 by coaches and athletic trainers*

	Coaches	Athletic Trainers	Total (n = 19)	χ^2	*P*
SAC	3	2	5	0.43	.51
MMSE	3	1	4	1.55	.21
Maddocks questions	2	0	2	2.48	.12
Other	3	7	10	2.55	.13

SCAT2 = Standardized Concussion Assessment Tool 2; SAC = Standardized Assessment of Concussion; MMSE = Mini-Mental Status Examination.

Table 8. *Completed concussion training by coaches and athletic trainers*

	Coach	Athletic Trainer	χ^2	*P*
None	0	0	n/a	n/a
School district	18	7	23.65	<.001
WSATA	4	23	10.69	<.001
Local conference	9	26	4.83	<.05
National conference	1	18	12.21	<.001
Other	3	17	6.32	<.05

n/a = not available; WSATA =Washington State Athletic Trainers' Association.

Table 9. *The number of years of experience and assessment methods used*

	0-10 Years		>10 Years			
	Yes	No	Yes	No	χ^2	P
Use of SCAT2	12	10	14	10	0.07	.80
Use of NCT	13	14	5	24	6.12	<.05

SCAT2 = Standardized Concussion Assessment Tool 2; NCT = neurocognitive testing.

study is that, in the survey, we did not require the respondent to specify which portions of the SCAT2 were completed by the athlete versus the coach or the athletic trainer. Also, as previously discussed in the Methods section, several of the questions may have been misinterpreted; however, due to the anonymous nature of the study, we were unable to contact respondents to make clarifications.

Despite the above limitations, our study provided a strong introduction to understanding common assessment methods used by coaches and athletic trainers in Washington State and can be used as a baseline for further studies designed to determine the most beneficial education to promote proper concussion management.

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