Measurement Properties of Headache-Specific Outcomes Scales in Adolescent Athletes

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Context: Recurrent headaches significantly affect health-related quality of life (HRQOL) in adults; the impact of headache on HRQOL among adolescents is unknown, and the psychometric properties of headache-specific outcomes instruments have not been adequately studied in this population. Objective: To evaluate the psychometric properties of the Headache Impact Test (HIT-6) and Pediatric Migraine Disability Assessment (PedMIDAS) in healthy adolescent athletes.

Design: Descriptive survey. Setting: High school athletic training facilities during the fall sports season. Participants: 177 high school athletes (89 males and 88 females). Interventions: A survey consisting of a demographic and concussion-history questionnaire, a graded symptom scale, the HIT-6, and the PedMIDAS. Internal consistency ($\alpha$), test–retest reliability ($r_s$), Bland-Altman analyses, and the Mann-Whitney $U$ test were used to evaluate psychometric properties and age and gender differences. Main Outcome Measures: The HIT-6 and PedMIDAS item and total scores. Results: Test–retest reliability for the HIT-6 total score was $r_s = .72$, and reliability of individual items ranged from $r_i = .52$ to $.67$. The test–retest reliability for the PedMIDAS total score was $r_s = .61$, and reliability of individual items ranged from $r_i = .23$ to $.62$. Both scales demonstrated acceptable internal consistency: HIT-6 $\alpha = .89–.90$ and PedMIDAS $\alpha = .71–.75$. Conclusions: The authors found moderate test–retest reliability for the HIT-6 and the PedMIDAS in a healthy adolescent athlete population. Research on the applicability and utility of the HIT-6 and PedMIDAS in concussed adolescents is warranted.

Keywords: concussion, patient report, reliability

There is increasing endorsement for the use of patient-based outcomes and evidence-based practice in athletic training. As the profession moves toward a more patient-centered approach to care, patient values and goals must become a priority in the management of injuries. Patient-based outcomes may include questionnaires or instruments completed by the patient that provide a patient perspective on the effectiveness of treatment, as well as insight into the impact of a particular condition on an individual’s health-related quality of life (HRQOL). HRQOL encompasses a variety of health domains including the physical, psychological,
and social domains of health that are influenced by personal experiences, beliefs, expectations, and perceptions. The assessment and rehabilitation of many athletic injuries, including sport-related concussion, warrant investigation using patient-based outcomes.

Approximately 1.6 to 3.6 million athletes are affected by concussions each year, making proper management and rehabilitation of these injuries a priority. Headache is the most commonly reported symptom after concussion and seems to linger in patients suffering from postconcussion syndrome. This is concerning because the frequency of posttraumatic headache in the high school and college population has been found to be as high as 86%, regardless of the age of the athlete. Research in the adolescent population indicates that concussive symptoms in this age group may take longer to resolve. It is also believed that lingering symptoms such as headache affect HRQOL because they cause physical, mental, and emotional problems that may interfere with daily activities, as well as the individual’s perception of his or her health and well-being. Although the evaluation of concussion typically emphasizes standardized assessment of symptoms, neurocognitive testing, and postural-control measures, the typical evaluation does not often include assessment of patient-based outcomes, making it difficult to assess the impact of the concussion, as well as any associated lingering symptoms, on the individual’s overall health status. As a result, little is known about the impact of concussion symptoms and, specifically, concussion-related headache on the HRQOL of adolescent athletes.

Lack of understanding of the impact of concussion on adolescent HRQOL is problematic because an adolescent’s life revolves primarily around school, extracurricular activities, social interactions, and family life. A decline in HRQOL may result in an increase in school absences and a decrease in academic performance. Participation in normal activities and involvement with friends and family may also suffer with a change in HRQOL. Implementation of HRQOL evaluation through patient-based outcomes instruments after concussion may highlight these potential academic and social issues, providing an opportunity for intervention. Adolescents are in a delicate period of their development in which they often define themselves through their activities, relationships, and peer interactions. Self-esteem, academic interactions, and sport participation in this population are significantly affected by chronic conditions. Clinicians have an opportunity to identify the impact of concussion symptoms on HRQOL early and by doing so may lessen the negative sequelae that follow lingering injuries. For all these reasons, investigation of headache-related conditions and HRQOL in this vulnerable population is important.

Several outcomes scales have been developed to assess the consequences of headaches or migraines on daily function and HRQOL. These scales have been found reliable and valid in the adult population, but it has not been determined whether their psychometric properties are adequate for use in adolescent athletes. Before any investigations of injured athletes, it is important to determine the psychometric properties of scales, including internal consistency and test–retest reliability. In addition, representative data need to be established for athletes of different ages and genders so that meaningful interpretations of scale scores can be made.

Therefore, our purpose was to determine the psychometric properties of the Headache Impact Test (HIT-6) and Pediatric Migraine Disability Assessment Scale (PedMIDAS) in healthy adolescent athletes to help determine their applicability.
to this population. The secondary purposes were to determine whether there was any relationship between age and scores on the HIT-6 and PedMIDAS and whether differences were noted between genders.

**Methods**

**Design and Setting**

A within-subjects, repeated-measures design was used to evaluate the psychometric properties of the HIT-6 and PedMIDAS in adolescent athletes. All subjects completed a graded symptom scale (GSS), the HIT-6, and the PedMIDAS on 2 occasions 2 weeks apart. The scales were administered in a classroom or the athletic training facility.

**Subjects**

Student athletes (N = 177) from local high schools in the greater Phoenix area were recruited for this study on the basis of their participation in athletics. Complete data sets were collected on 125 subjects, 60 males (age 15.5 ± 1.0 y, grade level 10.2 ± 0.9, height 178.7 ± 7.7 cm, mass 71.0 ± 10.9 kg) and 65 females (age 15.2 ± 1.1 y, grade level 10.0 ± 1.1, height 173.1 ± 8.0 cm, mass 60.0 ± 8.7 kg) participating in freshman, junior varsity, or varsity badminton, basketball, football, soccer, softball, or volleyball. Participants were excluded from the study if data forms were incomplete or if an injury resulting in a headache occurred during the 2-week test–retest period. Before participating in the study, all subjects and their parent or guardian read and signed an informed-consent form approved by the university’s institutional review board for the protection of human subjects.

**Instrumentation**

**HIT-6.** The HIT-6 consists of 6 items that cover various content areas reflected in HRQOL: pain, social functioning, role functioning, vitality, cognitive functioning, and psychological distress. It provides a broad overview of the impact of headache on HRQOL. The HIT-6 is useful in evaluating HRQOL for general-population studies, as well as more specific individual case studies.

Each of the 6 questions on the HIT-6 is formatted in a Likert style using 5 response categories: never, rarely, sometimes, very often, and always. For each item, 6, 8, 10, 11, or 13 points, respectively, are assigned to the response provided. These points are summed to produce a total HIT-6 score that ranges from 36 to 78. Higher scores indicate a greater impact of headaches on the daily life of a respondent. Scores can be interpreted using 4 groupings that indicate the severity of the headache’s impact on the patient’s life. Scores of 49 points or fewer reflect little or no impact, scores of 50 to 55 points reflect some impact, scores of 56–59 reflect substantial impact, and scores of 60 or more points reflect severe impact. When interpreting HIT-6 scores, a change of 5 points or more is clinically meaningful, and a 3-point change is considered noteworthy.

The HIT-6 has been validated in an adult population of headache sufferers, and the development study found the scale to have high internal consistency (α =
.89) and test–retest values \((r = .83)\). As a measure of HRQOL, the criterion-related concurrent validity of the HIT-6 has been evaluated against the Medical Outcomes Short Form (SF-36), a well-established general measure of HRQOL. Results revealed the strongest correlations between the HIT-6 and the role-physical \((r = -.52)\) and social-functioning \((r = -.57)\) subscales and the weakest relationship with the mental-health \((r = -.22)\) and general-health \((r = -.29)\) subscales. Moreover, the HIT-6 was well correlated with the Migraine Severity Scale and the functional \((r = .75)\) and social \((r = .73)\) subscales of the Qualité de Vie et Migraine scale. The HIT-6 has also been found to be able to discriminate between various headache severities; differences were noted on this scale between patients with migraine, migrainous disorders, and other episodic headaches, with the greatest impact on HRQOL in migraine patients and the lowest in those presenting with other episodic headaches.

**PedMIDAS.** The PedMIDAS is a 6-item scale developed to assess the impact of recurrent headache on HRQOL in adolescents. The scale was designed to measure aspects that specifically influence adolescents: school-related areas and social aspects, including organized activities and peer interactions. Hershey et al. found the PedMIDAS questionnaire to be sensitive, reliable, and valid for determining disability in adolescents suffering from headache pain. More than one-third of disability resulting from headache was related to the school setting, and two-thirds interfered with social and extracurricular activity.

The PedMIDAS contains items that ask the respondent about the number of days during the last 3 months in which headache affected day-to-day activities in various contexts. The days indicated by the subject are summed across categories for a total score. Scores can be interpreted using 4 groupings that indicate the disability of headache impact on the patient’s life, with 10 points or fewer reflecting little or no disability, 11 to 30 reflecting mild disability, 31 to 50 reflecting moderate disability, and a score greater than 50 reflecting severe disability.

**GSS.** The GSS includes 18 concussion-related symptoms presented in a Likert-scale format. A 7-point Likert scale is used, with 0 representing no symptoms; 1 to 2, mild symptoms; 3 to 4, moderate symptoms; and 5 to 6, severe symptoms. Subjects are asked to grade each symptom based on its severity within the past week. Instructions on the GSS were altered to ensure clarity and understanding in an adolescent population, as described by Mailer et al. Total symptoms endorsed was calculated by adding the number of symptoms that were graded a 1 or higher. Total symptom score was calculated by adding the scores for all symptoms together.

**Procedures**

After consent and assent were obtained from parents and subjects, data were collected during 2 administration sessions separated by a 2-week interval. The first administration session lasted approximately 25 minutes and required each subject to complete a data packet consisting of the demographic form, GSS, head-injury history and symptom questionnaire, and the HIT-6 and PedMIDAS. The second administration session lasted approximately 15 minutes and required the subjects to complete a data packet consisting of the GSS, HIT-6, and PedMIDAS. Before each administration, subjects were asked if they had suffered a physical injury...
during the preceding 2-week period that resulted in a headache. If the answer was affirmative, their data were discarded. Data collection was in strict compliance with all HIPAA and FERPA requirements.

**Statistical Analysis**

The Kolmogorov-Smirnov test was used to assess the normality of the data for each scale. Internal consistency was analyzed at both the initial and retest sessions using Cronbach’s alpha. Descriptive statistics (mean ± SD) were calculated for the HIT-6, PedMIDAS, and GSS (total symptom score and total symptoms endorsed) and used to evaluate floor and ceiling effects. To account for some nonnormality in the distribution of data, test–retest reliabilities were calculated using Spearman (rho) correlation coefficients. Data were also examined using Bland-Altman analyses. We considered reliability coefficients less than .50 to be poor, from .50 to .75 to be moderate, and greater than .75 to be good. Trends associated with age were evaluated with Spearman (rho) correlation coefficients, and differences between male and female subjects’ scores were analyzed using the Mann-Whitney U test for nonparametric data. All data analyses were conducted using SPSS 15.0 (SPSS Inc, Chicago, IL), and significance was set at \( P \leq .05 \), 2-tailed.

**Results**

Complete sets of data were obtained from 125 subjects and were used for the analysis reported. No subjects were excluded from the second test administration because of an injury resulting in a headache during the 2-week test–retest interval. Before the analysis, data were checked with the Kolmogorov-Smirnov test and found to be skewed; therefore nonparametric tests were employed. Analysis of frequencies indicated that the data were generally skewed toward zero, indicating less impairment. This may indicate a floor effect, which is expected considering the use of a healthy sample.

The first and second administrations of the HIT-6 scale demonstrated good internal consistency with values of \( \alpha = .89 \) and \( \alpha = .90 \), respectively. Results from the PedMIDAS scale resulted in moderate internal-consistency values of \( \alpha = .71 \) and \( \alpha = .75 \), respectively. The descriptive data for each outcomes scale are presented in Table 1.

Test–retest reliability for the HIT-6 total score was \( r_s = .72 \). Test–retest correlation values for the individual items on the HIT-6 scale ranged from \( r_s = .52 \) to \( .67 \) (Table 2). The test–retest reliability for the PedMIDAS total score was \( r_s = .61 \), and reliability of the individual items on the PedMIDAS scale ranged from \( r_s = .23 \) to \( .62 \) (Table 3). On the GSS, reliability coefficients of \( r = .73 \) were noted for both total symptoms endorsed and total symptom score.

The Bland-Altman analysis demonstrated that 5.4% of difference scores (initial minus retest) on the HIT-6 fell more than 2 SDs from the mean difference score (Figure 1). Of total scores on the PedMIDAS, 7.8% of difference scores (initial minus retest) fell more than 2 SDs from the mean difference score (Figure 2).

There was no relationship between age and total score on the initial HIT-6 total score (\( r_s = -.10, \ P = .180 \)) or for the retest HIT-6 (\( r_s = -.11, \ P = .228 \)).
Table 1  Descriptive Data for the Headache Impact Test (HIT-6) and the Pediatric Migraine Disability Assessment (PedMIDAS)

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Median (IQR 25th, 75th)</th>
<th>Range</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIT-6</td>
<td>45.93 ± 8.29</td>
<td>44.00 (40.00, 52.00)</td>
<td>37</td>
<td>36</td>
<td>73</td>
</tr>
<tr>
<td>HIT-6 retest</td>
<td>45.09 ± 8.10</td>
<td>44.00 (38.00, 50.00)</td>
<td>30</td>
<td>36</td>
<td>66</td>
</tr>
<tr>
<td>PedMIDAS</td>
<td>1.62 ± 3.67</td>
<td>0.00 (0.00, 1.00)</td>
<td>18</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>PedMIDAS retest</td>
<td>2.10 ± 4.76</td>
<td>0.00 (0.00, 2.00)</td>
<td>30</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>TSE</td>
<td>6.66 ± 5.20</td>
<td>6.00 (2.00, 11.00)</td>
<td>18</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>TSE retest</td>
<td>5.76 ± 5.24</td>
<td>5.00 (1.00, 8.50)</td>
<td>18</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>TSS</td>
<td>13.50 ± 13.99</td>
<td>8.50 (3.00, 21.00)</td>
<td>66</td>
<td>0</td>
<td>66</td>
</tr>
<tr>
<td>TSS retest</td>
<td>11.12 ± 12.49</td>
<td>7.00 (2.00, 18.00)</td>
<td>54</td>
<td>0</td>
<td>54</td>
</tr>
</tbody>
</table>

IQR, interquartile range; TSE, total symptoms endorsed; TSS, total symptom score.

* HIT-6 range 36–78, population mean = 50.

Table 2  Headache Impact Test (HIT-6) Item Descriptives (Mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>Initial administration</th>
<th>Retest</th>
<th>rs</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIT-6 Q1, severity of pain</td>
<td>8.27 ± 1.57</td>
<td>8.04 ± 1.66</td>
<td>.67</td>
</tr>
<tr>
<td>HIT-6 Q2, limitations in activities of daily living</td>
<td>7.52 ± 1.62</td>
<td>7.29 ± 1.58</td>
<td>.61</td>
</tr>
<tr>
<td>HIT-6 Q3, desire to lie down</td>
<td>9.09 ± 2.14</td>
<td>8.53 ± 2.04</td>
<td>.64</td>
</tr>
<tr>
<td>HIT-6 Q4, fatigue</td>
<td>7.18 ± 1.63</td>
<td>7.11 ± 1.63</td>
<td>.54</td>
</tr>
<tr>
<td>HIT-6 Q5, irritation</td>
<td>7.31 ± 1.74</td>
<td>7.24 ± 1.80</td>
<td>.58</td>
</tr>
<tr>
<td>HIT-6 Q6, inability to concentrate</td>
<td>7.24 ± 1.78</td>
<td>7.07 ± 1.56</td>
<td>.52</td>
</tr>
<tr>
<td>HIT-6 total score</td>
<td>46.60 ± 8.42</td>
<td>45.29 ± 8.45</td>
<td>.72</td>
</tr>
</tbody>
</table>

Table 3  Pediatric Migraine Disability Assessment (PedMIDAS) Item Descriptives (Mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>Initial administration</th>
<th>Retest</th>
<th>rs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PedMIDAS Q1, missed school—full</td>
<td>0.03 ± 0.28</td>
<td>0.05 ± 0.28</td>
<td>.34</td>
</tr>
<tr>
<td>PedMIDAS Q2, missed school—partial</td>
<td>0.02 ± 0.15</td>
<td>0.05 ± 0.29</td>
<td>.23</td>
</tr>
<tr>
<td>PedMIDAS Q3, decreased function</td>
<td>0.33 ± 0.98</td>
<td>0.76 ± 2.04</td>
<td>.62</td>
</tr>
<tr>
<td>PedMIDAS Q4, limitations in activities of daily living</td>
<td>0.61 ± 1.58</td>
<td>0.50 ± 1.47</td>
<td>.56</td>
</tr>
<tr>
<td>PedMIDAS Q5, unable to participate</td>
<td>0.21 ± 0.66</td>
<td>0.15 ± 0.60</td>
<td>.56</td>
</tr>
<tr>
<td>PedMIDAS Q6, participation limitations</td>
<td>0.48 ± 1.19</td>
<td>0.57 ± 1.26</td>
<td>.57</td>
</tr>
<tr>
<td>PedMIDAS total score</td>
<td>1.69 ± 3.64</td>
<td>2.08 ± 4.76</td>
<td>.61</td>
</tr>
</tbody>
</table>
Figure 1 — Bland-Altman plots (initial–retest) against mean for Headache Impact Test (HIT-6) scores.

There was also no relationship between age and total score on the initial PedMIDAS total score ($r_s = -.15$, $P = .055$) or for the retest PedMIDAS ($r_s = -.05$, $P = .611$).

Female subjects reported significantly higher total symptom scores on the GSS than males at initial administration ($U = 2496$, $P < .001$) and at retest ($U = 1015$, $P < .001$). Females scored higher than males on the HIT-6 at initial administration ($U = 2275$, $P < .001$) and at retest ($U = 1204$, $P < .001$). In addition, females scored higher than males on the PedMIDAS at initial administration ($U = 3006$, $P = .001$) and at retest ($U = 1355$, $P < .001$; Table 4).

Discussion

This study is the first to our knowledge to evaluate the measurement properties of the HIT-6 and PedMIDAS in an adolescent athlete sample. We found good internal consistency and test–retest reliability for the HIT-6 and moderate internal consistency and test–retest reliability for the PedMIDAS.

The article on the development of the HIT-6 reported a test–retest value of $r = .81$, compared with our value of $r_s = .72$. However, it is important to note that the developmental research on the HIT-6 was performed using an adult population. HIT-6 reliability among our population, though not as high as in the aforementioned study, tends to be similar to reports of test–retest reliability among other self-report measures in this age group.
The PedMIDAS was developed to enable measurement of disability resulting from headache in the adolescent population. Test–retest reliability in the article on its development was $r = .80$, whereas our study reported a lower value, $r_s = .61$. There are several reasons why our study differed from the validation study. First, the study included...
discrepancy between the values in our study and those in the development article may be a result of the types of subjects in each study. That is, the original validation study was performed in a population of adolescents with clinical diagnosis of migraine, whereas the current study involved a healthy adolescent athlete population. Another explanation for the difference between studies may be in the way the scales were administered. In the case of headache patients, completion of the scales would typically have occurred on an individual basis during an office visit, whereas the current study employed group administration with multiple athletes. In addition, distraction and motivation may have played a role; headache patients might see a different personal value in completing these scales than otherwise healthy adolescents. Finally, our scores were distributed differently (floor effect) from those of the validation studies, and this may have affected the value of the correlation coefficients.

The HIT-6 and PedMIDAS each demonstrated acceptable internal consistency in a healthy adolescent athlete population. Our internal-consistency values for the HIT-6 at initial administration (α = .89) and retest (α = .90) are consistent with the current literature in adult populations. Kawata et al\textsuperscript{16} reported an internal consistency of α = .87 among an adult population in a headache-specialty practice. Despite the similarity, it is important to note that Kawata et al used an adult population, and one should be cautious when generalizing the findings to adolescents. In terms of the PedMIDAS, previous internal-consistency values were reported to be α = .78 in those with a clinical diagnosis of migraine and α = .77 among adolescent headache patients who were classified according to the International Headache Society criteria.\textsuperscript{11} Our internal-consistency values were similar to those in the current literature at initial administration and retest—we found values of α = .71 and α = .75, respectively. The good internal-consistency values suggest that the 6 items on these scales are measuring various aspects of the same characteristic: the impact of headache or migraine characteristics on quality of life. Internal consistency among instrument variables is important when determining the domains or constructs of an outcomes instrument.

One concern when using these outcomes scales in healthy adolescent athletes is the presence of floor effects. An analysis of the frequency distributions of both scales in our sample demonstrates potential floor effects, a phenomenon in which subjects score toward the lower end of a scale, in this case indicating little impact of headache on HRQOL. Scores on the HIT-6 initial test (skp = 0.90), HIT-6 retest (skp = 0.78), PedMIDAS initial test (skp = 2.68), and PedMIDAS retest (skp = 3.19) were all positively skewed. These findings suggest the potential presence of floor effects when using the HIT-6 and PedMIDAS in healthy adolescent athletes. However, whether these floor effects exist in injured athletes has yet to be investigated.

In regard to self-reported symptoms, 58.5% of our subjects reported the presence of regular headaches on their GSS at initial administration, and 60.5% reported regular headaches at retest. However, these findings should not diminish the sensitivity of reported symptoms being an indicator of a possible concussion after a blow to the head or body during athletic activities. Our results support the findings of Maier et al,\textsuperscript{19} who found headache to be the most prevalent symptom endorsed in a healthy adolescent population, citing 61.9% identified headache symptoms at initial administration and 60.3% at retest. In addition, our findings support research done by Rhee et al,\textsuperscript{27} who found a high prevalence of headache in
a study investigating recurrent symptoms in adolescents. Furthermore, exploratory analysis of our data revealed that subjects who reported a headache \( (n_{\text{initial}} = 103, n_{\text{retest}} = 75) \) on the GSS also recorded higher scores on initial administration and retest of both the HIT-6 (initial \( P < .001 \), retest \( P < .001 \)) and the PedMIDAS (initial \( P = .007 \), retest \( P = .004 \)) than those who did not report a headache \( (n_{\text{initial}} = 73, n_{\text{retest}} = 49) \). These findings suggest that otherwise healthy adolescents report headaches and that the presence of headache affects their HRQOL, indicating that these scales can discriminate between adolescents with and without self-reported headache.

Age did not appear to play a role in the total score on either scale. The lack of a relationship between age and total score on the HIT-6 and PedMIDAS suggests that scores will not change as an athlete ages. Therefore, clinicians administering either scale as a baseline measure should not need to readminister the scale each school year if the athlete does not experience a change in headache status. However, when an athlete may have sustained a concussion or other injury that results in more frequent reports of headache, it may be appropriate to acquire new baseline measures of headache-related HRQOL.

Although age was not a factor in our results, our findings did demonstrate significant differences between sexes. Female subjects reported higher total scores on the HIT-6 and PedMIDAS at initial administration and at retest, endorsed more symptoms on the GSS, and reported a higher overall symptom score during each administration of the scale. These findings support those of Mailer et al.,\(^{19}\) who found a significant difference in total symptom score between sexes, with females reporting higher scores than males. Females also had a significantly greater number of total symptoms endorsed. This trend was also noted in a study investigating the psychosocial impact of headache on adolescents. Fichtel and Larsson\(^{28}\) found that females reported a significantly higher frequency of headaches and a higher perception of headache-related problems than males. In addition, Covassin et al.\(^{29}\) reported that female college athletes endorsed more symptoms at baseline than male athletes. Together, these investigations demonstrate the variability between the sexes that should be considered in patient evaluation. Furthermore, the tendency of female athletes to score higher on headache-related outcomes measures and symptom checklists supports the need for baseline testing in this population as a means of improving patient-centered health care.

Although there seems to be sufficient evidence that headache and other symptoms are more prevalent in otherwise healthy females, there is little consensus as to why headache appears to affect males and females differently. Egger et al.\(^{30}\) found an association between frequent headaches and depressive and anxiety disorders in adolescent females, yet this was not found in male adolescents. Fichtel and Larsson\(^{28}\) took these findings a step farther and suggested that the psychosocial impact of headache may in turn aggravate pain symptoms. Other research has suggested that reports of headache in the female population may be attributed to the menstrual cycle.\(^{29}\) All the aforementioned studies indicated the need for further research in the area of headache and gender differences. Understanding differences between men and women in their reports of headache may be crucial to assessing and managing concussion and concussion-related headache in female athletes.

Research also indicates that sport-related concussion can exacerbate previously existing headache disorders in athletes.\(^ {31,32}\) A study by Marcus\(^ {33}\) found that chronic headaches occurring 4 or more days per week occurred in 84% of
traumatic-headache patients, compared with 60% in non-traumatic-headache patients. Register-Mihalik et al.\textsuperscript{34} reported that patients having suffered 3 or more previous concussions were more likely to report the presence of headaches during baseline testing. They concluded that patients with headaches at baseline were more likely to suffer from an increased number and severity of symptoms after a subsequent concussion.\textsuperscript{34} Therefore, the use of self-report headache scales as part of an athlete’s baseline testing protocol for concussion may allow clinicians to better identify those with existing headache disorders and provide a baseline level of how these disorders affect individuals’ HRQOL.

Findings from these investigations suggest that the presence of a headache should be considered in combination with medical history and the clinical exam when determining course of action with an athlete.\textsuperscript{35} Based on our results, it would be appropriate for clinicians to consider including the HIT-6 or PedMIDAS in a baseline test battery during preseason evaluation of adolescent athletes. Our results and others indicate that otherwise healthy adolescent athletes experience a variety of symptoms on a regular basis, with headache being the most commonly endorsed symptom at baseline.\textsuperscript{19} Identification of these symptoms before the start of an athletic season is important, because many of the symptoms endorsed in this population are concurrent with symptoms experienced after concussion. Knowledge of baseline self-report symptoms is imperative in concussion assessment, because they provide a reliable standard against which to measure postinjury recovery.\textsuperscript{8} For example, an athlete could report a baseline score of 52, indicating some impact of headache on his or her life. After concussive injury this score could increase to 60, indicating a severe impact on HRQOL, making knowledge of the baseline score important because recovery to the point of little or no impact (score <49) may not be realistic. However, a change in 5 points from 60 to 55 suggests that the athlete is recovering and the headache is affecting her life and potential academic and social activities less.

The use of these scales may not be helpful in determining whether an athlete can return to play, although their use would be indicated in cases where adolescent athletes experience lingering symptoms that affect their ability to concentrate in school, interact with peers, or partake in other social activities. These scales may also have a place in the evaluation of athletes with a history of concussions to determine whether repeated concussive injuries begin to alter an athlete’s HRQOL. Future research into the cumulative effects of repeat concussions may also find that these scales provide valuable patient-report information to use in conjunction with neurocognitive and postural-stability testing.

We acknowledge that there were limitations to our study. Data were collected from convenience samples at local high schools, which prevents us from being able to generalize our findings to other populations including middle school and college athletes. Although we intended to administer the surveys in a quiet room, there were often noises and the presence of other individuals, which may have affected subject motivation and concentration. However, this type of setting is often used when mass baseline testing sessions for concussion are used before an athletic season. We recommend that these scales be administered in a quiet environment away from other individuals so that distractions are minimized. One other challenge was in ensuring patient motivation during the study. The follow-up administration of the survey took on average about 10 minutes less than the initial administration. This
time difference was likely because of subject familiarity with the research process and outcomes instruments, but it is possible that the subjects were disinterested and rushed through the testing.

To our knowledge, this is the first investigation evaluating psychometric properties of the HIT-6 in an adolescent population. In addition, although the PedMIDAS was developed specifically for the adolescent population, this investigation applied it to a healthy athletic population as opposed to the headache population that was used in the development study. Future research should consider investigating the HIT-6 and PedMIDAS in populations of concussed athletes, because headache is the most commonly reported symptom after a concussive injury.6–8

Conclusions

The purpose of this study was to determine the psychometric properties of the HIT-6 and PedMIDAS in healthy adolescents to help determine their applicability and usefulness in the adolescent population. Our results provide statistical evidence that the HIT-6 and PedMIDAS exhibit moderate test–rest reliability and acceptable internal consistency and are appropriate for this age group. Our findings support the integration of these scales into baseline concussion assessments, because they are able to identify those who are affected by headache, the most commonly reported symptom after concussion, and may be valuable in determining the extent of HRQOL deficits in athletes experiencing lingering symptoms or postconcussion symptoms. With additional research, the inclusion of these or similar scales into baseline testing of adolescent athletes may aid clinical practice by providing an opportunity to evaluate the impact of injuries, like concussion, on the individual’s overall well-being, which is critical for a population that is so easily affected by changes in academic and social environments.

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References


**Erratum**

In the last issue of *JSR, JSR* 19(4), in Mendel, F.C., Dolan, M.G., Fish, D.R., Marzo, J., & Wilding, E.G., Effect of high-voltage pulsed current on recovery after Grades I and II lateral ankle sprains, the authors did not identify the sponsor of their study. Mendel et al. wish to acknowledge the National Football League (NFL Charities Medical Grant) for sponsoring this study.