Clinical Outcomes Assessment for the Management of Sport-Related Concussion

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Patient Scenario: An adolescent female youth soccer athlete, with a previous concussion history, suffered a second concussion 4 wk ago. Her postconcussive symptoms are affecting her school performance and social and family life.

Clinical Outcomes Assessment: Concussion is typically evaluated via symptoms, cognition, and balance. There is no specific patient-oriented outcomes measure for concussion. Clinicians can choose from a variety of generic and specific outcomes instruments aimed at assessing general health-related quality of life or various concussion symptoms and comorbidities such as headache, migraine, fatigue, mood disturbances, depression, anxiety, and concussion-related symptoms.

Clinical Decision Making: The data obtained from patient self-report instruments may not actively help clinicians make return-to-play decisions; however, these scales may be useful in providing information that may help the athlete return to school, work, and social activities. The instruments may also serve to identify issues that may lead to problems down the road, including depression or anxiety, or serve to further explore the nature of an athlete’s symptoms.

Clinical Bottom Line: Concussion results in numerous symptoms that have the potential to linger and has been associated with depression and anxiety. The use of outcomes scales to assess health-related quality of life and the effect of other symptoms that present with a concussion may allow clinicians to better evaluate the effects of concussion on physical, cognitive, emotional, social, school, and family issues, leading to better and more complete management.

Keywords: patient report, mild traumatic brain injury, health-related quality of life

Sport-related concussion is a significant concern at all levels of athletic participation and an important public health issue because of the large number of athletes sustaining concussive injuries, the relatively young age of the individuals at the time of injury, and the potential for cumulative effects of repeated injuries. Clinicians currently have several tools for assessing the impairments associated with concussion by means of symptoms, neurocognitive testing, and balance testing. These typical concussion assessment batteries have focused on the impairment (symptoms, cognition, balance) aspect of contemporary disablement models; however, it is unclear at this time how concussion affects an individual’s health-related quality of life.
life (HRQOL). HRQOL is important because it addresses the disablement-model domains of functional loss and disability, which are thought to be more important to a person’s subjective experience of health than measures of impairment. In addition, sport-related concussion has been linked to depression, mood disturbances, sleep disturbances, and attention or concentration issues, all mediators that may shape one’s perception of HRQOL. Moreover, the most recent concussion consensus statement from the Concussion in Sport Group identifies psychological management as an area that should be addressed in concussed individuals, because mental health issues and depression may persist as long-term sequelae after concussion.

Although the use of these outcomes measures may be a new concept for sport-related concussion, the use of patient-based scales in the management of traumatic brain injuries is a standard part of clinical practice. Studies using various HRQOL scales have found decreased HRQOL after traumatic brain injuries in the areas of functional limitations, emotional problems, psychosocial functioning, and vitality. Therefore, it is feasible that athletes who suffer sport-related concussion respond similarly to patients with traumatic brain injuries, highlighting the importance of evaluating concussion beyond impairments. The purpose of this article is to discuss patient self-report measures that may help clinicians manage concussed athletes, using a scenario involving an adolescent female soccer player as an example.

**Patient Scenario**

A 14-year-old female soccer athlete suffered a concussion 4 weeks ago. She is having difficulty paying attention in class and complains of headache, fatigue, and sleep issues, and her parents have noticed a decline in her grades over the past couple of weeks. Her parents have also noticed that she is tired all the time and does not seem to want to socialize with her friends. The athlete was held out of school for 3 days after the concussion and then returned to a normal school day. She is still not participating in any physical activity because of lingering postconcussive symptoms. The athlete has a documented history of 1 prior concussion, suffered last season, but reports “blacking out” after banging heads with another player on 2 other occasions during soccer matches this season.

The concussion assessment done within the first week demonstrated an increase in her postconcussive signs and symptoms, with headache, fatigue, difficulty concentrating, and dizziness being her primary symptoms, noted on a graded symptom scale (GSS total symptom score = 47), as well as decreased balance indicated by a Balance Error Scoring System total error score of 18. She is now 4 weeks postinjury and is still reporting headache, sleep disturbances, drowsiness, irritability, feeling more emotional, and feeling slowed down. Her total symptom score on the GSS is 29. A balance assessment using the Balance Error Scoring System has returned to her preinjury, baseline score, and she is not subjectively complaining of balance or dizziness issues. A cognitive assessment using the Immediate Postconcussion Assessment and Cognitive Test shows deficits in the visual memory composite (47th percentile) and visual motor speed composite (58th percentile) compared with age-appropriate normative data. The athlete’s verbal memory composite (84th percentile) and reaction time composite (90th percentile) scores are more similar to age-appropriate data. She and her parents are concerned with her lingering symptoms and problems transitioning back into school.
Oftentimes a scenario of the type described here may result after a concussion that does not resolve in a short period of time (7–10 d). In addition, the scenario highlights common issues after concussion, including the presence of headache, fatigue, decreased social interaction, and an overall decrease in quality of life, all of which may linger for some time after the injury occurs. School performance and activities of daily living can be affected, which may result in depression in some athletes. As a result, a culmination of psychological and coping issues may present, even if only for a few days or weeks, which may leave the athlete feeling a loss of identity or isolation from his or her athletic team. Deficits in quality of life may occur as a result of these physical and psychosocial factors, which is concerning for any type of athlete, including adolescents. This scenario illustrates the importance of assessing outcomes beyond impairment because concussion has the potential to affect areas related to HRQOL and overall well-being. Unfortunately, the evaluation of patient-based outcomes is not commonplace in most concussion assessment protocols. Patient self-report instruments evaluate aspects of individuals’ perception of their health and may be beneficial in further exploring specific symptoms that concussed athletes report.

Clinical Outcomes Assessment

Unlike the numerous scales available for assessing shoulder or knee outcomes, there is no specific sport-related-concussion outcomes instrument. Therefore, to select outcomes instruments to evaluate concussed individuals like the patient here, clinicians need to understand the various symptoms associated with concussion and the accompanying issues that present with persistent symptoms and select from scales that are pertinent to those conditions. Both clinician-based and patient-based outcomes measures are appropriate and encouraged in the assessment of a concussed athlete.

Clinician-Based Measures

Traditionally, concussion management has included an evaluation of symptoms, cognition, and balance. Measures of cognition including pencil-and-paper or computerized neurocognitive tests and mental-status evaluations, such as the Standardized Assessment of Concussion, fall under the impairments aspect of disablement models (body structures and function). Similarly, balance assessments through clinical measures (eg, Balance Error Scoring System) or instrumented force-platform systems would be classified as clinician-based measures that evaluate impairments or functional limitations. These clinician-based measures have been used most often in concussion assessment and management and for making return-to-play decisions. In the scenario presented here, these measures would be incorporated into the athlete’s overall management plan, as they would allow the clinician to track cognitive recovery and help the athlete with her academic difficulties.

Patient-Based Measures

From an evaluation of the literature on traumatic brain injury, it seems that a combination of generic and condition-specific patient self-report scales may be valuable in assessing HRQOL after concussion (Table 1). Generic scales are
<table>
<thead>
<tr>
<th>Scale</th>
<th>License/User agreement requirements</th>
<th>Items</th>
<th>Age range (y)</th>
<th>Reliability</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36&lt;sup&gt;17-19&lt;/sup&gt;</td>
<td>yes</td>
<td>36</td>
<td>14+</td>
<td>a = .78–.93</td>
<td>Commonly used. Can compare across different conditions.</td>
<td>Scoring can be difficult. Items not specific to athletes.</td>
<td>Each 1-point difference or change in scores equals an effect size of .10.</td>
</tr>
<tr>
<td>PedsQL&lt;sup&gt;22-25&lt;/sup&gt;</td>
<td>yes (for funded research and clinical use)</td>
<td>23</td>
<td>5–25</td>
<td>a = .68–88</td>
<td>Specific to adolescents and young adults. Can distinguish between healthy and chronically impaired.</td>
<td>Items not specific to athletes.</td>
<td>Numerous modules that can be added for specific conditions.</td>
</tr>
<tr>
<td><strong>Specific</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIT-6&lt;sup&gt;37,41,59&lt;/sup&gt;</td>
<td>yes</td>
<td>6</td>
<td>15+</td>
<td>a = .89–.90, r = .72</td>
<td>Brief, easy to administer.</td>
<td>Provides only a composite score. Items not specific to athletes.</td>
<td>±3 points = noteworthy. ±5 points = clinically meaningful.</td>
</tr>
<tr>
<td>MIDAS&lt;sup&gt;38,42&lt;/sup&gt;</td>
<td>no</td>
<td>5</td>
<td>20–50</td>
<td>r = .52–.82 (item), r = .80–.83 (total), a = .73–.76</td>
<td>Brief. Outcome is lost days resulting from disability.</td>
<td>Reflects over the past 3 mo. Phrasing of some items is related. Items not specific to athletes.</td>
<td>Shown to correlate with physician impression of treatment and outcomes.</td>
</tr>
<tr>
<td>PedMIDAS&lt;sup&gt;40,41&lt;/sup&gt;</td>
<td>no</td>
<td>6</td>
<td>4–18</td>
<td>r = .61, a = .71–.75</td>
<td>Brief. Outcome is lost days resulting from disability.</td>
<td>Reflects over the past 3 mo. Items not specific to athletes.</td>
<td></td>
</tr>
<tr>
<td>BDI-II&lt;sup&gt;47,50&lt;/sup&gt;</td>
<td>yes</td>
<td>21</td>
<td>13–80</td>
<td>a = .92</td>
<td>Frequently used scale with extensive psychometric publications.</td>
<td>Main outcome is severity of depression, not contributing factors.</td>
<td></td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Scale</th>
<th>License/User agreement requirements</th>
<th>Items</th>
<th>Age range (y)</th>
<th>Reliability</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>PedsQL MFS&lt;sup&gt;51–53&lt;/sup&gt;</td>
<td>yes</td>
<td>18</td>
<td>5–25</td>
<td>a = .90–.95 (total), a = .76–.93 (subscales)</td>
<td>Assesses multiple domains of fatigue.</td>
<td>Not yet studied in athletes.</td>
<td></td>
</tr>
<tr>
<td>POMS&lt;sup&gt;55&lt;/sup&gt;</td>
<td>yes</td>
<td>40</td>
<td>18+</td>
<td>a = .66–.95 (abbreviated version subscales)</td>
<td>Used in numerous studies of healthy and injured athletes.</td>
<td>Includes mainly negative emotions.</td>
<td>Administrator can ask about the “past week, including today” or “right now.”</td>
</tr>
</tbody>
</table>

**Symptom Scales**

| GSS<sup>2,27,60</sup>        | no                                  | 9–22  | 10+           | ICC (total score) = .93, ICC (number endorsed) = .88 | Commonly used in sport concussion assessment.                                                  |                                                                      |                                                                      |
| RPCSQ<sup>32–36</sup>        | no                                  | 16    | 8+            | Test–retest = .91                                  | Assesses frequency and intensity of symptoms.                                                  | Instructions to rate symptoms over the past 24 h. Some concern in summing all 16 items because studies have shown 2 distinct clusters of symptoms. |                                                                      |

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SF-36, Short-Form 36 Health Survey Questionnaire<sup>17–19</sup>; PedsQL, Pediatric Quality of Life Inventory<sup>22–25</sup>; HIT-6, Headache Impact Test<sup>37,41,59</sup>; MIDAS, Migraine Disability Assessment<sup>38–42</sup>; PedMIDAS, Pediatric MIDAS<sup>40–41</sup>; BDI-II, Beck Depression Inventory-II<sup>47,50</sup>; PedsQL MFS, PedsQL Multidimensional Fatigue Scale<sup>51–53</sup>; POMS, Profile of Mood States<sup>83</sup>; GSS, Graded Symptom Scale<sup>2,27,60</sup>; RPCSQ, Rivermead Post-Concussion Symptoms Questionnaire<sup>32–36</sup>
such that they can be used with a variety of injuries or conditions and often measure global concepts related to the individual’s perception of his or her HRQOL, including physical, functional, emotional, and social aspects. On the other hand, specific self-report scales are more focused and evaluate HRQOL in relation to a specific injury, disease, condition, or population. With respect to concussion, specific scales may focus on the effects of concussion-related symptoms such as headache, depression, fatigue, and mood disturbances. Furthermore, scales specifically designed for athletes or with measurement properties studied in the athletic population may be most useful because athletes’ motivations and values may differ from those of the nonathletic population. Our review of patient self-report instruments is not all-inclusive but provides an overview of some outcomes scales that may be appropriate and useful in managing sport-related concussion. The Web site address for each scale is presented in Table 2.

Patient-Based Generic Scales

**Short-Form 36 Health Survey Questionnaire.** The Short-Form 36 Health Survey Questionnaire (SF-36), Version 2.0 (Quality Metric, Lincoln, RI), is a widely used generic measure of HRQOL, on which patients respond to questions covering 8

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**Table 2** Contact Information for Possible Sport-Related-Concussion Outcomes Scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Distributor/Licensing agency</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36</td>
<td>Quality Metric</td>
<td><a href="http://www.qualitymetric.com">www.qualitymetric.com</a></td>
</tr>
<tr>
<td>PedsQL</td>
<td>Mapi Trust</td>
<td><a href="http://www.pedsql.org/">www.pedsql.org/</a> or <a href="http://www.mapi-trust.org">www.mapi-trust.org</a></td>
</tr>
<tr>
<td>HIT-6</td>
<td>Quality Metric</td>
<td><a href="http://www.qualitymetric.com">www.qualitymetric.com</a></td>
</tr>
<tr>
<td>PedMIDAS</td>
<td>N/A</td>
<td><a href="http://www.cincinnatichildrens.org/svc/alpha/h/headache/pedmidas.htm">www.cincinnatichildrens.org/svc/alpha/h/headache/pedmidas.htm</a></td>
</tr>
<tr>
<td>BDI-II</td>
<td>Pearson</td>
<td><a href="http://pearsonassess.com">pearsonassess.com</a></td>
</tr>
<tr>
<td>PedsQL MFS</td>
<td>Mapi Trust</td>
<td><a href="http://www.mapi-trust.org">www.mapi-trust.org</a></td>
</tr>
<tr>
<td>POMS</td>
<td>Multi-Health Systems</td>
<td><a href="http://www.mhs.com">www.mhs.com</a></td>
</tr>
<tr>
<td>GSS</td>
<td>N/A</td>
<td><a href="http://www.nata.org/statements/#pos">www.nata.org/statements/#pos</a></td>
</tr>
<tr>
<td>RPCSQ</td>
<td>N/A</td>
<td>Various journal publications</td>
</tr>
</tbody>
</table>

SF-36, Short-Form 36 Health Survey Questionnaire; PedsQL, Pediatric Quality of Life Inventory; HIT-6, Headache Impact Test; MIDAS, Migraine Disability Assessment; PedMIDAS, Pediatric Migraine Disability Assessment; BDI-II, Beck Depression Inventory-II; PedsQL MFS, PedsQL Multidimensional Fatigue Scale; POMS, Profile of Mood States; GSS, Graded Symptom Scale; RPCSQ, Rivermead Post-Concussion Symptoms Questionnaire.
subscale with Likert-style responses. A score ranging from 0 to 100, with a lower score indicating lower HRQOL, is given for each of the 8 subscales: physical functioning, role limitations caused by physical health problems, bodily pain, general health perceptions, vitality, social functioning, role limitations caused by emotional problems, and mental health. A physical composite score and a mental composite score are also derived. The SF-36 is a valid and reliable ($\alpha = .78–.93$)\textsuperscript{17} instrument and has a substantial number of normative values for adults.\textsuperscript{17–19} There are also shorter versions including the SF-8 and SF-12.

In studies involving athletes and sport-related concussion, 1 investigation found that adolescent male football players with a self-report history of sport-related concussion reported significantly lower HRQOL for the bodily-pain, general-health-perceptions, vitality, and mental-health subscales and the mental composite score of the SF-36.\textsuperscript{20} Similarly, college athletes who self-report a history of 3 or more prior concussions demonstrated lower HRQOL related to pain, vitality, and social interactions.\textsuperscript{21} The SF-36 can provide valuable information to clinicians after concussion, specifically in more complicated cases, because it may provide them with an athlete’s overall perceived HRQOL. Perceived HRQOL may be indicative of many clinical issues including complications and long-term impact from concussions; however, the SF-36 may identify red flags for clinicians when psychological and physical-well being are affected after injury.

**Pediatric Quality of Life Inventory.** The Pediatric Quality of Life Inventory (PedsQL) is a 23-item generic HRQOL measure initially developed for the pediatric population (5–18 y)\textsuperscript{22} that has recently been validated in young adults.\textsuperscript{23} It is composed of 4 subscales including physical functioning (8 items), emotional functioning (5 items), social functioning (5 items), and school functioning (5 items) and allows the calculation of 2 summary scores (psychosocial health summary and physical health summary) and 1 total score. Each question is scored on a 5-point response scale, and total scores range from 0 to 100, with higher scores indicating better HRQOL. The PedsQL has multiple self-report forms for ages 5–7, 8–12, and 13–18 and parent-proxy forms for toddlers (2–4 y), young children (5–7 y), children (8–12 y), adolescents (13–18 y), and young adults (18–25 y), all with established reliability, validity, and feasibility values.\textsuperscript{22–24}

The PedsQL has been used in pediatric patients with a number of conditions and chronic illnesses including recurrent headache.\textsuperscript{25} The scale has demonstrated good internal consistency, test–retest reliability, criterion-related validity (concurrently evaluated with a headache diary), convergent validity (comparison with PedMIDAS), and responsiveness in adolescents suffering from recurrent headaches.\textsuperscript{25} The PedsQL may provide clinicians managing concussion in younger athletes with a better understanding of HRQOL, enabling them to better understand other factors (eg, physical, emotional, social, or school functioning) that may be influencing clinical recovery and helping all members of the sports-medicine team target these specific factors. Both the SF-36 and the PedsQL, as well as other general scales, may also provide valuable information as part of the preparticipation examination and the preseason baseline assessment, because they produce information on issues currently affecting athletes that may play a role in both injury risk and recovery.

In the scenario presented earlier, the PedsQL would be a good general measure of HRQOL to include in the athlete’s evaluation because it is specific to pediatric
athletes and addresses domains related to social, emotional, and school functioning.\textsuperscript{24} All concerns that the young athlete and her parents expressed regarding her prolonged concussion symptoms.

**Patient-Based Specific Scales**

**Symptom Scales and Checklists.** Numerous symptom scales and checklists have been developed to assess concussion-related symptoms preinjury and postinjury.\textsuperscript{2,26–28} A typical GSS is a list of concussion-related symptoms that the subject grades on a Likert scale of 0 to 6, with 0 representing no symptoms and 6, severe symptoms. Similar graded symptom checklists are included as part of the Immediate Postconcussion Assessment and Cognitive Test\textsuperscript{29–31} and recommended as part of the concussion assessment paradigm.\textsuperscript{2} These symptom scales can provide clinicians information about the variety, severity, and duration of symptoms if used serially after concussive injury. They may also provide information regarding postinjury differences if a preseason baseline measurement is obtained. The use of a GSS is warranted in the scenario we presented for the purpose of monitoring and assessing any changes in the athlete’s postconcussion symptoms and to help select other condition-specific outcomes measures to better evaluate lingering symptoms.

The Rivermead Post-Concussion Symptoms Questionnaire\textsuperscript{32–36} asks individuals to score specific postconcussive symptoms compared with how they felt before the incident. The Rivermead Head Injury Follow-Up Questionnaire\textsuperscript{34} is a 10-item follow-up questionnaire aimed at assessing basic activities of daily living that may be affected by brain injury. In addition to the symptoms questionnaire, this scale may be used to track recovery and improvement on patient-oriented outcomes at various points after a concussive injury. It should be noted that recent research has indicated that divergence of self-report symptoms and quality of life may occur with recovery from concussion; individuals sometimes report a high number of symptoms yet a high quality of life.\textsuperscript{36}

**Headache and Migraine Scales.** Numerous scales have been published that measure the impact of headaches and migraines on disability and quality of life. These include the Headache Impact Test (HIT-6),\textsuperscript{37} Migraine Disability Assessment (MIDAS),\textsuperscript{38,39} and Pediatric Migraine Disability Assessment (PedMIDAS),\textsuperscript{40} among others. These scales differ in the number of items asked, subscales addressed, recall period, and number of response categories used. In addition, some focus more on migraine characteristics, and others ask about headache in general and its impact on HRQOL.

Although these scales assess the role and impact of headache on quality of life in different ways, they all provide information about the role headache plays in individuals’ quality of life. Because headache and migraine scales ask questions that require the individual to reflect over a period of time, they may be most useful as a preseason baseline assessment to gain insight into the impact of headache on the individual’s life in general. It may also be useful for the clinician to repeat the use of these scales at specific time periods (eg, 1 wk, 1 mo) after the concussive injury to assess how the impact of headache on quality of life may change after injury.

The HIT-6 is a 6-item scale that was developed using items from previously validated headache disability instruments to measure a wide spectrum of the burdens of headache on HRQOL. The scale addresses the effects of headache on
pain, social function, role function, vitality, cognitive function, and psychological distress. The items selected for this scale were narrowed from a list of 89 items through a process of reliability, validity, and item-response theory. A higher score demonstrates a greater impact of headache on daily life, and scores are grouped into little or no impact, some impact, substantial impact, and severe impact.

In a population of adolescent athletes, the test–retest reliability for the HIT-6 total score was found to be $r_s = .72$, and reliability of individual items ranged from $r_s = .52$ to $.67$. Internal consistency of the HIT-6 in this population was reported to be $\alpha = .89$ to $.90$. Further study with this instrument in male adolescent athletes found that those who reported a history of concussion reported a greater impact of headache on their HRQOL than did those with no previous concussions. College athletes with a history of 3 or more concussions reported greater impact of headache than those with a history of 1 or 2 concussions and those with no previous concussions. The group with 1 or 2 previous concussions also had higher HIT-6 scores than the group with no concussion history. This measure is short and specifically addresses the impact of headache on HRQOL, so it is appropriate for our patient scenario because our athlete is still presenting with a headache and it is likely that her headache is contributing to some of her social and school problems.

The MIDAS is a 5-item, self-report scale that asks questions regarding the number of productive days lost over a 3-month time period because of migraine symptoms, with higher scores indicating a greater effect on HRQOL. The MIDAS also assesses disability in family, social, and leisure activities as a result of one’s migraine. It has demonstrated good internal consistency and test–retest reliability. However, one disadvantage is that the phrasings of the 5 items on the scale are somewhat related; the inability to work is correlated with the inability to perform social or leisure activities, even though each is treated as an individual item. In addition, the questions are more suited for individuals who are severely disabled by their migraines and provide no direct reflection of effects on athletic performance or participation. One report suggests that otherwise healthy college athletes report very little disability related to headache, as it pertains to athletic performance and on the MIDAS scale overall. However, there does appear to be some association between a higher headache disability score and history of multiple concussions.

The PedMIDAS is a 6-item instrument that assesses the impact of recurrent headache and migraine on HRQOL in children and adolescents. Questions on the scale focus on areas that may affect the HRQOL of this age group, including school, organized activities, and peer interactions. To complete the PedMIDAS, the patient reports the number of days during the last 3 months that headache has affected HRQOL. Scores can be calculated for each item or summed to create a total score and are interpreted along the following guidelines: $<10$ points = little or no disability, $11–30$ points = mild disability, $31–50$ = moderate disability, and $>50$ = severe disability. The PedMIDAS has been shown to be a reliable and valid questionnaire that is sensitive to detect differences in HRQOL between those with and without headache pain.

Studies using the PedMIDAS have found that over one-third of disability resulting from headache was related to school issues and another two-thirds affected the individual’s social and extracurricular activity. Specific to adolescent athletes, the test–retest reliability for the PedMIDAS total score was $r_s = .61$, and reliability of
individual items ranged from $r = .23$ to .62. The scale also demonstrated acceptable internal consistency ($\alpha = .71-.75$) in the adolescent athlete sample.\textsuperscript{41}

**Depression.** The Beck Depression Inventory-II (BDI-II) was developed in 1996 to replace the original BDI and to align better with the diagnostic criteria for depression established in the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition.\textsuperscript{47} The BDI-II is a 21-item scale intended to evaluate the intensity of depressive symptoms in healthy individuals and patients with a variety of physical and mental conditions. Individuals rate each item on a scale of 0 (*not present*) to 3 (*severe*) based on their perception of how they felt the 2 weeks before and including the day of administration. Scores for each item are summed, and the BDI-II total score can range from 0 to 63, with higher scores indicating more severe depression.\textsuperscript{47} The BDI-II has been used in studies investigating the relationship between symptoms and depression 5 years after whiplash injury,\textsuperscript{48} evaluating attention and depressive symptoms after traumatic brain injury,\textsuperscript{49} and assessing the psychometric properties of the scale in chronic-pain patients\textsuperscript{47} and healthy adolescents.\textsuperscript{50}

Depression is a common symptom after concussion. If an individual’s signs and symptoms extend beyond a week, depression may become more of an issue as individuals may miss normal activities. As a result, the BDI-II may provide valuable information concerning symptoms of depression, specifically around 2 weeks after injury—this is the time frame asked about in the scale. In addition, the BDI-II may be used during preseason baseline assessments to screen individuals for depressive symptoms possibly related to previous injuries.

**Fatigue.** The PedsQL Multidimensional Fatigue Scale (MFS) is an 18-item scale that addresses how general fatigue, sleep/rest fatigue, and cognitive fatigue influence HRQOL.\textsuperscript{51–53} Because of the known effects of fatigue, sleep disturbances, and cognitive deficits after sport-related concussion,\textsuperscript{26,54} this scale may be useful to clinicians in concussion evaluation. The scale uses a 5-point Likert format, and higher scores indicate better HRQOL. Similar to the PedsQL, the MFS has child, adolescent, young adult, and parent proxy-report forms. The MFS has previously demonstrated good to excellent self-report measurement properties in a healthy pediatric population and in patients with a number of illnesses including cancer, arthritis, and fibromyalgia.\textsuperscript{51–53}

The MFS can provide the clinician with valuable information as to the causative factors for fatigue both before and after a concussion. If a preseason baseline on fatigue levels is obtained, the follow-up evaluations may also provide information on how the concussive injury affects fatigue and its causes. In the presented scenario, the MFS may be a good instrument to include in the management of the athlete’s concussion, because she is complaining of sleep issues, fatigue, and problems in school.

**Mood States.** The Profile of Mood States (POMS) is aimed at assessing emotional response at a given point in time by rating moods (tension, depression, vigor, anger, fatigue, confusion, and self-esteem). Oftentimes the POMS brief version (POMS-B) is used, which consists of 40 adjectives organized into 7 subscales: tension, anger, vigor, depression, fatigue, confusion, and self-esteem. Patients respond to each of the 40 items on a 5-point Likert scale ($0 = \text{not at all}$,
4 = extremely). Scores can be calculated for each subscale, and a total mood disturbance can also be calculated by subtracting the vigor subscale (positive-mood score) from the sum of the other subscales (negative-mood scores), then adding 100. The scale has been used in tracking emotional response to injury in the athletic population. Studies among college athletes using the POMS-B suggest that concussion results in an emotional profile consisting of elevated fatigue and decreased vigor. Response to concussion, as evaluated by the POMS-B, appears different than response to musculoskeletal injury, which results in increased anger immediately after injury. These results highlight the role of emotional response after concussion and potential benefit of using tools such as the POMS in assessment after a concussive injury.

The POMS is unique in that the respondent can answer questions on how he or she is feeling at the time of administration, which may prove useful in the serial evaluations both before and after a concussive injury. This tool provides the clinician with the changing emotional profile of the individual after a concussive injury.

Clinical Decision Making

Patient self-report outcomes instruments may help in managing concussion, specifically concussions with longer-lasting symptoms. Clinicians using a GSS may be able to select condition-specific instruments to further assess symptoms that are ranked as moderate to severe on the GSS. Although meaningful change scores for each of the instruments presented have not been identified in concussed athletes, published change scores for other populations may provide some insight into whether alterations in an athlete’s scores across time demonstrate clinically important changes. Furthermore, clinicians may be able to review individual questions on these instruments to determine specific areas that warrant further evaluation or follow-up. For example, lower scores on the school-functioning subscale of the PedsQL or the cognitive-fatigue subscale of the MFS may indicate a need to increase cognitive rest and for consultation with school personnel (eg, teachers, administrators) to alter the student-athlete’s academic workload. Furthermore, generic scales such as the PedsQL can give members of the sports-medicine team a better idea of overall quality of life, both physically and mentally, of their concussed athletes.

Patient self-report instruments may also serve to identify issues that may lead to problems for the athlete down the road, such as depression or anxiety. Mood-related instruments (ie, the POMS) may give clinicians a better idea of the overall feelings of the athlete and can allow tracking of moods and tendencies throughout the injury and rehabilitation process. Instruments aimed at more specific conditions such as depression and anxiety are also useful in the management of concussion because athletes may feel isolated from their team after a concussive injury. In addition, because concussion is often not as visible as other injuries, athletes may begin to feel as though they are letting their team down by not participating, resulting in depression and anxiety. Anxiety may also be present as a result of decreased concentration leading to decreased school performance. Because many athletes are also students, not being able to participate in athletics combined with decreased performance in school-related work can lead to a combination of many psychological conditions and overall decreased quality of life. The instruments related to headache may help clinicians determine how much headache is contributing to the overall disabilities
and problems from which the athlete may be suffering. This information would aid clinicians in proper referrals, treatments, and management that may ultimately lead to an increased quality of life for the athlete. Consistent with the current concussion assessment paradigm, some baseline measurements before injury may further aid clinicians in measuring the effects of injury on specific quality-of-life domains.

In the scenario presented in this article of the female concussed soccer athlete, the use of a generic patient-self report scale (PedsQL) and 2 condition-specific scales (HIT-6 and MFS) provides the clinician with information that is useful in the successful management of the athlete’s concussion. Patient self-report scores at the current assessment period (4 wk postinjury) are as follows: HIT-6 = 62, indicating severe impact of headache on HRQOL; Pediatric Quality of Life Inventory (PedsQL) physical functioning = 34; emotional functioning = 50; social functioning = 55; school functioning = 40; MFS general fatigue = 45.83; sleep fatigue = 37.5; and cognitive fatigue = 54.17. Scores on the PedsQL and MFS fall near or below 50, indicating some impact on HRQOL in that these scales are scored from 0 to 100, with higher scores equaling better HRQOL. Clearly, this soccer athlete is affected by headache and feels that her concussion-related symptoms are affecting numerous aspects of her life. Subsequent administration of these assessments should occur so that the clinician can track improvements in HRQOL and help manage headache, fatigue, and social or school concerns so that the athlete can return to her previous level of physical, cognitive, and psychological function.

Summary

Concussion management may be enhanced by incorporating both clinician- and patient-based instruments into concussion assessment batteries. Scales specifically related to concussion symptoms and general quality of life are needed to fully understand the effects of concussion on athletes’ HRQOL and to more completely manage these injuries when they occur. However, existing instruments can be used to better evaluate and manage general quality-of-life issues related to concussion. Recent literature suggests that each concussed athlete be managed individually because the effects of concussion on physical, cognitive, emotional, social, school, and family issues will differ across individuals. Outcome-based instruments can help clinicians better evaluate the effects of concussion on all these areas, leading to better and more complete management. The scales presented are an example of those used to evaluate HRQOL and related concepts, and although they are some of the most commonly used instruments, the list is not exhaustive and there are other outcome scales that may be useful in the assessment and management of concussion.

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References


