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Original Research

Changes in Patient-Reported Outcome Measures From the Time of Injury to Return to Play in Adolescent Athletes at Secondary Schools With an Athletic Trainer

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Context: Typically, athletic trainers rely on clinician-centered measures to evaluate athletes' return-to-play status. However, clinician-centered measures do not provide information regarding patients' perceptions.

Objective: To determine whether clinically important changes in patient-reported outcomes were observed from the time of lower extremity injury to the time of return to play in adolescent athletes.

Design: Cross-sectional study.

Setting: The National Athletic Treatment, Injury and Outcomes Network (NATION) program has captured injury and treatment data in 31 sports from 147 secondary schools across 26 states. A subsample of 24 schools participated in the outcomes study arm during the 2012–2013 and 2013–2014 academic years.

Patients or Other Participants: To be included in this report, student-athletes must have sustained a knee, lower leg, ankle, or foot injury that restricted participation from sport for at least 3 days. A total of 76 initial assessments were started by athletes; for 69 of those, return-to-play surveys were completed and analyzed.

Main Outcome Measure(s): All student-athletes completed generic patient-reported outcome measures (Patient-Reported Outcomes Measurement Information System [PROMIS] survey, Global Rating of Change scale, and Numeric Pain Rating Scale) and, depending on body region, completed an additional region-specific measure (Knee Injury and Osteoarthritis Outcome Score or Foot and Ankle Ability Measure). All applicable surveys were completed at both the initial and return-to-play time points. Means and standard deviations for the total scores of each patient-reported outcome measure at each time point were calculated. Change scores that reflected the difference from the initial to the return-to-play time points were calculated for each participant and compared with established benchmarks for change.

Results: The greatest improvement in patient-reported outcomes was in the region-specific forms, with scores ranging from 9.92 to 37.73 on the different region-specific subscales (Knee Injury and Osteoarthritis Outcome Score or Foot and Ankle Ability Measure; scores range from 0–100). The region-specific subscales on average still showed a 21.8- to 37.5-point deficit in reported health at return to play. The PROMIS Lower Extremity score increased on average by 13 points; all other PROMIS scales were within normative values after injury.

Conclusions: Adolescent athletes who were injured at a high school with an athletic trainer may have shown improvement in patient-reported outcomes over time, but when they returned to play, their outcome scores remained lower than norms from comparable athlete groups.

Key Words: patient-reported outcomes, high school, NATION

Key Points

- After a lower extremity injury, adolescent athletes at high schools in which an athletic trainer was employed demonstrated improvements in patient-reported outcomes at return to play.
- Region-specific patient-reported outcomes were most sensitive to change after a lower extremity injury.
- A large portion of adolescent athletes returned to play with scores that were below the maximum on patient-reported outcome measures.

Participating in physical activity or athletics is associated with many benefits. Specifically, moderately intense physical activity helps prevent cardiovascular disease and hypertension, being overweight, and some types of cancers.[1–3] In addition to the personal health benefits of participating in athletics, academic performance[4] and socialization benefits such as increased confidence and competence,[5] initiative,[6] teamwork,[7] and moral development[8] also occur. However, participating in athletics also carries risks, specifically sport-related injury. Attention to the care of sport-related injuries is necessary in part due to the lasting effects these injuries can have on overall health.[9] More than 30 million children and adolescents participate in organized sports in the United

States, including intercollegiate athletics, high school sports, club leagues, and sports performance programs.[10,11] More than 7.7 million adolescents participate annually in high school athletics,[12] and the absolute number of participants in high school sports has increased 15% in the last decade.[13] Furthermore, an estimated 12 million student-athletes between the ages of 5 and 22 years sustain a sport-related injury annually, which leads to 20 million lost days of school[14] and generates approximately $33 billion in injury-related medical costs. A large number of these injuries are to the lower extremity, with estimates of 25.3% and 40.3% of all injuries occurring at the knee and ankle, respectively.[15] Unfortunately, evidence regarding the patient-reported outcomes of injury, such as those to the lower extremity among high school athletes, is limited.

Typically, when student-athletes experience sport-related injuries, the goal is to return them to athletic participation. Return to play is predominantly measured by a clinician's assessment of physical outcomes such as strength, range of motion, laxity, and fitness. Physical ability is obviously important because student-athletes need to be able to perform their sport and protect themselves from further injury. Furthermore, measures of physical recovery from the injury are informative to clinicians because they provide insight into the physiological state of tissues and physical impairments. However, these measures have several limitations: they do not provide information regarding the patient's perception of his or her health status,[16] and they may not show a relationship with an individual's overall health.[17,18] Consequently, the medical community has advocated the use of patient-reported outcomes to assess patients' health status.[19,20] This includes the evaluation of the effect of an injury and successive health care services from the patient's viewpoint.[18] Several organizations in the sports medicine and orthopaedic community have also emphasized the need for clinical outcomes data using patient-based outcome measures.[21,22] The data gained from patient-based outcome measures (including health-related quality of life [HRQoL], region-specific questionnaires, and ratings of pain) are also necessary for determining the effectiveness of treatments and interventions as well as the ability of health care professionals to predict return to play.[23,24]

Investigating sport-related injuries in high school student-athletes should be an area of extreme importance for the sports medicine community due to the large number of participants and the frequency of sport injury. Sports participation is the number-one cause of musculoskeletal injury, especially to the lower extremity, among children who are involved in sports.[25] Injuries resulting from sports participation are concerning because they may prevent an individual from continuing to participate in physical activity. Furthermore, a strong relationship exists between physical activity and psychosocial factors affecting children and adolescents.[26–28] Researchers[27] have also shown a strong relationship between physical activity and perceived life satisfaction among high school students. Furthermore, a previous history of injury can affect the HRQoL of collegiate student-athletes cleared for participation, suggesting that early injuries can have a lasting effect on health status.[29,30] However, reports of patient-based outcomes immediately after sport-related injuries, especially for secondary school student-athletes, are lacking. Therefore, the purpose of our study was to determine whether clinically important changes in patient-reported outcomes were observed from the time of lower extremity injury to the time of return to play in adolescent athletes at secondary schools with an athletic trainer (AT). Our primary research hypothesis was that we would observe improvements in patient-reported outcomes, on average, that met or exceeded the established minimally important change (MIC) values for the patient-reported outcomes of interest over time.

METHODS

Design and Setting

This was a prospective observational study conducted during the 2012–2013 and 2013–2014 academic years and is a companion project included in the broader program of the National Athletic Treatment, Injury and Outcomes Network (NATION).[31] The target population was all high school student-athletes whose lower extremity injuries were rehabilitated by an AT at a participating school and not referred to an outside clinic for treatment. The NATION project was reviewed and approved by the Western Institutional Review Board (Puyallup, WA); both student-athletes and ATs could decline participation in the outcomes arm of the study at any point in time.

In total, the NATION program has captured injury and treatment data for 31 sports from 147 secondary schools across 26 states.[31] A subsample of 24 schools participated in the health outcomes study arm of the NATION project during the 2012–2013 and 2013–2014 academic years. To be included in the outcomes study arm, a school had to meet specific inclusion criteria: (1) participation in the injury-surveillance study arm, (2) the majority of therapy and rehabilitation administered by the on-campus AT, (3) access to a private office or computer laboratory, and (4) access to the Internet. Participating ATs were provided an annual stipend due to the additional burden of administering the outcomes surveys. The NATION outcomes program used a rolling recruitment model, with enrollment growing year by year. In the first year, 7 schools provided outcomes data and in the second year, 17 schools provided outcomes data.

Participants

Over the 2 years, 183 lower extremity injuries qualified for inclusion in the outcomes study arm. On that basis, 76 (41.5%) initial assessments were completed by athletes, with 69 (90.1%) of those completing return-to-play surveys. There were 107 injuries that did not have initial surveys because either the athlete declined to participate or the AT was unable to obtain the completed survey from the athlete within 3 days of the injury. To be included in this report, a student-athlete must (1) have sustained an injury that restricted participation in athletics for at least 3 days and have completed the initial surveys within those 3 days, (2) have completed the surveys at return to play, and (3) have received care from an AT who determined the appropriate treatment. This left 69 injuries in the dataset. All surveys were completed within 3 days of each time point.

Procedures

One of the innovations of the NATION program is that it uses a common data element export standard to gather data from a variety of different injury-documentation applications.[18] The data-extraction process has been explained in detail,[31] and this same approach was used to deidentify and export common data elements from the outcomes application. The outcomes survey measures were administered via an online outcomes application developed specifically for this study and provided free to participating ATs. The outcomes survey measures were connected to the injury-documentation application. The purpose of connecting the outcomes and injury-documentation applications was to ensure that only injuries meeting the inclusion criteria were selected and all of the associated outcome measures were maintained with the injury record. In addition, the connected electronic outcomes and injury-documentation applications reduced the burden on clinicians by eliminating the need for double entry of injury or outcomes information.

An injury that caused a student-athlete to miss at least 3 days of sport participation met the initial criteria for inclusion in the outcomes arm of the NATION study. A qualifying injury triggered the system to notify the AT at the injured student-athlete's school that the outcomes surveys were ready for completion. The AT then notified the student-athlete about the surveys and instructed him or her to complete them within 3 days postinjury, either on a school or home computer. On return to play, the student-athlete completed the same patient-reported outcomes measures within 3 days of return to play. All participating student-athletes were asked to complete the generic patient-rated outcomes measures: the Patient-Reported Outcomes Measurement Information System (PROMIS), Global Rating of Change (GROC) scale, and Numeric Pain Rating Scale (NPRS). Student-athletes who sustained knee or ankle injuries were also asked to complete region-specific patient-reported outcomes measures. Those student-athletes who sustained a knee injury completed the Knee Injury and Osteoarthritis Outcome Score (KOOS), and those student-athletes who sustained an ankle injury completed the Foot and Ankle Ability Measure (FAAM). Descriptive information about each of the patient-reported outcomes measures used for this study is included in Table 1.[32–37]

Statistical Analysis

Means and standard deviations for the total score of each patient-reported outcomes measure at each time point (initial and return to play) were calculated for the entire cohort. Change scores that reflected the differences in patient-reported outcome measures from the initial to the return-to-play time points were calculated for all patients on all outcome measures at the individual level. The individual scale scores were compared with established benchmarks for change. The change score for a patient-reported outcomes measure from the initial to the return-to-play assessment that exceeded established benchmarks for change suggested that the individual experienced a meaningful change.

To identify a benchmark for change, responsiveness values that were relevant to the patient-reported outcomes measure were used. For the GROC, NPRS, KOOS, and FAAM, the benchmark for meaningful change was the *MIC*, which is the smallest amount of change in a scale score from 1 administration to the next that would be perceived as beneficial by patients. The MIC values for the GROC, NPRS, KOOS-Pain, KOOS-ADL, KOOS-Sport, KOOS-QOL, FAAM-Sport, and FAAM-Activities of Daily Living (ADL) have been previously identified.[32–35] The MICs were 5 points for the GROC (with a total possible score range of 0–15),[33] 1.3 points for the NPRS (with a total possible score range of 0–10),[32] 10 points for all KOOS scores (with a total possible score range of 0–100),[34] and 8 (FAAM-ADL) or 9 (FAAM-Sport) points for FAAM scores (with a total possible score range of 0–100).[35] Higher values indicate better scores for the KOOS and FAAM, whereas lower values indicate better scores for the GROC and NPRS. A change between initial and return-to-play assessments that exceeds the identified MIC is considered meaningful. No documented MICs are available for the PROMIS measures, so only group means and standard deviations are given. Norm-based scoring is used for the PROMIS variables, with a mean of 50 and a standard deviation of 10 (range = 0–100).[19] Higher scores indicate better function. All data were analyzed using Enterprise Guide software (SAS Inc, Cary, NC).

RESULTS

Athletes completed the initial surveys 2.71 ± 1.02 days after injury. The average time between the initial survey and the return-to-play survey was 17.25 ± 13.84 days for lower leg, ankle, and foot injuries, whereas the time between the initial survey and the return-to-play survey was 69.57 ± 99.64 days for knee injuries. All surveys were completed within 3 days of the athlete's return to play. The most frequent injury location was to the knee (31.9%, n = 22), followed by the ankle (27.5%, n = 19), lower leg (27.5%, n = 19), and foot (13.0%, n = 9). Means and standard deviations for each patient-reported outcomes measure for all lower extremity injuries at the initial and return-to-play visits are presented in Table 2. The greatest differences from the initial to return-to-play visits were seen in the region-specific patient-reported outcomes measures (KOOS and FAAM). From the initial survey to the return-to-play survey, the mean differences for all the scales of the KOOS and FAAM ranged from 9.92 to 37.73. The mean difference between the initial and return-to-play scores on the GROC was 3.11 points and on the NPRS was 3.33 points. When comparing the initial to the return-to-play surveys, we found that the PROMIS Lower Extremity scores increased on average by 13 points.

On the individual level at return to play, for the GROC, 64.7% of those with a knee injury and 70.6% of those with a lower leg, ankle, or foot injury exceeded the MIC. For the NPRS, 58.8% of individuals who sustained a knee injury and 56.9% of individuals who sustained a lower leg, ankle, or foot injury exceeded the MIC. For the KOOS scales, 52.9%, 29.4%, 58.8%, and 52.9% individually exceeded the MIC for the Pain, ADL, Sport, and QOL scales, respectively. For the FAAM ADL and Sports scales, 60.8% and 49.0% of athletes, respectively, exceeded the MIC.

Table 1. Patient-Reported Outcome Measures

Scale	Description	Psychometric Properties
Pediatric PROMIS Social[36,37]	Focuses on perceived wellbeing regarding social activities and relationships, including the ability to relate to individuals, groups, communities, and society as a whole	Reliability: ICC = 0.84 Validity: $r = 0.89$ Responsiveness (MIC): none reported Burden: <10 min to complete Alternative methods of administration: computer adaptive, parent proxy Age-specific normative value: 50.2
Pediatric PROMIS Pain[36,37]	Focuses on the interference effect of pain (effects on physical, mental, and social activities) and avoidance behaviors (behaviors one engages in to avoid, minimize, or reduce pain)	Reliability: ICC = 0.88 Validity: $r = 0.94$ Responsiveness (MIC): none reported Burden: <10 min to complete Alternative methods of administration: computer adaptive, parent proxy Age-specific normative values: 50.5
Pediatric PROMIS Anxiety[36,37]	Focuses on fear (eg, fearfulness), anxious misery (eg, worry), and hyperarousal (eg, nervousness)	Reliability: ICC = 0.84 Validity: $r = 0.89$ Responsiveness (MIC): none reported Burden: <10 min to complete Alternative methods of administration: computer adaptive, parent proxy Age-specific normative values: 44.1
Pediatric PROMIS Lower Extremity[36,37]	Focuses on physical mobility, such as arising from bed or a chair to activities such as running	Reliability: ICC = 0.73 Validity: $r = 0.90$ Responsiveness (MIC): none reported Burden: <10 min to complete Alternative methods of administration: computer adaptive, parent proxy Age-specific normative values: 52.0
Global Rating of Change[33]	Uses a 15-point scale ranging from a *very great deal better* to a *very great deal worse* with *about the same* in the middle	Reliability: ICC = 0.90 Validity: $r = 0.72–0.90$ Responsiveness (MIC): 5 Burden: <1 min to complete, easy to score Alternative methods of administration: orally Age-specific normative values: none
Numeric Pain Rating Scale[32]	Uses a 10-point system in which 0 is *no pain* and 10 is the *worst imaginable pain*	Reliability: ICC = 0.63–0.76 Validity: $r = 0.80–0.88$ Responsiveness (MIC): 1.3 Burden: <1 min to complete, easy to score Alternative methods of administration: orally Age-specific normative values: none
Knee Injury and Osteoarthritis Outcome Score[34]	Evaluates the short-term and long-term patient-relevant outcomes of knee injury; the 5 domains are pain, other symptoms, activities of daily living function, sport and recreation function, and knee-related quality of life for a total of 42 items.	Reliability: ICC = 0.78–0.82 Validity: $r = 0.72–0.79$ Responsiveness (MIC): 10 Burden: <15 min to complete, easy to score Alternative methods of administration: none Age-specific normative values: none
Foot and Ankle Ability Measure[35]	Developed as a region-specific instrument to assess physical performance of the leg, ankle, and foot; the instrument is divided into 2 subscales, the 21-item Activities of Daily Living and the 8-item Sports subscales	Reliability: ICC = 0.87–0.89 Validity: $r = 0.78–0.84$ Responsiveness (MIC): Activities of Daily Living = 8, Sport = 9 Burden: <10 min to complete, easy to score Alternative methods of administration: none Age-specific normative values: none

Abbreviations: ICC, intraclass correlation coefficient; MIC, minimal important change; PROMIS, Patient-Reported Outcomes Measurement Information System.

DISCUSSION

To our knowledge, we are among the first to examine both generic and region-specific patient-reported health-related outcomes of high school student-athletes who sustained lower extremity sport-related injuries and were treated by ATs. Overall, our results suggest that student-athletes perceived improvement in pain and region-specific health as they recovered from lower extremity injuries. In general, adolescent athletes who are injured at a high school in which an AT is employed show improvement in patient-reported outcomes. However, at return to play, a large portion of athletes had scores well below the best possible score on the instrument, suggesting remaining health deficits. For an injury to be included in this study, it had to be a knee, lower leg, ankle, or foot injury. In our sample, student-athletes with knee injuries were excluded from participation longer than those with lower leg, ankle, or foot

Table 2. Initial and Return-to-Play Outcome Measures (Mean ± SD)

Outcome Measure	Initial	Return to Play
Pediatric PROMIS		
Social (n = 69)	46.75 ± 8.33	47.50 ± 8.70
Pain (n = 69)	52.50 ± 6.25	49.75 ± 5.22
Anxiety (n = 69)	51.55 ± 5.72	44.65 ± 4.22
Lower Extremity (n = 69)	42.00 ± 5.05	55.00 ± 4.03
Global Rating of Change (n = 69)	4.99 ± 2.56	1.88 ± 1.64
Numeric Pain Rating Scale (n = 69)	4.22 ± 2.07	0.89 ± 1.42
Knee Injury and Osteoarthritis Outcome Score		
Pain (n = 22)	47.70 ± 23.65	70.04 ± 9.06
Activities of Daily Living (n = 22)	52.71 ± 22.95	69.96 ± 10.55
Sport (n = 22)	24.77 ± 31.26	62.50 ± 20.26
Quality of Life (n = 22)	53.98 ± 17.42	74.11 ± 10.65
Foot and Ankle Ability Measure		
Sports (n = 47)	52.49 ± 21.34	73.56 ± 7.52
Activities of Daily Living (n = 47)	68.20 ± 25.33	78.12 ± 10.67

Abbreviation: PROMIS, Patient-Reported Outcomes Measurement Information System.

injuries (missed days = 69.57 ± 99.64 versus 17.25 ± 13.84 days, respectively). Longer times away from play indicate that the knee injuries sustained by athletes in our study may have been more severe than the other lower extremity injuries. Evaluating patients with both generic and region-specific patient-reported outcomes measures was a strength of this study. Using generic patient-reported outcomes may highlight areas that are perhaps not thought of as being affected by injury (eg, depression, anxiety, social), whereas region-specific measures address areas that would be expected to demonstrate change (eg, pain, function). The initial PROMIS scores were similar to population norms (mean = 50) for the PROMIS Pain and Anxiety scales. All of the region-specific scales showed deficits at the initial time point. This may indicate that region-specific measures may be more appropriate for evaluating short-term deficits in function, and generic patient-reported outcomes may be more appropriate for assessing changes in general HRQoL over longer-term follow-up.[29,30] In addition, the PROMIS Lower Extremity scale, NPRS, KOOS, and FAAM displayed improvement from the initial to the return-to-play assessment, and these values exceeded the targeted benchmarks for change.

Generic measures of HRQoL tend to lack sensitivity when compared with region-specific measures because they typically ask questions that are more global in nature and may not specifically address the patient's health condition. This may be particularly true in high-functioning patients such as student-athletes in whom most injuries will resolve within 30 days of injury. The relatively short duration from injury to recovery may necessitate a specific patient-reported outcomes measure tailored to student-athletes who tend to recover quickly. To mitigate this limitation, we chose measures with recall periods of 7 days. Despite this, we were concerned that the generic measures would not be sensitive to change; however, both the PROMIS Anxiety and Lower Extremity scales reflected changes in the student-athletes' responses. The PROMIS Anxiety scale focuses on a particular emotional response and the Lower Extremity scale focuses on a particular body region. If a change in health status occurs, the region-specific patient-reported outcomes assessments are expected to be sensitive to the change due to the high relevance of the questions to the condition of interest. Therefore, region-specific patient-reported outcomes are recommended for use early in health care follow-up. However, generic patient-reported outcome measures are important, too, because they are more likely to detect unexpected changes in health, which is valuable information when providing patient-centered care. Generic patient-reported outcomes are recommended for use during longer-term health care follow-up. Our inclusion of generic and region-specific measures that highlight both unexpected and expected health changes provided the best opportunity to gain insight into the patient-perceived recovery of health after injury in sport.

Previous authors[16] used generic patient-reported outcomes in collegiate student-athletes who reported a mild or serious injury and compared them with those of uninjured student-athletes. The athletes with serious injuries demonstrated declines in the raw 36-Item Short Form Health Survey (SF-36) score for each of the 8 subscales and the 2 composite scores. Student-athletes classified with a mild injury scored lower than uninjured peers on the physical component summary score and the Role-Physical, Bodily Pain, Social Functioning, and General Health subscales.[16] Similar investigations[38,39] have been conducted with adolescent student-athletes. On the SF-36, the injured group demonstrated lower scores for physical functioning, limitations due to physical health problems, Bodily Pain, Social Functioning, and the Physical Summary score.[39] Adolescent student-athletes with self-reported injuries demonstrated a lower level of HRQoL than their uninjured peers. Social Functioning, as evaluated with the SF-36, and global HRQoL also declined, suggesting that the injuries affected areas beyond the expected physical component of health.[39] These results showed decreased HRQoL on generic patient-reported outcomes. When comparing our findings with normative values, we saw deficits on the PROMIS Lower Extremity scale but not on the other PROMIS scales. Additional research may be needed to establish normative values for the nonsensitive PROMIS instruments if used for adolescent athletes; otherwise, other generic patient-reported outcome measures specific to adolescent athletes should be considered.

Despite the statistically significant and clinically important improvements observed in many of the survey responses from the time of injury to return to play, many athletes still had scores that were much lower than the highest possible score on the scale when they returned to full, unrestricted participation in sport. Furthermore, only about half of the individual athletes displayed improvements that exceeded referenced MIC values. In our sample, the KOOS and FAAM subscales still averaged a 21.8- to 37.5-point deficit in reported health at return to play. This is well below the reference value for comparable age groups (depending on the specific subscale) at the time of return to play.[30,40] Self-reported impairments and functional deficits while participating in sport activities have been reported in the literature.[29,41,42] Soldatis et al[41] noted that shoulder deficits related to pain, strength, instability, and function were reported even though the athletes were actively playing. Similar results have been seen in the knee and

other body regions.[29,42] These reported deficits warrant further investigation. Preferably, return-to-play criteria and patient-reported health outcomes would be more closely aligned. Furthermore, at return to play, athletes' patient-reported health outcomes would be expected to be close to the highest possible instrument scores, suggesting good perceived health status. One plausible explanation for athletes returning to play while still demonstrating patient-reported deficits in health is that the patient-reported component of an evaluation is not incorporated into the return-to-play decision. The risk and larger concern is that if athletes return to play while reporting perceived functional impairments, suggesting incomplete recovery, they may be at risk for sustaining subsequent injury or developing chronic musculoskeletal conditions such as osteoarthritis. Lastly, these findings stress the importance of obtaining individualized baseline patient-reported outcome measure scores at the beginning of the season to identify normal health for a particular patient. A better understanding of normal health will assist clinicians in making more informed return-to-play decisions after injury.

Although we did note changes in PROMIS Anxiety subscale scores (injured student-athletes reported less anxiety at the return-to-play assessment than at the initial assessment) and Lower Extremity scores (injured student-athletes reported better function at the return-to-play assessment than at the initial assessment), we did not observe changes on the PROMIS Social or Pain subscales. Regarding the PROMIS Social scale, it may be that the time to injury resolution was short enough that the injury had no effect on social health. We found it interesting that whereas the PROMIS did not capture changes in pain, both the NPRS and the KOOS Pain scales did. It is possible that the questions on the PROMIS Pain subscale did not address pain in a way that resonated with the patients in our study. Because pain is a common reason people seek care, more research comparing different pain scales and changes in pain as a result of interventions is needed.

Many high schools rely on ATs to manage athletic injuries. Adolescent athletes who are injured at a high school in which an AT is employed showed improvements in patient-reported outcomes over time. Regarding global HRQoL, only the scores on the PROMIS Anxiety and Lower Extremity subscales exceeded the targeted benchmarks for change. Using values representative of responsiveness is important in outcomes-based research because it is a significant psychometric property to consider when interpreting patient-reported outcomes measures for use in clinical practice. Without these values, it is difficult to determine whether a patient's health has improved, stayed the same, or worsened. However, for responsiveness values to be useful, both initial and return-to-play injury data are needed. Therefore, clinicians should measure patient outcomes throughout the care process so that the meaningful effects of the care provided can be captured and shared.

LIMITATIONS

This study had several limitations. It was limited to a convenience sample of student-athletes who agreed to complete all surveys (only 41.5% agreed to do so), restricting generalizability. Because of this, it is possible that only those with positive outcomes chose to complete the surveys. We were also unable to control for the types, frequency, or forms of therapy provided by ATs. Therefore, we cannot determine whether the effects of acute injury management, follow-up therapy, or both contributed to the positive outcomes of these student-athletes. All injuries included in the study were sustained to the knee, lower leg, ankle, or foot, and injured individuals needed to be withheld from play for at least 3 days. The injury definition had no other requirements, which led to the large variations in time to return to play. We also did not control for sex, specific injury, or injury history in our analyses. Despite these limitations, we believe the uniqueness and approach of this research offer a good first step in the process of assessing patient-reported health outcomes in the secondary school setting. Future research to improve on our methods is encouraged.

CONCLUSIONS

Overall, the region-specific PROMIS Lower Extremity and NPRS were the most sensitive instruments in determining functional deficits in student-athletes who sustained sport-related injuries. Generally, adolescent athletes who are injured at a high school in which an AT provides care show improvement in patient-reported outcomes over time. However, the patients' scores appeared to be below normative levels, suggesting that these athletes were not at perceived optimal health even though they were fully cleared to return to play. It may be important for future authors performing outcomes research to consider baseline assessments of perceived health status, similar to the standards established for concussion management. Further research on the comparative effectiveness of different therapy protocols is warranted as we continue to measure the outcomes of health care after athletic injuries.

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