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Low Back Pain in Adolescents: A Comparison of Clinical Outcomes in Sports Participants and Nonparticipants

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Context: Back pain is common in adolescents. Participation in sports has been identified as a risk factor for the development of back pain in adolescents, but the influence of sports participation on treatment outcomes in adolescents has not been adequately examined.

Objective: To examine the clinical outcomes of rehabilitation for adolescents with low back pain (LBP) and to evaluate the influence of sports participation on outcomes.

Design: Observational study.

Setting: Outpatient physical therapy clinics.

Patients or Other Participants: Fifty-eight adolescents (age = 15.40 ± 1.44 years; 56.90% female) with LBP referred for treatment. Twenty-three patients (39.66%) had developed back pain from sports participation.

Intervention(s): Patients completed the Modified Oswestry Disability Questionnaire and numeric pain rating before and after treatment. Treatment duration and content were at the clinician's discretion. Adolescents were categorized as *sports participants* if the onset of back pain was linked to organized sports. Additional data collected included diagnostic imaging before referral, clinical characteristics, and medical diagnosis.

Main Outcome Measure(s): Baseline characteristics were compared based on sports participation. The influence of sports participation on outcomes was examined using a repeated-measures analysis of covariance with the Oswestry and pain scores as dependent variables. The number of sessions and duration of care were compared using t tests.

Results: Many adolescents with LBP receiving outpatient physical therapy treatment were involved in sports and cited sports participation as a causative factor for their LBP. Some differences in baseline characteristics and clinical treatment outcomes were noted between sports participants and nonparticipants. Sports participants were more likely to undergo magnetic resonance imaging before referral (P = .013), attended more sessions (mean difference = 1.40, 95% confidence interval [CI] = 0.21, 2.59, P = .022) over a longer duration (mean difference = 12.44 days, 95% CI = 1.28, 23.10, P = .024), and experienced less improvement in disability (mean Oswestry difference = 6.66, 95% CI = 0.53, 12.78, P = .048) than nonparticipants. Overall, the pattern of clinical outcomes in this sample of adolescents with LBP was similar to that of adults with LBP.

Conclusions: Adolescents with LBP due to sports participation received more treatment but experienced less improvement in disability than nonparticipants. This may indicate a worse prognosis for sports participants. Further research is required.

Key Words: spine, athletes, disability

Key Points

- Among these adolescents with low back pain, sports participants attended more physical therapy sessions over a longer duration and experienced less improvement in disability than nonparticipants.
- Overall, the clinical outcomes pattern in this sample of adolescents with low back pain was similar to that seen in adults with low back pain.

Low back pain (LBP) has long been recognized as an almost universal problem in the adult population, with an estimated yearly prevalence of 15% to 20% and a lifetime prevalence of up to 80%.[1] Conventional wisdom has traditionally held that the presence of LBP in adolescence is a relatively rare event, one that is possibly indicative of a serious condition.[2] Authors[3,4] of more recent studies have found, however, that LBP is not uncommon in adolescents and that most cases are musculoskeletal in origin. Depending on the definition of LBP used, estimates of the 1-year prevalence of LBP in adolescents have ranged between 10% and 56%.[5–7] Prevalence increases with age among adolescents.[8] For example, in a study[9] of Danish schoolchildren, the 1-month prevalence of LBP among third graders (8–10 years old) was 4%, but among ninth graders (14–16 years old), the 1-month prevalence increased to 20%. By the age of 18 years, rates of LBP approach those documented in adults.[10]

The relationship between physical activity and LBP in adolescents appears to be curvilinear, with both low levels and very high levels of physical activity being associated with an increased risk of LBP in adolescents.[11,12] The particular type of physical activity has also been related to risk of LBP in adolescents, with higher risk reported[13–15] for activities that place greater stresses on the lumbar spine, such as gymnastics, wrestling, rowing, diving, and football. Sports such as swimming, which places less stress on the lumbar spine, may result in a reduced risk of LBP.[12] Although we know that certain sports can increase the risk of LBP for adolescents, the effect of sports participation on recovery from an episode of LBP is not as clear. Few researchers have examined the natural history of LBP in adolescents, and even fewer have reported the outcomes of treatment. The influence of sports participation on the likelihood of recovery is unknown.

Much remains to be learned about the natural history of LBP in adolescents, but it is obvious that the condition cannot always be considered benign. Back pain in adolescents has been related[16–18] to decreased quality of life, increased likelihood of seeking medical attention, increased use of analgesic medications, and absence from school. Some adolescents with an episode of LBP experience substantial and prolonged pain and activity limitation,[19–22] and experiencing LBP in adolescence has been linked[23,24] to an increased risk of LBP in adulthood. Recognizing the consequences of LBP during adolescence should increase our focus on determining the outcomes of different management strategies and investigating the factors that may influence outcomes. The purposes of our study were to examine the clinical outcomes of treatment provided to adolescents with LBP and to evaluate the influence of sports participation on the clinical outcomes.

METHODS

Patients

Data for this study were collected from the clinical outcomes database maintained by the Rehabilitation Agency of Intermountain Healthcare, a private, nonprofit, integrated health care delivery system. Outpatient physical therapy clinics in the Rehabilitation Agency track clinical outcomes for all patients receiving care. In the clinical outcomes database, each new patient is entered at the initial physical therapy session using a Web-based application. At the initial session and at subsequent sessions, each patient completes a condition-specific disability outcome score appropriate to the injury or condition and a numeric pain intensity rating, and these scores are entered into the database. A numeric pain rating scale ranging from 0 (*no pain*) to 10 (*worst imaginable pain*) is used to measure pain intensity.[25] Numeric pain rating scales are generally considered to be valid for adolescents and have been used previously in studies[26] examining adolescents with LBP. The Modified Oswestry Disability Questionnaire (OSW)[27] is the condition-specific disability scale used for patients with a chief complaint of LBP. The OSW has been used previously for adolescents with LBP,[19] but the instrument has not been validated in this age group. Additional information in the outcomes database includes the patient's age, sex, symptom duration, and number of treatment sessions. This study was approved by the Institutional Review Board of Intermountain Healthcare.

The sample for this study was drawn from data entered into the clinical outcomes database from 4 outpatient physical therapy clinics. From the outcomes database, we identified adolescents attending physical therapy with LBP between January 1, 2005, and December 31, 2007, and we retrospectively analyzed the outcomes of treatment. Specific inclusion criteria were a chief complaint of LBP, as indicated by entry of the OSW into the database as the condition-specific outcome measure, and patient's age at the date of the initial physical therapy session (between 12 and 17 years). Patients were excluded from this study if they had previously undergone lumbar spine surgery or if they attended fewer than 2 treatment sessions.

Measurements

For each patient meeting the inclusion criteria, we extracted the following variables from the clinical outcomes database: age, sex, duration of current LBP symptoms (based on the patient's self-report), number of physical therapy sessions attended, and duration of the physical therapy episode of care. We recorded the initial and final scores for the OSW and the pain rating for each patient and consulted the treatment chart to determine the nature of the injury or onset of LBP. The onset was categorized as *related to sports participation* if the onset occurred during participation in a school-sponsored or organized sports team or group that involved coaching and a regular schedule of competition or if the onset was related to participation (eg, gradually developed during training). Additional variables collected from the patient's chart included height, weight, use of diagnostic imaging before physical therapy referral, presence of symptoms extending into the lower extremities, and presence of signs of nerve root compression in the clinical examination (ie, positive signs of nerve root tension [straight-leg raise or femoral nerve test], diminished sensation, muscle stretch reflexes, or muscle strength in a pattern associated with a lumbar nerve root). The medical diagnosis provided by the referral source or indicated by the diagnostic imaging results was also recorded from the patient's chart. The medical diagnosis was categorized as specific or nonspecific using definitions described previously.[28] *Specific diagnoses* included any lesions of a bony structure (eg, stress fracture) or intervertebral disc (eg, herniation) in the lumbosacral region or nomenclature indicating a specific underlying condition (eg, sciatica). *Nonspecific diagnoses* included back pain, strain or sprain, or any other nonspecific nomenclature (eg, "lumbago").

Clinical Outcome Measures

The OSW and pain rating scores were used to determine the clinical outcomes of the episode of care for each patient. The percentage change for each of these measures was computed for each patient using the following formula: ($[\text{Score}_{\text{initial}} - \text{Score}_{\text{final}}]/\text{Score}_{\text{initial}} \times 100\%$). We also dichotomized each patient's outcome as *successful* or *nonsuccessful* using a threshold of achieving at least 50% improvement on the OSW to define *success*. We have previously[29–32] used this definition of success to examine the outcomes of various treatments for adults with LBP. The use of 50% improvement on the OSW as a marker of a successful rehabilitation outcome has been validated[33] for adults but not for adolescents.

Data Analysis

The sample was divided into patients with LBP related to sports participation or LBP not related to sports participation. Descriptive statistics, including means with SDs for continuous variables and frequency counts for categorical variables, were calculated for the entire sample and for the subgroups based on sports participation. Comparisons

Table 1. Baseline Characteristics of Study Sample

	Entire Sample (N = 58)	Sports Participants (n = 23)	Nonparticipants (n = 35)
Age, mean ± SD, y	15.40 ± 1.44	15.43 ± 1.24	15.37 ± 1.57
Sex, % female	56.90	47.83	62.86
Body mass index, mean ± SD, kg/m^2	21.64 ± 3.25	21.21 ± 2.08	21.63 ± 3.82
Duration of current symptoms? Median, (interquartile range), d	107 (28–316.25)	67 (22–157)	163 (43–365)
Symptoms distal to buttock(s)?, % yes	13.79	13.04	14.29
Signs of nerve root compression?, % yes	8.62	4.34	11.43
Diagnostic imaging performed?, % yes	65.52	69.56	62.86
Spinal radiographs	48.28	22.86	57.14
Magnetic resonance imaging	22.41	39.13	11.43
Computerized tomography scan	5.17	8.70	2.86
Bone scan	3.45	8.70	0
Medical diagnosis, % nonspecific	67.24	56.52	74.29
Initial pain rating, mean ± SD	4.76 ± 2.06	4.48 ± 1.93	4.94 ± 2.16
Initial Modified Oswestry Disability Questionnaire score, mean ± SD	24.69 ± 13.30	20.87 ± 10.85	27.19 ± 14.29

were made between patients with and without sports-related LBP using t tests or χ^2 tests of association for continuous and categorical variables, respectively.

The percentage of patients achieving a successful outcome was determined using the definition described previously. The mean number of physical therapy sessions and duration of the episode of care were computed. The number of physical therapy sessions and the duration of care were compared between sports participants and nonparticipants using independent-groups t tests. The influence of sports participation on clinical outcomes was examined using repeated-measures analysis of covariance (ANCOVA). Time was the within-patients factor, with 2 levels (initial and final assessment). Sports participation was the between-patients factor, with separate analyses performed using the OSW and pain ratings scores as the dependent variable. Age, sex, duration of current LBP symptoms, and duration of the physical therapy episode of care were covariates. The percentages of sports participants and nonparticipants achieving a successful outcome were compared using a χ^2 test of association. Significance was set at $P < .05$ for all analyses.

RESULTS

The study sample included 58 adolescents with LBP. Mean age was 15.40 years (SD = 1.44 years), and 33 adolescents (56.90%) were female (Table 1). Twenty-three adolescents (39.66%) were injured or developed symptoms as a result of sports participation, whereas 35 adolescents (60.34%) were categorized as nonparticipants. Basketball (n = 6, 26.09%) was the most common sport associated with LBP, followed by football (n = 4, 17.39%). Two patients each developed LBP associated with participation in gymnastics, volleyball, or cheerleading, and 1 patient each reported the development of LBP with swimming, figure skating, softball, wrestling, golf, track (long jumping), or cross-country. Among patients categorized as nonparticipants, 2 reported regular sports participation (1 track, 1 cheerleading), but sports participation was not related to the development of LBP.

The mean baseline numeric pain rating for all patients was 4.76 (SD = 2.06), and the mean baseline OSW score was 24.69 (SD = 13.30). No difference was noted in baseline pain rating between sports participants and nonparticipants (mean difference = 0.47, 95% confidence interval [CI] = −0.65, 1.58, $P = .41$). The difference in baseline disability approached significance, with nonparticipants tending toward greater disability (mean difference = 6.32, 95% CI = −0.69, 13.34, $P = .076$). No differences between participants and nonparticipants were seen with respect to age, sex, body mass index, median duration of current LBP symptoms, proportion of patients with symptoms into the lower extremities, proportion of patients with signs of nerve root compression, or proportion of patients receiving diagnostic imaging before referral ($P > .05$) (Table 1). Overall, 38 patients (65.52%) underwent at least 1 diagnostic imaging procedure before referral. The most common imaging procedures were spinal radiographs (n = 28, 48.28%) and magnetic resonance imaging (MRI) of the lumbar spine (n = 13, 22.41%). Patients who were sports participants were more likely to undergo an MRI before referral ($P = .013$) (Table 1). A total of 39 patients (67.24%) had nonspecific medical diagnoses, and the proportion of patients with nonspecific diagnoses did not differ based on sports participation (Table 1). Among the 19 patients with specific medical diagnoses, 7 (36.84%) had spondylolytic lesions. Three patients had medical diagnoses of scoliosis, 2 patients each had medical diagnoses of disc herniation or juvenile disc disease, and 1 patient each had a medical diagnosis of neurofibromatosis, sciatica, coccydynia, lumbar compression fracture, or pelvic fracture.

Patients injured as a result of sports participation attended more physical therapy sessions (mean difference = 1.40 sessions, 95% CI = 0.21, 2.59, $P = .022$) over a longer duration of care than did nonparticipants (mean difference = 12.44 days, 95% CI = 1.28, 23.10, $P = .024$) (Table 2). No differences were found in the final values obtained for the OSW or pain rating between groups ($P > .05$). Overall, 24 patients (41.38%) achieved a successful treatment outcome. The proportion of successful treatment outcomes did not differ between groups (Table 2).

The repeated-measures ANCOVA examining the difference in OSW scores resulted in an interaction between time and sports participation. The nature of the interaction (Figure 1) indicated that nonparticipants experienced a greater change in the OSW from the initial to the final assessment than did sports participants (adjusted mean difference = 6.66 points, 95% CI = 0.53, 12.78, $P = .048$).

Table 2. Clinical Outcomes of Study Participants

	Entire Sample (N = 58)	Sports Participants (n = 23)	Nonparticipants (n = 35)
Number of sessions, mean ± SD	4.22 ± 2.28	5.00 ± 2.94	3.71 ± 1.56
Duration of episode of care, mean ± SD, d	25.55 ± 17.74	32.43 ± 22.37	21.03 ± 12.27
Final Modified Oswestry Disability Questionnaire score, mean ± SD	16.79 ± 12.58	15.22 ± 11.64	17.83 ± 13.23
Final pain rating, mean ± SD	3.28 ± 2.21	3.13 ± 2.46	3.37 ± 2.06
Change in Modified Oswestry Disability Questionnaire score, mean ± SD, %	33.50 ± 41.73	31.66 ± 49.28	34.70 ± 36.65
Change in pain rating, mean ± SD, %	22.35 ± 56.18	20.47 ± 72.70	23.58 ± 44.32
Successful outcome, %	41.38	47.83	37.14

The repeated-measures ANCOVA examining the difference in numeric pain rating scores did not demonstrate an interaction between time and sports participation ($P = .20$) (Figure 2). A main effect for time was noted (adjusted mean difference = 1.39, 95% CI = 0.75, 2.03, $P < .001$).

DISCUSSION

In this study of 58 adolescents receiving treatment for LBP, about 40% directly linked the onset of their LBP symptoms to participation in sports. This finding appears to be consistent with research[11,34] that has identified sports participation as a risk factor for the development of LBP in adolescents. Alternatively, previous investigators[35] also have found that only a small percentage of adolescents with LBP seek medical care; therefore, this finding may indicate an increased likelihood of seeking care for LBP when the adolescent is involved in sports. The trend toward lower baseline disability scores in this study may support this hypothesis, indicating a lower threshold for seeking care or receiving referral for treatment when the adolescent is involved in sports.

A majority of the recent research examining LBP in adolescents has focused on risk factors for the onset of symptoms. Research related to the prognosis for recovery and risk factors for poor outcomes or recurrence after the onset of LBP is less plentiful. It does appear that experiencing LBP during adolescence can lead to recurrent episodes that persist into adulthood,[23] but little is known about specific factors that may increase the risk of persistent or recurrent episodes. We examined the influence of sports participation on short-term outcomes for adolescents undergoing rehabilitation in physical therapy. Adolescents injured as a result of sports participation experienced less change in disability over the course of their treatment, even though they attended a greater number of treatment sessions over a longer period of time. Interpretation of these findings must be cautious because of the observational study design. It is possible that involvement in sports is a risk factor for poor outcomes; however, other clinical outcome indicators in this study did not demonstrate differences based on sports participation (eg, change in pain rating).

Alternative explanations for these findings include an increased tendency to continue treatment when adolescents are involved in and attempting to return to sports participation, even if functional improvement is limited. Less improvement in disability scores may also reflect the fact that adolescents involved in sports tended to have lower levels of baseline disability, as measured by the OSW questionnaire, and, therefore, had a lower margin on the OSW with which to demonstrate improvement. This may indicate that the OSW lacks validity and is insufficiently responsive to demonstrate improvement in adolescents with LBP, particularly those involved in sports. Such a concern has been suggested previously[19] and points to the need for further research to identify the best outcome measures for adolescents with LBP. In particular, the functional demands of athletes may necessitate the use of different outcome tools for adolescents with LBP attributable to sports participation.

We found few differences at baseline between adolescents based on sports participation. No differences were

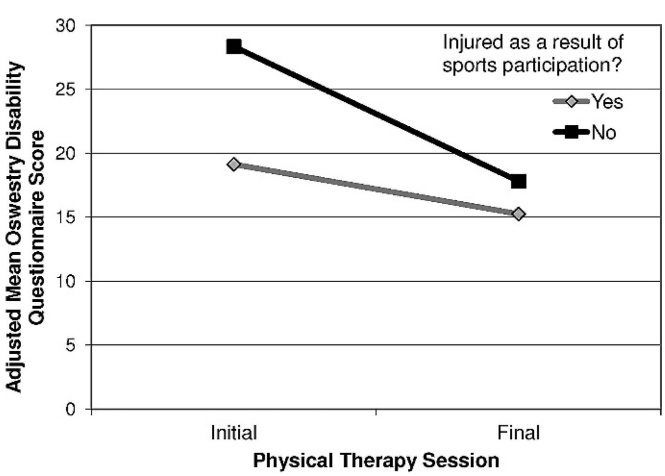

Figure 1. Adjusted mean scores on the Oswestry Disability Questionnaire for sports participants and nonparticipants at the initial and final treatment sessions. The interaction between sports participation and time was significant ($P < .05$).

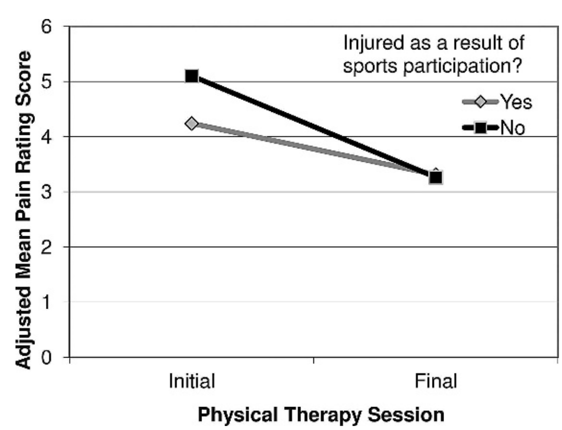

Figure 2. Adjusted mean pain rating scores for sports participants and nonparticipants at the initial and final treatment sessions. The interaction between sports participation and time was not significant ($P > .05$).

noted in age, sex, body mass index, duration of symptoms, clinical presentation (presence of symptoms in the leg[s] or signs of nerve root compression), or likelihood of receiving diagnostic imaging or having a specific medical diagnosis. The small sample size in this study may partially explain the lack of differences in some of these characteristics.

When compared with studies describing the typical characteristics of adults seeking treatment for LBP, the baseline characteristics of this sample of adolescents with LBP do indicate some potentially important differences. The mean baseline OSW score for this sample of adolescents was about 25, whereas samples of adults with LBP drawn from the same clinics generally exhibited a mean baseline OSW score of about 40.[31,36] The lower baseline OSW scores in adolescents may reflect the inadequacy of the measure or may indicate a lower level of disability resulting from LBP in adolescents than in adults. Authors[37] of studies conducted in adults with LBP have reported that 80% to 90% cannot be given a specific medical diagnosis and are instead diagnosed with nonspecific conditions such as "back pain" or "lumbar strain." In this sample of adolescents with LBP, the percentage with a nonspecific diagnosis was somewhat lower (67%). The most common specific diagnosis for adolescents in this sample was a spondylolytic condition, such as spondylolisthesis or spondylolysis. These findings are consistent with the suggestions of others[22] that a specific pathoanatomic cause is more likely identifiable among adolescents with LBP; spondylolytic conditions are the most common cause of persistent LBP in adolescents. When specific pathoanatomic causes are identified in adults, most are related to the intervertebral disc,[28] a finding that is less common in adolescents. These results should be viewed with caution, because we did not standardize the pre-referral diagnostic work-up for patients; instead we relied on the physician's diagnosis and the results of diagnostic imaging. Therefore, it is possible that additional patients had specific medical diagnoses that were not identified. It is also important to recognize that, as was the case in adults,[38] no direct relationship between diagnostic imaging results and the presence of symptoms of LBP was demonstrated, indicating a potential for false-positive imaging results.

Interpreting the clinical outcomes found in this study is difficult because of a lack of data on the outcomes of care provided to adolescents with LBP. The adolescents in the current study demonstrated mean percentage improvements of 34% and 22% for disability and pain, respectively, with a 41% success rate, based on achieving at least 50% improvement on the OSW. In a previous investigation[31] we examined the outcomes of 1190 adults with acute LBP (of less than 90 days' duration) receiving physical therapy in the same clinics included in this study. The adults with LBP demonstrated mean percentage improvements in disability and pain of 45% and 47%, respectively, with a 52% success rate. Although these numbers appear quite different, when the analysis of the results of the current study was limited to the 28 patients with symptoms of less than 90 days' duration, mean percentage improvements in disability and pain were 46% and 44%, respectively, with a success rate of 43%. Additional research examining the response to treatment in adolescents with LBP is needed to clarify the prognosis of individuals in this age group relative to the prognosis of adults with LBP.

We did not control for the interventions used to treat the adolescent patients with LBP. At this time, research examining treatment strategies for adolescents with LBP is lacking, making it difficult to determine the preferred interventions. Some experts[8] have suggested that the treatment recommendations based on research conducted on adults with LBP are likely applicable to adolescents, but no evidence supports this presumption. In a recent randomized trial,[39] the use of an 8-week exercise program (strengthening, flexibility, and aerobic exercises) was compared with a no-treatment control group in 54 adolescents with LBP. After 8 weeks, greater improvements in pain, range of motion, and trunk muscle endurance were seen in the patients receiving the exercise treatment. These results support the potential benefits of treatment for adolescents with LBP, but further research is needed to determine optimal treatment strategies and to examine long-term outcomes.

In summary, we found that many adolescents with LBP receiving outpatient physical therapy treatment were involved in sports and cited sports participation as a causative factor for their LBP. Some differences in the baseline characteristics and clinical outcomes of treatment were noted between adolescents based on sports participation. In particular, adolescents with LBP as a result of sports participation tended to have lower baseline disability scores and to experience less improvement in disability than did nonparticipants. The overall pattern of clinical outcomes in this sample of adolescents with LBP was similar to reports of outcomes from adults with LBP. Additional research is needed to determine the prognosis of adolescent LBP, to identify risk factors for recurrence or delayed recovery, and to clarify optimal management strategies.

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