SURVEY DESIGN STUDY

Low Back Injuries in Women’s Gymnastics: An Exploration into the Role of the Physical Therapist

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ABSTRACT

*Study Design:* Survey design using questionnaire and interview. *Background:* Low back pain affects approximately 80% of gymnasts during their gymnastics career, and diagnosed low back injuries are among some of the most common injuries gymnasts’ experience. With these types of injuries, collaboration between physical therapists (PT) and coaches is essential. The purpose of this study was to examine the prevalence of low back injuries in women’s artistic gymnastics in the state of Arkansas. Additionally, the relationship between gymnastics coaches and physical therapists was explored to identify potential areas of collaboration to minimize these injuries and maximize return to sport. *Case Description:* To explore PT/coach collaboration in women’s gymnastics, ten head coaches from gymnastics centers participated in the study. The interview consisted of thirteen questions that investigated the prevalence of back injuries in each gym, the prevention strategies of each gym, and the perceived relationship between gymnastics coaches and PT. *Outcomes:* The incidence rate for chronic low back pain or diagnosed low back injuries was approximately 1.5%. Ninety percent of the gyms interviewed currently practice some low back prevention exercises. Seventy percent of the coaches interviewed stated that they did not feel there is currently a collaborative relationship between coaches and PT in the sport of gymnastics. Coaches report lack of direct communication between the PT and the coach as a barrier to collaboration. *Conclusion:* Direct communication could improve the relationship between gymnastics coaches and PT in Arkansas, and improving this relationship could benefit gymnasts, coaches, and PT.

Background

Low back pain and low back injuries such as spondyloysis, spondylolisthesis, stress fracture, and pelvic obliquities are common in female gymnasts. Spondyloysis is thought to account for 50% of adolescent back pain in sports.¹ Low back pain is a problem reported to affect about 80% of gymnasts at some point during their short career, but diagnosed back injuries affect a much smaller population.² Caine reported that 12.3% of elite level gymnasts at the US National Championship competition over a three year period had spondylolysis, and that low back injuries were the second most common area of injury for the gymnasts competing at this level of competition.³ Another researcher found that spondylolysis is found in about 17% of gymnasts.⁴ Previous studies reported that the female gymnastics population has about “four times greater incidence of pars interarticularis”
injuries such as spondylolysis when compared to the general population.\textsuperscript{5,6}

Most back injuries in gymnastics only occur in gymnasts in level six through elite, and these gymnasts make up less than half of all gymnasts.\textsuperscript{4} High level gymnasts are at an extreme risk for low back pain and a higher risk than other gymnasts for low back injuries due to high repetitions of demanding skills and increased weekly training hours compared to low level gymnasts.\textsuperscript{7} Another contributing factor to the development of low back injuries is repeated impact to the low back from pounding, twisting, and excessive back extension which places high demands on the body. These factors can contribute to a gymnast developing an overuse injury. Adequate strength and flexibility in addition to utilization of correct technique in skill execution are essential for injury prevention.\textsuperscript{8}

Limited literature regarding prevention of low back injuries in the gymnastics population is available, and it is unclear how often and efficiently these few strategies are implemented. Commonly, the focus is on increasing flexibility of the thoracic spine, hip flexors, and hamstrings, as well as increasing strength of the abdominal and gluteal muscles.\textsuperscript{9,10} The bridge, or backbend, is one of the most common positions in gymnastics that requires hyperextension of the back (figure 1). While taught to beginners, the position is also involved in many of the difficult skills that even elite gymnasts regularly perform. If the gymnast performs the bridge correctly, the arch will be distributed evenly throughout her spine: her shoulders, thoracic spine, and hips will be extended. Some recreational gymnasts do not perform the bridge correctly due to lack of flexibility in either the shoulders or hips. If a gymnast lacks flexibility in her shoulders, as shown in figure 2, then she will most likely overcompensate to achieve the bridge position using her lumbar spine.\textsuperscript{10}

In the same manner, if she lacks flexibility in her hips, she will also try to achieve the bridge position by overextending her low back. If a gymnast lacks both shoulder and hip flexibility, again, she may achieve the skill through excessive movement in her low back, as shown in figure 3. The bridge is a commonly repeated skill and if the gymnast performs the position incorrectly, the lumbar spine repeatedly receives increased pressure and is at an increased risk for injury. The lumbar spine’s primary function is to stabilize, so problems arise when it acts as
the primary area of movement instead.\textsuperscript{11} A gymnast who has excessive flexibility throughout her body, especially in the lumbar spine (figure 4), can also experience back pain or injury if the flexibility is not controlled. Prevention, in this instance, includes strengthening the abdominal and gluteal muscles. If the abdominal and gluteal muscles are strong enough, then they can assist in keeping the lumbar spine more stable, decreasing the hyperextension.\textsuperscript{8}

Gymnasts often have very strong trunk flexor muscles that are required to achieve basic skills on the parallel bars, but a muscle group imbalance can exist with the trunk extensors. One group of investigators researched strengthening the trunk extensor muscles prior to the competitive season to examine the relationship between low back pain and stronger trunk extensors.\textsuperscript{12} The researchers hypothesized that increasing trunk extensor muscle strength and endurance during the preseason would decrease low back pain incidence during the competitive season. Fifteen collegiate gymnasts participated in 15-minute trunk extensor and lateral flexor muscle training sessions biweekly for ten weeks. Fifteen college-aged non-athletes acted as the control group. The athletes did pre- and post-strength tests and demonstrated a significant improvement in strength of the muscle groups targeted. During the competitive season following this 10-week intervention, only one gymnast reported low back pain. The same athlete, however, also reported chronic low back pain before the study. Increasing trunk extensor strength and endurance in gymnasts could be an important component to effectively prevent low back pain in gymnasts.

As indicated in the review of literature, previous research shows that two factors contributing to low back injuries in female gymnasts are decreased shoulder and hip flexibility, or excessive flexibility combined with decreased core strength. The purpose of the current study was to examine the prevalence of low back injuries in Arkansas women’s gymnastics and identify other possible contributors to injury. Additionally, the aim was to explore the relationship between gymnastics coaches and physical therapists to identify potential areas of collaboration to minimize low back injury prevalence and maximize efficient return to sport practices for this population.

\textbf{Figure 3.} A bridge performed by a gymnast with inadequate shoulder flexibility which results in excessive lumbar motion.

\textbf{Figure 4.} A bridge performed by a gymnast with excessive shoulder flexibility.
Case Descriptions

Twenty-seven gymnastic centers exist in Arkansas with competitive women’s gymnastics teams. Head women’s gymnastics coaches from ten gymnastics centers (approximately 37% of centers) in Arkansas participated in this study. An email describing the nature of the study and asking for participation was sent out to all gyms in the state. Permission to conduct this study was granted by the University of Central Arkansas Institutional Review Board.

After an informed consent was obtained from the interviewee (the coach), thirteen-question interviews were conducted either in person or via telephone. Utilizing both a Likert scale and open-ended questions for comments, the investigators created the interview questions. A Likert scale is a scale in which the participant states that they strongly agree, agree, neutral, disagree, or strongly disagree with the statement the researcher provides. The Likert scale was developed by Rensis Likert in 1932 and has been proven to be valid and reliable. The interview (appendix A) consisted of questions about the number of competitive women’s gymnasts, the prevalence of low back injuries, current prevention techniques, and the relationship between physical therapists and gymnastics coaches.

During each interview, information about the prevalence of back injuries at individual gyms was recorded. In the ten gyms that were interviewed, there were about 425 competitive gymnasts at the time of the interviews. The coaches were asked how many gymnasts at their gym, within the last five years, had experienced low back pain, defined as pain limiting workout in some capacity for three to four consecutive weeks or requiring a visit to the doctor.

Outcomes

Thirty-two gymnasts experienced low back pain or were diagnosed with a low back injury within the last five years in these ten gyms in Arkansas. The incidence rate is about 15 per 1000, or 1.5%. Twelve gymnasts who experienced consistent low back pain did not seek medical attention. Eight gymnasts went to the doctor, but were not diagnosed with a specific injury. Twelve gymnasts were diagnosed with specific injuries such as stress fractures, muscle spasms, or herniated discs. Seven of those twelve gymnasts who were diagnosed with a specific injury were diagnosed with stress fractures, making it the most commonly diagnosed injury reported in this study.

Overall, coaches seem to know why gymnasts experience low back injuries, thus 90% of the gyms interviewed had some sort of prevention exercises in place in their respective gyms. All ten coaches interviewed said they implement conditioning programs to increase core strength, specifically targeting the abdominal muscles. Four coaches mentioned that they learned their prevention practices from educational meetings or classes set up.
by USA Gymnastics (USAG). One gym had both an athletic trainer and physical therapist on their coaching staff so exercises from their knowledge base were a major part of the workouts. One gym hired a strength and conditioning coach to work with the competitive level gymnasts to strengthen and prepare their bodies for the demands of the sport. Both of the gyms that had some sort of adjunct health care professional helping with their conditioning and training were among the five largest gyms in the state.

The coaches often felt like they did not have enough information regarding return to play or contraindicated events or skills. Seventy percent of coaches disagreed with the statement that a collaborative relationship currently exists between coaches and physical therapists, and 20% neither disagreed nor agreed with the statement. Only one coach said she had direct communication with the physical therapist treating an athlete at her gym. All other coaches with gymnasts who had utilized a physical therapist during recovery communicated with the therapist only through the parents, gymnast, or a note. A coach reported that a note from the physical therapist can be helpful, but it was vague and left her with a lot of questions. Communication through the parent or gymnast may not be reliable, so direct communication between coaches and therapists needs to be a priority.

Regarding the effectiveness of a physical therapist when rehabilitating the female gymnast, about 80% of the coaches were pleased with the results when working with physical therapists to return their gymnasts to the sport. Many coaches stated that physical therapists know a great deal about the body, but they do not know enough about the sport. Overall, the coaches had a positive view of physical therapists, but in relation to gymnastics, the majority of coaches agree that physical therapists need to know more about specific skill requirements in the sport to really be effective in rehabilitating gymnasts. See Table 1 for specific comments from the coaches related to common themes of improved communication, strengthened partnership, providing education, and knowledge of sport.

Table 1: Specific coaching comments related to emerging themes.

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<th>Theme</th>
<th>Coaches Comments</th>
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| Improved Communication | Coach 1: There was open communication between the PT and the coach because the parent gave permission for the PT to be able to talk to the coach about progress of gymnast.  
Coach 3: The PT usually talked to the gymnast and parent. One PT also wrote a note to the coach that asked them to take things slow and make sure they weren’t adding things in too early or getting back in too fast.  
Coach 4: No direct communication from therapist to coach, it was through the parents. |
| Strengthened Partnering | Coach 6: It would be helpful to have a PT in the gym more.  
Coach 7: Coaches who need help should reach out to sports PTs, and PTs who treat gymnasts should reach out to coaches.  
Coach 8: Having a PT that knows the sport and is willing to get out there to help would be great. |
| Providing Education | Coach 2: PTs could provide education about what stretches are good and bad stretches. And how to stretch correctly.  
Coach 3: We would benefit from a person [PT] coming into the meeting and talking with the coaches about ways we can protect the common areas of injury. |
| Knowledge of Sport | Coach 1: Physical therapists need to know the dynamics behind the sport. The sport is relatively unknown so PTs are not as educated as they should be about what the sport demands of the body.  
Coach 3: Most PTs don’t have a great understanding of gymnastics and what is physically required of them in the sport. They don’t understand what kinds of stresses are put on the gymnast or what the strength and flexibility that is required.  
Coach 10: Both sides need to recognize the expertise of the other. |
Discussion

The information from all ten interviews revealed that low back injuries and low back pain do occur in the state, but not at the prevalence reported in previous studies. Each of the participating coaches seemed to be aware that gymnastics places an abnormal amount of strain and pressure on the back. Many coaches attributed the cause of low back pain and injuries in gymnastics to the repetitive arching that causes overextension or hyperextension of the lumbar spine. Two coaches specifically reported that they believed gymnasts with low back problems are usually either too flexible in the spine and weak in the muscles used to control movement or not flexible enough throughout the spine. Additionally, the coaches also recognized that the gymnasts who are too flexible hyperextend even more than the skill requires and could be placing excessive strain on their lumbar spine. While these responses are the opinions of the coaches in our sample, these opinions align with the findings of Purcell and Micheli who report that low back injuries may be prevented by addressing risk factors related to repetitive hyperextension and muscle imbalance.8

One coach attributed part of the injury problem to improper warm-up practices, stating that gymnasts sometimes do not stretch or warm up their body before they begin their workout and are, therefore, not ready to train the skill with high levels of repetition. The coach also pointed out that gymnasts often pick a dominant side and over-exert that side. This particular coach encouraged working on skills leading with both dominant and non-dominant legs to provide more balance. More research is needed to investigate warm-up practices as well as to explore the effect of asymmetrical use and exertion of the body on injury.

One coach associated low back pain in gymnasts with a lack of education for coaches on proper pre-habilitation and rehabilitation practices for the gymnasts. Though coaches may know a great deal about the mechanics of the sport, this coach indicated that the staff could benefit from collaborations with physical therapists to establish and advance training programs to prevent injuries. The coaches in our sample did not report targeting trunk extensor muscles to prevent low back injuries. However, consistent with the findings of Durall et al who found that increasing strength and endurance of the trunk extensor and lateral flexor muscles could have a significant effect on decreasing the incidence of low back injuries in gymnastics, physical therapists and coaches could collaborate to implement more comprehensive programs to target these muscle groups.12

According to the coaches in this study, the relationship between coaches and physical therapists is an area for improvement. One of the primary reasons the coaches did not believe a current collaborative relationship existed between physical therapists and the coaching staff is the limited direct communication between the two parties. Only one coach who participated in this survey had direct communication with the physical therapist who worked with the injured gymnast, and that coach only had access to direct communication because she is also a physical therapist. All other coaches who had gymnasts who were treated by a physical therapist for back injuries said that their communication with the therapist came through the parents, gymnasts, or a written note. Second-hand information may not prove to be as reliable or accurate as information passed directly between the physical therapist and coach. Four coaches stated that they often did not feel like they had clear guidelines about how much the gymnast could do during the rehabilitation period as well as when trying to get back to
When asked about ways in which the relationship between physical therapists and coaches could be improved, coaches in this study agreed that both parties need to recognize that the expertise that each side holds. Several suggestions for improving a collaborative relationship were mentioned. First, the coaches suggested an increased presence of physical therapists onsite at large gymnastics meets during competition season. Next, the coaches would like to see physical therapists leading continuing education about rehabilitation and prevention at the state coaches meeting each year. Third, coaches could invite physical therapists into their gyms during training to collaborate on conditioning practices. In this manner, physical therapists will inherently learn about skill progression and be able to make more direct suggestions regarding plans for return to competition following injury. If even a few of the recommended steps were implemented, the collaboration between coaches and physical therapists might improve, thus benefitting everyone, especially the gymnasts.

Conclusion

According to the literature and the results of this study, back injuries, though they may only occur in a small percentage of gymnasts, are injuries that do occur and have the potential to majorly impact the gymnast. Based on the interviews conducted, prevention exercises for back injuries are currently being implemented in gyms throughout Arkansas. The collaborative relationship between gymnastics coaches and physical therapists is crucial. In Arkansas, improving direct communication between the physical therapist and the coach could benefit gymnasts, coaches, and physical therapists through prevention and rehabilitation of injuries.

References

11. The Hybrid Perspective: Linking Gymnastics and Physical Therapy. Available at:


Acknowledgements

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Appendix A

Interview Questions

1. How many competitive team girls do you have? (Levels 2-10)

2. How many team gymnasts have you coached with low back pain (defined as pain limiting workout in some capacity for 3-4 consecutive weeks or requiring a visit to the MD) in the past five years? (percent)

3. How many gymnasts have had to go to the doctor with low back pain or a low back injury?

4. How many gymnasts have been diagnosed with a low back injury? What were those injuries?

5. What do you think is the cause of low back pain and injury in gymnastics?

6. Do you currently have a plan in place to prevent back injuries? Ex: specific conditioning and stretching plan to strengthen the right muscles and increase flexibility in the upper back specifically

7. Do you think it is necessary to have a prevention plan in place? Where did you learn or hear about the specific prevention plan that you are implanting in your gym?

8. Physical therapists have the ability to assist athletes with return to competition after injury. Strongly agree, agree, neutral, disagree, strongly disagree.

9. Have you had gymnasts see a physical therapist for back pain or injuries?

10. How did the process go when trying to get the gymnast back into the sport with physical therapy? Did the therapist have discussions with the athlete or coaches on steps to transition the athlete back to the level of previous performance?

11. What improvements do you think physical therapists could make when rehabilitating gymnasts?

12. What improvements do you think could be implemented into current strength and conditioning practices to decrease back injuries?

13. I feel that coaches and physical therapists currently have a collaborative relationship. Strongly agree, agree, neutral, disagree, strongly disagree?
   ○ If a neutral - disagree answer, what steps could be taken to develop a collaborative relationship.