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Description

Female athletes are at greater risk for certain injuries and conditions than are their male counterparts due to unique anatomic, physiologic, and psychological factors. Injury to the female high school student athlete may significantly impact her physical and mental well-being, disrupt the athlete's family life with medical appointments, and affect her team's success. Athletic trainers and therapists (ATs) should consider these injury risk factors when developing injury prevention programs for female student athletes.

Disciplines

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Injury Prevention for High School Female Cross-Country Athletes

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FEMALE ATHLETES are at greater risk for certain injuries and conditions than are their male counterparts due to unique anatomic, physiologic, and psychological factors.[1-4] Injury to the female high school student athlete may significantly impact her physical and mental well-being, disrupt the athlete's family life with medical appointments, and affect her team's success.[5] Athletic trainers and therapists (ATs) should consider these injury risk factors when developing injury prevention programs for female student athletes.

Key Points

- Female cross-country athletes have a greater risk of injury than do their male counterparts.
- There is growing evidence suggesting a relationship between dysfunctional hip muscles and running injuries.
- Injury prevention programs for the female cross-country athlete, including core and hip exercises, may reduce the risk of injury.

Incidence of Injury in Female High School Cross-Country Runners

Female high school cross-country athletes have a greater risk of sustaining a lower extremity injury than do their male counterparts.[6, 7] Rauh et al.[6] tracked the incidence of injury in high school cross-country runners in what has been the longest longitudinal study of its kind. The authors found that female cross-country athletes have both a higher risk of initial injury and subsequent reinjury.[6] When injured, a majority of the female cross-country athletes were able to return to running after being sidelined for 1–4 days.[6] While this time loss at first seems short, it becomes significant if the injury occurs a day or two before a competition. Further, even after rehabilitation, the female cross-country athlete is at risk for reinjury. According to Rauh,[6] "The female cross-country athlete has up to a 5-fold increase of a reinjury to the same region of her body during the season."[6,7]

Running Injuries and Potential Injury Risk Factors

Cross-country athletes risk injury to the low back,[8] the hips,[9-11] the knees,[12,13] and the feet and ankles.[14,15] Suggested risk factors for sustaining a sports-related running injury include age,[16] running frequency,[16] poor training or conditioning,[16] previous history of lower extremity injury,[7] foot pronation,[12,17] and lower extremity biomechanical malalignment.[7,11,18]

Not all of these factors have been shown to directly contribute to the onset of a running injury. For instance, neither foot pronation (as measured by navicular drop) nor a lack of ankle range of motion predicted the onset of exercise-related leg pain.[19] Static lower limb alignment measurements were similar between recreational runners with and without patellofemoral pain.[20] Schache et al.[21] failed to find a relationship between anthropometric or kinematic parameters of the lumbo-pelvic-hip complex and running injuries.

A "bottom up" approach has been used to assess and explain running pathomechanics. A "bottom up" approach identifies potential dysfunction at the distal segments of the lower extremities that may contribute to injury;[12,17] however, a "top down" approach, which identifies potential dysfunction in the proximal segments of the lower extremities, warrants consideration.

Hip musculature may play a significant role in maintaining optimal lower extremity biomechanics and reducing the risk of a running injury.[9,22] Failure of the hip musculature to maintain optimal lower extremity alignment could lead to medial collapse of the lower extremity during a unilateral weightbearing stance.[22,23]

The Role of the Hip Muscles in Sport

Dysfunctional hip musculature may contribute to the onset of a lower extremity injury in a cross-country athlete. Poor proximal stability at the hips may create abnormal motion about the femur and tibia, affecting patellofemoral mechanics and the forces experienced by the knee joint.[16] This theory would support the premise that an athlete with asymmetrical hip strength or poor hip strength in general may be unable to maintain ideal lower extremity alignment throughout an endurance run. This inability combined with repetitive loading may contribute to a sports-related injury.

Recently, hip muscle strength and stability have been highlighted as important in athletic populations. Nadler et al.[24] prospectively tested the hip strength in collegiate athletes to determine if hip strength imbalances increased the likelihood for low back pain treatment. Female college athletes who reported a lower extremity injury or low back pain had decreased hip extensor strength compared to that for noninjured female athletes.[24]

Recreational runners, ages 15-55 years with a unilateral running related overuse injury showed no significant differences in hip strength between the control group and their own uninvolved hip.[25] Their hip abductors on the injured side were weaker, however. Hip abductor weakness has also been found in distance runners with iliotibial band syndrome (ITBS).[26] These results are similar to nonathlete young females who have been diagnosed with patallofemoral pain syndrome. They showed 26% less hip abduction strength and 36% less external rotation strength than a matched noninjured group.[27] Investigations dealing with anterior cruciate ligament (ACL) injury prevention programs have also identified that female athletes have significantly decreased gluteus maximus activation and a trend toward lower gluteus medius activation during a single-leg landing.[28]

In view of this growing body of evidence, clinicians who work with cross-country athletes should evaluate the strength of the hip muscles and implement a targeted strength training program.

Strength Training the Muscles of the Hips

Many cross-country athletes fail to perform resistance exercises due to a perceived lack of training time or a lack of knowledge regarding the importance of this form of training. As a result, many high school female cross-country athletes may have deficient body core or hip strength.

Sports medicine researchers have identified open kinetic chain and closed kinetic chain exercises that activate key core muscle groups.[29,30] The findings from these investigations, combined with clinical experience, will help to guide exercise prescription and progression.[29,30] Many female cross-country athletes will present with deficient hip abductor and hip extensor strength. During the initial functional assessment, an athlete who has a dysfunctional core will present with less than optimal hip strength when tested in traditional manual muscle test positions and will demonstrate poor lower extremity biomechanics in functional movement patterns. To address the poor or deficient activation of the gluteus maximus and gluteus medius, the initial training program for the cross-country athlete should consist of open kinetic chain exercises (Table 1 & Table 2). Exercises such as the clamshell, side-lying hip abduction, and prone hip extension will strengthen functionally weak muscles.[29,30] A key feature to these exercises is that they utilize specific muscles or movement patterns at the hip. These exercises challenge the athlete's ability to activate specific muscles while allowing the athletic trainer or therapist to observe for any compensatory movement patterns. For example, many individuals with a weak gluteus medius may have difficulty abducting the hip, instead compensating by activating the tensor fascia late and the hip flexors. By performing these supervised open kinetic chain exercises, the athletic trainer or therapist will be able to monitor activation of a targeted muscle that could not be addressed in a closed kinetic chain position.

Table 1. Description of Exercises

Clamshell	Instruct the client to assume a side lying position with the hips slightly flexed and the knees bent to approximately 90°. The client will raise the top knee off of their bottom knee as if a clamshell was opening. The movement should be isolated to hip external rotation. Observe for form deviations including torso and pelvic rotation.
Side-lying hip abduction	Instruct the athlete to assume a side-lying position. The athlete should abduct (raise) the straight leg approximately six inches, hold for 1 to 2 seconds, lower the leg slowly, then repeat for the desired number of repetitions.
Prone hip extension	Instruct the athlete to assume a prone position, bending one leg at the knee 90 degrees. The athlete will lift her thigh off of the training surface 2 to 4 inches by lifting from hip while avoiding spinal extension.
Side plank	Instruct the athlete to assume the side plank position, supporting body weight with one forearm and two feet. Perform the abdominal brace, holding the plank position for 10 seconds. Lower the body, rest, and repeat for the desired number of repetitions on both sides.
Front plank	Instruct the client to support her body with the forearms and at the feet. The torso and hips should be in alignment. Hold this pose for 10 seconds. Rest. Repeat for the desired number of repetitions.
Squat	Instruct the client to stand with both feet shoulder width apart. A bar is positioned across the upper back resting on either the trapezius muscle or the trapezius and deltoids. The athlete will lower her body by bending at their hips and knees. The motion should be initiated by extending the hips posteriorly. The knees should not fall in front of the feet. The client squats lowering to a position of almost full hip and knee flexion and thighs parallel to the floor. The client must maintain a neutral spine posture throughout the squat. Patient returns to the starting positioning by extending the hips and knees.
Lunge	Instruct the athlete to stand with legs shoulder width apart. The client steps (lunges) forward flexing the lead hip and knee. The lead knee should be in alignment with the hip and foot and the thigh parallel to the ground. The body is lowered toward the floor to the point that the trailing knee almost contacts the ground. The client reverses the position returning to the starting position. The lunging sequence is repeated with the opposite leg stepping forward.
Side plank with hip abduction	The client assumes the side plank pose. Once in position, instruct the athlete to abduct (raise) the top leg off of the bottom leg.
Front plank with hip extension	The client assumes the front plank pose. Once in position, instruct the athlete to lift one leg. Hold for 1 to 2 seconds. Lower the leg to the plank position. Repeat to the opposite side.

Table 2. Hip Strengthening Program

Phase I

Perform these exercises for 2–3 sets of 15–20 repetitions, 2 days a week:

- Clamshells
- Side lying hip abduction
- Prone hip extension

Perform these exercise for 2–3 sets of 10-second holds (each side for the side planks), 2 days a week:

- Side planks
- Front planks

Phase II

Perform these exercises for 2–3 sets of 10 repetitions, 2 days a week:

- Squats
- Lunges

Perform 2–3 sets of 15–20 repetitions, 2 days a week:

- Side plank with hip abduction
- Front plank with hip extension

In addition to prescribing the open kinetic chain exercises, basic core exercises should also be initiated.[29,30] The side plank (Figure 1) and the front plank (Figure 2) are effective exercises to improve core stability and strengthen the muscles of the hip.[30] Ekstrom et al.[30] found that the side plank exercise created the greatest activation of the gluteus medius muscle.

The second phase of the athlete's program should consist of closed kinetic chain exercises and advanced core stabilization exercises. When the athlete has demonstrated improved functional lower extremity biomechanics and improved hip strength, introduce the squat and the lunge (Figure 3). These exercises continue to activate muscles of the hip in positions that reproduce functional athletic movements.[30] Advanced core stabilization exercises such as the side bridge with hip abduction (Figure 4) and the front plank with hip extension (Figure 5) will also provide a greater challenge to the muscles of the trunk and hip.

Figure 1 Side plank exercise.

Figure 2 Front plank exercise.

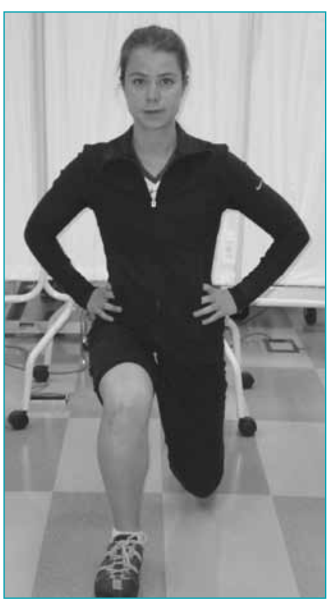

Figure 3 Lunge exercise.

Figure 4 Side plank with hip abduction.

Figure 5 Front plank with hip extension.

Conclusion

Reducing the risk of injury in female cross-country athletes will benefit both the student-athlete and the team. The program presented addresses core and hip muscles that are frequently dysfunctional in the endurance athlete. To improve our ability to develop optimal injury prevention programs, both prospective investigations identifying potential cause and effect relationships between hip strength deficits and running injuries as well as prospective intervention programs in female high school cross-country athletes are warranted. ▮

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