

The incidence of eccentric and isometric hamstring strength asymmetries among U19 youth elite soccer players in Slovakia

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ABSTRACT

Physical preparation in soccer is requiring individualization through regular monitoring the physical abilities of players. When it comes to injury prevention, muscle strength and performance asymmetries detection is reliable way to identify increased risk for injury. The primary objective of this study was to analyze the incidence of eccentric and isometric hamstring strength asymmetries among U19 youth elite soccer players in Slovakia and provide the necessary information for physical coaches to improve the injury prevention training protocols. Two hundred eighty-six players (Age 17.29 ± 0.65 years, Height 180.75 ± 12.27 centimeters, Bodyweight 72.97 ± 6.67 kilograms) from 14 Slovakian soccer academies participated in testing their eccentric and isometric hamstring strength during the September 2023. The results showed very high incidence of eccentric as well as isometric hamstring strength asymmetries, when almost 47% of all players scored above 10 % difference between the lower extremities in one or both tests. More than 34 % of all players ($p < 0.01$, $d = 0.3$) achieved above 10 % inter-limb difference in eccentric hamstring strength and 26.22 % of all players ($p < 0.01$, $r = 0.36$) scored above 10 % inter-limb difference in isometric hamstring strength. Surprisingly, when it comes about players position the results are inconclusive, since some positions showed significant inter-limb differences in eccentric strength, but not in isometric strength and vice versa. Nevertheless, since above 10 % difference in strength testing is considered as a caution for increased chance for injury in any sport, our results suggest that for the players who scored higher asymmetries the physical training intervention for minimizing the inter-limb strength differences might be helpful as a part of injury prevention strategy. Further research needs to be conducted to confirm our findings. It might be interesting to compare the history of players injuries with their strength performance.

KEY WORDS: Asymmetries, Eccentric strength, Hamstring, Isometric strength, Youth soccer players

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INTRODUCTION

Hamstring injury is a common issue among elite youth soccer players; it generally causes considerable time away from the game. It also influences player development and team performance negatively, which creates concern. Since hamstring injuries are multifactorial in nature, much focus has been directed at asymmetry in muscle strength over the last years. Clinical and applied strength asymmetry of the left and right hamstrings during isometric and eccentric contractions is normally viewed as major risk factors for this injury. Elite youth soccer players who are constantly training intensely and playing high-level games could be particularly susceptible to these imbalances because of the repetitive and uneven demands their sport makes upon them. Isometric strength represents the muscles' ability to develop force without lengthening, while eccentric strength means that the muscle is lengthened under tension—for example, the deceleration of running. Eccentric as well as concentric muscle action are playing crucial role, when it comes about hamstring function in soccer. More specifically rapid acceleration, sprinting, cutting and kicking. An imbalance of isometric and eccentric hamstring strength disrupts movement mechanics, which leads to compensatory patterns and puts the athlete at a greater risk of injury. In this regard,

research among professional soccer players demonstrates that eccentric hamstring strength is one of the resultant factors that decrease the incidence of muscle strain injuries among athletes. Previous studies showed that players with strength deficiencies were highly prone to sustaining an injury. ⁽¹⁾ Other research proved, that specific strength training can be used to eliminate asymmetries and significantly reduce the incidence of hamstring injuries and reinjuries in players. ⁽²⁾ These studies examined the adult players, but in our opinion same asymmetries might be present in youth players as well. De ste Croix examined the muscular strength of young soccer players and reported significant asymmetries in eccentric strength between limbs, with a strength deficit exceeding 10 percent on one side for many of the players. They urged that, unless such imbalances were corrected, they had a potential to increase injury risk as the players continued in their careers. The finding underlines that early detection, and intervention might be of substantial importance to handle chronic asymmetries and related injury risks in young athletes. ⁽³⁾ Read et al. conducted a longitudinal study among elite youth soccer players, showing fluctuations in hamstring strength asymmetry throughout a season, often with an increase when the competition was fiercest. They then recommended that in-season monitoring and

strength maintenance programs be performed to prevent injury levels, as they are higher during the highly demanding periods associated with increased fatigue. ⁽⁴⁾ This supports a study by Timmins et al., who, referring to the importance of the assessment of both eccentric and isometric hamstring strength for injury prevention programs, prescribed asymmetries higher than 15% between limbs as treated. ⁽⁵⁾ Since very few studies examined the asymmetries in youth players, our research might be helpful for the coaches in youth teams. The unique features of development in youths—which include rapid growth with muscular imbalances—make it necessary to target research at this age. Understanding the prevalence of such asymmetries is, therefore, crucial in designing appropriate interventions that minimize the risks of injury and promote long-term athletic development constructively. It also tugs at the specific incidence of isometric and eccentric hamstring strength asymmetries in elite youth soccer players, providing useful insights into injury prevention and performance enhancement. The current research work, therefore, may prove to be a worthy addition to the growing literature by identifying asymmetry patterns, investigating their relationship with injury history, and offering practical recommendations for strength training and injury prevention.

OBJECTIVE

The primary objective of this study was to analyze the incidence of eccentric and isometric hamstring strength asymmetries among U19 youth elite soccer players in Slovakia. The secondary objective was to determine, whether the asymmetries are significant enough to identify the higher risk for injury, which could serve as a hint for physical coaches in soccer.

METHODS

Two hundred eighty-six players (Age 17.29 ± 0.65 years, Height 180.75 ± 12.27 centimeters, Bodyweight 72.97 ± 6.67 kilograms) from 14 Slovakian soccer academies participated in this research. There were 28 goalkeepers, 48 full-backs, 48 center-backs, 42 wingers, 78 midfielders and 42 strikers included. Research took a part during the September and October 2023, when the monitoring of youth academies players and their physical abilities occurred thanks to the cooperation between Slovak football association and dr. Roman Švantner, who provided his professional experiences and qualified team for the testing. The criteria for the participation were no competitive match or any demanding physical activity at least 48 hours prior the testing due to the results validation. Each player went through the same testing protocol, starting by RAMP warm up for 10 minutes, followed by testing the linear speed

for five, ten and thirty meters. After the speed testing, they performed the vertical and horizontal jump tests (squat jump, counter-movement jump, depth jump from 40 cm box and broad jump) and after the strength tests for eccentric and isometric hamstring strength as well as adductors and abductors isometric strength. For the purposes of this study only eccentric and isometric hamstring strength tests results were used. Hamstring eccentric and isometric strength were measured by the NordBord device (Vald Performance, Australia) using the methods previously described by Opar et al. ⁽⁶⁾ The eccentric Nordic hamstring test assesses the muscle's force-generating capacity during lengthening contractions—a scenario common in sprinting and rapid directional changes. The participant kneels on the NordBord platform with their ankles secured under padded hooks. They slowly lean forward from the knees while keeping their body straight, resisting the fall as much as possible. Once they can no longer resist, they catch themselves with their hands on the ground. The Iso 30° test is an isometric evaluation used in the NordBord hamstring testing system, designed to assess hamstring strength at a knee flexion angle of 30 degrees. This angle is specifically chosen because it closely mirrors the knee joint position during the “strike” phase of running gait, offering valuable insights into the muscle's performance in athletic scenarios. In this test,

the participant kneels on the NordBord platform with their ankles secured under hooks and their hands resting on the ground for support. The knees are flexed to 30°, and the individual maintains this position while exerting maximum force by pulling upward against the ankle hooks for a specified duration. Each player completed two repetitions of each test with only best result in Newtons units recorded for each leg independently. IBM SPSS Statistics software (Version 27) was used for statistical analysis. Shapiro-Wilk's test was used to calculate the data distribution and 1 sample t-test or Wilcoxon signed rank test were then used for determining the statistical significance of the result. The effect size represented by Cohen's *d* or *r* coefficient were calculated as well. For the effect size we used Cohen's scale 0.2 small effect, 0.5 medium effect, 0.8 large effect. ⁽⁷⁾

RESULTS

Two hundred eighty-six players were tested for eccentric and isometric-specific hamstring strength. Data analysis showed that, 134 from all 286 players scored 10% or more asymmetry from at least one of the two tests, which represent 46.85% of the players. When it comes to the players positions, results in **Table 1** presenting how many players for each position scored more than 10 % difference for each test individually or combined.

Table 1 How many players scored more than 10 % asymmetry

Position	Eccentric > 10% Diff	Eccentric % from All Players	ISO 30 > 10% Diff	ISO 30 % from All Players
Goalkeeper	10	35.71	5	17.86
Full-backs	21	43.75	17	35.42
Center-backs	10	20.83	11	22.92
Wingers	14	33.33	13	30.95
Midfielders	30	38.46	21	26.92
Strikers	13	30.95	8	19.05
Total ecc and iso 30	98	34.27	75	26.22
TOTAL asymmetries	134 from 286 players		46.85 %	

Results in **Table 1** are alarming, since in strength training more than 10% strength asymmetries are considered and linked to be a warning sign for increased risk for injury. ⁽⁸⁾ With that in mind there exists a higher probability for hamstring injury for almost half of all youth Slovakian soccer players and this

could serve as a very valuable information for their physical coaches.

Statistical analysis was performed to determine whether the performance differences between the lower extremities are significant supported by effect size calculations. Results are presented in **Table 2**.

Table 2 Statistical analysis of asymmetry significance

Position	Eccentric nordic statistical significance	Eccentric nordic effect size	Iso 30 statistical significance	Iso 30 effect size
goalkeeper	p < 0.01	r = 0.14	p > 0.01	r = 0.26
full-backs	p > 0.01	cohen's d = 0.16	p > 0.01	r = 0.37
center-backs	p < 0.01	cohen's d = 0.48	p < 0.01	cohen's d = 0.39
wingers	p > 0.01	cohen's d = 0.01	p > 0.01	cohen's d = 0.04
midfielders	p > 0.01	cohen's d = 0.39	p < 0.01	cohen's d = 0.24
strikers	p < 0.01	cohen's d = 0.15	p > 0.01	cohen's d = 0.03
TOTAL	p < 0.01	cohens' d = 0.3	p < 0.01	r = 0.36

The results from **Table 2** showed that there are significant differences between the lower extremities eccentric hamstring strength mostly in center-backs and strikers, while in isometric strength, mostly center-backs and

midfielders showed significant differences between the lower extremities. Globally, considering all 286 players the differences between the lower extremities for eccentric as well as for isometric hamstring strength

seems to be significant with small to medium effect size.

CONCLUSION

The aim of this investigation has been to examine the occurrence of asymmetry in hamstring strength—eccentric and isometric—among elite youth soccer players in the U19 category in Slovakia. The gained data revealed inclining asymmetry rates in eccentric and isometric hamstring strength. Eccentric and isometric hamstring strength constitutes a major factor affecting the performance and incidence of injury among elite young soccer players. Recent studies have emphasized the benefits of eccentric training with respect to strength development and muscle balance. In fact, the NHE is basically a method of resistance exercise that involves eccentric loading of hamstrings; such a method has been used to demonstrate significant increases in hamstring strength and, subsequently, a reduction in injury risk. This would then mean that an eccentric-focused training program, including the NHE, increased the eccentric hamstring torque by 11% and improved isometric strength by 7%.⁽⁹⁾ These changes directly contributed to an improvement in the hamstring-to-quadriceps ratio of strength—important for the prevention of injuries. Moreover, the reliability study for various hamstring strength assessments among soccer players shows that

eccentric testing provides more reliability, and the isometric testing can be useful during the initial period of recovery but not as effective in the long-term process of strength evaluation.⁽¹⁰⁾ A pilot study also suggested that even one session of NHE may enhance isometric hamstring strength in adolescent soccer players, thereby contributing both to muscle balance and preventing injury.⁽¹¹⁾ However, other studies still indicate that eccentric and isometric tests measure two different things and that one test should not be used to make inferences about the other.⁽¹²⁾ It was, therefore, important to monitor them regularly to understand their injury history and compare them with present strength performance results and asymmetries. Such an approach would allow the determination of the percentage of inter-limb strength differences that could be a benchmark for identifying those with higher injury risk. Consistent monitoring likewise provided a sound basis for integrating the injury prevention strength training program specific to each player's individual needs.

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