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Ratio of maximum hamstring torque to maximum quadriceps torque in professional basketball and soccer players

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Abstract

Purpose: The aim of the study was to determine the differences between football players and basketball players in the mean absolute values of maximum torque flexors and extensors, ratio of maximum hamstring torque to maximum quadriceps torque dominant (DOM) non-dominant (ND) leg and differences in bilateral imbalance of flexor muscles and knee extensors.

Material and methods: The research included a sample of 39 professional athletes. The first subsample included 19 professional basketball players while the second subsample included 20 professional soccer players.

Results: Based on the results of the torques of the extensors in the knee joint of the DOM and ND legs, it was established that there is no statistically significant difference between basketball players and football players. However, a statistically significant difference was found in the torque flexors of the knee joint DOM ($p \leq 0.01$) and ND ($p \leq 0.00$) of the leg between basketball players and football players. On the other hand, the results of the research indicate that the difference between basketball players and football players in the ratio of Hamstrings peak torque to Quadriceps peak torque was recorded only in the ND leg ($p \leq 0.02$), while the difference in the DOM leg is not statistically significant. The results of our study indicate that basketball players have a higher percentage of imbalances compared to football players, especially in m. hamstrings.

Conclusion: This study provides normative data on populations specific to soccer and basketball, but does not provide evidence of the ability of the isokinetic assessment of lower extremity muscle strength to predict injuries to football players and basketball players.

Key words: knee joint, isokinetic testing, torque, extensor muscles and flexors

Анотація

Олександр Кукрич, Марко Йоксимович, Борко Петрович, Франческа Латіно, Ратко Павлович, Ружица Кувалья. Співвідношення максимального крутного моменту на підколінних сухожиллях та максимального крутного моменту на чотириголовому м'язі у професійних гравців у баскетбол та футбол

Мета: Метою дослідження було визначити відмінності між футболістами та баскетболістами у середніх абсолютних значеннях максимальних згиначів та розгиначів крутного моменту, домінуючої (DOM) недомінантної (ND) ноги та співвідношення максимального крутного моменту на підколінних сухожиллях до максимального крутного моменту на чотириголовому м'язі та відмінностей у двосторонньому дисбалансі м'язів -згиначів та розгиначів коліна.

Матеріал і методи: Дослідження включало вибірку з 39 професійних спортсменів. Перша підвибірка включала 19 професійних баскетболістів, тоді як друга підвибірка включала 20 професійних футболістів.

Результати: На підставі результатів обертальних моментів розгиначів у колінному суглобі ніг DOM та ND було встановлено, що немає статистично значущої різниці між баскетболістами та футболістами. Однак була виявлена статистично значуща різниця у згиначах крутного моменту колінного суглоба DOM ($p \leq 0{,}01$) та ND ($p \leq 0{,}00$) ноги між баскетболістами та футболістами. З іншого боку, результати дослідження вказують на те, що різниця між баскетболістами та футболістами у співвідношенні H / Q була зафіксована лише на етапі ND ($p \leq 0{,}02$), тоді як різниця в нозі DOM не є статистичною значний. Результати нашого дослідження показують, що баскетболісти мають більший відсоток дисбалансу порівняно з футболістами, особливо в м. підколінні сухожилля.

Висновок: Це дослідження містить нормативні дані про популяції, характерні для футболу та баскетболу, але не надає доказів здатності ізокінетичної оцінки сили м'язів нижніх кінцівок передбачити травми футболістів та баскетболістів.

Ключові слова: колінний суглоб, ізокінетичне тестування, крутний момент, м'язи -розгиначі та згиначі

Аннотация

Александар Кукрич, Марко Йоксимович, Борко Петрович, Франческа Латино, Ратко Павлович, Ружица Куваля. Соотношение максимального крутящего момента на подколенных сухожилиях к максимального крутящего момента на четырехглавой мышце у профессиональных баскетболистов и футболистов

Цель: Целью исследования было определение различий между футболистами и баскетболистами в средних абсолютных значениях максимального крутящего момента сгибателей и разгибателей, отношение максимального крутящего момента на подколенных сухожилиях и максимального крутящего момента на четырехглавой мышце доминирующей (DOM) и недоминантной (ND) ноги и различий в двустороннем дисбалансе. мышц сгибателей и разгибателей колена.

Материал и методы. В исследовании участвовали 39 профессиональных спортсменов. В первую подвыборку вошли 19 профессиональных баскетболистов, а во вторую - 20 профессиональных футболистов.

Результаты. На основании результатов крутящих моментов разгибателей в коленном суставе ног DOM и ND установлено, что статистически значимой разницы между баскетболистами и футболистами нет. Однако статистически значимая разница была обнаружена в сгибателях крутящего момента коленного сустава DOM ($p \leq 0{,}01$) и ND ($p \leq 0{,}000$) ноги между баскетболистами и футболистами. С другой стороны, результаты исследования показывают, что разница между баскетболистами и футболистами в соотношении H / Q была зафиксирована только в ноге ND ($p \leq .02$), в то время как разница в ветви DOM не является статистически достоверной. существенный. Результаты нашего исследования показывают, что у баскетболистов более высокий процент дисбалансов по сравнению с футболистами, особенно в m. подколенные сухожилия.

Выводы. Это исследование предоставляет нормативные данные о популяциях, специфичных для футбола и баскетбола, но не предоставляет доказательств способности изокинетической оценки силы мышц нижних конечностей прогнозировать травмы футболистов и баскетболистов.

Ключевые слова: коленный сустав, изокинетическое тестирование, крутящий момент, мышцы-разгибатели и сгибатели.

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Introduction

Muscular strength and power are important in terms of basic physiological capacities in most sports games (soccer, basketball, handball, et.al.). Soccer (a planetary phenomenon) is the most played sport in the world, and according to some estimates, as of 2006, there are as many as 265 million active football players [1]. The football game is characterized by intermittent periods ranging from high-intensity activities to low-intensity activities. In terms of physiological requirements, the football imperative implies that players be competitive in several aspects of fitness, which requires a high level of aerobic and anaerobic power, muscle strength, flexibility, and agility [2]. Precisely defined aspects of fitness differ depending on the position in the team as well as the style of play [3]. Unlike soccer, basketball is also increasingly popular in many countries, the game is played by more than 450 million people. Numerous tests and training programs are used at the professional level to monitor the cardiovascular and athletic performance of players and the results of these tests are used to adapt training techniques in an attempt to prevent traumatic and excessive injuries [4]. It is an intermittent sport that involves rapid, explosive, and repeated changes of direction [5] which during a field game (smaller dimensions) changes the direction of movement on average every 2 seconds. Energy mobilization during a basketball game comes mainly from aerobic sources, although this activity requires specific performance associated with short accelerations and jumps, which are more dependent on anaerobic sources [6].

During soccer and basketball matches, players perform various and numerous jumps, punches, turns of various technical exercises, which characterize the dynamics of the game by constantly changing the place, ie the position on the field. Functionally analyzed, such movements are primarily based on maximum strength muscle capacity. Therefore, the relationship between torque and speed (and consequently muscle strength) of the lower extremities of athletes is especially important for football and basketball matches [7]. In team sports, the quadriceps and hamstrings muscles are integrated into motor skills such as running and jumping [8] and muscle strength appears to be one of the most important components of these sports, both for high performance and for injury prevention [9]. Injuries to these muscle groups are one of the main problems faced by today's athletes. Inherent in these sports is a higher risk of anterior cruciate ligament (ACL) injury compared to other sports which causes a significant loss of time due to competition. It is assumed that one of the possible causes of injuries is an unbalanced relationship between muscle agonists and antagonists, which in practice is referred to as muscle imbalance [10]. Muscle imbalance is a condition in which one muscle is stronger or weaker than the other and can also occur as a result of reduced muscle length (shortened muscle).

A typical example of muscle imbalance is the unbalanced action of extensor and flexor muscles in the knee joint. In conditions when m. quadriceps femoris during dynamic activities generates significantly greater muscle force compared to m. hamstrings, excessive translational displacement of the upper leg may occur. In such conditions, the anterior cruciate ligament (ACL) suffers significantly higher pressure forces than usual. Therefore, if m. hamstrings too weak and cannot be opposed with sufficient force to the action of m. quadriceps femoris, ACL injury most commonly occurs in the knee joint [11]. These allegations are confirmed by Opar et al. [12], which indicate that if m. quadriceps femoris extremely strong and its activity in certain phases of movement too large, excessive elongation of m can occur. hamstrings, leading to its damage. The main reasons for such an injury are weakness of the flexor in the knee joint, bilateral imbalance m. hamstrings, an inadequate relationship between the flexor and extensor in the knee joint (H / Q ratio), which causes injuries to m. hamstrings up to 2.5 times more frequent than injury m. quadriceps femoris. Lower limb strength, strength imbalance between Hamstring and Quadriceps muscles and strength imbalance between dominant and non-dominant limbs are considered very important in increasing performance and also preventing injury [13].

According to Alentorn-Geli et al. [1] lower extremity plyometrics, dynamic balance and strength, stretching, body awareness and decision-making, and targeted core and trunk control appear to be successful training components to reduce non-contact ACL injury risk factors (decrease landing forces, decrease varus/valgus moments, and increase effective muscle activation) and prevent non-contact ACL injuries in players. Various laboratory tests are used to assess the strength parameters of elite soccer players and basketball players. Most studies have used isokinetic equipment at different speeds and joint angles for direct comparison [7, 6]. Isokinetic dynamometry tests have been widely used and are the most common tools to assess Quadriceps and Hamstring muscle strength both in professional athletic. Isokinetic testing also provides the essential information about the Hamstring to Quadriceps ratio (H/Q) and limb asymmetry index (LSI) which can be used for evaluating lower limb muscle strength and imbalance between the muscles of the lower limb [14, 15, 16, 17].

Soccer and basketball are different sports games with different technical abilities, different training and playing positions. Therefore, muscle groups m. hamstrings and m. The quadriceps femoris include several important motor skills such as running and jumping. The aim of the research is to determine the differences between football players and basketball players in the mean absolute values of maximum torque of flexors and extensors, H / Q ratio dominant-non-dominant leg and differences in bilateral imbalance of flexor and extensor muscles of the knee joint.

Material and methods

Study participants

The research included a sample of 39 professional athletes. The first subsample included 19 professional basketball players with an average (Mean ± Std.Dev) body height 196.68 ± 8.00 cm, body weight 96.05 ± 8.64 kg, BMI 24.82 ± 1.69 kg / m2, age 25.95 ± 3.73. All basketball players are members of the Adriatic Basketball Association (ABA league), the highest competitive rank in the Balkans. The second subsample included 20 professional soccer players with body height 182.90 ± 6.80 cm, body weight 73.82 ± 5.64 kg, BMI 22.06 ± 1.00 kg / m2, age 21.05 ± 4.53. All football players are participants in the Premier League, the highest competitive rank in Bosnia and Herzegovina. The study is of a transversal nature and testing was done in the pre-competition period in the 2020/2021 season.

The criteria for inclusion were: that the players are participants of first team for at last least six months, that all the players went through the preparation period with the team, without injuries in the last six months, that they played one half-season before testing. Exclusion criteria were: athletes in the recovery phase from some form of acute or chronic injury, athletes who did not complete the entire preparation period. All respondents were first informed about the study, the purpose and goal of the research and possible consequences were explained to them. Also, the procedure and the course of the testing itself were explained to the respondents. Prior to the survey, each respondent signed a consent form to participate. For this research, the consent and

approval of the head coach and the president of the club were obtained, and after that, testing was started. The research was approved by the Ethics Commission of the Faculty of Sports and Physical Education, University of Banja Luka in accordance with the Declaration of Helsinki [18]. The players were instructed not to consume performance enhancing substances such as creatine, ribose etc. (coffee was limited to 1 cup) prior to tests, not to engage in high intensity physical activity 24 hours prior to the tests [19].

Study organization

Testing was performed by the same experienced examiner in the Laboratory for isokinetic testing at the Faculty of Physical Education and Sport in Banja Luka, Bosnia and Herzegovina. Laboratory was air-conditioned and room temperature was held between 22℃ - 24℃. Testing was performed between 09.00 am and 14.00 pm. Before testing on isokinetic apparatus, morphological characteristics of examinees had been tested. The day before the examination of the body composition, the examinees had to follow a protocol, which included the requirements not to consume food or drink after 22 pm. Additionally, in the morning, before the test, the respondents did not consume food and drink. The body weight and percentage of adipose tissue were measured by bioelectrical impedance, using a specialized scale Tanita BC418a (USA), with an accuracy of 0.1 kg, while body height was measured using an altimeter Seca 216 (Germany), whose accuracy is 0.5 cm. Testing on an isokinetic dynamometer (Cybex) was performed according to standard recommendations [20]. Prior to testing, a ten-minute warm-up was performed on a stationary bicycle (Monark), followed by stretching of the lower extremities [21].

Preparation for testing was continued on an isokinetic dynamometer, where 5 submaximal repetitions were performed in a concentric mode of flexor and extensor muscle work in the knee joint. After a break of 1 min, with maximum effort and commitment, the subjects performed 4 maximum concentric contractions of the flexor and extensor muscles in the knee joint. The test was performed in a sitting position on an isokinetic dynamometer chair (upper / lower body angle was approximately 85 °), where subjects were fixed with straps over the chest, hips, and distal end of the thigh. In the concentric mode of muscle work, flexors and extensors in the knee joint were tested at a speed of 60 $°\cdot s^{-1}$ The lateral femoral condyle was used as a reference point for the axis of rotation, and the length of the lever was determined individually for each individual [22]. The amplitude of the movement was determined at 90 ° (maximum extension was recorded and set as anatomical zero). Gravitational force correction was performed in order not to help the flexors, that is, to make the activity of the extensor muscles more difficult when performing movements in the knee joint. Measure of the hamstrings to quadriceps ratio (H / Q ratio), calculated as the peak torque of the hamstrings divided by the peak torque of the quadriceps within the same limb (1) [16]:

$$\text{H/Q ratio} = \frac{Hamstrings\ peak\ torque}{Quadriceps\ peak\ torque} \quad (1)$$

Another ratio is calculated to compare peak torque between limbs and is referred to as the limb symmetry index (LSI). LSI is used to assess peak torque in the non-dominant relative to the dominant limb (2) [17]:

$$\text{LSI} = \frac{Dominant\ leg\ peak\ torque - nondominant\ leg\ peak\ torgue}{Dominant\ leg\ peak\ torque} \times 100\% \quad (2)$$

Statistical analysis

Data were processed using the Statistical Package for Social Sciences SPSS (v20.0, SPSS Inc., Chicago, IL, USA). In the first step, the basic descriptive parameters and distribution of variables were determined. Central and dispersive parameters were calculated for all tests: arithmetic mean (Mean), standard deviation (Std. Dev.). To determine the differences between the groups we used T-test. The statistically significant differences were determined at the level of $p < 0.05$.

Results

Table 1 contains the mean values and standard deviation of the maximum torques m. quadriceps femoris and m. hamstrings of the dominant (DOM) and non-dominant (ND) legs of basketball players and soccer players as well as the differences in mean values between the defined sample of athletes for each muscle group. In both groups of subjects, the right leg was dominant, and based on absolute values, it is evident that basketball players achieved slightly higher torque values in both tested muscle groups, for m.quadriceps femoris (DOM = 211.18 ± 43.28 $N \cdot m^{-1}$; ND = 200,37 ± 51,31 $N \cdot m^{-1}$), for m.hamstrings (DOM = 170,89 ± 35,86 $N \cdot m^{-1}$; ND = 169,32 ± 33,10 $N \cdot m^{-1}$) in relation to the sample of football players where torque value for m.quadriceps femoris (DOM = 196 ± 33.79 $N \cdot m^{-1}$; ND = 192.58 ± 42.84 $N \cdot m^{-1}$), and for m. hamstrings (DOM = 147.75 ± 18.92 $N \cdot m^{-1}$; ND = 141.69 ± 26.45 $N \cdot m^{-1}$). Applying the appropriate statistical procedures, it was found that there is a statistically significant difference in only the maximum torques of m.hamstrings between basketball players and football players in the dominant ($p \leq 0.01$) and non-dominant ($p \leq 0.001$) leg.

Table 1

Comparison between dominant and non-dominant muscle peak torque at $60° \cdot s^{-1}$

Muscle	Sports	Mean±Std.Dev.	Mean±Std.Dev.	p value	
		DOM	ND	DOM	ND
Quadriceps ($N \cdot m^{-1}$)	Basketball	211.18±43.28	200.37±51.31	0.22	0.60
	Soccer	196.00±33.79	192.58±42.84		
Hamstring ($N \cdot m^{-1}$)	Basketball	170.89±35.86	169.32±33.10	0.01*	0.00**
	Soccer	147.75±18.92	141.69±26.45		

Notes: DOM: Dominant leg (right); ND: non-dominant leg (left); *p≤0.05; **p≤0.01

Table 2 contains the average values of the limb asymmetry index (LSI) at maximum muscle torques m. quadriceps femoris-a and m. hamstrings DOM and ND legs (%) and H / Q ratio of DOM and ND legs in basketball players and football players. LSI is presented as a percentage difference in the strength of the extensor muscle (Quadriceps), that is, the flexor (Hamstring) in the knee joint DOM relative to the ND leg. The results confirmed that there is no statistically significant difference between basketball players and football players in terms of bilateral differences between extensor muscles (p=0.35) and flexors (p=0.30) in the knee joint. The H / Q ratio is presented as a coefficient corresponding to the quotient of the results of the maximum torques of the flexor and extensor muscles in the knee joint. The results obtained indicate that there is a statistically significant difference between basketball players and soccer players in the H / Q ratio of ND legs (p=0.02), while the difference was absent when it comes to DOM legs.

Table 2

Limb asymmetry index (LSI) and Hamstring to Quadriceps ratio (H/Q)

Velocity	Sports	H/Q ratio		LSI	
		Mean±Std.Dev.	Mean±Std.Dev.	Mean±Std.Dev.	
		DOM	ND	Quadriceps (%)	Hamstring (%)
$60°\cdot s^{-1}$	Basketball	0.81±.11	0.86±.14	13.91±9.56	15.92±12.09
	Soccer	0.76±.12	0.75±.14	11.27±7.87	12.46±8.31
	p	0.22	0.02	0.35	0.30

Notes: DOM: Dominant leg (right); ND: non-dominant leg (left); *p≤0.05; H/Q ratio: Hamstring / Quadriceps ratio; LSI: Lims asymmetry index

Discussion

The aim of the study was to determine the differences between soccer players and basketball players in the mean absolute values of maximum torque of flexors and extensors, H / Q ratio dominant-non-dominant leg and differences in bilateral imbalance of flexor and extensor muscles of the knee joint. Appropriate power m. quadriceps femoris-a and m. hamstrings is essential for sports performance because these two muscles are functional antagonists; contraction m. quadriceps femoris results in knee extension, while contraction m. the hamstrings leads to flexion in the knee joint. These muscle groups together control the acceleration and deceleration of the lower leg relative to the thigh, and sufficient strength in both muscle groups is required for running, jumping, stopping, and other sports activities [23].

Based on the results of the mean values of the maximum torques of the extensors and flexors in the knee joint, obtained in this study, it can be concluded that the dominant leg in basketball players and football players is the right leg. Based on the results of the torques of the extensors in the knee joint of the DOM and ND legs, it was established that there is no statistically significant difference between basketball players and soccer players. On the other hand, a statistically significant difference was found in the torques of the knee joint flexor DOM ($p\leq.01$) and ND ($p\leq.00$) of the leg between basketball players and football players. Given the markedly different body weights of basketball players and soccer players, it was to be expected that basketball players would achieve significantly higher values of extensor torques in the knee joint compared to soccer players. Given that the tested groups differed significantly in body weight, and that body weight was associated with the manifestation of muscle strength, such results were expected. Larger body dimensions, significantly larger physiological cross-section of muscles, is one of the reasons why basketball players achieved slightly higher absolute values of torque [24].

In a study by Bradić et al. [25] in which elite basketball players participated, as a result of different body dimensions between players of different positions, different torque values were obtained. At an angular velocity of $60°\cdot s^{-1}$, the lowest values of the extensor torques in the knee joint were achieved by playmakers 268.7 ± 48.8 $N\cdot m^{-1}$, and the highest values were achieved by the centers 321.7 ± 38.5 $N\cdot m^{-1}$. When it comes to flexors in the knee joint, playmakers scored 157.1 ± 29.4 $N\cdot m^{-1}$, while the centers scored 183.4 ± 24 $N\cdot m^{-1}$. The mean value of the torque of the extensor in the knee joint of all subjects was 297.5 ± 43.5 $N\cdot m^{-1}$, and the flexor 172 ± 27.3 $N\cdot m^{-1}$. Compared to the results of our research, higher values of the torque of the extensor in the knee joint were achieved, while the values of the flexors are almost identical.

Comparing the results of our study with the results of other studies, subjects in both groups achieved low values of torque extensors in the hip joint, as well as approximately similar results of torque flexors in the hip joint [25]. The results of our study are not consistent with the results of the Erdemir [26] study, in which the authors, comparing top basketball players and soccer players, noted a statistically significant difference in torque extensors and flexors in the knee joint at the left and right leg. In isokinetic testing at $90°\cdot s^{-1}$, Magalhães et al. [27] noted a statistically significant difference in the maximum torques of extensors and flexors in the hip joint of the DOM and ND legs between volleyball players and soccer players. In both studies, the authors cited as one of the causes of statistically significant differences in the strength of the flexors and extensors of the knee joint markedly different body dimensions of the examined groups. Identical results with elite football players and basketball players were obtained [8, 28, 29].

The relationship between the strength m. hamstrings (flexor muscles) and m. the quadriceps femoris (extensor muscle), also known in the literature as the H / Q ratio, is widely used in the areas of sports training and rehabilitation to describe muscle strength properties affecting the knee joint and the detection of muscle imbalance. The conventional H / Q ratio is defined as the ratio between the peak torque m. hamstrings and m. quadriceps femoris and is usually measured during concentric contraction, while the functional H / Q ratio is defined as the ratio between the peak torque m. hamstrings of the lower leg eccentric contraction and peak torque m. quadriceps femoris during concentric contraction (Hecc / Qcon) (representative of knee extension). Low values of H / Q ratio, strength (<0.6 for 60°·s^{-1}) may increase the risk of lower extremity injuries, especially anterior cruciate ligament (ACL) injuries and m deformities hamstrings [30], so this H / Q ratio is a measure of normal knee function and stability [31]. The results of our study in the H / Q ratio are in line with the results obtained [32, 33] , they are also above the set norms stated by Pelicer-Chenoll et al. [30]. On the other hand, the results of the research indicate that the difference between basketball players and soccer players in H / Q ratio was recorded only in ND leg (p≤.02), while the difference in DOM leg is not statistically significant, therefore, lower values of H / Q ratio were recorded. in football players, which has been confirmed in studies [34, 35, 36] in which it is stated that m. hamstrings is not as strong as m. quadriceps femoris. It is this disproportionate H / Q ratio that may be inversely related to the occurrence of lower extremity injuries [37].

Our results of maximum strength of both legs can be explained by analysis of the physiological requirements of sports training. Garret et al. [38] point out that the muscles of m. hamstrings have a relatively high proportion of type II fibers compared to m. quadriceps femoris. Hunter et al. [39] and Hamada et al. [40] analyzed the structural and metabolic characteristics of muscles and concluded that the characteristic that most affects fatigue is the type of muscle fibers, where type II muscle fibers are more susceptible to fatigue than type I muscle fibers, so the difference in muscle composition may be a major factor in the divergence of strength loss between muscle groups. Biopsy studies have shown that a higher proportion of type II muscle fibers is higher in m. hamstings than in m. quadriceps femoris [41]. According to Croiser, [22] this imbalance and muscle weakness predispose to injuries m. hamstring. According to Benjuia et al. [43], this balance between muscle groups with antagonistic action is an essential element in understanding the epidemiology of many muscle injuries. Therefore, it is important to assess the H / Q ratio as a relevant factor in preventing muscle injury. Substantial lower limb neuromuscular asymmetry with regard to strength and power has been described as an important risk factor for sport injuries and linked to decrements in sports performance [44].

The relationship between strength and power asymmetry and injury risk or poor performance could be related to the inability of a weaker lower limb to produce and / or absorb the same amount of force that a stronger limb can. Previous research suggests that lower limb imbalances exist in cutting and pivoting sports such as basketball [31], soccer [45]. Analyzing the bilateral deficit of extensors and flexors in the knee joint, several studies have confirmed that an imbalance in muscle strength of 10% - 15% is considered as an indicator of a disturbed relationship of flexors and extensors of both legs [46, 47]. The results of our study indicate that basketball players have a higher percentage of imbalances compared to soccer players, especially in m. hamstrings. These differences in performance between the legs may be associated with anatomical asymmetry [48], previous injuries such as ACL rupture [49], specific sports requirements [44], training experience, and toys. positions [48]. The role of inter-limb strength asymmetry in lower limb injury prevention is not clear. In a recent meta-analysis [50] the hamstrings inter-limb asymmetry was shown to play a reduced role in predicting hamstrings injury risk. Nevertheless, it was reported previously that the inter-limb hamstrings eccentric strength asymmetry was predictive of the hamstrings strain-type injury risk [51].

Additionally, a reduced quadriceps inter-limb strength asymmetry is essential for a safe return to the sport after injury [52]. Interestingly, hamstrings and quadriceps inter-limb strength asymmetry were recently shown to be negatively correlated with changes of direction (COD) and sprinting ability [53]. Those authors reported that increasing the inter-limb asymmetry decreased the COD and sprint performance, with no impact on jumping ability. This could be due to the key role of both hamstrings and quadriceps in stabilizing, braking and accelerating the body during COD and a sprint [54], while the stronger limb seems to compensate for the work of the weaker limb in jumping ability [55].

Conclusion

This study provides normative data on populations specific to soccer and basketball, but does not provide evidence of the ability of the isokinetic assessment of lower extremity muscle strength to predict injuries to football players and basketball players. In addition, the isokinetic dynamometer allows the assessment of only the joint movement, limiting the conclusion about the complex multi-joint activities that are performed in both soccer and basketball.

Conflict of interest

The authors declare that there is no conflict of interest.

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