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Analysis of the joint flexibility and prevalence of soccer-related injuries according to age

Análise da flexibilidade segmentar e prevalência de lesões no futebol segundo faixa etária

Análisis de la flexibilidad segmentaria y prevalencia de lesiones en el fútbol según franja etárea

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ABSTRACT | Muscle shortening has been associated with asymmetrical posture and Sports Injuries (SI) in soccer players in distinct ages. The objective of the present study was to analyze the joint flexibility, muscle extensibility and the SI prevalence in soccer players according to age: young and adults practitioners. Studied subjects integrated 170 male soccer players from amateurs and professional teams of a sports club from Campo Grande (MS), Brazil. Participants were divided into three age groups: G1 (juvenile), G2 (teenagers) and G3 (adults). To obtain information about injuries, was used a morbidity survey. Anthropometry and clinical tests were performed to analyze the joint flexibility (sit and reach test) and muscle extensibility (Thomas test; Schöber test and posture analysis). In relation to SI prevalence, 48 athletes (28.2%) reported SI incidence during two last years, with register of 55 SI; G3 presented 0.68 IS/ athlete, while G2 showed 1.4 IS/injured athlete. Moreover, G2 reported higher degrees of hip flexibility, with range of 26.3±8.0 cm in sit and reach test, and presence of lumbar shortening in response to Schöber test. In addition, G3 exhibited greater indexes of muscle shortening in hip flexors, evidenced in Thomas examination. In conclusion, evidences have been showing that professional athletes have presented higher incidence and prevalence of sports injuries. However, muscle shortening scores were more important results in youth soccer players, suggesting a possible interaction between intrinsic and extrinsic as cause of skeletal muscle disturbances in youth athletes.

Keywords | Muscle, Skeletal; Athletic Injuries; Soccer; Age Groups.

RESUMO | Retrações musculares têm apresentado relações com má postura e Lesões Desportivas (LD) em jogadores de futebol jovens e adultos. Este estudo teve por objetivo avaliar a flexibilidade articular, extensibilidade muscular e prevalência de LD em praticantes de futebol, relacionando-as com a faixa etária. A casuística integrou 170 participantes do sexo masculino, procedentes das equipes de base profissionalizante e profissional de um clube desportivo de Campo Grande (MS). Os participantes foram distribuídos em três grupos: G1 (infantojuvenil), G2 (adolescentes) e G3 (adultos). Para a tomada de informações sobre lesões, utilizou-se de um inquérito de morbidade referida. Foram realizadas análises para caracterização antropométrica, flexibilidade articular, extensibilidade muscular e alinhamento corporal. Em relação à prevalência de LD, foram registrados 55 LD durante as duas últimas temporadas, sendo que 48 participantes (28,23%) relataram presença de LD. O G3 revelou a maior taxa de prevalência de LD, totalizando 0,68 LD/atleta. A taxa de lesão por atleta lesionado apresentou-se maior no G2, com 1,4 LM/atleta lesionado. O G2 apresentou maior grau de flexibilidade articular do quadril, com alcance de 26,3±8,0 cm no teste de sentar e alcançar. O G3 apresentou os maiores índices de prevalência de retração para flexores de quadril. Ao teste de Schöber, o G2 mostrou a maior prevalência de inflexibilidade lombar. Conclui-se que atletas profissionais têm maior incidência e prevalência de LD. Os índices de inflexibilidade foram particularmente importantes em faixas etárias mais jovens, sugerindo que uma possível interação entre atributos intrínsecos e extrínsecos se associe a distúrbios musculoesqueléticos em jovens atletas.

Descritores | Músculo Esquelético; Traumatismos em Atletas; Futebol; Grupos Etários.

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RESUMEN | Retracciones musculares han presentado relaciones con mala postura y Lesiones Deportivas (LD) en jugadores de fútbol jóvenes y adultos. Este estudio tuvo por objetivo evaluar la flexibilidad articular, extensibilidad muscular y prevalencia de LD en practicantes de fútbol, relacionándolas con la franja etárea. La casuística integró 170 participantes del sexo masculino, procedentes de los equipos de base profesionalizante y profesional de un club deportivo de Campo Grande (MS). Los participantes fueron distribuidos en tres grupos: G1 (infanto-juvenil), G2 (adolescentes) y G3 (adultos). Para la obtención de informaciones sobre lesiones, se utilizó una averiguación de morbilidad referida. Fueron realizados análisis para caracterización antropométrica, flexibilidad articular, extensibilidad muscular y alineamiento corporal. En relación a la prevalencia de LD, fueran registrados 55 LD durante las dos últimas temporadas, siendo que 48 participantes (28,23%) relataron presencia de LD. El G3 reveló la mayor tasa de prevalencia de LD, totalizando 0,68 LD/atleta. La tasa de lesión por atleta se presentó mayor en el G2, con 1,4 LM/atleta lesionado. El G2 presentó mayor grado de flexibilidad articular de la cadera, con alcance de 26,3±8,0 cm en el test de sentarse y alcanzar. El G3 presentó los mayores índices de prevalencia de retracción para flexores de la cadera. Al test de Schöber, el G2 mostró la mayor prevalencia de inflexibilidad lumbar. Se concluye que atletas profesionales tienen mayor incidencia y prevalencia de LD. Los índices de inflexibilidad fueron particularmente importantes en franjas etáreas más jóvenes, sugiriendo que una posible interacción entre atributos intrínsecos y extrínsecos se asocie a trastornos musculoesqueléticos en jóvenes atletas.

Palabras clave | Músculo Esquelético; Traumatismos en Atletas; Fútbol; Grupos de Edad.

INTRODUCTION

Soccer has attracted children and adolescents as a means of physical, technical and tactical development also aimed at sportive professionalization[1,2]. This is especially important when it comes to epidemiology, for young athletes are at high risk of sports injuries (SIs)[3]. Soccer is related to specific physical contacts and gestures such as running, jumping, landing, speeding, abrupt changes in direction, kicking and tipping[4,5]. Specific physical demands, adequate physica conditioning and constant training may predispose practitioners to SIs[6]. Moreover, the prevalence of SI is proportional to the competitive demands in soccer: adult and professional athletes are usually more susceptible than younger ones[3,7].

Besides training issues, athletes' characteristics such as age[7] and joint flexibility[8] are intrinsic risk factors for SI[6]. Flexibility and muscle strength are physical attributes that are essential to the performance of sports gestures and that goes through adaptations depending on the modality[9]. Flexibility, in particular, is also influenced by age, and decreases as the years go by[10]. The installation of muscle retractions have presented relations with bad posture, contributing with SI in young[3,11] and adult players[8,12].

Some papers have attributed to posture the etiological power to SI in soccer players[13,14], suggesting that there are misalignments between muscle chains. Ribeiro *et al.*[13] classify postural research as an intrinsic feature to young athletes. However, we found no studies trying to figure out which of these etiological factors — segmental flexibility and/or global postural alignment — is more directly associated with the incidence of SI in soccer among players of all ages.

The purpose of this study was to assess joint flexibility, muscle extensibility and prevalence of SI in soccer players according to age. We also aimed to analyze the association between these characteristics and the incidence of SIs, attempting to identify the etiological factors that most contribute with the installation of SIs in the context of soccer. The initial hypothesis formulated was that adults would be more prone to segmental retractions, which are more directly related to SI incidence.

METHODOLOGY

In total, 170 male soccer players participated in the study, all of them affiliated to a sports club of Campo Grande (MS). All subjects or their caregivers were informed of the purposes of the study and its volunteer character, and all of them signed the informed consent form, approved by the Ethics Committee of UFMS (protocol 2035).

The volunteers were allocated in three groups divided by age[15]. Group 1 (G1) held young players aging 11 to 14 years; group 2 (G2), players aging 15 to 18 complete years; and group 3 (G3) players older than 18 years. The subjects were interviewed for personal data, history of soccer practice, and occurrence of SI in the last periods. Analyses for anthropometric characterization, joint flexibility, muscle extensibility and body alignment were made. Muscle extensibility

was defined as the amplitude in which the joint could be moved passively, considering the influence of muscle extension[16,17].

In order to evaluate hip and lumbar spine flexibility, we used the sit and reach test[18] and the modified Schöber test, respectively[19]. Hip flexor muscle extensibility was assessed by Thomas test[20,21]. The posterior (Posture 1) and anterior (Posture 2) static muscle chains were analyzed by specific postural evaluations[20,21]. Muscle retraction was considered facing specific compensatory disorders[20,21]. All procedures were performed by two trained researchers. To collect information about SI, an Inquiry of Referred Morbidity was applied to participants[22]. Details of cases of worsening were presented in a recent publication[23].

To assess demographic data and information about training history, we used a variance analysis and Student-Newman-Keuls test. Results of physical evaluation were assessed by Goodman test[25]. All conclusions were discussed at a 5% significance level, and Odds Ratio was calculated by variables association.

RESULTS

Overall, height, body mass and time of soccer practice increased according to age, showing to be different in all comparisons (Table 1). In total, 55 SIs were registered, as 48 patients (28.23%) reported having gone through it. G3 presented higher rate of SIs, with 15 athletes presenting injuries (51.7%), thus summing up an incidence of 0.68 SI/athlete. The rate of SI per injured athlete was higher in G2.

As to the hip joint, G2 had a higher level of flexibility, with reach of 26.3±8.0 cm (Figure 1).

The tests of hip flexors muscle strength showed alterations in all groups (Table 2). Considering age, G3 presented a higher rate of hip flexor retraction (97-100%). At Schöber test, G2 presented a higher prevalence of lumbar retraction. This feature was particularly important in G1 also, where positive Schöber was associated with a three times higher probability of SI (OR=2.80, CI 0.99-7.89; p=0.047).

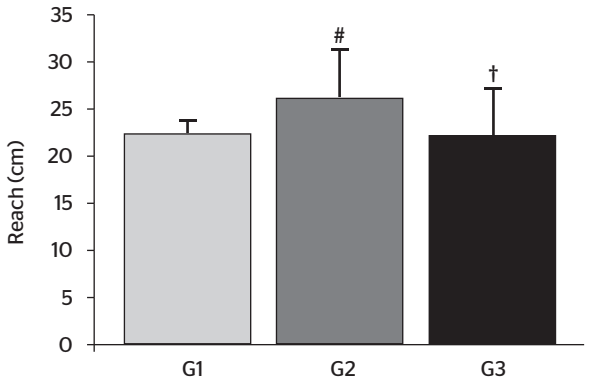
When it comes to posterior muscle chain extensibility, G1 and G2 showed higher incidence of postural changes of posture 1. In posture 2, G1 has changes in 81 cases (98.8%), and G3 in 16 cases (72.7%; p<0.05).

Among adults, segmental retraction in posture 2 was associated with a 14 times higher change of SI

Table 1. General characteristics

Variables	Groups		
	G1	G2	G3
Age (years)	12.5±1.2	15.6±0.8*	24.4±4.7*#
Height (cm)	152±20.2	171±8.0*	177±8.0*
BM (kg)	45±11.2	64±9.1*	74±6.2*#
TH (years)	3.70±2.31	5.30±2.89*	13±4.68*#
Individuals	97	44	29
NIA	28 (28.9%)	5 (10.41%)	15 (31.25%)
Injuries	28 (50.90%)	7 (12.72%)	20 (36.36%)
IRA	0.29	0.15	0.68
IRIA	1	1.4	1.3

Demographic data and Training history (TH) expresses in mean ± standard deviation; G1: athletes aging 11 to 14; G2: athletes aging 15 to 18; G3: adult athletes; *p<0.05 *versus* G1; #p<0.05 *versus* G2; †p<0.05 *versus* G3; ANOVA and Student-Newman-Keuls test (p<0.05). NIA: number of injured athletes; Injuries: total number of injuries by age group; IRIA: injury rate per injured athlete; IRA: injury rate per athlete



G1: athletes aging 11 to 14; G2: athletes aging 15 to 18; G3: adult athletes; # p<0.05 *versus* G1; †p<0.05 *versus* G2

Figure 1. Mean and standard deviation of segmental amplitude responses (cm) obtained from Sit and Reach Test on Well's chair

Table 2. Absolute and relative (%) distribution of changes in flexibility by age group

Variables		Cases	Groups			Total
			G1	G2	G3	
TR	MF	Absent (-)	81 (65.9)	42 (34.1)*	0 (0.0)*#	123
		Present (+)	16 (34.0)§	2 (4.3)*§	29 (61.7)#§	47
	BF	Absent (-)	7 (100.0)	0 (0.0)*	0 (0.0)*	7
		Present (+)	90 (55.2)§	44 (27.0)*§	29 (17.8)*§	163
TL	MF	Absent (-)	85 (67.4)	40 (31.7)*	1 (0.8)*#	126
		Present (+)	12 (27.3)§	4 (9.0)§	28 (63.6)*§	44
	BF	Absent (-)	2 (66.7)	0 (0.0)	1 (33.3)	3
		Present (+)	95 (56.9)§	44 (26.3)*	28 (16.8)	167
Schöber		Absent (-)	78 (63.4)	24 (19.5)*	21 (17.1)*	123
		Present (+)	19 (40.4)	20 (42.6)*§	8 (17.0)*#	47

G1: athletes aging 11 to 14; G2: athletes aging 15 to 18; G3: adult athletes; TR: Thomas test for right lower extremity; TL: Thomas test for left lower extremity; MF: monoarticular hip flexors; BF: biarticular hip flexors. Horizontal comparisons (group): *p<0.05 *versus* G1; #p<0.05 *versus* G2. Vertical comparisons: §p<0.05 *versus* Absent (-); Goodman test for contrast between and among multinominal populations (p<0.05).

(OR=14.0, CI 1.4-137.3; p=0.023). Deviations in posture 1 was related to a 4.88 times higher chance of having SIs in G3 subjects (OR 4.88, CI 0.78-30.30; p=0.089) (Table 3).

DISCUSSION

This paper was aimed at analyzing joint flexibility, muscle extensibility and prevalence of SI in soccer players characterized by age. We also attempted to point whether there is an association between these characteristics and SI occurrences. The study design is justified by the possibility of contributing with professional activity in the field of prophylaxis of intrinsic risk factors and treatment for SIs, consequently providing subsidize for physical, tactical and technical development of soccer players in the leading categories.

G2 presented higher rates of thigh posterior muscles flexibility. These findings are associated with a high incidence (42.6%) of lumbar inflexibility. This group held athletes with longer history of soccer training, so the values of thigh flexibility could be the result of intrinsic factors common to chronologic maturation[15] and extrinsic factors related to soccer itself. Therefore, the effects of bone and muscle growth, in addition to musculoskeletal development resulting from regular specialized sports training, might have contributed with the increased flexibility in the posterior thigh muscles. By analogy, these factors may have caused lumbar adaptations due to the higher demand of segmental stabilization of the trunk and pelvis that needed to perform specific motor gestures in soccer, including running, kicking and tipping[4,5].

Although it is only speculation for G2, this finding is an important support for the association between lumbar retraction and SI in G1 (OR=2.8). This group held beginners with brief past training history, so it is possible that these adaptive responses be more marked at the beginning of sports physical training and later on result in higher chance for SIs.

It is likely that the physical-motor demands in these cases are associated with bioarticular hip flexor retraction, because all groups had high rates of this muscle disorder. The prevalence of retraction was progressively increased with age and with training history, culminating in rates of 96.6 to 100% in adult athletes presenting muscle shortening. Due to the higher demand of contractions to the hip flexor muscles in specific soccer movements, the retraction of this group is a common finding among soccer players[10,11] and can cause lumber hyperlordosis, pelvic anteversion, and posterior thigh muscle tensioning[20].

When young athletes enroll very early in sports clubs for training, they are submitted to strength and potency demands that are not balanced by specific flexibility exercises[10]. We may say, therefore, that specific requirements of Soccer may lead to unbalance between agonist and antagonist muscle groups, favoring postural disorders[9,12]. When combined to technical error in movement execution, these may become important causes of muscle damages[12], the leading causes of soccer-related injuries[23].

Although the prevalence of posterior muscle chain retraction is reduced with aging, this response is an important finding. These outcomes may not only be due to soccer, but also to disparities in the ostheomyoarticular development, which are very common in adolescence. Overload from systematic physical exercises is associated with increase in bone mineral density[26]. These responses, however, are more effective when physical demands accompany the bone maturation velocity during puberty[26,27]. In addition, the osteogenic effects of exercises are governed by the overload frequency and intensity, as physical demands of strength and muscle potency in situations of impact, very common in soccer[4], accelerate bone development[26].

In contrast, these demands usually result in hypertrophy and muscle shortening[9]. This unbalance between bone growth and muscle maturation may have supported the decreased extensibility of the posterior muscle chain in both G1 and G2, which is an important etiological factor in worsening specific of adolescence such as Osgood-Schlatter and Sever diseases[28].

The global shortening of the posterior chain, although not so marked in G3, was also relevant, resulting

Table 3. Absolute and relative (%) distribution of retractions of posterior chain by posture and age group

Groups	Posture 1		Posture 2	
	Absence (-)	Presence (+)	Absence (-)	Presence (+)
G1	16 (16.5)	81 (83.5)*	2 (2.1)	95 (97.9)*
G2	12 (27.3)	32 (72.7)*	2 (4.5)	42 (95.5)*
G3	8 (38.1)	21 (61.9)	8 (38.1) §	21 (61.1)*#§

G1: athletes aging 11 to 14; G2: athletes aging 15 to 18; G3: adult athletes; Horizontal comparisons (group): *p<0.05 *versus* absence of retractions. Vertical comparisons (group): §p<0.05 *versus* G1; #p<0.05 *versus* G2; Goodman test for contrast between and among multinomial populations (p<0.05).

in 14 times higher chances of SI in adult life. The repetition of certain activities, with repeated positions and movements, in addition to the training period and overload, may lead to a process of organic adaption resulting in damaging effects for posture that can cause muscle unbalance[13,21], which is supported by longer training history in G3, for instance. Moreover, specific movement of soccer and technical error in execution may increase SI prevalence[6].

Nevertheless, the cross-sectional character of this study turns the results into speculation only. Theefore, further studies are needed to confirm what the etiologic factors acting in SI according to age are.

CONCLUSIONS

The results lead us to conclude that adult athletes are more prone to SI resulting specially from retractions of the posterior chain. However, the lumbar retraction index were particularly important in the physiopathology of Sis among adolescents, which suggests a possible interaction between intrinsic and extrinsic features in more severe occurrences with young athletes.

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