Rev Andal Med Deporte. 2015;xxx(xx):xxx–xxx

Revista Andaluza de
Medicina del Deporte

www.elsevier.es/ramd

Original

Comparison of conventional hamstring/quadriceps ratio between genders in level-matched soccer players

M. Pellicer-Chenoll[a], P. Serra-Añó[b], R. Cabeza-Ruiz[c,*], A. Pardo[d], R. Aranda[a], L.M. González[a]

[a] Department of Physical Education and Sport, University of Valencia, Valencia, Spain
[b] Department of Physiotherapy, University of Valencia, Valencia, Spain
[c] Department of Physical Education and Sport, University of Seville, Seville, Spain
[d] Department of Physical Education, Catholic University of Valencia, Valencia, Spain

ARTICLE INFO

Article history:
Received 12 May 2015
Accepted 28 May 2015
Available online xxx

Keywords:
Muscular imbalance
Isokinetic strength
Soccer
Strength ratios
Torque
Injury risk

ABSTRACT

Objectives: The main goal of our study is to compare the hamstring/quadriceps (*H*/*Q*) ratio at different knee angles between level-matched male and female soccer players and to determine whether differences in the *H*/*Q* ratio exist between the dominant and the non-dominant leg.
Methods: A cross-sectional study design was used to compare an isometric *H*/*Q* ratio and functional isokinetic ratio (between hamstring in eccentric contraction and quadriceps in concentric contraction) between males ($n = 14$) and females ($n = 14$). These ratios were studied at two different speeds of movement ($60^\circ\ s^{-1}$ and $180^\circ\ s^{-1}$) and in five different positions (40°, 50°, 60°, 70° and 80° degrees of knee flexion).
Results: Our results showed no differences in the *H*/*Q* ratio between genders. The ratio in the dominant leg showed an average of 9% higher values. The ratios were an average of 53.4% lower in positions near flexion than in positions near extension.
Conclusions: For both men and women, the results showed lower ratios in the non-dominant leg compared to the dominant leg. At higher velocities, the force ratios were higher, while in more knee-flexed positions, the ratios were lower. Finally, we did not find differences in ratios between men and women.

Comparación del ratio de fuerza convencional isquiotibial/cuádriceps entre jugadores de fútbol de niveles similares de ambos sexos

Palabras clave:
Desequilibrio muscular
Fuerza isocinética
Fútbol
Ratios de fuerza
Momento de fuerza
Riesgo de lesión

RESUMEN

Objetivos: El objetivo principal del estudio es comparar el ratio de fuerza isquiotibial/cuádriceps (ratio H/Q) en diferentes ángulos de rodilla entre jugadores de fútbol de niveles similares y determinar si existen diferencias en dicho ratio entre la pierna dominante y la no dominante.
Métodos: Se utilizó un diseño transversal para comparar el ratio isométrico H/Q y el ratio funcional isocinético (ratio entre la fuerza durante una contracción excéntrica de isquiotibial y la fuerza durante una contracción concéntrica de cuádriceps) entre hombres ($n = 14$) y mujeres ($n = 14$). Estos ratios se estudiaron en dos velocidades ($60^\circ\ s^{-1}$ y $180^\circ\ s^{-1}$) y en 5 posiciones diferentes (40, 50, 60, 70 y 80 grados de flexión de rodilla).
Resultados: Nuestros resultados no mostraron diferencias significativas en el ratio H/Q entre sexos. El ratio en la pierna dominante mostró valores un 9% más altos que en la pierna no dominante. Los ratios fueron de media un 53.4% más bajos en posiciones cercanas a la flexión que en posiciones cercanas a la extensión.

* Corresponding author.
E-mail address: ruthcr@us.es (R. Cabeza-Ruiz).

http://dx.doi.org/10.1016/j.ramd.2015.05.002

Please cite this article in press as: Pellicer-Chenoll M, et al. Comparison of conventional hamstring/quadriceps ratio between genders in level-matched soccer players. Rev Andal Med Deporte. 2015. http://dx.doi.org/10.1016/j.ramd.2015.05.002

Conclusiones: Para ambos sexos los resultados mostraron ratios más bajos en la pierna no dominante comparado con la pierna dominante. A velocidades superiores, los ratios de fuerza fueron mayores, mientras que en posiciones de mayor flexión de rodilla los ratios fueron menores. Por último, no se encontraron diferencias significativas en los ratios entre hombres y mujeres.

Comparação da relação de força convencional entre isquiotibiais/quadríceps entre jogadores de futebol com níveis semelhantes, de ambos os sexos

R E S U M O

Objetivos: O principal objetivo do nosso estudo é comparar a relação de força entre Isquiotibiais/Quadríceps (H/Q) em diferentes ângulos do joelho entre jogadores de futebol (masculino e feminino) de níveis semelhantes para determinar se existem diferenças na relação entre H/Q entre o membro dominante e a não-dominante.
Método: U estudo de delineamento transversal foi utilizado para comparar a relação isométrica entre H/Q e isocinética funcional (razão entre a força dos isquiotibiais em contração excêntrica e do quadríceps em contração concêntrica, durante a extensão do joelho) entre homens (n = 14) e mulheres (n = 14). Estas razões foram estudadas em duas velocidades diferentes de movimento (60°/s e 180°/s) e em cinco posições diferentes (por exemplo 40, 50, 60, 70, e 80 graus de flexão do joelho).
Resultados: Os resultados não mostraram diferenças significativas na relação H/Q entre os sexos. A relação da perna dominante mostrou valores médios de 9% mais elevados em relação a perna não dominante. As proporções foram, em média, 53,4% menor em posições próximas a flexão do que em posições perto da extensão.
Conclusões: Para ambos os sexos, os resultados mostram razões mais baixas no membro não dominante em comparação com a dominante. À velocidade mais elevadas, as relações de força foram superiores, enquanto que em maiores flexões de joelho as relações foram menores. Finalmente, não foram encontradas diferenças significativas nas proporções entre homens e mulheres.

Palavras-chave:
Desequilíbrio muscular
Força isocinética
Futebol
Relações de força
Momento de força
Risco de lesões

Introduction

The ratio between the strength of the hamstring (flexor muscles) and that of the quadriceps (extensor muscles), also known in the literature as the *H*/*Q* ratio, has been widely used in the fields of sports training and rehabilitation to describe the strength properties of muscles that affect the knee joint and to detect muscle imbalances.[1] The conventional *H*/*Q* ratio is defined as the ratio between the peak torque of the hamstring and the quadriceps and is generally measured during a concentric contraction, while the functional *H*/*Q* ratio is defined as the ratio between the peak torque of the hamstring during an eccentric contraction and the peak torque of the quadriceps during a concentric contraction (H_{ecc}/Q_{con}) (representative of knee extension).[2,3] Low values of the *H*/*Q* strength ratio (<0.6 for $60^{\circ}\ s^{-1}$) may increase the risk of injury to the lower limb, especially anterior cruciate ligament (ACL) injuries and hamstring strains.[4,5] Female athletes are 4 times more likely to suffer an ACL injury than their male counterparts.[6,7] In recent years, some authors have linked the higher incidence of ACL injury to a reduced *H*/*Q* strength ratio in women.[8,9]

Although some studies have found differences in the *H*/*Q* ratio between males and females,[8] there is insufficient evidence to show that level-matched athletes performing the same sport and undergoing similar training programs show sex-related differences. In fact, studies that compared active men and women with similar activity levels did not find significant differences in the strength ratio between the anterior and posterior thigh muscles.[10,11]

On the other hand, some articles suggest that women may have a reduced *H*/*Q* ratio in some knee joint positions,[12] however, as far as we know, no study has compared the strength ratios between level-matched athletes at different knee joint angles. We consider this comparison important because the realization of certain technical gestures required in specific sports involves the activation of different muscles throughout their range of movement; consequently, the risk of injury can vary.

Soccer players may display unequal development of the right and left limbs due to certain technical actions performed in the sport, and such unequal development can cause functional or even structural asymmetries. The dominance of one side of the body over the other produces a greater ability of the dominant side and may involve differences in the strength of various muscles that depend on the actions required in the sport. Some studies of soccer players have shown differences in strength and flexibility between the dominant and the non-dominant leg[13] and even biomechanical asymmetries between them.[14]

In this study, our aims were (i) to compare the functional and conventional *H*/*Q* ratios between level-matched male and female soccer players at different knee angles and (ii) to determine whether differences in the *H*/*Q* ratio exist between the dominant and non-dominant leg in these players.

Method

Experimental approach

This study was designed as a cross-sectional group comparison. The participants were divided into two groups using sex (i.e., male or female) as the classification criterion. Body mass and height were measured for each subject. One week before the day of the test, the subjects attended a familiarization session in which the procedures of the study were explained and in which they learned how to execute the various protocols. In the test session, isometric and isokinetic torque (at $60^{\circ}\ s^{-1}$, $180^{\circ}\ s^{-1}$) were recorded. These data

Please cite this article in press as: Pellicer-Chenoll M, et al. Comparison of conventional hamstring/quadriceps ratio between genders in level-matched soccer players. Rev Andal Med Deporte. 2015. http://dx.doi.org/10.1016/j.ramd.2015.05.002