Flexibility of the hamstring muscles and the position of the trunk in boys training football

Eliza Smoła[A,B,D,E], Katarzyna Wódka[A,B,D,E],
Marta A. Bibro[A,B,D,E], Agnieszka Jankowicz-Szymańska[A-D,F, *]

University of Applied Sciences in Tarnów, Faculty of Health Sciences, Tarnów, Poland

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Abstract

Introduction: The objective of the study was to assess the flexibility of the hamstring muscles and their relationship with the position of the spine, shoulder and pelvic girdles in individual planes in boys training football.
Material and methods: The study included 28 boys aged 10-14, training football 3 times a week for at least 2 years. The subjects were divided into two groups: correct bilateral flexibility of the hamstring muscles, bilateral shortening of the hamstring muscles. Body height and weight were measured and BMI was calculated. The three-dimensional position of the trunk was examined using the Zebris pointer ultrasound system. The passive straight-leg-raising test was used to assess the flexibility of the hamstring muscles.
Results: 32% of people were diagnosed with the correct length of both hamstring muscles, 57% had shortened muscles in both limbs. Mean values determining the depth of thoracic kyphosis indicated its deepening in each of the groups, however, lower values were recorded in boys with reduced flexibility of the hamstring muscle mass. This group was also characterised by a better balance of the trunk in the sagittal plane. The average depth of lumbar lordosis in both groups was within the normal range. In the frontal plane, in both groups of footballers there was a tendency to lift the left shoulder (more frequent in the group with normal flexibility), the pelvis on the left side and shift the trunk to the right.
Conclusion: Shortening of the hamstring muscles is common in boys who train football, but no evidence of a relationship between the limited flexibility of these muscles and the position of the trunk was found.

Keywords: football, shortening of the hamstring muscles, spine, body posture, children

Introduction

Football is one of the most popular sports disciplines in children and teenagers. According to the International Federation of Association Football (FIFA), it is estimated that around the world 265 million people play football, including 22-38 million under 18. Between 2000 and 2006, the number of registered young footballers increased by 7% worldwide [1]. This discipline is very popular mainly in boys, but in recent years there has also been an increase in interest in this discipline in girls [2]. Football requires players to have a high level of physical fitness, which includes motor skills. In addition to endurance, speed and strength, an important element in maintaining full fitness is the appropriate level of flexibility. The correct level of flexibility affects the correct performance of, among others, agility and

*Address for correspondence:
jankowiczszymanska@gmail.com

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technical exercises in football, as well as the effective work of muscles in speed and strength exercises [3]. Proper muscle flexibility is a prerequisite for maintaining proper ranges of motion in the joints. Hence. it seems that reducing the flexibility of certain muscle groups may have an impact on the position of adjacent parts of the body. and thus on the quality of body posture.This is also confirmed by the concepts that take into account the myofascial connections between tissues [4]. Body posture changes throughout life and depends on many factors. both internal and external. It is significantly influenced by physical activity. the environment in which we live. the emotional state and movement patterns. The differences in body posture are undeniably influenced by age. character. race. physique or somatic type [5].

The influence of systematic football training on the body posture of young people is not fully understood. While some see changes in the position of the spine. others do not find such connections [6, 7, 8, 9]. In addition to the many health benefits of systematic football training. the literature also mentions a high risk of injury [1, 10, 11, 12]. The most common injuries in footballers are sprains and dislocations of the ankle and knee joints. According to Read et al. [10] in the case of young athletes. the risk of injury is associated with changes in the body resulting from the processes of puberty. According to some researchers. the cause of frequent injuries in the lower limbs may be reduced flexibility of the hamstring muscles [13, 14]. Hence. the objective of our study was to assess the flexibility of the hamstring muscles and their relationship with the position of the spine. shoulder and pelvic girdles in each of the planes. The results of the study are meant to help assess the validity of the use of stretching exercises in the postural re-education of young footballers.

Material and methods

The examination of the body posture and the assessment of the flexibility of the hamstring muscles were performed in a group of 28 boys. All participants of the study trained football for at least 2 years, 3 times a week at the LKS Łęgovia football club in Łęg Tarnowski. The condition for inclusion in the examinations was: well-being on the day of the study, age between 10-14 years of age, no chronic diseases, inflammations, fractures, and surgical procedures within the musculoskeletal system for min. 6 months before the described examinations, systematic (confirmed by the coach) football training for at least 2 years, willingness to participate in the examinations. The consent of the subjects and their parents was obtained for the examinations. All examinations were carried out in accordance with all the guidelines of the Helsinki Declaration. The subjects were divided into two groups: correct bilateral flexibility of the hamstring muscles, bilateral shortening of the hamstring muscles.

Examination procedures

Anthropometric measurements

Body height was measured using a calibrated anthropometer (ZPH Alumet No 010208, Warsaw, Poland) from the Basis point to the Vertex point with an accuracy of 0.01 m. Body weight was examined using a TANITA scale (body composition analyser bf-350; Tanita Corporation of America, Inc., Arlington Heights, Illinois) with an accuracy of 0.1 kg. Using the BMI threshold values for girls and boys of a given age proposed by Cole, the body mass status was determined.

The mean age of the respondents was 11.21 ± 1.70. The body weight of the subjects was 41.96 ± 11.35 kg and ranged from 24.10 kg to 68.60 kg. The body height of the subjects was 1.45 ± 0.13 m and ranged from 1.24 m to 1.77 m. BMI was 19.42 ± 2.57 kg/m^2 and ranged from 15.12 kg/m^2 to 23.98 kg/m^2. Of all the examined boys, 19 (67.85%) had normal body weight, and 9 (32.14%) were overweight.

Body posture examination

The Zebris Pionter ultrasound system [15] was used to assess body posture. Its reliability and coherence of which with the X-ray examination was confirmed by examinations [16, 17, 18]. This system consists of a measuring sensor placed on a tripod with built-in microphones, an ultrasonic indicator with two transmitters and a reference marker attached to the pelvic girdle of the subject. During the examination, which lasted about 2 minutes, the subject stood in a habitual position, arms lowered along the trunk and gaze straight ahead, barefoot in shorts lowered below the iliac spines. The size of thoracic kyphosis was defined as the sum of the angles of all thoracic vertebrae and the depth of lumbar lordosis as the sum of the angles of all lumbar vertebrae. Values are given in degrees assuming that the correct value of thoracic kyphosis is 21°-32°, while in the case of lumbar lordosis it is 28°-34°. The angle between the vertical plane and the plane passing through the spinous process of the C7 vertebra and the L5/S1 transition in degrees defined the balance of the trunk in the sagittal plane (total trunk inclination). Values of less than 2° indicated excessive backward inclination of the body, values greater than 11° indicated excessive forward inclination of the body. The normative data provided by the manufacturer was used.

Passive straight-leg-raising test - PSLR test

The PSLR test was used to assess the flexibility of the hamstring muscles. This test has been assessed for reliability and repeatability [19, 20]. The subject was in the supine position, legs straight at the hip and knee joints. The lower back and sacrum lie flat. The examiner lifted one of the legs by bending it at the hip joint. During the movement, the knee of the tested leg was straightened and the foot was loosened. The leg that was not tested was held by the therapist with the other hand. After reaching the motion barrier (resistance felt by the therapist), the range of motion was measured using a goniometer whose axis was placed in line with the transverse axis of the hip joint on the greater trochanter of the femur. The movable arm of the goniometer was pointed to the head of the fibula. The fixed arm was positioned along the body, parallel to the ground and directed towards the head. Shortening of the hamstring muscles was demonstrated by a score of less than 80° [21, 22].

Results

Nine people were diagnosed with the correct length of both hamstring muscles, and in 16 the muscles were shortened in both limbs. Due to the small number of people with unilateral shortening of the hamstring muscles (3 people), these people were not included in the further analysis.

The mean values of thoracic kyphosis indicated their deepening in each of the groups distinguished on the basis of the flexibility of the hamstring muscles. However, higher mean values of thoracic kyphosis (exceeding the norm) were recorded in the group of boys, with normal flexibility of the hamstring muscle mass in both limbs. The mean values of lumbar lordosis in both groups were within the normal range. The sagittal trunk inclination indicated the correct balance of the body. In the frontal plane, a slightly greater asymmetry in the position of the trunk was observed in the group of boys with bilateral reduction in flexibility of the hamstring muscles. These changes were not statistically significant (Tab. 1).

In every third footballer in each group, the thoracic spine was correctly positioned in the sagittal plane. The correct shape

Table 1. Selected features of the torso position and the flexibility of hamstrings

Variable	Hamstring muscles*	n	x̄	Me	Min-Max	SD	p
Thoracic kyphosis [°]	Both n.	9	39.61	40.60	25.70-63.80	9.62	p = 0.53
	Both s.	16	34.42	38.60	7.40-53.00	14.34	
Lumbar lordosis [°]	Both n.	9	30.17	28.30	15.30-43.70	9.17	p = 0.59
	Both s.	16	28.78	27.40	21.10-44.60	7.00	
Sagittal trunk inclination [°]	Both n.	9	3.39	3.10	0.20-8.00	2.87	p = 0.16
	Both s.	16	4.83	4.85	1.40-9.30	2.32	
Pelvic torsion [°]	Both n.	9	5.31	1.90	0.40-18.20	6.25	p = 0.46
	Both s.	16	4.04	2.65	1.50-10.20	2.77	
Pelvic obliquity [°]	Both n.	9	1.78	2.00	0.40-3.20	0.94	p = 0.82
	Both s.	16	1.94	1.95	0.10-3.80	0.99	
Pelvic/shoulder obliquity [°]	Both n.	9	2.30	1.70	0.10-5.90	1.93	p = 1.00
	Both s.	16	2.14	2.15	0.30-4.50	1.41	
Shoulder height difference [mm]	Both n.	9	6.16	2.40	0.60-22.40	7.54	p = 0.29
	Both s.	16	8.81	5.30	0.10-29.60	8.74	
Pelvic height difference [mm]	Both n.	9	6.41	6.60	1.40-11.40	3.40	p = 0.41
	Both s.	16	7.92	7.90	0.30-18.10	4.58	
Lateral inclination [°]	Both n.	9	1.30	1.00	0.50-3.00	0.80	p = 0.15
	Both s.	16	0.88	0.65	0.10-2.20	0.71	

* s. – shortened; n. – normal elasticity

of lordosis was noted in every second player, also from both groups. The players from the group with bilateral shortening of the hamstring muscles were characterised by a better balance of the trunk in the sagittal plane (93.75%) than the players from the group where there was no shortening of the hamstring muscles (every second).

In the frontal plane, both groups of footballers showed a tendency to lift the left shoulder (in almost ⅔ of the group with bilateral shortening of the hamstring muscles, in ¾ of the group with correct bilateral flexibility of the hamstring muscles) and the pelvis on the left side. Additionally, in both groups, in almost ⅔ of subjects there was a tendency to shift the trunk to the right (Tab. 2).

Discussion

The obtained results do not seem to clearly indicate the existence of a relationship between the flexibility of the hamstring muscles and the position of the trunk in the sagittal plane. In the course of the examinations, it was observed (regardless of the assignment to the group: correct length of hamstring muscles, reduced length of hamstring muscles) that the correct positioning of the thoracic spine occurred in every third subject and the correct positioning of the lumbar spine in every second subject. Correct balance of the trunk in the sagittal plane was noted in half of the subjects from the group of footballers with normal flexibility of hamstring muscles and in 93.75% with reduced flexibility of hamstring muscles. Gajdosik [23] looked for a relationship between the flexibility of the hamstring muscles and the position and mobility of the spine in the sagittal plane. The PSLR test was used to evaluate the length of the hamstring muscles. His observations indicate that shortened hamstring muscles are accompanied by reduced mobility of the pelvic and lumbar inclination and increased mobility of the thoracic flexion. There was no correlation between the flexibility of hamstring muscles and the position of the spine in the sagittal plane in a standing position. Muyor et al. [24], while determining the relationship between the flexibility of the hamstring muscles and the position of the spine and pelvis in cyclists, concluded that the extensibility of the hamstring muscles is significantly related to the maximum inclination of the trunk with bent and extended knees, but there are no relationships when standing or sitting on a bicycle. Whereas, Lopez-Minaro et al. [25] assessed the influence of the flexibility of hamstring muscles on the size of the curvature of the spine in the sagittal plane. The examinations was carried out on a group of 65 young rowers aged approximately 13.35 ± 0.61. The PSLR test was used to evaluate the length of the hamstring muscle.

Table 2. The size of the physiological curvatures of the spine, the balance of the torso in the sagittal plane and the positioning of the body in the frontal plane in boys with correct bilateral flexibility, bilateral shortening of hamstrings

Variable		Both n.	Both s.	Total in row
Thoracic kyphosis	flat	3 (33.33%)	5 (31.25%)	8 (32%)
	normal	3 (33.33%)	6 (37.50%)	9 (36%)
	round	3 (33.33%)	5 (31.25%)	8 (32%)
	all	9 (36%)	16 (64%)	
Lumbar lordosis	flat	3 (33.33%)	6 (37.50%)	9 (36%)
	normal	5 (55.56%)	8 (50%)	13 (52%)
	round	1 (11.11%)	2 (12.50%)	3 (12%)
	all	9 (36%)	16 (64%)	
Sagittal trunk inclination	backward	4 (44.44%)	1 (6.25%)	5 (20%)
	normal	5 (55.56%)	15 (93.75%)	20 (80%)
	all	9 (36%)	16 (64%)	
Shoulder height difference [mm]	right higher	2 (22.22%)	6 (37.50%)	8 (32%)
	left higher	7 (77.78%)	10 (62.50%)	17 (68%)
	all	9 (36%)	16 (64%)	
Pelvic height difference	right higher	3 (33.33%)	4 (25%)	7 (28%)
	left higher	6 (66.67%)	12 (75%)	18 (72%)
	all	9 (36%)	16 (64%)	
Lateral inclination	right side	6 (66.67%)	10 (62.50%)	16 (64%)
	left side	3 (33.33%)	6 (37.50%)	9 (36%)
	all	9 (36%)	16 (64%)	

The obtained results indicate no correlation between the flexibility of hamstring muscle and the position of the spine in the sagittal plane. Researchers have noted that the flexibility of hamstring muscles affects the position of the thoracic cage and pelvis, but only during the maximum trunk flexion.

In the available literature, there is evidence of a relationship between reduced flexibility of hamstring muscles and a higher risk of recurrent injury [13, 26], back pain (both in children and adults) [13, 14, 27], altered gait pattern [26], risk of developing patellofemoral tendinopathy and pain [28]. However, these links are not entirely clear [29, 30]. On the other hand, other researchers find links between the reduced length of the hamstring muscles and the sagittal position of the pelvis and trunk [25, 23, 31, 32]. The decreased flexibility of these muscles during adolescence is mentioned in said literature. This is explained by the faster growth of the skeleton in relation to the muscles and tendons. However, there are publications that question this thesis [33, 34].

The limitation of the presented research is the small number of tests and the lack of evaluation of the flexibility of other muscle groups, e.g. the erector spinae or calf muscles. It is also worth assessing the quality of the habitual sitting position of people with correct and reduced flexibility of the hamstring muscles, because they affect the position of the pelvis in this position.

Conclusions

Shortening of the hamstring muscles is common in boys who train football, but no evidence of a relationship between the limited flexibility of these muscles and the position of the trunk was found.

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