

Comparison of muscle imbalance in students 3rd year at cpu

Authors' Contribution:

A - Study Design
B - Data Collection
C - Statistical Analysis
D - Manuscript Preparation
E - Funds Collection

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Abstract *The goal of the thesis was to identify and then compare the incidence of muscle imbalance at 3rd grade students in the academic years 2012/2013 and 2013/2014 at EF CPU in Nitra. The object of our monitoring were 78 students in decimal age from 20.21 to 27.58 years. We analyze the overall incidence of muscle imbalance in the two academic years, the frequency of shortened muscles, weakened muscle and movement stereotypies disorder. At the same time we compare identical characteristics among all female students and among male students as well. We examined the muscle imbalance according to method of Janda (1982) modified by Thurzová (1992) for the purpose of physical education. Based on the measurements, we discovered a high occurrence of overall muscle imbalance at every tested subject in both academic periods. We noticed that the occurrence of shortening in shortened muscles was the highest in the first period in m. rectus femoris and in 78.4 % of subjects and next period at m. quadratus lumborum in 82.4 % of subjects. The frequency of muscle weakened was the highest in both periods the extensors of hip joint in 83 % of subjects first period, 85.3 % of subjects of the second period. When movement stereotypies we observed a high incidence of breaches of movement stereotypies in extension in hip joint in both academic years and 83% (2012/2013) and 82.4 % (2013/2014) subjects. Based on the identified results, we can deduce that not only in individuals that lead hypokinetic way of life but also for students who are regularly engaged locomotor activity but no emphasis on thorough compensation tends to develop muscle imbalances.*

Key words: *Muscle imbalance, Shortened muscles, Weakened muscles, Movement stereotypies disorder.*

INTRODUCTION

Proportion of poor health of the population is constantly increasing due to hypokinetic way of life, resulting in the occurrence of muscle imbalance is constantly increasing in all age categories.

Movement is an integral part of an individual's ontogeny. Its lack, or long-lasting unilateral loading frequently exhibit negative deviations from a normal motor and a mental development [17]. We can characterize muscle imbalance as a disorder of functional relations between postural and phasic muscular systems. Muscle imbalance can results in a faulty posture. The cause of muscle imbalance we can often be attributed to inadequate functional loads, but also to improper unilateral exposure of a qualitative nature [19, 4]. This disorder can

be considered as a kind of initial stage of more severe functional disorders of the musculoskeletal system. The causes of muscle imbalances lie in hypokinesia (lack of loading), chronic overloading over the limit given quality muscle, asymmetric burdened without adequate compensation and psychological stress (negative emotions) [11].

The muscle imbalance leads to changes in movement patterns with subsequent overloading ligaments, tendons and joints [16].

The results of persistence of the muscle imbalance are formation of syndromes that are characterized by grouping shortened and weakened muscles, disorder of respective movement stereotypies, change of statics and dynamics of the spine, poor posture, typical pain and disease states [2].

Currently, we are trying to highlight the alarming incidence of muscle imbalances not only in children but also in elite sporting, recreationally sporting or general population.

The goal of our work was to identify and then compare the incidence of muscle imbalance of students in 3rd grade curriculum Teaching physical education combined in the academic years 2012/2013 and 2013/2014 at EF CPU in Nitra.

METHODS

The studied group consisted of 78 students EF CPU in Nitra in decimal age from 20.21 to 27.58 years. 44 students (including 25 men and 19 women) were located in the academic year 2012/2013. In the year 2013/2014 3rd year 34 students studied, which consisted of 23 men and 11 women. All probands attended 3rd year of grade curriculum Teaching physical education with another subject. During the 3 -year study they completed 312 hours of practical teaching physical education.

We have implemented examination of muscle imbalances by the method of Janda [7] modified Thurzová [19]. The description of the methodology was based on the work Kanášová [11], and we used 11 tests for screening assays of the muscles that tend to shorten; 5 tests for investigating the muscles, which tend to weaken; 7 tests for investigating the basic movement stereotypies.

Following the shortened muscles, weakened muscles and movement stereotypies we placed the students to one of four quality levels [14]: Ist level - muscle balance; IInd level - easy step muscle imbalances; IIIrd level - moderate degree of muscle imbalance; IVth level - generalized muscle imbalance.

We applied the percentage analysis and frequency analysis for indicators of the functional state of the musculoskeletal system, respectively qualitative analysis of indicators of muscle imbalance. We calculated the frequency of occurrence percentage. Statistical significance of differences in muscle imbalance indicators according to their frequency of occurrence was evaluated by the chi - square (χ^2) at 1%, 5% and 10% significance level .

RESULTS

In the overall assessment of functional disorders of the musculoskeletal system, we found that muscle imbalance was diagnosed all students (Fig.1). Results of the evaluation of muscle imbalance may be due to the overall stringency of the criteria for assessing muscle imbalance, which has reduced the occurrence of a single shortened muscle, weakened muscle or failure in one movement stereotypies, we place the individual to the group of subjects with the occurrence of muscle imbalance.

Shortened muscles, as the first evaluated trait muscle imbalances, were registered by all

the students. Also the second evaluated trait muscle imbalances - weakened muscles were recorded in all the students. The third reference feature - muscle imbalances were disorders of movement stereotypies, that we found in the academic year 2012/2013 in all students in the following year at 97.1% of students.

The results of the survey show, that the overall muscle imbalance in the academic year 2012/2013 had the same proportion of shortened muscles, weakened muscles and disorder movement stereotypies. The highest share of overall muscle imbalance shortened muscles and weakened muscles was in the academic year 2013/2014. The first impulse of muscle imbalance could be incorrect movement stereotypies fixed in early school age students, as stated by Janda (1996).

Differences in the frequency of occurrence of shortened muscles

The incidence of shortened muscles in subjects in both academic years was as follows. In the first reporting period (2012/2013) we filled most often shortened muscle *m. rectus femoris* and at 78.4%, below *m. pectoralis major* at 77.3% and *m. tensor fasciae latae* in 75% of subjects. For students in the second reporting period (2013/2014) the riskiest, respectively the most frequently shortened muscles was *m. quadratus lumborum* at 82.4%, *m. rectus femoris* 77.9% and *m. tensor fasciae latae* at 70.6%. Statistically significant differences in the frequency of occurrence of shortened muscles was recorded at 1% significance level at the *iliopsoas* and *m. quadratus lumborum* and *knee flexors* at the 5% significance level (Fig.2).

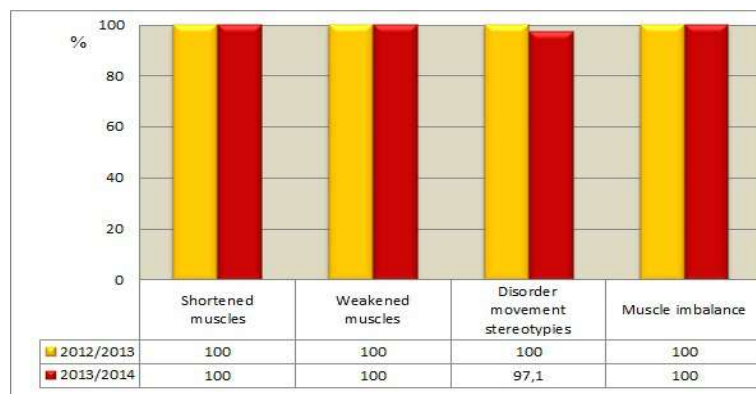


Fig. 1. Differences in the incidence of muscle imbalance, shortened muscles, weakened muscles and disorder movement stereotypies

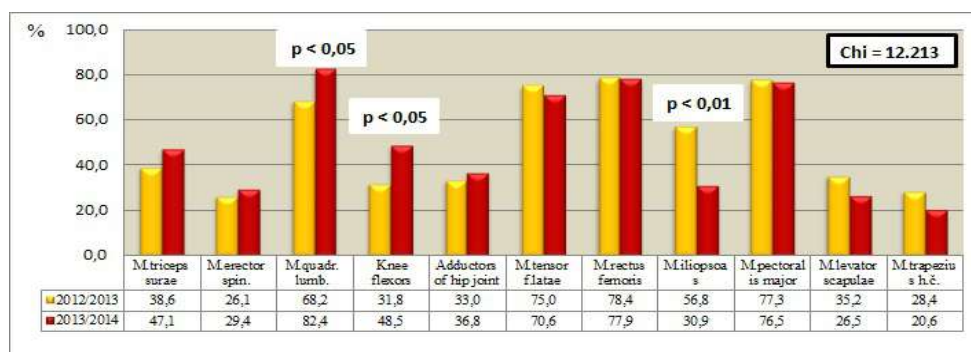


Fig. 2. Differences in the frequency of occurrence of shortened muscles in subjects under academic years

During comparison the frequency of shortened muscles in men in both academic years was as follows. Most often shortened muscles in the first test period (2012/2013) was *m. pectoralis major* at 88%, followed by *m. rectus femoris* at 84% and *m. tensor fasciae latae* in 78% of the students. In the second test period (2013/2014), the incidence of shortened muscles at the highest *m. rectus femoris* at 87%, *m. quadratus lumborum* at 82.6% and *m. pectoralis major* with 80.4% of students. Statistically significant differences in the frequency of occurrence of shortened muscles were on the level of significance ($p < 0.01$) at *m. iliopsoas* and ($p < 0.05$) in the *knee flexors* (Fig.3).

In evaluating of the occurrence of shortened muscles in women we noticed the highest rate of registered by (2012/2013) at *m. rectus femoris* and *m. tensor fasciae latae* well with 71.1% of female students and *m. pectoralis major* 63.2% of female students. The highest incidence of shortened muscles at *m. quadratus lumborum* at 81.8%, *m. tensor fasciae latae* at 72.7% and *m. pectoralis major* with 68.2% of female students was in the academic year 2013/2014. Between the two academic years, we found statistically significant differences at the 5% significance level at *m. erector spinae* and 10% significance level at *m. quadratus lumborum* and the *m. trapezius* muscle (Fig.4).

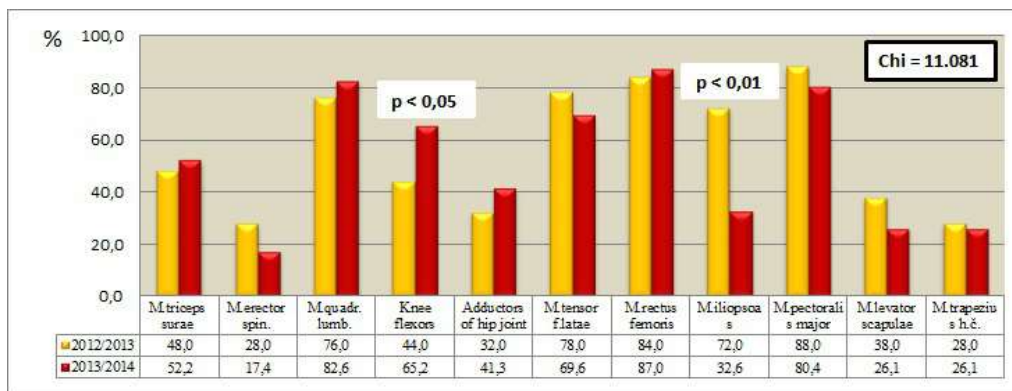


Fig. 3. Differences in the frequency of occurrence of shortened muscles in men

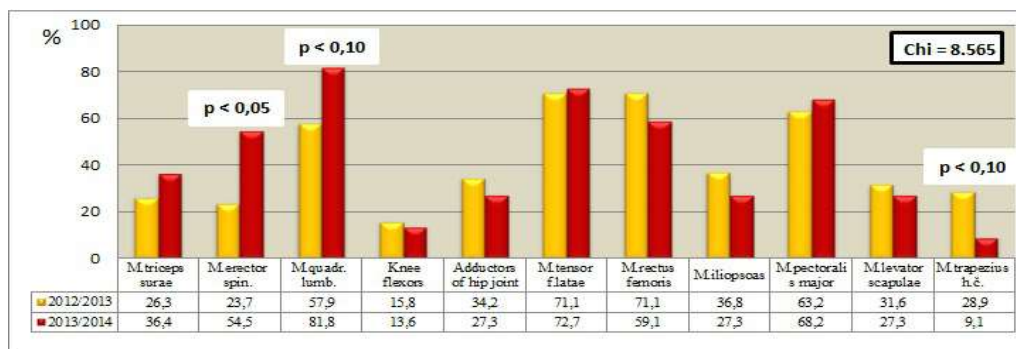


Fig. 4. Differences in the frequency of occurrence of shortened muscles in women

Differences in the frequency of occurrence of weakened muscles

From muscles and muscle groups that are most frequently involved in muscle weakness were *extensors of hip joint* among students in the first reporting period (2012/2013) in 83% of subjects. We observed frequent weaken *abdominal muscles* at 44.3% and *lower fixators of spatulas* in 43.2% of subjects next. In the following season (2013/2014) was the highest recorded incidence of muscle weakness as well in *extensors of hip joint* at 85.3%, followed by the *abdominal muscles* were 50% and in third place there was *lower fixators of spatulas* in 48.5% of subjects. The incidence of muscle weakness at these three groups was most often higher in the academic year 2013/2014. Statistically significant differences in the frequency of occurrence of weakened muscles was recorded at 1% significance level in *deep flexors of the neck* (Fig. 5).

The most often participating muscles in muscle weakening in men were in the academic year (2012/2013) at 92% of *extensors of hip joint*, 56% *abdominal muscles* and 48% of the *abductors of hip joint*. In the following season (2013/2014), it were *extensors of hip joint* in 82.6% of subjects, *abdominals muscles* and *lower fixators of spatulas* were recorded equally in 47.8% of subjects. Significant differences in the frequency of occurrence of weakened muscles are registered by the 1% significance level in the *deep flexors of the neck* and the 10% significance level at *lower fixators of spatulas* (Fig.6).

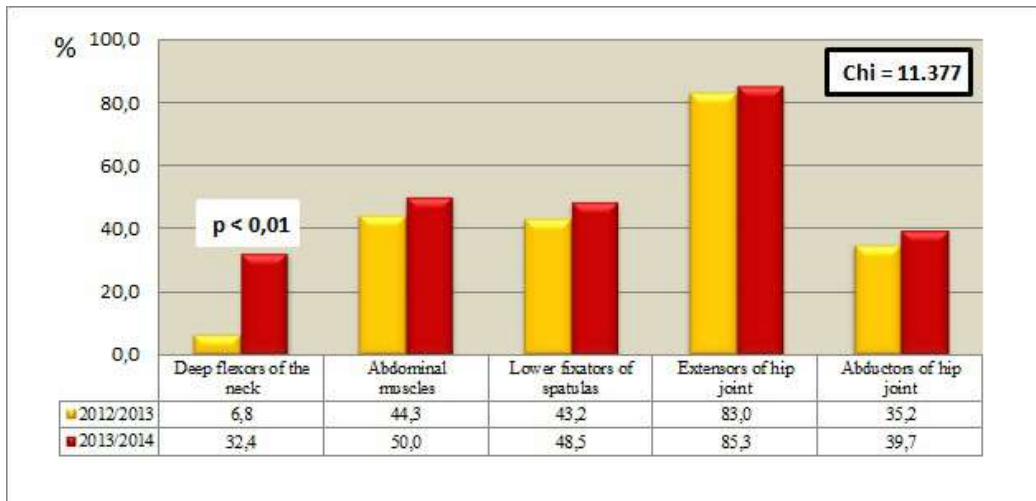


Fig. 5. Differences in incidence of weakened muscles in subjects under academic years

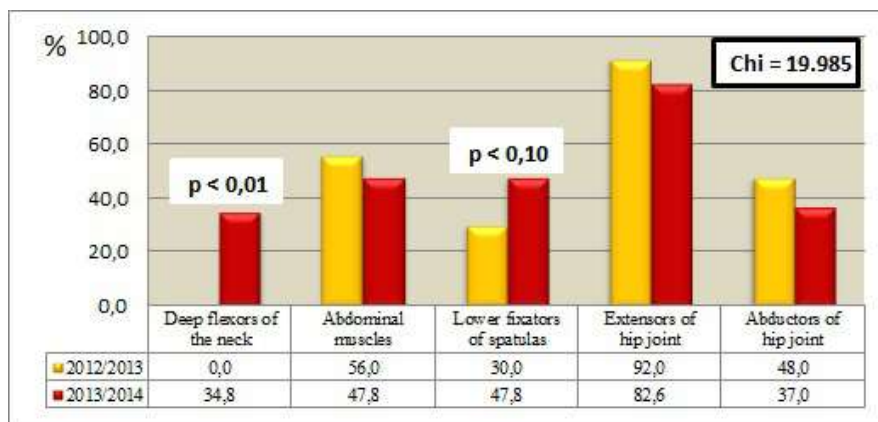


Fig. 6. Differences in incidence of weakened muscles in men

The occurrence of muscle weakness in women was most common in the *extensors of hip joint* at 71.1%, *lower fixators of spatulas* at 60.5% and *abdominal muscles* in 28.9% of female students in the first test period (2012/2013). In the second test period (2013/2014), it was just *extensors of hip joint* at 90.9%, following the *abdominal muscles* at 54.5% and *lower fixators of spatulas* in 50% of female students. Statistically significant differences were seen in the *abductors of hip joint* at the 5% significance level and the *extensors of hip joint* significance level ($p < 0.10$) (Fig.7).

Differences in the frequency of occurrence of Movement stereotypies disorder

The most frequently movement stereotypies were broken by students in academic year 2012/2013 in *extension in hip joint* at 83%, *abduction in hip joint* in 42% and *one-leg stand* 37.5%. In the academic year 2013/2014, there was the highest frequency of the disturbed movement stereotypies at the *extension in hip joint* phase at 82.4%, while *one-leg stand* at 61.8% and *sitting down* 50% of subjects. The significant differences in the frequency of occurrence of disturbed movement stereotypies we observed at 1% significance level by *one-leg stand* and movement stereotypies *push-up*. Movement stereotype - *sitting down* - have filed significant differences at the level of significance ($p < 0.10$) (Fig.8).

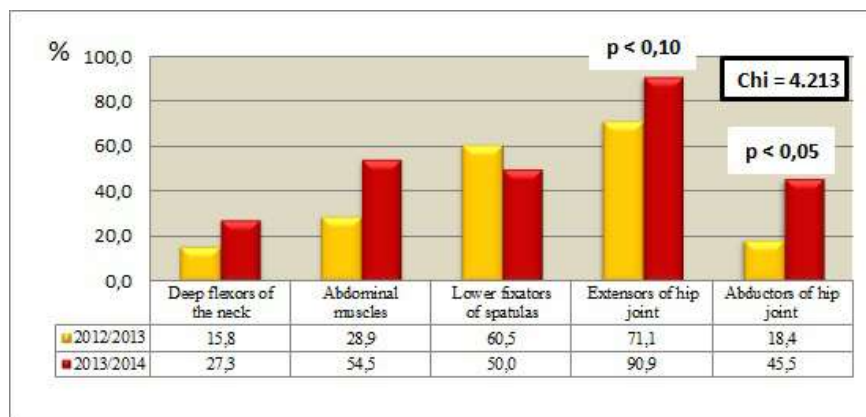


Fig. 7. Differences in incidence of weakened muscles in women

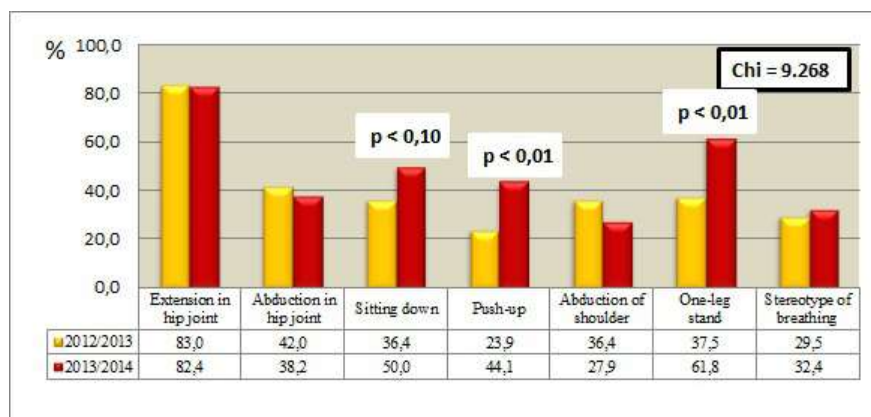


Fig. 8. Differences in incidence of disturbed movement stereotypies in subjects under academic years

In the first reporting period (2012/2013) was the most frequently disturbed movement stereotype of men in *extension in hip joint* at 86% students, and *abduction in hip joint* and disturbed movement stereotype *sitting down* for just 48% of students. Likewise in the next period (2013/2014) was the most frequently disturbed movement stereotype in *extension in hip joint* at 76.1%, the second most disturbed movement stereotype was *one-leg stand* at 60.9% and *push-up* at 52.2% students. Statistically significant differences were recorded for the 1% significance level movement stereotype *push-up* and 5% significance level when movement stereotype *one-leg stand* (Fig.9).

The highest frequency of disturbed movement stereotype in female students was in the academic year 2012/2013 at the *extension in hip joint* at 78.9%, *abduction of shoulder* at 42.1% and *one-leg stand* at 39.5% female students. The next year (2013/2014) the most disturbed the movement stereotype was in *extension in hip joint* at 95.5%, *one-leg stand* at 63.6% and *sitting down* at 54.5% female students. At a frequency of the occurrence of disturbed movement stereotype for female students was recorded statistically significant differences at 1% significance level in the movement stereotype *sitting down* and 10% significance level for the movement stereotype in *extension in hip joint* and *one-leg stand* (fig.10).

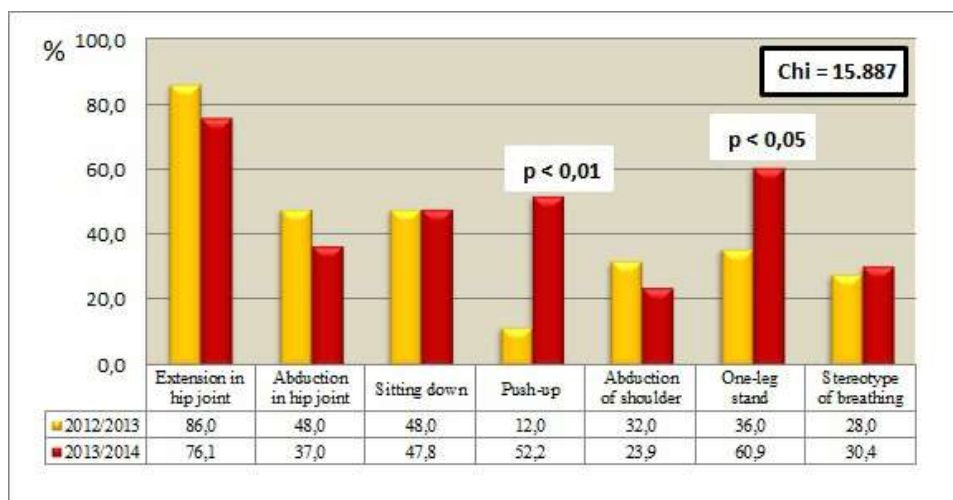


Fig. 9. Differences in incidence of disturbed movement stereotypes for men

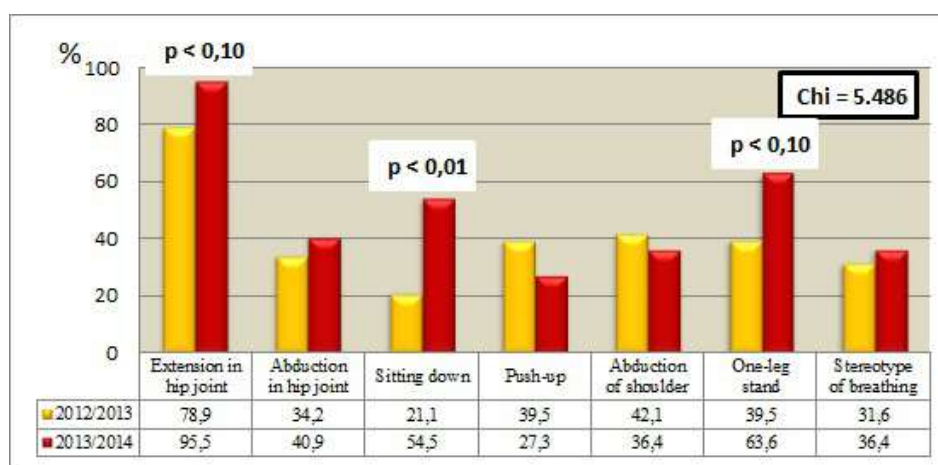


Fig. 10. Differences in incidence of disturbed movement stereotypes for women

DISCUSSION

Noticed results of shortening muscle group *m.rectus femoris* correspond with the results of other authors who deal with the normal and sporting population [1,8,9,15,16]. Frequency of the occurrence of *m. quadratus lumborum* corresponds with the results of the authors [3,5,8,16], who report frequent shortening of the muscle group *m. quadratus lumborum*. The high occurrence of shortening *m. tensor fasciae latae* correspond with the results of Kováčová - Medeková [12]. Our findings do not confirm the finding Čučková et al. [3], who reported that the most often shorten was *m. levator scapulae*.

The highest occurrence of weakened muscle groups of *extensors of hip joint* coincides with results of other authors [1,8,12,15,18]. They all noticed the highest frequency of occurrence in this muscle group and described it as the most frequently weakened muscle in sporting and general youth. The second most frequently weakening of the *lower fixators of spatulas* correspond with the findings of authors [8,12]. Several authors [8,12,15,16] support our findings that the most common group includes a weakened *abdominal muscles*.

Our results correspond with the results of Čučková et al. [3], Kanášová [10], Kanášová - Šimončíčová [8], Kováčová [13], Lopata [15], Přidalová [18], who reported a disturbed movement stereotype in *extension in hip joint* as the most frequently occurring at sporting and general population. The finding that the disturbed movement stereotype *one-leg stand* is also a frequently occurring confirms the view of Lopata [15]. Čučková et al. [3] rank among the most frequently disturbed movement stereotype *abduction in hip joint*, what we can confirm with our findings.

CONCLUSIONS

Overall muscle imbalance in terms of all its components (shortened muscles, weakened muscles, disturbed movement stereotype) was found in all the students in both academic years.

The highest frequency occurrence of shortened muscles were noticed at *m. rectus femoris*, *m. pectoralis major*, *m. tensor fasciae latae* and *m. quadratus lumborum*. The significant differences in the frequency of occurrence of shortened muscles were recorded at 1% significance level at *m. iliopsoas*, where the frequency of shortened muscles was 25.9% higher in subjects in the first reporting period and at *m. quadratus lumborum*, where the frequency was conversely higher in the second reporting period. Statistically significant differences were also recorded at the 5% significance level at *knee flexors* occurs more frequently in subjects in the academic year 2013/2014. The most frequently shortened muscles in men belonged *m. pectoralis major*, *m. rectus femoris*, *m. tensor fasciae latae* and *m. quadratus lumborum*. Statistically significant differences in the frequency of occurrence of shortened muscles was recorded at 1% significance level in *m. iliopsoas* (higher incidence of 39.4% in the academic year 2012/2013) and the 5% significance level at *knee flexors* (incidence increased by 21.2% in the academic year 2013/2014). The most common shortened muscles in women belonged *m. rectus femoris*, *m. tensor fasciae latae*, *pectoralis major*, *m. quadratus lumborum*. Comparing the female students in academic years, we found statistically significant differences at the 5% significance level at *m. erector spinae*, where the incidence was lower by 30.8% in the period 2012/2013 and the 10% significance level at *m. quadratus lumborum* (more frequently in subjects shortened 2013/2014) and *m. trapezius*, which is more frequently in subjects in the period 2012/2013.

The most frequently involved muscles to muscle weakness were in students at the *extensors of hip joint*, *abdominal muscles* and *lower fixators of spatulas*. Statistically significant differences in the frequency of occurrence of weakened muscles we recorded the level of

significance ($p < 0.01$) in the *deep flexors of the neck* with higher incidence of 25.6 % in subjects in the academic year 2013/ 2014. The incidence of muscle weakness in men was most common in the *extensors of hip joint, abdominal muscles, abductors of hip joint* and *lower fixators of spatulas*. Significant differences in the frequency of the occurrence of weakened muscles, we filed the 1% significance level in *deep flexors of the neck* (34.8 % more in the second period of the test) and significance level ($p < 0.10$) at the *lower fixators of spatulas* (17.8 % less in the first period of the test) . The incidence of muscle weakness was the most frequently in women in the *extensors of hip joint, lower fixators of spatulas* and *abdominal muscles*. Statistically significant differences were seen at *abductors of hip muscles* of significance ($p < 0.05$) with a frequency of greater by 27.1% in the 2013/2014 and in the *extensors of hip joint* at 10% significance level (more frequent incidence of 19.8% equally in subjects 2013/2014).

The frequency of disturbed movement stereotypies werethe most frequently among students in the *extension in hip joint, abduction in hip joint, one-leg stand* and *sitting down*. We observed he significant differences in the frequency of occurrence of disturbed movement stereotypies at significance level ($p < 0.01$) at *one-leg stand*, where the frequency is lower by 24.3% in subjects in the first period of the test and movement stereotype *push-up* (well 20.2% less in 2012/2013). The movement stereotyoe *sitting down* have filed significant differences at 10% significance level. Movement stereotype of *sitting down* occurred less than in the academic year 2012/2013 by 13.6% of subjects. The most frequently movement stereotypies were broken by men in *extension in hip joint, abduction in hip joint, sitting down, one-leg stand* and *push-up*. Statistically significant differences were recorded for the 1% significance level in movement stereotype *push-up* (more frequent incidence of 40.2% in the period 2013/2014) and the significance level ($p < 0.05$) when movement stereotype *one-leg stand*, which is often discovered by students in academic year 2013/2014. The highest frequency of the disturbed movement stereotypies in women was the *extension in hip joint, abduction of shoulder, one-leg stand* and *sitting down*. At a frequency of occurrence of disturbed movement stereotypies in female students, we recorded significant differences at 1% significance level in movement stereotype *sitting down* with higher incidence of 33.4% in subjects in the second reporting period and the level of significance ($p < 0.10$) in movement stereotype *extension in hip joint* and *one-leg stand* (frequency higher in subjects in the academic year 2013/2014).

Based on the results of research we found that not only the general population can sometimes unaware of the importance of sports and recreational counterpart, but also physical education students who will be future teachers as well as an example for children and youth. It is necessary to find a suitable way in which we operate on the whole population, while it motivate you to the correct physical activity and thus eliminate the incidence of functional disorders of the musculoskeletal system.

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