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REDUCING SHORTENED MUSCLES IN 10-12-YEAR-OLD BOYS THROUGH A PHYSICAL EXERCISE PROGRAMME

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Abstract

Introduction: Shortened muscles, is one of the components of muscular disbalance that can have a dominant position in the development of muscular instability. Therefore, this is the focus of our research study a school population. We attempted to investigate the state of shortened muscles and implement stretching exercises to improve shortened muscle status by the school physical education.

The work has been elaborated based on the pedagogical research. The purpose of this study was to obtain and expand knowledge regarding the prevelance of shortened muscles in 10–12-year-old boys within their physical education lessons.

Material and methods: The subjects of our study group were 49 (forty-nine) boys from two primary schools in Nitra, Slovakia. Subjects were observed for a time period of two school years. Durying the 5th year of school there was no intervention and during the sixth years, we initiated a programme of Physical Education lessons. In the childrens' fifth year of elementary school without Physical Education lessons and in 6th year with the experimental variable with the programme of the school Physical Education lessons. Shortened muscles were examined using the method by (1), modified for the purposes of physical education practice by (2). We observed 11 muscles with the tendency to shorten, where muscles and muscle groups separately on the right and left sides were examined: m. trapezius, pars superior (upper part), m. levator scapulae, m. pectoralis major, m. iliopsoas, m. rectus femoris, m. tensor fasciae latae, lumbal joint adductors, hamstrings, m. quadratus lumborum, m. erector spinae, m. triceps surae.

Results: We found a high prevelance of shortened muscles in the tested 10 –12 year-old pupils. In some muscles and muscle groups (hamstrings) up to 89%. The prevelance of shortened muscles in pupils in 5th year of elemetary school at a standard contents of Physical Education lessons has markedly increased. In the same pupils in sixth grade, after implementing goal-oriented exercises focused on the removal of shortened muscles within the Physical Education lessons. After a year of implementation of the programme we recorded favorable changes in the functional state of the motor system. The frequency of occurence of shortened muscles, which ranked one to five, in boys decreased by 30 to 34%.

Conclusions: Timely and appropriate initiation of a focused exercise programme within the Physical Education lessons at school can positively influence the removal of shortened muscles.

Key words: *muscular disbalance – muscular balance, shortened muscles, qualitative levels*

Introduction

The care of a child, of his healthy physical development from the young age, is the primary task of not only parents but also of teachers at elementary and secondary schools. Functional disorders of motor system in children and adolescents are titled "civilization disease." It was proved that the majority of these disorders occurs early the a child's life, as as result there is insufficiency, in particular, excessive or one-sided motor loading. There are about 50% of children affected by these disorders. Furthermore, the most frequent functional disorder of the motor system can be considered muscular disbalance. It originates as a disorder of functional relations between the postural and phasic muscular systems. E.g. in some people there comes to the shortening of musculus iliopsoas, thus limiting the range of movements in the opposite direction (extension). Extensors of the hip joint, mainly musculus gluteaus maximus may not be fully activated, are suppressed and weakened. Thus, walking stereotype (extension phase) is broken (2). It negatively influences body posture, fuctional and motor skills as well as coordination. Additionally, it limits the range of joints movement, which are unevenly distributed and overloaded. Occurence of postural muscles, which can have a dominant effect on muscular disbalance in boys. This negatively effects the functional state of the motor system and decreases the quality of health.

Infavourable consequences of the absence of adequate movement on the health of children thus require an increased attention by sports teachers in their everyday day classes with children, where there is the best chance to intervene in the sense of primary prevention (3–5).

Negligence of these issues may lead to disproportionate growth, incorrect body posture and various physical disorders and malfunctions of the human body. Finally, the results of transformation of our society transfer a fair part of health care onto the

individual, the basic grounds of formation of healthy way of life habits are forming, besides the family circle, at school.

It is obvious from past research that there is an large prevelance of motor system disorders in the school population with a tendency towards further increase, and finally, to our the present way of life of people. The above mentioned tendency has been clearly increased and shifted to the lower age categories.

In this context, it is important to realize that muscular disbalance is a certain kind of a pre-grade, or possibly the direct first stage of further, in the majority of cases, already weighty functional disorders of the motor system. Again, muscular disbalance may be considered the most important functional disorder, which negatively influence body posture, movement stereotypes, muscular coordination. For example, it limits the range of joint movements which are then unevenly and disproportionately loaded. Consequences of these processes (often at the level of pain) hinder the quality of life of individuals in a substantial way.

Unfavourable consequences of the absence of adequate movement on the health of our population then require that this problem would be given an increased attention from the side of physical education pedagogues in their everyday practice.

The aim of the work was to obtain and enlarge the knowledge on muscular disbalance, first of all shortened muscles, and opportunities of influencing the functional disorders in 10 – 12 year-old boys using compensation exercises within the school physical education lessons.

Hypothesis

Ho (null hypothesis): Prevelance of shortened muscles in the conditions of a standard contents of physical education at school is increased in pupils of 5th-6th grades.

Hypothesis: We expect that the exercise programmes, included in the lessons of physical education at schools, will decrease the prevelance of shortened muscles.

Methods

The observed group of pupils was represented by pupils of randomly chosen elementary schools in Nitra – Elementary School Nábrežie Mládeže and Elementary School Fatranská. We used a single-group successive experiment. The experimental group was formed by 49 experimental boys from 5th grade of elementary schools. All the experimental pupils formed an experimental group which was then observed for two years, during the school years 2001/2002 and 2002/2003. In the course of the second year of experiment, we applied the exercise programme in the experimental group. In the first year of observation the experimental pupils did not undergo any special stimulus. Examinations of muscular disbalance in terms of shortened muscles were carried out in 5th year at the beginning and at the end of the school year. These are labelled as 1st and 2nd measurements in order to be clearly understood and interpreted. After two months of holidays, at the begining of 6th year of studies, we carried out 3rd measurement in the same pupils. Then started the aimed programme of exercises and after it, at the end of the school year we performed 4th measurement. Shortened muscles were examined using the method by (1), modified for the purposes of physical education practice by (2). We observed 11 muscles with the tendency to shorten, where muscles and muscle groups separately on the right and left sides were examined: m. trapezius, pars superior (upper part), m. levator scapulae, m. pectoralis major, m. iliopsoas, m. rectus femoris, m. tensor fasciae latae, lumbal joint adductors, hamstrings, m. quadratus lumborum, m. erector spinae, m. triceps surae. Shortened muscles were evaluated as qualitative signs using two-stage assessment, alloting number 1 to the norm and 2 to shortened muscle.

1. *M. trapezius – pars superior*

Testing exercises: lying backwards, legs stretched, arms next to the body. Press the shoulder on the side of the tested muscle towards the mat using one hand. Put the other hand around the head so that the palm or at least fingers covered the ear on the side of the tested muscle.

Fig. 1. *Examination of m. trapezius – upper part (6)*

Slightly pulling along the mat, bend the head towards the shoulder until you feel the strain of muscles (Fig.1).

Norm: at full range of movement, ear draws nearer to the shoulder.

Muscle shortening: head side bend is limited. The subject does not reach the opposite shoulder with his/her ear in the upper part of musculus trapezius, or he/she feels an unpleasant strain (or pain) in the area of its attachment.

2. *M. levator scapulae*

Fig. 2. *Examination of m. levator scapulae (6)*

Testing exercise: lying backwards, the subject puts the hand on the tested muscle with the palm towards the mat. Head grasp, movement and its assessment are identical with the ones in m. trapezius (Fig. 2).

Norm: the ear draws close to the shoulder at the full range of head side-bend.

Muscle shortening: head bend is limited. The subject does not reach the opposite shoulder with his ear in the upper part of musculus trapezius, or he feels an unpleasant strain (or pain) in the area of its attachment.

3. *M. pectoralis major*

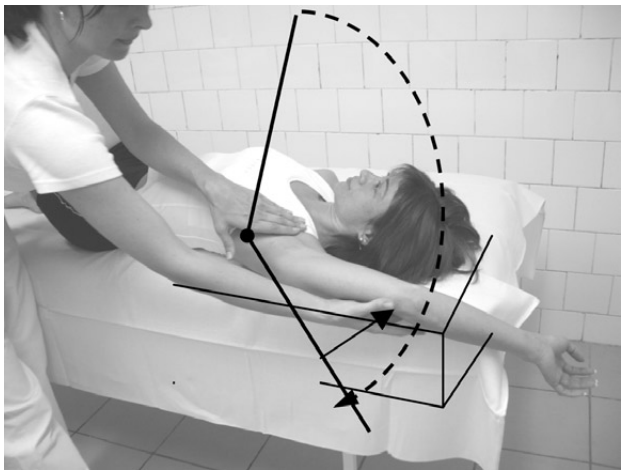


Fig. *3. Examination of m. pectoralis major (6)*

Testing exercise: lying backwards on the edge of the table, legs bent, feet laid on the mat. Move your arm to the front and up so that the arm is situated freely in the open space and the elbow is minimum on the level of the table (Fig. 3).

Norm: the raised arm reaches the level of the mat or drops under it.

Shortened muscle: raised arm does not reach the level of the base. The subject feels strain at breasts.

4. *M. iliopsoas*

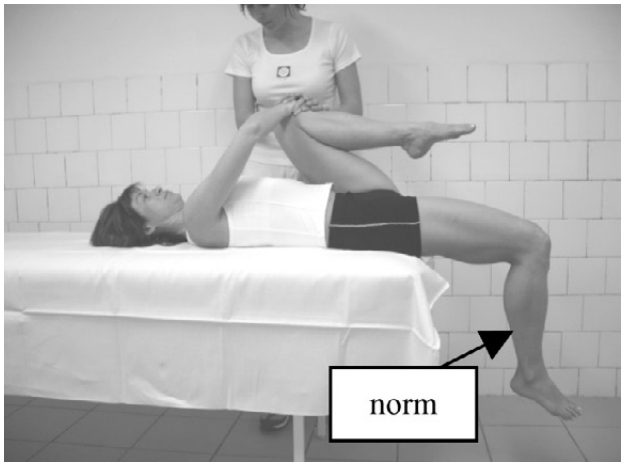


Fig. 4. *Examination of m. iliopsoas - norm (6)*

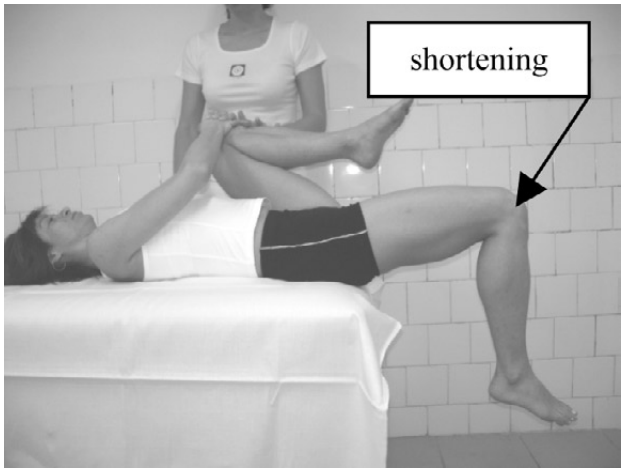


Fig. 5. *Shortened m. iliopsoas - shortening (6)*

Testing exercise: the subject sits on the edge of the table so that he/she leans on it with the protuberance of the ischium. He/she followingly lies backwards. The non-tested leg is drawn close to the belly using hooked hands, thus straightening the waist lordosis. The tested leg is freely lowered (Fig. 4).

Norm: the thigh of the subject's leg is situated in a horizontal direction, or under the table level, while the lower leg is directed in an upright position to the ground.

Muscle shortening: the thigh is above the table level. As a consequence of m. iliopsoas shortening there comes to the lumbar joint bend. The subject may feel an unpleasant strain in the area of the groin (Fig. 5).

5. *M. rectus femoris*

Testing exercise: The subject sits just on the edge of the table so that he/she leans on it with the protuberance of the ischium. He/she followingly lies backwards. The non-tested leg is drawn close to the belly using hooked hands, thus straightening the curvature of the waist part of the backbone. The other leg is freely lowered (Fig. 6).

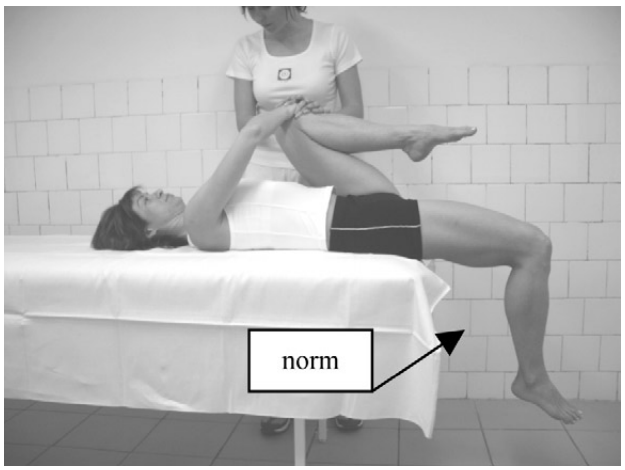


Fig. 6. *Examination of m. rectus - norm (6)*

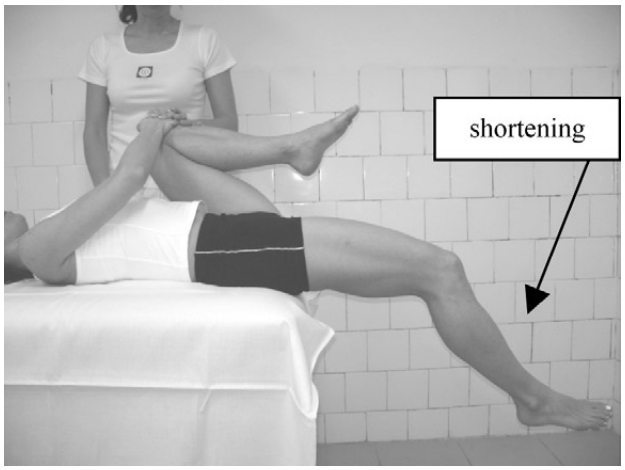


Fig. 7. *Shortened m. rectus femori - shortening (6)*

Norm: the lower leg is directed in an upright position to the ground (Fig. 6).

Muscle shortening: the lower leg is directed obliquely to the front, the angle between the thigh and the lower leg is larger than 90°. The shortened m. rectus femoris straightens the knee, when we try to bend it (while pressing the lower leg of the subject), thus feeling an unpleasant pull (or even pain) under the knee in the front. (Fig. 7).

6. *M. tensor fasciae latae*

Fig. 8. *Examination of m. tensor fasciae latae (6)*

Testing exercise: The subject sits just on the edge of the table so that he/she leans on the edge with the tail bone, or the protubrerance of the ischium. Then, he/she lies backwards. The non-tested leg is drawn close to the belly using hooked hands, thus straightening the curvature of the waist part of the backbone (Fig. 8). The other leg is freely lowered.

Norm: the thigh points directly ahead.

Muscle shortening: the thigh points to the side; it is deviated from the straight axis; on its outer side there is an expressive cavity (Fig. 8).

7. *Lumbar joint adductors*

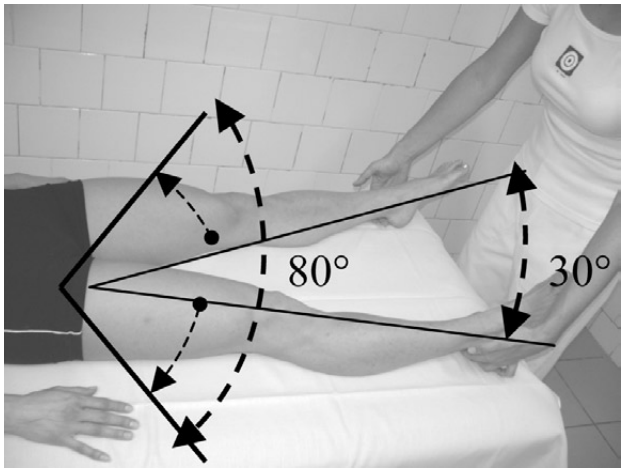


Fig. 9. *Examination of lumbar joint adductors (6)*

Testing exercise: lying backwards, arms freely along the body, legs stretched. We grasp the ankle of the leg of the tested person and push it away from the body so that the sole was not twisted. The movement should be performed up to the 80° angle (Fig. 9).

Norm: the angle of the feet parting is 80°.

Muscle shortening: the range of feet parting is lower than 45°. The subject feels pulling on the inner side of the thigh. Shortening of the right or left lumbar joint adductors can be distinguish by means of an alternative straddling sideways.

8. Knee joint flexors (ischiocrural muscles). This group of muscles is situated at the back of the thigh and is formed by the *m. biceps femoris*, *m. semitendinosus* and *m. semimembranosus.*

Testing exercise: lying backward, the non-tested leg is bend in the knee. Grasp the tested leg firmly so that the thigh was in the upright position to the ground. Put the hand on the knee from the top. Put the other hand above the heel (fix it). The tested leg is raised using our shoulder, while bending it in the lumbar joint (Fig. 10). The movement is finished when the subject starts to bend the knee. In this position we measure the angle between the leg and the ground.

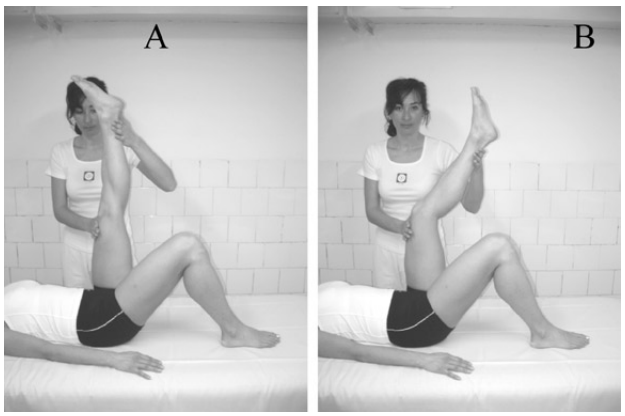


Fig. 10. *Examination of knee joint flexors A) norm, B) shortening (6)*

Norm: The leg forms the angle of 90 degrees with the mat. It means that in the subject the 90° (normal range) bending in the lumbar joint was reached (Fig. 10 A).

Muscle shortening: The leg can be bent in the lumbar joint within the range lower than 90°, while the subject feels strain (or even pain) on the back side of the thigh and in the hamstring during bending (Fig. 10 B).

Fig. 11. *Examination of m. quadratus lumborum (6)*

Testing exercise: standing upright facing the wall, arms freely besides the body. The subject slides his/her arm along the outer side of the thigh, without front or back bending, or raising the other shoulder (Fig. 11). Weight must be distributed evenly on both legs, the pelvis may neither be raised nor slided on the other side. We compare the range of movements on both sides.

Norm: side bend is performed without front or back bending. The side bending is carried out until the fingers reach the edge of the knee. The finger shift along the thigh must be at least 20 cm. The vertical line drawn from the opposite armpit passes through the groove between the buttery or overlaps it.

Muscle shortening: it is not possible to make a side bend without front or back bending, the finger tips do not reach the knee, the finger slide along the thigh is lower than 20 cm. The vertical line drawn from the opposite armpit does not reach the groove between the buttery (Fig. 11).

10. *M. erector spinae*

Fig. 12. *Examination of m. erector spinae (6)*

Testing exercise: sitting with the whole thighs on a higher mat, lower legs are freely lowered. Arms are leaning on the lumbar bones blades, while the subject presses towards the mat. He/she makes a deep front bend (arched back), trying to draw the forehead to the knees.

Norm: the subject touches the knees with his/her forehead, or at least as close as 10 cm.

Muscle shortening*:* the subject is not able to touch the knees or draw the forehead as close as 10 cm, he/she feels clear strain in the muscles along the backbone (Fig. 12).

11. *M. triceps surae*

Fig. 13. *Examination of m. triceps surae (6)*

Testing exercise: standing upright, arms to the front. The subject makes a short squat on full soles, the knees slightly apart (Fig. 13).

Norm: the subject makes a squat on full soles.

Muscle shortening: the subject can do the full squat only when standing on tiptoes.

Based on the number of shortened muscles we deduced the level of the overall shortening of muscles from level I to level IV as follows: Ist level – without muscle shortening, IInd level – light muscle shortening, IIIrd level – middle degree of muscle shortening, IVth level – heavy level of muscle shortening. Muscular disbalance was evaluated by qualitative symbols.

Table 1. *Qualitative grades of muscle shortening*

Qualitative grades of shortened muscles	Number of shortened muscles
Ist – muscular balance	0
IInd – tolerable (minor) shortened muscles	1-6
IIIrd – moderate shortened muscles	7-16
IVth- generalized shortened muscles	17-22

Specially focused exercise programmes applied within the compulsory schol physical education lessons formed the experimental factor. Physical education was taught during 2 lessons per week with a modified contents of education. Experimental group performed 15 minutes of exercises focused on the removal of shortened muscles as part of the introductory, preparatory and final parts of each lesson in the second year of experiment and at the same time home exercises once a week for 15 – 20 minutes.

The experimental factor was formed by 30 exercises and 47 variations of these exercises, which make use of the consecutive attenuation in order to relax the stretched muscles (7). When selecting exercises we used the methodology by (8). A special block of exercises focused on each observed muscle groups and muscles was elaborated for each month. Time portion and contents of individual exercises has been changing during one month. This combination of exercises was performed by pupils once a week in the form of home exercises. Thus, technically perfect acquisition of exercises by pupils was ensured.

The following methods were used and outlined below:

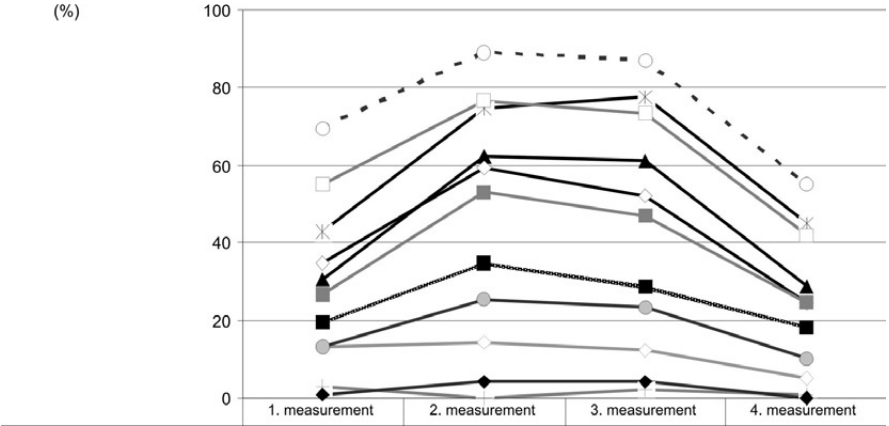
a) For indicators of the functional state of the motor system (qualitative analysis of indicators of shortened muscles) percentage and frequency analysis were used.
b) Statistic significance of changes of indicators of shortened muscles as to the distribution of experimental pupils in qualitative zones at individual measurements and statistic significance of differences from the point of view of a sex were evaluated using chi – quadrate (χ^2) method on 1%, 5% and 10% levels of significance.

Results

Frequency of incidence of shortened muscles

In the initial **first testing** we found out that the most often shortened muscles of boys were the knee flexors (**ischiocrural muscles**) with a 70% occurrence (Fig. 14). We noticed the highest occurrence of knee flexors of boys in all four testing.

While evaluating other muscles participating in high occurrence of short muscles we noticed **m. qu-**



	1. measurement	2. measurement	3. measurement	4. measurement
M. trapezius -pars superior	13.3	14.3	12.2	5.1
M. levator scapulae	19.4	34.7	28.6	18.4
M. pectoralis major	30.6	62.2	61.2	28.6
M. iliopsoas	13.3	25.5	23.5	10.2
M. rectus femoris	42.9	74.5	77.6	44.9
M. tensor fascia latae	34.7	59.2	52	24.5
Lumbal joint adductors	3.1	0	2	1
Hamstrings	69.4	88.8	86.7	55.1
M. quadratus lumborum	55.1	76.5	73.5	41.8
M. erector spinae	1	4.1	4.1	0
M. triceps surae	26.5	53.1	46.9	24.5

Fig. 14. *Occurence frequency of short muscles >>Boys<<*

adratus lumborum 55.1% on the second place and **m. rectus femoris** 42.9% in the first testing.

The order of the first three short muscles of **boys** was kept at **second testing.** However, we noticed a decline in the occurrence of all tested muscles with a tendency to shorten. The occurrence of knee flexors raised by 88.8%, m. quadratus lumborum to 76.5% and m. rectus femoris to 74.5% (Fig. 14). The occurrence of short muscles raised almost to 20 – 30%. To summarize we can say that after one year of exploration we found out an increased frequency of short muscles in all subjectss.

We found out the same order of short muscle occurrence in **boys** on the first six places in the **third testing** (Fig. 14). M. rectus femoris (77.6%) shifted to second place, m.quadratus lumborum (73.5%) to the third place. Knee flexors (86.7%) had again the most significant representation. We can state that from among 11 explored muscles and muscle groups, the percentage of occurrence in 9 of them declined markedly.

After a one-year-long influence of the experimental factor, which was the exercise programme of target compensation exercises within physical education lessons, we noticed a strong decrease in shortened muscle occurrence in all explored muscles in the **fourth testing**. The highest occurrence and the first in order were again knee flexors with the frequency of occurence of 55.1%. M. rectus femoris (44.9%) ranked second and m. quadratus lumborum (41.8%) ranked third (Fig. 14). The frequency of all short muscles occurrence was 8 – 30% lower than in third testing. We highlight the advanced decline of particular short muscles occurence by means of an influence of the exercise programme.

Changes in the incidence of shortened muscles according to qualitaive levels

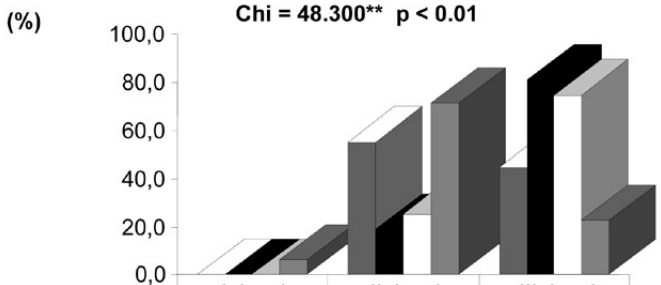
Shortened muscles **at the first examination** at the beginning of 5th grade were diagnosed in each boy. No experimental children were thus found in the Ist qualitative level. In IInd level there were 55.1% boys and in the third level – 44.9% (Fig. 15).

At the second examination, realized at the end of the 5th grade, we did not intrude in the contents of physical education lessons. In ***boys*** there came to a statistically significant decrease in the state with a higher incidence of shortened muscles on the level of statistical significance p<0.01 (Fig. 15). Almost 81% boys were found in the third qualitative level. Neither here any experimental child ranked into the first level.

We did not record any statistically significant differences in the incidence of shortened muscles between **2nd and third measurements**. We assume that this can be caused by the decreased static loading of the motor system after the compulsory school attendance in school benches and at the same time by expressive motor stimuli as to the range and diversity of motor activity during summer hoilidays. **The third measurement** was carried out at the beginning of 6th form of the school attendance.

After the influence of the experimental programme of stretching exercises, implemented in the contents of school physical education lessons, **between 3rd and 4th measurements**, a significant decrease in the level of muscle shortening in boys on the level of significance of p<0.01 was recorded.

Upon 4th examination, 6.1% boys were found in Ist qualitative level, 71.4% boys in IInd level and only 22.5% boys were found in IIIrd qualitative level (Fig. 15). Experimental boys recorded a marked shift from IIIrd qualitative level into the IInd and Ist qualitative levels, thus into the zones with a lower deviation from the standard. Our results mention the positive effect of the focused application of the programme, which lowers the progression of incidence of shortened muscles. This has been proved also by changes in incidence of shortened muscles according to qualitative zones.



	I. level	II. level	III. level
1st m.	0.0	55.1	44.9
2nd m.	0.0	19.2	80.8
3rd m.	0.0	25.5	74.5
4th m.	6.1	71.4	22.5

Partial **Chi**-quadrates

1 - 2.m.	2 - 3.m.	3 - 4.m.	1 - 4.m.
13.231	0.552	**26.747**	**7.699**
p < 0.01		p < 0.01	p < 0.05

Explanatory notes:
Ist – muscular balance (unshortened muscles)
IIIrd – moderate shortened muscles
IInd – tolerable (minor) shortened muscles
IVth – generalized shortened muscles
1st m. = 1st measurement
2 nd m. = 2nd measurement
3 rd m. = 3rd measurement
4 th m. = 4th measurement

Fig. 15. *Changes in the incidence of shortened muscles according to qualitative levels >>Boys<<*

After the elapse of two school years between 1st and 4th measurements, boys recorded a decrease in the incidence of shortened muscles within the zones with a higher degree of shortening, which was statistically significant on the $p<0.05$ level of significance. A positive effect of our experiment can be underlined also by comparing the results of shortened muscles measurement upon input examination and at the end of the whole research monitoring.

Discussion

Our results confirm the current knowledge of several authors that knee flexors belong to the most frequently shortened muscles within the population of young people, mostly boys (6,9-17). These authors at the same time present that the incidence of shortened hamstrings increases with the growing age, which was recorded also at our second examination. We have thus proved the present knowledge on the dominance of ischiocrural muscles in the group of shortened muscles. We support the opinion of (16) that high incidence of shortened knee flexors mainly in boys is a weighty phenomenon, which followingly can influence the mobility in several directions. Based on the above mentioned reasons, which potentially create conditions for the lowering of muscular strength, inhibition of phasic antagonists, incidence of non-stable knee and worthening of walking stereotype, it is necessary to pay attention to the prevention, or correction of the mentioned phenomenon within the compulsory school physical education using suitably selected stretching exercises.

In our group of boys, shortening of m. rectus femoris ranked second. Shortening of muscles from the area of lumbar joint flexors (m. rectus femoris, m. tensor fasciae latae), which form muscular disbalance in the area of pelvis, was called the lower cross syndrome by (1). It is a compensation mechanism for the stabilization of lumbar joint. Dynamic changes represent rebuilding of the step stereotype ending in overloading the lumbosacral segments of spine with the consecutive pathologic changes in the area of the spine and pelvis. Shortening of m. rectus femoris simultaneously increases the requirements on the knee extension.

Our results only partially correspond to the results of (18), who diagnosed the following shortened muscles: m. erector spinae, m. ischiocrurales, m. quadratus lumborum in the specific group of young tennis players, which is in contradiction to the common population. The author in accord with us found out a high frequency of shortened muscles and muscle groups, while in boys the frequency of incidence (43-86%) was found in 12 out of 15 examined muscles or muscle groups, in girls in 4 muscles (44-71%). Our results point to the concord with (14), who found out in experimental group of 5th and 6th formers the highest incidence of shortened knee flexors. Shortened knee flexors in our boys ranked first at all examinations.

Our results similarly point to the possibilities of targeted effect of physical education process, which can decrease the progress of occurence of shortened muscles. The frequency of incidence of first five shortened muscles in boys has lowered by 30 to 34%.

The observed prevelance of shortened muscles in qualitative levels partly corresponds to the results found by (14), who similarly reported the highest incidence of shortened muscles in IInd qualitative level in the fifth form of common population, however, the frequency of incidence of shortened muscles in the level of lighter deviation from the standard was different.

The found incidence of shortened muscles in qualitative zones is not in coincidence with the results by (14), who found out a distribution of shortened muscles by 20% higher in IInd qualitative level in boys of 6th form. She recorded by 30% less boys with shortened muscles in IIIrd qualitative level. Experimental boys with shortened muscles in the group of (14) showed higher distribution in more agreeable qualitative levels – with a lighter level of shortening.

Another aspect, arising from our results is that by using the compensation exercises in the school physical education lessons it is possible to significantly mitigate the development of muscular shortening. The reasons are underlined by (1), who warns that especially in dynamic malfunctions of the motor system muscular shortening can play an important role. He assumes that these are even more important than the muscular weakening in the chain of functional disorders of the motor system.

Our results correspond to the other authors (5,19), who point to the period of fast pre-puberty development, during which the muscular component of the motor system is the most unstable element. In this period, postural muscles lag behind the intensive growth of extremities as to their length, while in the development of muscular disbalance they have a dominant position. It has been proved that the overall malfunction of motivity is formed during years, that is why it is important to pay a spacial attention to children.

Conclusion

By means of examining the group of 49 ten to twelve year old boys from elementary schools, functional changes in the motor system were diagnosed in the sense of shortened muscles.

The hypothesis concerning the increased incidence of shortened muscles in 5th grade of elementary school upon observing the standard contents of physical education lessons, is proven.

In boys, highest incidence of shortened knee flexores was found, where after a year´s application of the exercise programme the frequency of incidence decreased by 30%. Also in other shortened muscles a decreased incidence by about 30% was recorded.

In summary, we can state that upon developing muscular disbalance in boys of our experimental group the frequency of incidence of shortened muscles had markedly increased during 5th grade, when the functional state of the motor system was not intentionally effected by the exercise programme, only in the range of exercises normally taught during P.E. lessons. The frequency of incidence of shortened muscles decreased when they were intentionally effected by the school P.E. lessons. Out results point to the fact that there are possibilities to effect the incidence positively, by means of school physical education, which can decrease the progression of muscular disbalance, which was markedly evidenced on the state of postural muscles.

Based on the results of our experiment we can recommend intentional and long-term application of exercises for the compensation of static loading during school physical education lessons for the prevention and improvement of muscular disbalance.

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Author's contribution
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection