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The Level of Muscular System of Secondary School Pupils in Relation to Health

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Abstract

Article provides primary information about state and level of musculoskeletal system of secondary school female pupils of third grades in the Central (L. Mikuláš, Ružomberok) and Eastern (Košice, Prešov) parts of Slovakia. In terms of how data have been chosen we use standardized method of evaluating muscular system for clinical and educational practice where we found that the most common shortened muscle groups are significantly (p <0.1%): m. rectus fermor, m. trapezius (upper part), m. levator scapulae. At the same time the riskiest weakened muscle groups significantly (p <0.1%) include: hip extensors which are too risky and most often impaired movement stereotypes which are observed in the age group of female pupils. Symptoms of muscle imbalance as functional disorder was significantly acute pain in the monitored file schoolgirls.

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Keywords: muscular system; muscular imbalance; pupils; health.

Introduction

The basic source and assumption for optimal functioning of the human is health which is manifestation of harmoniously balanced of physical and mental state of human being.Physical activity in relation to quality of life, lifestyle and health shows a tight connection (Nowak, 1997). In spite of lifestyle in which is absence of movement this became a social problem not excluding children nor youth. Questions about physical fitness in relation to health are at the beginning of our millennium which is one of the most actual problems of modern society. Thus, the essential

basis of human health and the prevention of civilization diseases is a degree of fitness of each system (cardiovascular, respiratory, metabolic, endocrine, digestive, excretory, nervous, and immune) which are in mutual homeostasis of the disruption to a change in the level and quality of health.

One of the areas of the health is the area of musculoskeletal system of human beings, where posture has become negative syndrome, respectively civilization diseases of our time and it is also reflected in works of authors (Kopecký, Ely, 2007; Jurášková, Bartík, 2010; Adamčák, Kozaňáková, 2012).

Véle (2006) understands musculoskeletal system holistically which performs its basic functions - locomotion, postural, communication, materials handling (creative) as well as the basic vital functions (respiratory, nutritional) and is also sensitive mirror, in which is reflected dysfunction of various systems around organism as viscerovertebral syndromes (Krombholz 2007; Novotny, 2008). On the other side, diseases of musculoskeletal manifest themselves in other systems such as vertebrovisceral syndromes (Toth, Urtis, 2004; Vaňásková, Tošnerová, 2006).

The basis of position and movement coordination is functional muscle balance, which provides the status of the various parts of the body and their posture. Disruption of the balance of musculoskeletal system due to hyperkinesia and unilateral static overload leads to functional tissue and later changes to stabilizing deep autochthonous muscles itself spine so dynamic ligament - mm. multifidi, semispinales (Buran, 2002). These changes are also mentioned by Krobot (1997) which are today considered as priority in the development of intervertebral instability. Therefore, this disorder of motor function in dorsalis we understand as failure stabilization. Vojtaššák (2000) reports that musculoskeletal disorders affecting the musculoskeletal system as a whole. Typically, this occurs when the functional disorders which are under the chain of movement system. Muscle imbalance which arises from results of long-term overloading of the muscular system as a functional disorder manifests in: cervical spine and upper torso, shaft, pelvis and hip, legs.

One change follows the next. Such a state creates some syndromes which are characterized by grouping of shortened and weakened muscles, disturbances of relevant motion stereotypes, changes of the dynamics and statics of the spine and ultimately bad and wrong posture. In the area of shoulder girdle which arises upper cruciate syndrome as well as pelvic and hip joints which are formed by lower wry syndrome.

Generalization is occurring when the functional disorders are at several levels (Buran, 2002 Véle, 2006) and in the area of managing of central nervous system (CNS) by the corticospinal and subcortical, the executive musculoskeletal system by the myo-fascial and in the tissue-joint space.

Generalization of functional disorders of the musculoskeletal system (FPPs) can be carried out in a vertical and a horizontal level (Véle, 2006).

In the vertical level which can spread disorders ascendant from the periphery to the central nervous system or descendant, from the central nervous system to the periphery. Generalization in the horizontal level is indicated by the one level, where the trigger point is in a muscle condition the trigger point in a muscle (Levit, 1998).

Muscles are in the movement system at the intersection, they converge to the effects of the central nervous system (brain, spinal cord) and the periphery (skin, subcutaneous tissue, fascia, ligaments and joints). It follows that the central nervous system (CNS) from receptors of the skin, subcutaneous tissue, muscle and joint pains which receives the information of the pattern of movement of the draw, the order and strength of contraction of individual muscles. In the proper movement of the muscles are involved in the correct order. If the muscles are imbalance and in addition they receive the wrong commands (changes of the order of muscle involvement, absence of muscle in the chain) the whole movement is broken. Such movement is inaccurate, slower, uneconomical therefore strenuous whole organism. Sequentially the fatigue and damage consists of muscle insertions, ligaments, joints and then intervertebral discs (Guth 2006; Véle, 2006). What is more, in muscle imbalance, changes of the starting position in all joints, and thus the tension of the ligaments and the muscle fascia, and the pressure on the surface of the joints. Limited mobility (flexibility) of the individual joints and the spine may cause many functional and structural problems. The most common symptom of functional changes in the musculoskeletal system is pain.

Pain is associated with the change of tension in these tissues. Everything what is increased of muscle tension is also increasing the pain on the other hand. Reflective line which is providing

more painful muscle spasms and accompanies spondylosis disease (spasm - pain - spasm) states Jakubínová (2007).

Genesis of musculoskeletal pain are often secondary origin have an additive effect and can be at the forefront of the whole pain syndrome. Permanent overload occur in disorders of coordination and faulty innervation of muscles (Cricket, 1999), resulting in a deterioration of degenerative processes.

Wrong and incorrect posture, back pain,disorders of musculoskeletal stereotypes, early development of degenerative joint changes (Janda, 1985; Thurzová, 1999) most often occurs when the distortion and change in muscle balance, which mostly occurs of shortened muscle, starting from the concept of functional disorders states Janda (1985) and Véle (2006) musculoskeletal muscle imbalances which reflect to variations of posture and limited range of motion in the joints.

From the above, it is important to note that we can distinguish three main levels of the locomotors system which takes place functional disorders and produce characteristic symptoms (Thurzová, 1992) (Figure 1).

State of musculoskeletal system is also closely related to breathing, which is reflexively affect the function of other internal organs (e.g. digestive system), which acts to somatic resp. psychosomatic balance of human beings.

The causes that lead to muscle imbalance can by Thurzová (1998) summarized by the following factor groups:

1. hypokinesia, insufficient loading,
2. overloading or chronic loading of the line of a given quality of muscle
3. asymmetrical loading without adequate compensation,
4. psychological stress, negative emotions.

The lack of primary and secondary prevention (Šimberová, Polášková, 2003), diagnosis, or neglect of functional and morphological changes musculoskeletal system are often the result of the prevalence of vertebrogenic disorders in adulthood, where correction of weakness in adulthood is already very small, or not possible which is involved in the other functional and structural disorders of health (Blizzard et al., 2000).

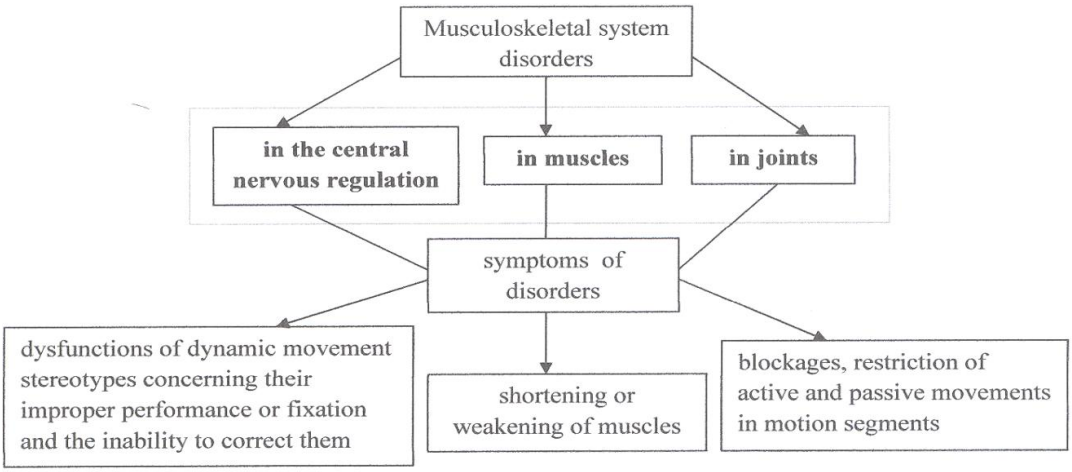

Figure 1 Functional disorders of the musculoskeletal system (Thurzová, 1992)

Aim. Identify, highlight and expand knowledge about the level of musculoskeletal system of female pupils in secondary schools with intentions on the muscular system and muscle imbalance which is subsequently predication of structural changes. Given the prevalence of painful symptoms of musculoskeletal system of female pupils in secondary schools we assume occurrence of functional disorders - muscle imbalances.

Materials and methods

The research group consisted of 336 female pupils in age of adolescence, from Central (L. Mikuláš, Ružomberok) and of Eastern parts (Košice, Prešov) of Slovakia. They were the third grade female pupils in secondary schools where the overall average age was 17.5 years. The primary characteristic of the group ispresented in Table 1. The survey was conducted in private therapists with clinical casuistry.

To evaluate the muscular system, we used a standardized method of investigation by Janda (2004), which is modified for the purpose of physical education practice by authors Labudová, Thurzová (1992).

In assessing of shortened (postural) muscles were examined following eleven groups of muscles: m. trapezius - pars superior, m. levator scapulae, m. pectoralis major, m. iliopsoas, m. rectus femoris, m. tensor fascia latae, m. hip adductors, flexors of the knee joint, m. quadratuslumborum, m. erector spinae, m. triceps surae.

To assess examinations of muscles with a tendency to weaken, we used five tests: the deep neck flexors, abdominals - m. abdominis, rhomboideus minor, hip extensors, hip abductors. The primary movement patterns include: extension of the hip, the hip abduction, subsidence, press- up, shoulder abduction, standing on one lower leg, breathing stereotype that were the subject of our monitoring. At the same time we have obtained the X-ray images.

Table 1: Characteristics of group (n = 336)

n/factors	**Girls (n = 336)**	
	Height/cm	**Weight/kg**
	169,3	63,6
Age/years	17,5 years	
BMI	24,6	

The data which were processed by us are the percentage frequency analysis, where in the evaluation of the quality level of the muscular system, and the components of female pupils in secondary schools, we used the Chi - squared test on a 1 % ($p < 0.01$) and 5 % ($p < 0.05$) levels of statistical significance. Moreover, we used the method of logical analysis and synthesis by using inductive and deductive methods of comparisons and generalizations.

Research results and discussion

Based on the targets and tasks of work, we present part of issues, which are the subject to additional monitoring and processing within the project.

From analysis of the overall evaluation of the occurrence of functional disorders of the musculoskeletal system and its changes, we registered 100 % occurrence of muscle imbalance, where we found that muscle imbalance occurs in all the surveyed female pupils, in which it points to a rather serious problem of functional state of musculoskeletal system of 17 years old pupils. It means that the total muscle imbalance was diagnosed on each pupil. The individual components of muscle imbalance contribute not in just small way in the overall of muscle imbalances.

In the first level of muscle imbalance which we consider to be perfect, we have not registered any of the pupils. Based on detected state as well as on selection methodology for the evaluation of muscle imbalances we found that the total muscle balance is a perfect state but relatively difficult to achieve in point of sustainability and relativity in terms of the current lifestyle of youth. For the key fact we consider other qualitative degree of muscle imbalance which is acceptable from the level of the health of the musculoskeletal system of youth and which is known as the easy level of muscle imbalance.

The found state of muscle imbalance was occurred in the qualitative degree of 19 % of female pupils. In the third qualitative grade that we mark as medium important deviation from the norm was the occurrence of female pupils with muscle imbalance of 75 %. The degree of muscle imbalances also showed high significance ($Chi = 63.968$; $p < 0.01$). In judging the distribution of

female pupils in the fourth qualitative degree, in which was generalized muscle imbalance of 6 % (Table 2).

Table 2: Qualitative level of muscular system of female pupils (n = 336)

n/level	**I. level**	**II. level**	**III. level**	**IV. level**
Girls	0%	19%	75%	6%
	-	-	(p < 0.01)	-

In input examination of physiotherapist we found out shortened at least two to three muscle groups in all female pupils (Table 3). Riskiest and the most often shortened muscles were significantly (Chi = 72.843; p <0.01) thigh muscle (m. rectusfemoris) of 82.6% of female pupils in which was found limited flexion of the knee. On the second place was significantly (p < 0.01) m. trapezius pars superior and on the third place was m. levator scapulae (p < 0.01) which led to shortening, reduced flexion, rotation and inclination of the head to the opposite side.

Table 3: Order of shortened muscles of female pupils (n = 336)

Postural muscle groups	**Percentage (%)**	**Order**
M. trapezius pars superior	72,6% (p < 0.01)	2.
M. levator scapulae	69,9% (p < 0.01)	3.
M. pectoralis major	29,5%	9.
M. iliopsoas	51,8%	7.
M. rectus femoris	82,6% (p < 0.01)	1.
M. tensor fasciae latae	30,7%	10.
M. adduktory bedrobého kĺbu	19,6%	11.
M. flexors of the knee joint	63,9%	4.
M. quadratus lumborum	47,2%	8.
M. erector spinae	57,2%	6.
M. tricep ssurae	58,3%	5.

Shortening of m. erectorspinae (57.2%) manifested in limited flexion of the trunk. Shortening of m. iliopsoas (51.8%) manifested in limiting extension of the hip. Shortening of m. tricepssurae (58.3%) manifested in reduced dorsal flexion of the ankle.

The lowest percentage of shortened muscles, we found in the muscle group m. hip adductors (19.6%), m. tensorfasciaelatae (30.7%), and m. pectoralis major (29.5%).

In evaluation of the overall frequency of occurrence of weakened muscles, as the second component of muscle imbalance of female pupils we register 100% occurrence of muscle weakness (Table 4).

The most often weakened muscle groups were significantly (p <0.01) with 90.3% of female pupils of hip extensors. In evaluation of other muscle groups that participated in the high occurrence of weakened muscles, we registered weakening of the abdominal muscles (p <0.01) with 79.2% of female pupils. The phasic muscles- deep flexors of neck, we measured the occurrence of muscle weakness (p <0.01) in 63.1% of tested pupils.

Table 4: Order of weakened muscle groups of female pupils (n = 336)

Weakened muscle groups	**Percentage (%)**	**Order**
Deep flexors of neck	63,1 % (p < 0.01)	3.
Abdominal muscles	79,2 % (p < 0.01)	2.
Lower fixators of scapula	60,9 %	5.
Extensors of hip joint	90,3 % (p < 0.01)	1.
Abductors of hip joint	61,6 %	4.

In order of other weaken muscle groups we found out: abductors of the hip joint (61.6%) and fixators of scapula (60.9%).

State of the total muscle imbalance is closely related to the quality of implementation of movement stereotypes (Table 5) as a third component of muscle balance.

From the analysis of the collected data we found out that among female pupils was 96.1% occurrence of incorrect movement stereotypes. In the first place with the highest percentage was the extension of the hip joint (82.3%), press- up was the second ranked with 79.7% and standing on one leg with the lower occurrence. Disorder of sitting stereotype was observed in 62.8% of female pupils and breathing stereotype was found in 61.9% of tested pupils. Breach of movement stereotype in abduction of hip joint was found in 57.9% of female pupils. Incorrect movement stereotype of abduction of arm was acquired by 53.5% of female pupils.

We assume, in accordance to Janda (1996) that the first impulse to the formation of muscle imbalance could be likely the incorrect movement stereotypes fixed at younger school age of female pupils.

Table 5: Order of incorrect movement stereotypes of female pupils (n = 336)

Movement stereotypes	**Percentage (%)**	**Order**
Extension of hip joint	82, 3 % ($p < 0.01$)	1.
Abduction of hip joint	57, 9 %	6.
Sitting down	62,8 %	4.
Press- up	79,7 % ($p < 0.01$)	2.
Abduction of arm	53,5 %	7.
Standing on one leg	77,2 % ($p < 0.01$)	3.
Breathing stereotype	61,9 %	5.

Frequency occurrence of disorders pointed out the summation of shortened and weakened muscle groups in the upper and lower cruciate syndrome. In the upper cruciate syndrome, we found muscle imbalance between the shortened muscles (upper m. trapezius m. levator scapulas, m. sternocleidomastoid, mm. pectorales) and weakened muscles (mm. scaleni, middle and bottom of the m. trapezius m. rhomboideus, m. serratusanterior and paravertebrally muscles in the thorax of the spine). Manifestation is the outpost of posture of head and magnification of the cervical lordosis.

In the lower cruciate syndrome summation of muscle imbalances was manifested between the muscle groups: shortened hip flexors (all or only some of them m. iliopsoas, m. rectusfemoris, m. tensorfascielatae) and mm. and rectorestrunci and weakness of the abdominal and buttocks muscles. Manifestation is the increase in lumbar lordosis and forward extruded of abdominal area.

In long-term state thus contributes to deteriorate of functional state of musculoskeletal system, thereby overloading the cervical, thoracic and lumbosacral segments in at least two levels, sagittal and lateral. This creates pain and progressive degeneration of the intervertebral discs (Lebkowski, Dzieciol, 2002).

Disclosure of pain is usually rather in functional disorder of joints and muscles, as the changes in the structure of the joints and intervertebral discs. Yet Travell in 1952 (In Tilscher, 2000) proceed that non-specific lower back pain is muscle pain that can be caused by reflection. Thurzová (1997) and Finley (2006) state that it is the primary muscle aches myofascial pain syndrome, which may be the cause of headache migraine (Jancová, 1999).

The health state of female pupils was assessed on their own terms, in terms of clinical history relating to health. When assessing the health of the greater part of pupils they deemed healthy though not a fit (56%). Completely healthy with a fit is considered 19% female pupils. The remaining 25% of female pupils indicated that they have not health problems. Back pain reported that having ($Chi = 36.233$; $p < 0.01$), 69% of female pupils.

Female students were reported with clinical casuistry that pain is manifested by stiffness cervical spine and movement restrictions of head which is said that the difficulties were functional nature, which we found spontaneously retreated. In this context it is important to say that acute pain is physiological, the defense function stimulates the defense forces (Bernadič, 2002), where

the functional blockade of the defensive response to the specific movement stereotypes, which must be first adjusted and muscles return to its original working state. It is also important to point out the changes of spondylartrotic which are characterized by osteophytes (bony outgrowths) sometimes considerably large size. They are formed by the reaction of connective and bone tissue for long-term or repeated breach of spinal function. Osteofytyventral and ventrolateral reduce the mobility of the spine but in contact with the nerve structures (spinal cord and dorsal root) are generally getting back osteophytes. Osteophytes are the most common and most affected by the spinal segments that are most exposed- lower cervical (C), lower thoracal (Th) and lumbar (L) of the spine, which were diagnosed in (Chi = 5, 983p <0.05) 29% of female pupils in X-ray examination. Our findings confirm several works (Kanásová, 2004; Majerík 2006; Bartík, 2011), which also can ask and answer the question: ,,What next ... "

These results cannot be generalized, but it is necessary to understand them in context, as a guide and source with respect to the health and lifestyle of female pupils of secondary schools.

In this context, it is important to note and remember that prevention plays a very important role in relation to health and the selected commodity which is the correct functioning of the locomotor system. It plays a role properly which is chosen by physical activity sports and recreational nature, either with compensation, relaxing, restorative or compensatory importance.

The important is knowledge and the degree of muscle imbalance because it is not recommended in pulling muscles in acute states of the joints or muscles at different anatomical changes in the joints and bone changes with increased fragility. It is not appropriate to pull muscles that are tight or reflex muscles with increased irritability. Never pull-out the muscles to extreme lengths, but just enough to achieve the desired length to perform useful motion in the joints further we continue strengthening muscle after its testing. Removing shortened muscle may lead to spontaneous recovery of muscle weakness and automatically insertion into the movement stereotypes.

Conclusion

Our results confirmed the prior state of the high occurrence of muscle imbalance and the riskiest groups of muscles which symptoms are significantly (p <.01) pain.

From the postural muscle groups which are involved the most frequently in the shortening of female pupils were found: (p <0.01) m. rectusfermoris, m. trapezius (upper part), m. levator scapulae. From phasic muscle groups were: hip extensors which are also reflected as incorrect movement stereotypes.

As we know, not only the lack of physical activity arise deviations from the correct functional state of the musculoskeletal system, but also in regular physical activity by one-sided, excessive musculoskeletal overload, without adequate regeneration and classification of targeted compensation exercises, focusing on the most risky muscle groups.

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