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Original Article

Effect of recreational taekwondo training on musculoskeletal system of primary school age children

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Abstract:
The article presents a comparative characteristic of the posture and foot shape of the primary school age children involved in various sports groups with children employed only in physical education according to the school curriculum. The aim is to substantiate the effect of taekwondo training on the musculoskeletal system of the junior students. Objective: To investigate visually the correct posture and foot shape of the primary school age children; to identify and assess posture and foot shape of the junior students by calculating brachial index and foot shape index; to make a comparative analysis of posture and foot indices of the students prior to and after the educational experiment as well as of the children involved during the experiment only in the physical education according to the school curriculum, in sports groups in basketball and taekwondo. To achieve these objectives we used the following methods: theoretical analysis of scientific and methodological sources; educational experiment; methods of somatoscopy and somatometry, methods of mathematical processing. Material: 70 primary school age students participated in the study, including 23 girls and 47 boys. For seven months, 43 children in addition to physical education classes were involved in the extra-curricular sports groups: 17 boys - in the basketball group, 12 girls and 14 boys - in the taekwondo group. Results: Efficiency of applying this martial art as health-improving means was proved in the course of the study on the basis of studying the effect of taekwondo training on the formation of correct posture and foot shape of the primary school age children. Conclusion: It was proved that through special means used in taekwondo the number of children involved in the recreational taekwondo group with normal posture and normal foot shape is much bigger than the children involved in the basketball group and those not involved in the sports groups at all. A large percentage of children with normal posture among students involved in the taekwondo sports group can be explained by the specificity of the sport.
Key words: primary school age children, posture, foot shape, recreational training, taekwondo.

Introduction

Today, in reformation of the national school system it is necessary to pay attention to the issue of children's health, increasing their motor activity through physical education and recreational exercises in the day regimen and after school. By encouraging regular physical exercises among children we form skills of correct behavior, relationships, i.e. the basis for their active life in the future. The problems of training the responsibility for their own physical condition among the primary school age children were studied by N. Basiuk (2005), L. Lokhvytska (2010). The problem of student patriotic education was studied by A. Leonenko (2016), I. Bekh (2014). Significant attention to the psychoemotional and psychophysical state of the students was paid by Ya. Galan (2016). The effect of different types of motor activity on human health was examined in the papers by A. Jegier (2007), O. Andrieieva (2017), H. Butenko (2017). However, traditional means, forms and methods of extracurricular physical education and recreational activities with children are not quite up to date today and need improvement (O. Pochtar, 2010; M. Dutchak, 2007; L. Mazurenko, 2008). Despite the large number of scientific papers, according to N. Goncharova (2012), the problems of systematic approach to organizing extracurricular physical education and recreational activities of the primary school age children in order to improve the level of their physical condition and health are still poorly examined. One of the most objective indicators of children's health is a state of their physical development. The commonly used methods to determine physical development of the primary school age children are somatoscopy, somatometry and physiometry (O. Dubohai, 2006; N.Dedeliuk, 2010; T. Krutsevych, 2011).

The analysis of the scientific and technical literature determined that despite a large number of studies of the effect of different sports and recreational training on the physical health of students as well as differences

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in the research techniques, almost all scientists in their research used the following indicators to assess children's physical health: body weight, chest circumference, hand dynamometry, heart rate, arterial pressure, lung vital capacity, absence of disease, indicators of physical fitness. Also, many studies were conducted separately on the issue of posture and foot formation of the primary school age children. At the same time, the available data in the literature indicate a lack of research on the effect of some sports, including taekwondo, the formation of correct posture and correct foot arch. It is the search for the new approaches to conduct recreational taekwondo training to determine the effect of this training on the formation of the foot and posture of the primary school age children that is urgent today. There is a number of papers on the problems of foot and posture formation of the primary school age children, studying the effect of bad posture and scoliosis on the body functions of children of the different age groups.

In terms of biomechanics a foot has functionally practical anatomical structure and performs several important functions: support, spring, motor, balancing. Foot arch flattening effects the pelvis and spine positioning. Therefore, flat feet are usually accompanied by the development of various types of bad posture N. Farino, (2010). Posture depends on many factors. It is connected, first, with the condition of the muscular system, i.e., development of the back muscles, muscles of chest, abdomen and lower extremities, as well as with muscle functionality, its ability to prolonged static stress. Posture is also affected by the spine mobility, shape of the foot and the leg on the whole. Bad posture may gradually reduce mobility of the chest, diaphragm, deteriorate spring function of the spine. This in turn adversely affects the activity of the central nervous system, cardiovascular and respiratory systems, accompanying many chronic diseases, resulting in emergence of functional weakness, imbalance of muscle condition and ligamentous apparatus of a child. (O. Peshkova, 2012). The effect of bad posture of the primary school age children on their physical condition indicators was studied by S. Popov (2005), N. Goncharova (2012), O. Annushak (2015), Yu. Valetskyi (2015) investigated the effect of bad posture on the work of all systems and organs of the child's body. A. Romanowska (2007), O. Bychuk (2012), K. Serhiienko (2013), researched the issue of preventing the support-spring malfunction of the foot. A. Turanskii (2012) offered special water exercises to correct the children's posture. The issues of the effect of physical exercises on the student posture was investigated by Š. Balkó (2017). The effect of different sports on children's posture was examined in the papers by N. Ozolin (2004), V. Dubrovskyi (2005), L Bukova (2013); A. Kadylnykova (2015).

Material and methods.

During the research we used the following methods: theoretical analysis of scientific and methodological sources; educational experiment; methods of somatoscopy and somatometry, methods of mathematical processing.

Somatoscopic methods allowed us to visually identify the correct posture of junior students which changes at different ages as well as the foot shape. With somatometric method we measured the width of the shoulders and the brachial arch to determine bad posture. In our study educational experiment was to determine the effect of taekwondo training on the foot shape and posture of the primary school age children. It consisted of ascertaining experiment. The results of our study was processed with the methods of mathematical statistics, providing quantitative and qualitative analysis of the indicators.

Participants

70 primary school age children of Municipal Institution of Sumy Specialized School of I-III Levels No. 1 named after V. Strelchenko participated in the research, including 23 girls and 47 boys. At the beginning of the school year we assessed posture and foot shape of the children under study using methods by T. Krutsevych (2010) and N. Dedeliuk (2010). The following activities in the extracurricular sports groups were chosen from the total number of the 43 children under study in addition to physical education classes: 17 boys were involved in the basketball group, 12 girls and 14 boys chose the taekwondo group. Classes were held three times a week for one and a half hours. 27 children (11 girls and 16 boys) were involved only at the physical education classes according to the school curriculum for 3 academic hours per week.

Procedure

To identify and assess the posture we used the method of external examination of child's posture and calculated the brachial index. Through external examination of the posture we checked the height of the shoulder lines location, inferior angles of shoulder blades and their delay from the chest, shape of the lumens formed by the inner surface of arms and torso. In normal posture the straight head position and the same shoulder level, symmetrical shoulder blades and waist triangles, normal physiological spine curvature and average location of the line of the spinous processes can be observed. To calculate the shoulder index we used centimetric tape to measure shoulder width (the distance of a straight line between the acromions) in front and shoulder arch which equals the distance between these acromions and is measured from behind.

During the visual study of the foot we determined location of the heel bone relative to the shin (view from behind), state of the longitudinal and transversal foot arches. Axis of the shin and heel match in the normal foot. With flat feet axis of the heel and shin most frequently form an angle open outwards. To identify and assess the foot we calculated the index which describes the foot shape (N. Dedeliuk, 2010).

Results

During the preliminary examination of the children at the beginning of the school year it was found out that of the total number of children only 30% had normal posture and 25.7% had normal foot shape. From Table 1 we see that among the 47 boys who participated in the study only 29.8% of the students had normal posture and 25.5% had unflattened foot shape. Accordingly, the number of boys with stooped posture amounts to 70.2%, with the flattened foot shape - 53.2%, with flat feet - 21.3%. The percentage of girls of 9-10 years old with normal posture (30.4%) and normal foot (26.1%) is much lower than the percentage of female students with bad posture (69.6%) and foot malfunction (73.9%).

These examination results speak about an upward tendency of the prevalence of musculoskeletal system diseases among the primary school age children in a variety of forms of bad posture and foot malfunction, including scoliosis, stoop, flat feet.

Table 1

Results of assessing posture and foot shape of the primary school age boys and girls at the beginning of the school year

children (n=70)	posture				foot shape					
	normal posture		stoop		unflattened		flattened		flat	
	n	%	n	%	n	%	n	%	n	%
boys (n=47)	14	29.8	33	70.2	12	25.5	25	53.2	10	21.3
girls (n=23)	7	30.4	16	69.6	6	26.1	13	56.5	4	17.4

The examination of the children under study was conducted seven months later to determine the effect of training in sports groups on posture and foot shape. As we can see from Table 2, from the total number of the primary school age children under study the percentage of students with stooped posture (54.3%) is significantly higher than the number of children with normal posture (45.7%) ($p<0.05$). The number of children with stooped posture, involved in sports groups, compared with the initial data has significantly decreased from 70% to 54.3%, indicating the effectiveness of training in sports groups ($p<0.05$).

Table 2

Assessment of the posture of the primary school age children by brachial index after the educational experiment

Posture		Children uninvolved in sports (n=27)		Children involved in basketball (n=17)		Children involved in taekwondo (n=26)		Overall under study (n=70)	
BI[a]	characteristic of posture	n	%	n	%	n	%	n	%
< 89.9	stoop	19	27.2	10	14.4	9	12.7	38	54.3
90-100	normal posture	8	11.4	7	10	17	24.3	32	45.7

Note. [a] BI - index brachial

Studies showed that the number of students who were involved in the taekwondo sports group and had a normal posture is significantly higher (24.3%) than those involved in the basketball group (10%) and those involved only in physical education according to the school curriculum (11.4%) ($p<0.05$).

As shown in Figure 1, from the total number of boys of 9-10 years under study the number of children involved in taekwondo with normal posture is 12.6%. 10% of the involved in basketball and 5.8% of the uninvolved in sports groups have good posture. Accordingly, among girls the number of students with normal posture involved in taekwondo is 11.5%. 5.8% with normal posture attend only the physical education classes at school.

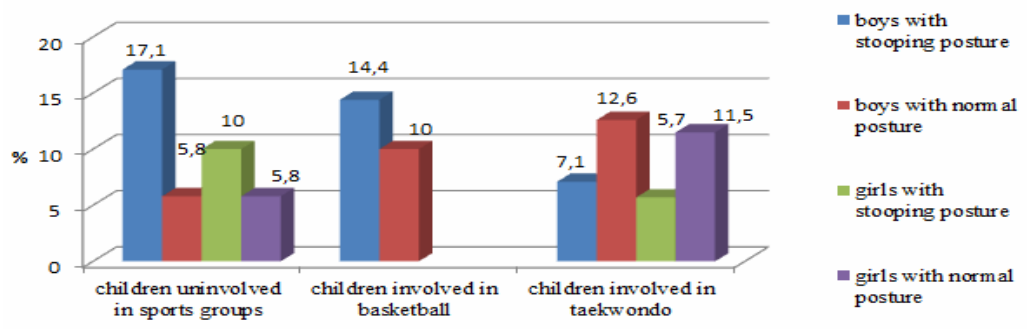

Fig.1. Distribution of primary school-age children of different sexes in the form of posture

10% of girls not engaged in sports groups and 5.7% of girls engaged in taekwondo group have stooping posture. Among boys with stooped posture 17.1% of boys are uninvolved in sports groups, 14.4% are involved in basketball and 7.1% are involved in taekwondo. According to the examination results it can be concluded that the largest number of both boys and girls with normal posture is among those who attend taekwondo training.

As a result of the study it was revealed that there are significant differences between students involved only in physical education according to the school curriculum, students involved in the basketball sports group and those involved in the taekwondo sports group according to the foot shape index (unflattened and flat feet). The total number of children uninvolved in sports groups with normal (unflattened) feet is much smaller (8.6%) than those involved in basketball (7.1%) and taekwondo (15.7%). The number of children with flat feet uninvolved in sports is significantly bigger (10%) than the number of children involved in the basketball group (5.7%) and the taekwondo group (2.9%) ($p<0.05$).

There are no significant differences between students with flattened feet in all three groups under study (20%, 11.4% and 18.6%, respectively) ($p>0.05$) (Table 3). A smaller percentage of children with flattened feet involved in basketball can be explained by fewer students who participated in the study.

Table 3

Assessment of the primary school age children by foot shape index after the educational experiment

Foot		Children uninvolved in sports (n=27)		Children involved in basketball (n=17)		Children involved in taekwondo (n=26)		Overall under study (n=70)	
FSI[a]	foot shape	n	%	n	%	n	%	n	%
0.0-1	not flattened	6	8.6	5	7.1	11	15.7	22	31.4
1.1-2	flattened	14	20	8	11.4	13	18.6	35	50
2 and >	flat	7	10	4	5.7	2	2.9	13	18.6

Note. [a] FSI - index of foot shape

As shown in Figure 2, the number of girls with foot malfunction involved only in physical education at school is much higher (39.1%) than the number of girls involved in taekwondo (26.1%) ($p<0.05$). In addition the former group has 13% with flat feet while the latter group has none.

The study found that there are 17.1% of children uninvolved in sports, 23.4% of children involved in basketball and 14.9% of children involved in taekwondo among boys with foot malfunction. Accordingly, the number of junior students with normal foot is 8.5%, 12.8% and 14.9%.

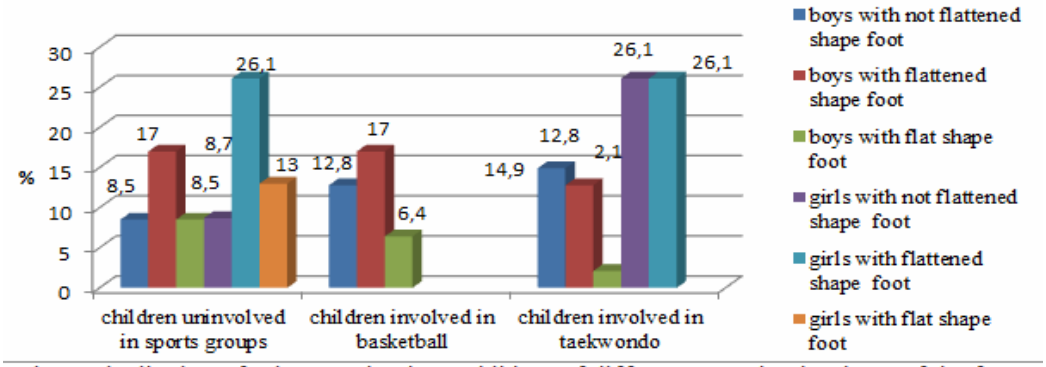

Fig.2. Distribution of primary school-age children of different sexes by the shape of the foot

Discussion

Modern high level of information load and low overall motor activity in a period of intense growth and development of the child's body adversely affects the musculoskeletal system of the primary school age children.

Taekwondo training fully provides: health promotion and comprehensive development of the involved children, formation of the vital motor abilities and skills. Due to various methods and exercises taekwondo can serve as the means of body strengthening and health improvement. Correction of the foot shape and child's posture can serve as an example of taekwondo's health-improving effect.

The study discovered that compared with the previous examination of children at the beginning of the school year the number of children with normal foot shape and normal posture after seven months of training in the taekwondo and basketball groups has increased by 5.7% and 14.3% respectively. At the same time there are by 17.2% more children with normal foot involved in taekwondo than the children involved in basketball and there are by 5.7% more children with normal posture.

Fewer number of children with foot malfunction involved in taekwondo (21.5%) can be explained by the means used during the training. Taekwondo as a martial art and modern Olympic sports also includes elements of the recreational activities. In taekwondo all strikes are kicks: performed by foot or instep. To

properly perform the kicks it is necessary for foot to be very agile and strong. For that reason, warm-up and a part of general physical training include exercises for developing the foot mobility and strengthening the muscular-ligamentous apparatus of foot and shin. These exercises are both preventive and curative.

A large percentage of children with normal posture (24.3%) among students involved in the taekwondo sports group can be explained by the specificity of the sport. Due to the prevailing national traditions, this type of martial arts practice jumping technique and kicking in different versions. This taekwondo technique involves kicking in about 70% of cases and punching in only 30% (Rim Seung-min, 2003; V. Romanenko, 2008). Pelvic rotation which occurs while performing kicks and balancing arm movements is good at developing the abdominal muscles. Most strikes in taekwondo are connected with high insteps which develop side muscles of the torso and inner surface of the thighs (V. Tverskikh, 2006; Su Youn Cho, 2017). Trained muscular system allows to maintain a direct spine position and, accordingly, a correct posture.

Conclusions

1. The study results give reasons to conclude that training in sports groups has a positive effect on the musculoskeletal system, namely, the posture and the foot shape of the primary school age children.

2. Taekwondo is precisely the sport that allows to strengthen and improve the child's body all-round through various techniques and exercises. A large percentage of children with normal posture (24.3%) and normal foot shape (15.7%) among the students involved in the taekwondo sports group can be explained by the specificity of the sport. The efficiency of using this martial art after studying the effect of recreational taekwondo training on the formation of correct posture and foot shape of the primary school age children was proved.

3. It was proved that through special means used in taekwondo the number of children involved in the recreational taekwondo group with normal posture and normal foot shape is much bigger than the children involved in the basketball group and those uninvolved in the sports groups at all.

4. In our opinion, it is recreational taekwondo training that may be the key to forming and maintaining the proper health of the primary school age children as well as a preventive regarding malfunctions of the musculoskeletal system of the child's body.

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