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Original Article

Effect of an exercise program on the body posture of young school-aged pupils

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Abstract
Introduction: Physical activity plays a crucial role in children's overall health, particularly in preventing musculoskeletal disorders. This study aims to evaluate the effectiveness of exercise program integrated into physical education classes at schools, with the goal of improving the posture of younger school-age pupils. **Material and Methods:** The group consisted of Σ63 pupils, comprising boys (n=30) aged 10,21±0,42 years, and girls (n=32) aged 10,32±0,37. The Intervention Movement Program involved selected tools using musical-movement and dance activities, implemented for a period of 18 weeks, twice a week per 45 minutes within the lessons of Physical and Sports Education. As far as data collection, standardized PE test was used, and the Klein-Thomas test modified by Mayer was used to evaluate the body posture. Based on statistical evaluation, the Wilcoxon signed-rank test was used, the effect of the implemented movement program on the significance level 0,05 was verified. **Results:** A significant progress in the quality of body posture in both groups of observed girls ($p<0.5\%$) and boys ($p<0.5\%$) was observed. There were significant changes in all evaluated segments of both girls' and boys' groups - Head and neck posture ($p<0.5\%$), Chest shape ($p<0.5\%$), Abdomen and pelvic inclination ($p<0.5\%$), Total Spine curvature ($p<0.5\%$), Shoulder blades/ scapulae ($p<0.5\%$). **Conclusion:** Regular and targeted movement activities of students in the school environment significantly affect the quality of posture as one of the manifestations of health. Based on the findings listed above, an exercise program with music and dance activities can be considered a highly effective tool.
Key words: body posture, musical-movement and dance activities, physical education, primary school pupils

Introduction

Human health is a basic prerequisite for a full life and optimal performance of an individual. Being healthy is the primary prerequisite for achieving success in education, in the desire to achieve a dignified place in society, and at the same time for the individual's psychological and physical stability. However, there has been in recent years, a sharp deterioration in the health of the population, which can be described as a global problem (Łubkowska & Troszczyński, 2011; Luparenko, 2013; Morano et al., 2016; Di Maglie, 2017; Rusnak et al., 2022). If the global population were more active, up to 5 million deaths per year could be avoided. At time when lots of people were stuck in their homes due to COVID-19, the new guidelines on physical activity and sedentary way of life issued by WHO emphasize that any person, regardless of their age and abilities, can be physically active, and that any type of movement counts. The new guidelines recommend at least 60 minutes of movement activities for children and adolescents (WHO 2020). The WHO guidelines on physical activities and sedentary way of life were issued to offer significant medical advantages and reduce health risks. In addition to the objective causes of this phenomenon, the existence of subjective causes was also distinguished, such as ignorance or ignoring of a healthy lifestyle, negligence in taking care of one's own health, significant reduction in physical activity, preference for a sedentary lifestyle associated with the use of electronic devices, etc. It is worrying that the above-mentioned phenomena were already observed in children at a young age, which can lead to a large-scale outbreak of non-infectious diseases of a wide range aetiology or to chronic diseases (Vukelja et al., 2022). The development of risk factors in childhood is considered a precursor to risks in adulthood. This means that unhealthy children of today are tomorrow's potential patients. However, if the control of the risk factors development in childhood is managed, it may enable to predict and prevent the development of cardiorespiratory and other chronic disorders in adulthood (Vukelja et al., 2022). This confirms the need for an effective approach to the development of education in the field of healthy lifestyle, starting with school headteachers and teachers, with the intention of actively influencing students of all levels of education (Gozhenko et al., 2018; Diachenko-Bohun et al., 2019; Kashuba et al., 2020). Physical and sports education in the curriculum plays a fundamental role in education in this area. Being an essential part of the educational process of pupils, it contributes to the prevention of a sedentary lifestyle, provides for physical activity of pupils, and contributes to a holistic formation of the personality of a young individual, creating lasting habits into adulthood in accordance with WHO recommendations (Mantjes et al., 2012; Colella, 2016; Marttinen et al., 2018; D'Anna et al., 2019; Marinho et al., 2022). One of the areas of health care are the human musculoskeletal

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system. It is an area which is nowadays given increased attention due to the impacts of changed lifestyles and to the fact that it is the cause of civilization diseases already in young age categories (Adamčák, 2007; Jurášková & Bartík, 2010; Żukowska et al., 2014; Łubkowska et al., 2015; Rozim et al., 2022), but also due to the diseases associated with the Covid -19 pandemic. The dynamic balance between the functions of the musculoskeletal system in direct relation with the good functioning of the internal organs and the nervous system is considered the optimal condition. Quantitatively inappropriate functional load (the unreasonable, excessive, or insufficient one) or qualitatively inappropriate loading (e.g. one-sided, long-lasting, or uneven one) can be the cause of development of muscle imbalance and subsequently lead to incorrect posture. A condition where the musculoskeletal system cannot cope with the usual functional requirements, for example being exposed to the effects of gravity, is referred to as functional insufficiency or impairment of the musculoskeletal system (Adamčák, 2007). Therefore, regular physical activity is essential for strengthening health, mental and physical well-being. Its absence causes a loss of physical fitness and resistance of the organism. At the same time, it negatively affects the musculoskeletal system of the individual (Bendíková & Rozim, 2020; Novotná et al., 2020; Rozim et al., 2022;), which is the subject of our interest. Targeted physical activity is very beneficial in correcting milder degrees of muscle imbalance. To remove it, it is necessary to achieve the resting length and elasticity of the muscles that have shortened and restore the strength of the muscles that have weakened. There are several studies on the effectiveness of exercise programs and the effect of health-oriented exercises on the movement apparatus associated with positive changes in the musculoskeletal system, including documentation of their positive effect (Rowe & Jacobs, 2002; Bendíková & Stackeová, 2015; Novotná et al., 2020). Positive results were also found in a study by Mishenko et al. (2023) who investigated a method of correcting postural disorders using health-promoting action rhythmic gymnastics, which was included in the physical education curriculum for 8 to 10 year old girls for a duration of 15 to 20 minutes. It was shown that 78.5% of girls in the experimental group experienced stabilization of the value of the spinal curvature angle in the frontal plane. In the control group, stabilization was observed in only 28.5% of the girls. In the experimental group, only two (14.2%) girls had a slight deviation in posture. The authors recommend the method of health-promoting story rhythmic gymnastics for widespread use in posture correction.

Incorporation of posture correction activities into the teaching process was also observed by Kashuba et al. (2020), 139 students (aged 6 to 10 years) with hearing impairment were included in the testing. Children with postural deviation were included in a transformation experiment in which the implementation technology was designed for them, taking into account the indicators of the biometric profile of posture. The whole block consisted of prevention modules (postural prevention teaching, yoga breathing exercises, exercises according to Gitman Pilates, exercises on a fit ball). It was shown that the effect of the intervention program improved the biogeometric profile index of the respondents at a statistical level of $p<0.05$. The results of other studies (Gao et al., 2013; May et al., 2019; Andrieieva et al., 2021; Kashuba et al., 2021) confirm that dance and choreographic exercises can be one of the most effective means of developing a child's body, forming correct posture, and preventing postural disorders.

Designing the exercise program, supported by studies, also enabled to try to influence the quality of the musculoskeletal system and the body posture, and thus, ultimately, the health of the pupils.

The aim of our research was to ascertain the effect of a movement program containing musical-movement and dance activities included in physical and sports education classes on the posture of primary education pupils.

Material & methods

Participants

In accordance with the goal, the group included on the whole Σ n=62 pupils (n=30 boys, n=32 girls) of the town of Banská Bystrica, Slovak Republic, aged 9-10 years, i.e. pupils of early school age, willing to participate in research, with the consent of their parents takers and of the school. Pupils participated voluntarily with written parental consent. Ethical approval was obtained from the ethical committee at the Matej Bel University under project number 1522/2022. Measurements were carried out in accordance with the ethical standards of the Declaration of Helsinki. The primary characteristic of the groups is presented in Table 1.

Table 1 The primary characteristics of research group (n=62)

	Research group (n=62)	
Measured values	Boys (n=30)	Girls (n=32)
Age/years	10.21±0.42	10.32±0.37
Body weight/kg	43.21±7.54	35.41±7.11
Body height/cm	145.37±6.54	138.1 ± 6.24
BMI kg/m^2	20.45±2.21	18.57 ± 2.11

kg - kilogram, cm - centimetre, BMI - Body mass index**,** kg/ m^2-kilogram per square meter

Measurement organization

The research took place in the academic year 2021/2022 at an elementary school in Banská Bystrica. After a thorough preparation of the research with the aim of achieving the goal, initial diagnostics (V1) of

somatometric indicators were carried out in February and a diagnostics of body posture evaluated by a standardized test used in school practice. Subsequently, an exercise program aimed at health promotion in relation to the correct posture of the pupils, was included in the teaching content of compulsory physical and sports education, twice a week for 45 minutes, for a period of 18 weeks, a total of 36 lessons. Each lesson of exercise program included music-implementing exercise and dance activities (Table 2), contained 10-minute warm-up, 25-minute main part and 5-minute Cool-Down. Every lesson included a 10 min warm up with stretching.

The music was played at a soft rhythm 120 - 128 beats per minute (bpm). Main part included 30 min continuous musical-movement and dance activities, such as aerobic, dances, dance games, exercise on the wall bars, exercise on the over ball and stability ball, skipping rope games. The intensity of the main program was 60% -75% of the maximum heart rate with a rhythm of 130-135 bpm in the first six weeks. After six weeks, from week seven to week eleven, the intensity was increased to 75% - 85% of the maximum heart rate (music 140-150 bpm). In the next seven weeks, the intensity of the program was variable, every other hour was reduced to 60% - 70% of the maximum heart rate and rest weeks was 75 – 85% of the maximum heart rate. In the last part of the lesson, the participants were given 5 min. cool down. It included muscular strength exercises with slow and relaxing rhythm music. The process of teaching was led by a qualified teacher with years of experience. Subsequently, output testing (V2) of the same indicators was performed.

Table 2 Movement exercise program plan for 1 month (sample)

Lesson	Warm-up (10min.)	Main Part (30 min.)		Cool down (5min.)
		A part	B part	
1	Warm-up	Stability ball	Dance games	stretching
2	Warm-up	Low Aerobic	Dance- modern	stretching
3	Warm-up	Stability ball	Dance- folk	stretching
4	Warm-up	Dance Aerobic	Dance - modern	stretching
5	Warm-up	Over ball	Rope Skipping	stretching
6	Warm-up	Exercise on the wall bars	Dance games	stretching
7	Warm-up	Skipping Rope games	Dance- folk	stretching
8	Warm-up	Low Aerobic	Dance Aerobik	stretching
Σ	80min.	240 min/month		40 min.

Measurement Taking

From among the data collection methods, the main method of visual assessment for physical education practice was used - the standardized method of posture assessment according to Klein and Thomas, modified by Mayer (Bendíková, 2011). The evaluation of individual body segments was expressed by the sum of points, while each area was allotted 1, 2, 3, 4 points, according to the current level of posture. The evaluation was focused on: I. Head and neck posture, II. Chest (shape), III. Abdomen and pelvic inclination, IV. Spine curvature, V. Frontal body posture (Evaluation of shoulders - Shoulder blades/ scapulae).

Evaluation of body postures:

I. Correct body posture ..... 5 points
II. Good (almost correct) body posture ..... 6 – 10 points
III. Bad body posture …..... 11 – 15 points
IV. Incorrect body posture ..... 16 – 20 points

Data Analyses

In terms of data processing methods, mathematical and statistical methods were used to process the collected data and to calculate basic descriptive statistics: arithmetical mean (x) and selective standard deviation (SD), percentage frequency analysis (%). To ascertain statistical significance of achieved results in the level of body posture, the Wilcoxon signed-rank test was used, $p<0.05$ –statistically significant on the level of 5 %.

Results

This section will present the results of the research which cannot be generalized, but a significant application of movement programs in practice can be pointed out, aimed at improvement of body posture as one of the factors of health. The acquired data of physical development (body weight, body height, BMI) of the monitored group were compared with the reference standards Sedláček and Cihová (2009), finding out, that the groups of girls and boys fall into the average category of Slovak population. Body posture reflects the quality level of the muscular system, and it reflects the movement stereotypes that are part of our daily lives. Body posture represents the position of individual segments of the body in time and space, which may be correct or incorrect (Bendíková, 2011). In the monitored group of elementary school pupils, investigating the effect of the proposed movement-exercise program on the quality of body posture was investigated, separately in girls' group (Table 3) and separately in boys' group (Table 4). Based on the sum of the points for individual body segments, the qualitative level of posture was evaluated.

Table 3 Evaluation of body postures of the girls (n=32)

Level of the body posture	points	V_1	V_2
I. Ideal body posture	5	6.25%	18.75%
II. Good body posture	6-10	71.87%	75%
III. Poor body posture	11-15	21.87%	6.25%
IV. Incorrect body posture	16-20	0%	0%
Wilcoxon test		0.000001012	

V_1 – input, V_2 – output, $p<0.05$ –statistically significant on the level of 5 %,

Table 4 Evaluation of body postures of the boys (n=30)

Level of the body posture	points	V_1	V_2
I. Ideal body posture	5	0%	13.33%
II. Good body posture	6-10	63.33%	70%
III. Poor body posture	11-15	36.66%	16.66%
IV. Incorrect body posture	16-20	0%	0%
Wilcoxon test		0,00000227	

V_1 – input, V_2 – output, $p<0.05$ –statistically significant on the level of 5 %,

It was ascertained that due to the intervention up to 15.6% more girls and 20% more boys were classified in quality level I. Ideal body posture and level II. Good body posture, which confirms a significant qualitative shift in the level of body posture ($p<0.5\%$). The overall posture of the monitored group is believed to have been mainly caused by an incorrect postural stereotype, which is also caused by insufficient control of motor functions with low neuro-muscular coordination and other external and internal factors, as it is confirmed by Bendíková (2020).

When evaluating the individual segments of posture, positive improvement in favour of the observed groups of girls (Table 5) and boys (Table 6) was noted.

Table 5 Evaluation of body posture segments of the girls (n=32)

	points	**1**	**2**	**3**	**4**	**p**
Head and neck posture	**V1**	18.75%	81.25%	0%	0%	0.00003585
	V2	71.87%	28.12%	0%	0%	
Chest shape	**V1**	18.75%	68.75%	12.5%	0%	0.000001492
	V2	75%	25%	0%	0%	
Abdomen and pelvic inclination	**V1**	12.5%	71.87%	15.62%	0%	0.0000008125
	V2	75%	25%	0%	0%	
Total Spine curvature	**V1**	12.5%	75%	12.5%	0%	0.00009208
	V2	53.12%	43.75%	3.12%	0%	
Shoulder blades/ scapulae	**V1**	9.37%	75%	15.62%	0%	0.00006134
	V2	43.75%	53.12%	3.12%	0%	

V_1 – input, V_2 – output

Table 6 Evaluation of body posture segments of the boys (n=30)

	points	**1**	**2**	**3**	**4**	**p**
Head and neck posture	**V1**	20%	76.66%	3.33%	0%	0.00006134
	V2	70%	26.6%	3.33%	0%	
Chest shape	**V1**	23.33%	63.33%	13.33%	0%	0.00003186
	V2	73.33%	23.33%	3.33%	0%	
Abdomen and pelvic inclination	**V1**	16.66%	73.33%	10%	0%	0.00001233
	V2	66.66%	33.33%	0%	0%	
Total Spine curvature	**V1**	20%	63.33%	16.66%	0%	0.0003135
	V2	43.33%	56.66%	0%	0%	
Shoulder blades/ scapulae	**V1**	6.66%	73.33%	20%	0%	0.005367
	V2	20%	70%	10%	0%	

V_1 – input, V_2 – output

Evaluating the first body segment, Head and neck posture, significant changes were noted($p<0.5\%$), when there was an improvement in both girls' and boys' group. Comparing with the situation at the beginning of the experiment, 53% of girls and 50% of boys more received grade 1 with perfect head and neck position in the output assessment. To start with an early awareness or correction of the position of the head and neck is believed to be a necessity, especially in relation to long-term sitting and the use of technical devices.

In the second assessed segment of Chest shape, it was ascertained that the chest is most often slightly flattened, which is also related to the position of the head and neck. Improvement of the second segment correlates with the first one, while a shift to the first qualitative level in 56% of girls and 50% of boys was observed; the significance of changes was confirmed ($p<0.5\%$).

More significant deficiencies were found during the initial assessment in girls' group in the third observed segment, Abdomen and pelvic inclination. The most common cause were weak abdominal muscles and a bulging abdomen. As a result of the intervention program, the output testing showed a significant improvement ($p<0.5\%$), when 62.5% more girls and 50% more boys were included in the first quality level, and at the same time no one showed qualification level of 3rd degree.

A significant improvement ($p <0.5\%$) was also experienced in the fourth assessed segment, Total Spine Curvature, The first stage included 40.62% more girls and 23.33% more boys than at the beginning of the experiment and at the same time no boy in the output testing showed signs of 3rd degree.

When evaluating the Shoulder Blades/ Scapulae segment, the most common incidence of incorrect body posture was noticed, namely up to 96.2% of girls and 93.3% of boys, which figures correspond to other studies (Jurášková & Bartík, 2010; Kanátová & Broďáni, 2007). Due to the intervention, the incidence of 1st qualitative grade increased by 34.38% of girls 13% of boys, which proved to be significant ($p <0.5\%$).

Having analysed the results, the positive impact of a targeted movement program containing musical-movement and dance activities on the quality of body posture has been observed and confirmed.

Discussion

Looking at our findings, but also the findings of other studies, it can be concluded that incorrect posture occurs in a high percentage of children and changes of the musculoskeletal system can be observed at the beginning of younger school age, while persisting on a long term basis (Nosko et al., 2016; Balko et al., 2017; Marko & Bendíková, 2019; Ziętek et al., 2022) provided they have not been given attention at an early stage. We agree with Jurášková and Bartík (2010) that leaving the body posture of children to natural development affected by the modern way of life is irresponsible in a civilized society. Frequent use of electronics such as mobile phones, tablets or computers aggravates the risk of children's erroneous posture increases, starting with forward head posture, various scoliosis types, or round back, as well as other disorders associated with abdominal pain, head or general weakness (Colquitt, 2016). It should be noted that the number of children who exhibit body posture abnormalities increases with age. The studies conducted by Bogucka and Głębocka (2017) show that both overweight and underweight have a profound effect on the child's body posture. In the sagittal plane, underweight children suffer from an abnormal position of the shoulders and winged scapula. In the coronal plane, underweight boys were found to have more prominent scapular winging.

The progression of those posture defects is caused by the sedentary lifestyle and insufficient physical activity (Ziętek et al., 2022). It is in the competence of the teacher to reverse this situation during the lessons of Physical Education and Sports for the benefit of the pupils. This has been confirmed by our findings as well as positive results of numerous studies (Kanásová & Broďáni, 2007; Walkowiak et al., 2017; Rozim et al., 2022). Teachers are recommended to take more musical-movement and dance activities, which will contribute to the increase of the class attractiveness. They are also recommended to make pupils aware of the danger of not practicing physical exercise and of the negative influence of the health's risk factors. Introducing in the education a teaching about health which contributes along with the physical education to building up and changing pupils' mentality regarding the health maintenance and the life quality improvement. In summary, the application of a musical movement, aerobic and dance program is easy for physical education teachers to design and enjoyable for pupils to apply. It can be said that today, the application of such programs is imperative due to the modern way of living, which is characterized by the absence of any kinetic activity. One of the goals set in the State Education Program of the Slovak Republic (ISCED1) is to support correct body posture, either through compensatory and regenerative exercises, basic gymnastics, musical-movement and dance activities, yoga, fitball/exercise ball exercises, etc. It can be concluded that, on the basis of our results, the objective can be accomplished through application of our intervention program, which will contribute to improvement in poster quality of the pupils' body.

Conclusion

The aim of the present study was to determine the effect of a musculoskeletal exercise program containing musical-movement and dance, included in the educational process, on the quality of body posture in girls and boys of primary education. It was concluded that at the beginning of the research, 71.87 % of girls and 63.87 % of boys had good body posture. Up to 21.87 % of girls and 36.66 % of boys had 3rd qualitative degree of Poor body posture. Based on the statistical processing of the results obtained, the positive effect of the implemented exercise program on the quality of the body posture was confirmed when 15.6% more girls, and 20% more boys were classified in the 1st qualitative degree Ideal body posture and 2nd qualitative degree Good body posture, which confirmed a significant qualitative shift in body posture ($p <0.5\%$).

In the monitored groups of girls as well as boys, significant changes have also been recorded in all rated segments of body posture - Head and Neck Posture, Chest Shape, Abdomen and Pelvic Inclination, Total Spine Curvature, Shoulder Blades/ Scapulae ($p <0.05$). The monitored group of pupils was instructed on the eventual possibilities of correcting individual shortcomings, focusing in particular on improvement or stopping additional progress of incorrect body posture of the pupils, as well as the need for an activity affecting the physical

development of pupils within the physical education classes and physical activities of pupils throughout their daily regime.

Based on the findings listed above, an exercise program with music and dance activities can be considered a highly effective tool. Its regular application can contribute to the proper body posture of pupils, which is in line with the latest WHO (2020) recommendations aimed to form the right exercise habits and improve children's health, which is a common goal of society.

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Conflicts of interest *The authors declare that there is no conflict of interest.*

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