

Possible Factors to Pre-School Children's Irregular Posture Formation

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ABSTRACT

Background. A review of the health and physical activity of children and teenagers in Lithuania over the last twenty years has shown that many aspects of pupil physical capacity have deteriorated between 1992 and 2012 (Venckunas, Emeljanovas, Mieziene, & Volbekiene, 2017). Also research has shown that musculoskeletal disorders were most commonly found in children aged 4 to 6 years (Daniusevičiūtė-Brazaitė & Grėbliauskienė, 2019). Therefore, if these negative trends continue, the growing health problems will pose a greater threat to human well-being and become a serious financial burden for the state and society. Currently technologies are an integral part of everyday life, so the need for interactive games or animated programs cannot be doubted. Research (Lobel, Engels, Stone, Burk, & Granic, 2017) has shown that the use of play-based intervention for children significantly improves fine and visual motor performance. Hence, it is important to identify the possible factors affecting pre-school children's irregular posture formation.

Methods. The study included 377 preschool children from 4 to 6 years old. Three evaluations were performed in the study: posture (using W. K. Hoeger posture assessment methodology), abdominal and back muscle endurance, and balance (Arcinavičius, Kesminas, & Milčarek, 2004).

Results. Assessing the results of the shoulder position of 5-year-old children, results showed that only 16% had good shoulder posture, satisfactory – 74%, bad – 10%. Age was found to have no effect on posture assessment results. According to the study, balance, back, and abdominal functional capacity were better in 6-year-old children.

Conclusion. After analyzing 4-year old children group torso, abdomen, lower spine and legs, we can see that a higher percentage of children had a satisfactory posture in the aforementioned body parts. According to the posture results, the most abnormal part of the body was the abdomen. The study data showed that 6-year-old subjects' balance, lower spine and abdominal performance were better compared to other age groups.

Keywords: preschool child, physical activity, posture.

INTRODUCTION

Technological progress and the rapid development of their easier accessibility make no doubt about the need of interactive games and animated programs in the society. Interactive video games are becoming more realistic and more accessible. The success of video games or animated programs as a physical therapy tool is associated with increased engagement and motivation, i.e. video games complement routine and repetitive tasks, resulting in significant improvement in the therapeutic outcome (Hayes & Silberman, 2007). Research has shown that the use

of play-based intervention for children significantly improves fine and visual motor performance (Lobel et al., 2017). Lithuanian Health 2014–2025-year program (2014) had the following goals for developing competence in child health protection: to form healthy lifestyle and culture, to ensure optimal physical activity conditions for preschool children, safe and healthy living in kindergarten and public space environment.

Researchers have already agreed that the interactive video games are effective tools to be physically active (Macanovic & Momčinovic-Gajic,

2010). Not only the muscles but also the brain, especially the space-evaluating cells that are located in the hippocampus, are trained during complex exercises (Dishman et al., 2006). This is why complex preschool exercises that combine motor and minor motor development improves better speech and writing functions, the coordinated movements which are combined with smooth functioning of hands, feet, and eyes, also improves attention focus and better concentration (Visagurskienė & Grigonienė, 2016). The research results showed that 35.4% of all pre-school children were healthy who were screened prophylactically in 2018/2019 school years in Kaunas city and the proportion of perfectly healthy children decreased with increasing age (Daniusevičiūtė-Brazaitė & Grėbliauskienė, 2019). A review of the health and physical performance of children and teenagers in Lithuania over the last twenty years has shown that many aspects of pupil physical fitness deteriorated between 1992 and 2012 (Venckunas et al., 2017). Negative trends were observed already in 2002, but over the next decade, the results of physical preparation deteriorated further (Venckunas et al., 2017). The results of the preschool medical conditions study showed that the major defects were visual, musculoskeletal and speech defects (Daniusevičiūtė-Brazaitė & Grėbliauskienė, 2019). Musculoskeletal disorders were most commonly found in children aged 4 to 6 years (Daniusevičiūtė-Brazaitė & Grėbliauskienė, 2019). All the aforementioned health conditions lead to a pre-existing risk of health problems in adult life. Therefore, if these negative trends endure, health problems that are prematurely present will pose a greater threat to people's well-being and also will pose a significant financial burden on the state and society.

This study has been motivated by the need to explore some of the challenges and related opportunities at the intersection of the rising skeletal muscle disorders in children, and the growing role of gamification and learnification using innovative technologies in recent years. While there is some early evidence of the positive impact of video games on fine motor skills in children (Lobel et al., 2017), the mechanisms underlying these improved outcomes are yet to be understood. Hence, it is important to identify the possible factors to pre-school children's irregular posture formation. Insufficient back muscle tone of 6–7-year-old children does not guarantee stable spin curves (Davison & Jago, 2009).

The aim of the current study was to identify the possible factors to 4–6-year-old children's irregular posture formation.

METHODS

Organization of research. Data about subjects. The study involved 377 preschool children. The age distribution of the study subjects was very similar: 6 years, $n = 129$, 5 years, $n = 121$, 4 years, $n = 127$. After the evaluation, the gender distribution of the subjects revealed that 49% were girls and 51% boys. The subjects' average body weight was 18.9 ± 0.87 kg and average height was 110 ± 0.92 cm.

Posture Assessment by W. K. Hoeger. Using the W. K. Hoeger Posture Assessment Methodology, deviations from the norm are assessed by scoring in registration protocol (Arcinavicius et al., 2004). Individual body segments are evaluated in the frontal and sagittal planes. This method initially evaluates individual body parts: head, shoulders, spine, pelvis, knees, ankle in the frontal plane, and the position of the neck, upper spine, torso, abdomen, lower spine in the sagittal plane. Each individual body position is evaluated by scoring, which is summed up as a result of the whole body assessment in the prescribed questionnaire. Depending on the sum of the scores, body posture is evaluated as excellent, good, satisfactory, bad, very bad (Arcinavicius et al., 2004).

Evaluation of static strength endurance of abdominal and back muscles. To determine the endurance of the static strength of the dorsal muscles, the subject rests face down on the gym bench with the hip joints above the end of the bench, arms flanked or strapped behind the head, and the subject presses on the bench. The length of time the subject is able to hold the body in a horizontal position is recorded (Visagurskienė & Grigonienė, 2016). When testing the endurance of the static force of the abdominal press, the subject sits on the mat, the back is straight, the fingers are behind the head or the hands are on the chest, legs are held and bent at 90 degrees with the whole foot resting on the mat. From this position, the torso is raised. The length of time the subject is able to hold the body in this position is recorded (Visagurskienė & Grigonienė, 2016).

Flamingo balance test. The Flamingo test allows us to conclude the effectiveness of physiotherapy in children with abnormal posture. It was done with the child standing with one foot on the boom (length

50cm, height 4cm, width 3cm), trying to keep balance as long as possible (while the other leg is bent). The researcher chose the leg to stand depending on whether there was a right-handed or left-handed person. This position had to be maintained for one minute when the child released the investigator's hand. Each time the subject lost balance and put his/her foot upright and knees bent, the chronometer stopped. After each loss of balance, the movement was repeated initially until one minute elapsed. The total number of falls or loss of balance in 60 seconds was recorded (Gruodytė-Račienė, Rutkauskaitė, & Miežienė, 2018).

The Windows software SPSS 19.0 was used for statistical analysis.

RESULTS

The results showed that 98 children (50 scores) had an excellent posture according to W. K. Hoeger method, 207 children – good posture (40–44 scores), 67 children – satisfactory posture (30–39 scores) and 5 children – bad posture (20–29 scores). According to our results no child had a very bad posture.

Comparing the study data with all three age groups (Table 1), the posture assessment results slightly differed between ages.

Table 1. Results of posture assessment by age of subjects

	4 years (%)	5 years (%)	6 years (%)
Excellent	37	41	43
Good	49	45	47
Satisfactory	13	12	10
Bad	1	0	0

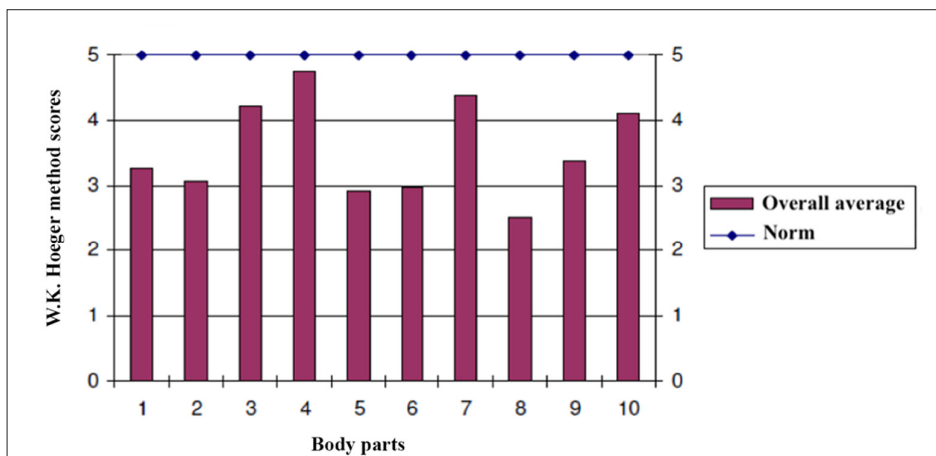
According to the assessment results of 54 children' individual body parts by W. K. Hoeger method the most abnormal part of the body was the abdomen. Children with satisfactory or bad posture had an average abdominal rating of less than 3. The head, shoulders, knees and ankles, neck and upper spine, and lower spine were rated at an average of 3 points. The spine, pelvis, torso, and legs were scored more than 4 points. The pelvis was closest to the norm – pelvis was rated 4.7 points on average (Figure).

According to the 4-year-olds' posture assessment results, the majority of children had a good head (79%), shoulders (71%), neck and upper body (82%) posture. The 5-year-olds had a similar head, neck and upper spine scores (good posture – head (79%), shoulders (only 16%), neck and upper body (88%). However, when evaluating shoulder position results of 5-year-olds, the results showed that only 16% had good shoulder posture, 74% had satisfactory shoulder posture and 10% – bad posture. According to the 6-year-olds posture assessment results, the majority of children had a good head (79%), shoulders (57%), neck and upper body (64%) posture (Table 2).

According to the 4-year-olds' spinal positioning results, children had good (76%), satisfactory (72%) and bad (7%) spine position. Children of the same age had good pelvis (88%), knee and ankle (67%) position. Looking at the 5-year-olds' spine, pelvis, knee, and ankle position results, children had a good spine (83%), pelvis (16%), knee and ankle (67%). Looking at the spine, pelvis, knee and ankle position results for 6-year-old children, they had only satisfactory spine (58%), pelvis (58%), knee and ankle (75%) positions (Table 3).

According to the 4-year-olds' torso, abdomen, lower spine and leg positioning results, children had

Figure. Assessment of individual body parts of children with abnormal posture by W. K. Hoeger Method



Note. 1 – head, 2 – shoulders, 3 – spine, 4 – pelvis, 5 – knees and ankles, 6 – neck and upper spine, 7 – waist, 8 – abdomen, 9 – lower spine, 10 – legs.

Table 2. Analysis of head, shoulders, neck and upper spine in the age group of 4–6-year-old children

	Head position (in frontal plane, %)			Shoulder position (in frontal plane; number, %)			Neck and upper spine (in sagittal plane, number, %)		
	4 years	5 years	6 years	4 years	5 years	6 years	4 years	5 years	6 years
Good	79	79	79	71	16	57	82	88	64
Satisfactory	21	21	21	29	74	43	18	12	36
Bad	0	0	0	0	10	0	0	0	0

Table 3. Analysis of spine, pelvis, knee and ankle in the age group 4–6-year-old children

	Spine position (in frontal plane, %)			Pelvis position (in frontal plane, %)			Knee and ankle position (in frontal plane, %)		
	4 years	5 years	6 years	4 years	5 years	6 years	4 years	5 years	6 years
Good	76	83	42	88	16	42	65	67	25
Satisfactory	17	7	58	12	74	58	35	29	75
Bad	7	10	0	0	10	0	0	4	0

Table 4. Analysis of position of torso, abdomen, lower spine and legs in the age group 4–6-year-old children (%)

	Torso position (in sagittal plane, %)			Abdomen position (in sagittal plane, %)			Lower spine position (in sagittal plane, %)			Legs position (in sagittal plane, %)		
	4 years	5 years	6 years	4 years	5 years	6 years	4 years	5 years	6 years	4 years	5 years	6 years
Good	24	67	64	7	21	36	18	42	64	18	29	50
Satisfactory	76	33	36	93	68	64	82	54	29	82	54	43
Bad	0	0	0	0	11	0	0	4	7	0	17	7

a satisfactory torso (76%), abdomen (93%), lower spine (82%) and leg (82%) position. Assessing the 5-year-olds torso, abdomen, lower spine and leg positioning results, children had a good torso (67%) position, but the abdomen (68%), lower spine (54%) and leg (54%) positions were only satisfactory (Table 4). After analyzing 4-year-old children's torso, abdomen, lower spine and leg results, the higher percentage of children had a satisfactory posture in the aforementioned body parts.

The static back muscle strength endurance, abdominal and Flamingo test results showed that 4-year-olds' back muscle static strength endurance test result was 34 seconds, the abdomen – 29 seconds and the Flamingo test result – 25 falls. Accordingly, the 5-year age group results: static back muscle strength endurance was 22 seconds on average, the abdomen – 20 seconds and the Flamingo test result – 20 falls; for 6-year-olds, the static back muscle strength endurance was 17

seconds on average, the abdomen – 16 seconds, and the Flamingo test result – 15 falls.

There was a weak but significant correlation between age and back muscle static strength endurance results. Also the medium significant correlation was found between age and abdomen results. There was no statistically significant correlation between age and balance results.

DISCUSSION

Insufficient back muscle tone of 6–7-year-old children does not guarantee stable spin curves (Davison & Jago, 2009). The preschool children's posture is an important society problem that attracts the scientists' interest (Okely, Trost, Steele, Cliff, & Mickle, 2009), when posture is formed during the pre-school period and taking into account fine motor skill peculiarities, it is possible to ensure the optimal movement function (Rodger & Vishram, 2010). It is known that during the corrective exercises

(physiotherapy), the whole movement system improves when the neck, shoulders, abdomen, back and hips are strengthened, also it improves speed, strength, endurance, mobility, the muscles engaging into the work, metabolic circulation and reduces pain (Macanovic & Momčinovic-Gajic, 2010). Using gaming interventions on fine motor skills with vision-related motor skills is absolutely useful (Lobel et al., 2017). Attention for preschool children's posture formation is increasing. The researchers (Mockevičienė, Vaitkevičius, & Židonienė, 2003), when examining the peculiarities of children's growth and posture development, did not point out significant differences between the gender and age. The results of our study showed that children's age also did not affect the formation of irregular posture. Mockevičienė and other researchers (2003) showed that many children with poor posture had weak abdominal muscles, stretched muscles in the legs, flat back, a variety of foot deformities, and others. These results are partly confirmed by our research. The results of the study showed that the largest disorders were observed in the knees and ankles, neck and upper spine, and abdominal muscles. Mockevičienė and other researchers (2003) showed that weak abdominal muscles were largely influenced by irregular posture.

After analyzing currently research data of the 4-year-old children group's torso, abdomen, lower spine and legs, we can see that a higher percentage of children had a satisfactory posture in these body parts. Summing up the posture results, we can state that the most abnormal part of the body is the abdomen. Also the current study data showed that 6-year-old subjects' balance, lower spine and abdominal performance were better according to other age groups. According to research, children

should use a targeted physiotherapy program as a preventive measure to avoid postural and fine motor skills disorders (Dobbins, Corby, Robeson, Husson, & Tirilis, 2009). Researchers state that the world of interactive video games is an effective way of being physically active (Macanovic & Momčinovic-Gajic, 2010). Animated game programs, where players-children create stories with beloved fairy tale or cartoon characters, create songs through playing activity and imagination, will motivate them to engage in a targeted physiotherapy program more as a preventive measure to avoid posture and fine motor skill disorders. The success of video games or animated programs as a way of physical therapy is associated with increased engagement and motivation (Hayes & Silberman, 2007). Nowadays the growing children with a wide range of technological capabilities (mobile phones, computers, interactive training tools, internet, etc.) are more confident, want attractive information that is more adapted to each person, want to see, hear, act and create in a real environment rather than watch movies or listen passively to the stories about the environment and memorize the information (Visagurskienė & Grigonienė, 2016).

CONCLUSIONS

1. After analyzing 4-year age children group torso, abdomen, lower spine and legs we can see that a higher percentage of children had a satisfactory posture in the aforementioned body parts. According to the posture results, the most abnormal part of the body was the abdomen.
2. The study data showed that 6-year-old subjects' balance, lower spine and abdominal performance were better compared to other age groups.

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