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Postural disorders in preschool children

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Abstract

The occurrence of spinal deformities during periods of rapid growth in children has been increasingly recognized as a significant issue within the broader community. This study aimed to evaluate the spinal posture during one of the most critical phases of physiological development in a specific group of preschool children. The research involved 153 preschool aged 4 to 6 years (mean age ± standard deviation: 4.6 ± 1.1 years) residing in Sarajevo. Postural assessment was conducted using the method proposed by Napoleon Wolanski (1975), which evaluates segmental relationships through the following parameters: head posture assessment (HPA), shoulder posture assessment (SPA), scapular posture assessment (SBPA), chest posture assessment (CPA), scoliotic posture evaluation (SCP), abdominal posture assessment (APA), leg posture assessment (LPA), and foot posture assessment (FPA). Deviations were categorized based on severity, assigned negative points as follows: 0 points for no deviation, 1 point for mild deviation, and 2 points for significant deviation. The associations between the eight parameters were analyzed using Spearman's correlation coefficient (rho). The highest degree of correlation was observed between the variables of abdominal posture assessment and head posture assessment (0.536). Poor abdominal posture, often linked to weakened core muscles or imbalances in the lumbar region, can result in compensatory shifts in the head and neck to preserve balance and visual orientation.

Keywords: *body posture, preschool children, correlation coefficients*

Introduction

Today the lifestyle of young people is characterized by lack of motion, in fact it becomes more sedentary. Almost one third of the children spend more than 4 hours a day sitting by the TV (Marshall, Gorely and Biddle, 2006). A special problem is the fact that the number of children with posture problems is increasing every year (Lafond et al., 2007). Correct body posture plays a vital role in human health. It has been proposed that ideal upright posture is a sign of musculoskeletal health and is one of key indicators of health of the movement system (Tutsuni et al.,2019). It is therefore understandable that deviations in human posture could have detrimental effects on health. For example, it has been shown that postural changes associated with aging could lead to an increased risk of falls. An increased risk of falls was observed in those with a decreased lumbar lordosis, increased sagittal vertical axis and increased horizontal distance between the C7 plumb line and the centre of the ankle (Silman et al.,1910). Any deviation from the normal degree of spinal curvature is considered a deformity (Torlakovic et al., 2013). The motor and sensory systems responsible for postural stability undergo a transition between the ages of four and six, reaching adult maturity between seven and ten years (Lafond, Descarreaux, Normand, & Harrison, 2007). The posture of a preschool-aged child serves as a valuable indicator of their current growth, development, and overall health, while also providing insights into the future health of their spine. Modern lifestyles present numerous challenges, emphasizing the need to incorporate fundamental motor activities from an early age to ensure adequate muscle development and support. Identifying postural disorders is of utmost importance, particularly during preschool years. Any people, especially children, suffer from spinal deformities caused by congenital malformations, certain degenerative diseases, spinal trauma, but especially caused by poor posture formed from the childhood (Łubkowska et al., 2014; Stoychevski, 2021). It is thought that poor posture is becom-

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ing more and more common in society because of changes in human physical activities brought about using technology in modern lifestyles (Jung at el. 2016). This is because early formation of a "good posture pattern" created in early childhood not only contributes to proper growth and development but also positively impacts long-term health and quality of life (Protić-Gava & Krneta, 2010). Children are engaging less in play and physical activity, such as sports, while spending more time in passive positions, sitting or lying down (Cvetković & Perić, 2009). The prevalence of poor posture among children during their sensitive growth phases has been significantly documented in studies by various authors, particularly in preschool and early school-aged children. The aim of this study was to determine the interrelationship of variables assessing deviations from normal posture in the head, shoulders, scapulae, spine, abdomen, legs, and feet among preschool-aged boys and girls. It is assumed that all variables will demonstrate a certain degree of intercorrelation, as the identification of deviations from correct posture in the examined body segments serves as an indicator of potential issues related to overall postural alignment.

Methods

Participants

The sample consisted of 153 preschool children aged 4-6 years (SD=1.1 years) living in Sarajevo and were tested in the preschool institution during their stay there. The descriptive statistics are presented in the Table 1. The height of the children ranged from 91.0 cm to 126.0 cm, with an average height of 111.912 cm (SD = 7.3005). The body weight ranged from 10 kg to 37 kg, with an average weight of 20.22 kg (SD = 4.706). The Body Mass Index (BMI) ranged from 9.79 to 24.46, with a mean value of 15.9933 (SD = 2.44068). All 153 participants were included in the analysis without any missing data, as indicated by the Valid N (listwise). The assessment of children's posture was conducted with parental written consent and by two experts, with bachelor's degree in sports and physical education, one male and one female. The testing of children was done individually and in a separate room. Legal guardians were asked to sign a written contest declaring allowance to participate in research and confirming absence of injuries and medical condition that may compromise health. All procedures were conducted according to Helsinki declaration with permission of local Ethical Committee.

Table 1. Descriptive Statistics of the preschool participants subjected to the assessment of body posture (n=153)

	Minimum	Maximum	Mean	SD
Height (cm)	91.0	126.0	111.91	7.30
Body mass (kg)	10	37	20.22	4.71
BMI (kg/m^2)	9.79	24.46	15.99	2.44

Procedures

The measurement was conducted in the morning hours after breakfast. The room temperature was maintained at 22°C. Children were accompanied by educators who assisted them in changing into their underwear. Male children were examined by a male kinesiologist, while female children were examined in a separate room by a female kinesiologist. During individual assessments, children wore only underwear and were visually observed in frontal and sagittal planes. They then performed a forward bend and gradual return to the starting position to analyze the alignment of the spinal column. Each child received a specific demonstration of the required movements before standing in front of the kinesiologist. To evaluate the postural status, we used a reduced Napoleon Wolanski method (Wolansky, 1975). As part of that evaluation, we used 8 variables (Table 2.) for the observed body parts: assessment of head posture (HPA), assessment of shoulder posture (SPA), assessment of scapular posture (SBPA), assessment of chest posture (CPA), scoliotic posture (SCP), assessment of abdominal posture (APA), assessment of leg posture (LPA), and assessment of foot posture (FPA). Table 3 presents posture assessment according to N.Wolanski deviations and were categorized based on severity, assigned negative points as follows: 0 points for no deviation, 1 point for mild deviation, and 2 points for significant deviation.

Table 2. Sample of variables

	Variables
HPA	Assessment of head posture
SPA	Assessment of shoulder posture
SBPA	Assessment of shoulder blade posture
CPA	Assessment of chest posture
SCP	Scoliotic posture
APA	Assessment of abdominal posture
LPA	Assessment of leg posture
FPA	Assessment of foot posture

Table 3. Posture assessment according to N.Wolanski

Score	Degree of deviation from proper posture
0	No deviation
1	Partial deviation
2	Extreme deviation

Statistical analysis

Data are presented as Mean ± SD or correlation level. Prior to the statistical procedure, data were systematized in Excell sheet according to the variables and gender structure. The associations between the eight parameters of posture deformities were analyzed using Spearman's correlation coefficient ρ (rho). Correlations (positive or negative rho values) were defined as follows: >0.90, very strong; 0.70 to 0.89, strong; 0.50 to 0.69, moderate; 0.30 to 0.49, weak; <0.30, little or no correlation. All data were analyzed using SPSS 21.0 software (IBM, Corp.) for statistical analysis. Statistical significance was set at $p<0.05$.

Results

Table 4 presents the Spearman correlation coefficients, with the highest degree of correlation observed between abdominal posture assessment and head posture assessment (0.536). Poor abdominal posture, often linked to weakened core muscles or imbalances in the lumbar region, can result in compensatory shifts in the head and neck to preserve balance and visual orientation. Analyzing the remaining variables revealed lower correlations between the following variables: Assessment of shoulder posture and assessment of head posture (0.441), assessment of leg posture and assessment of head posture (0.438), assessment of chest posture and assessment of shoulder blade posture (0.432), scoliotic posture and assessment of abdominal posture (0.388), assessment of shoulder blade posture and assessment of head posture (0.389), assessment of leg posture and assessment of foot posture (0.360), scoliotic posture and assessment of head posture (0.359), assessment of shoulder posture and shoulder blade posture (0.344), assessment of chest posture and assessment of head posture (0.323), assessment of abdominal posture and assessment of chest posture (0.307), and scoliotic posture and assessment of foot posture (0.301).

Table 4. Spearman correlation coefficients between different posture body segments

	HPA	SPA	CPA	SBPA	SCP	APA	LPA	FPA
Assessment of head posture	1.000	0.441**	0.323**	0.389**	0.359**	0.536**	0.400**	0.438**
Assessment of shoulder posture	0.441**	1.000	0.221**	0.344**	0.270**	0.201*	0.239**	0.267**
Assessment of chest posture	0.323**	0.221**	1.000	0.432**	0.156	0.307**	0.195*	0.202*
Assessment of shoulder blade posture	0.389**	0.344**	0.432**	1.000	0.230**	0.240**	0.201*	0.182*
Scoliotic posture	0.359**	0.270**	0.156	0.230**	1.000	0.388**	0.216**	0.301**
Assessment of abdominal posture	0.536**	0.201*	0.307**	0.240**	0.388**	1.000	0.190*	0.369**
Assessment of leg posture	0.400**	0.239**	0.195*	0.201*	0.216**	0.190*	1.000	0.360**
Assessment of feet posture	0.438**	0.267**	0.202*	0.182*	0.301**	0.369**	0.360**	1.000

Abbreviations are related and explained in table 2

Discussion

A correlation was observed between abdominal posture and head posture (0.536), suggesting a moderate connection. This means that deviations in abdominal posture can significantly impact head posture, and there is a high probability that modern lifestyle, and consequently the way children spend their time, causes certain conditions. These conditions are often unfavourable for health, as they do not positively contribute to strengthening the musculature that supports the spine and, in turn, proper body posture. The number of hours spent in a seated position by children and adolescents, both at home and at school, continues to rise (Lafond, Descarreaux, Normand, and Harrison, 2007). This relationship likely arises from the interconnection between the core muscles and the cervical spine in maintaining overall body alignment. Poor abdominal posture, often associated with weakened core muscles or imbalance in the lumbar region, can result in compensatory shifts in the head and neck to maintain balance and visual orientation. These findings emphasize the importance of strengthening the stability of the core and abdominal muscles in early interventions aimed at improving or maintaining proper head posture. It is estimated that more than 60% of schoolchildren and adolescents have postural disorders (Jovović, 1999; Radisavljević, Koturović, and Aranđelović, 1982). The established connection between the head and shoulders (correlation coefficient 0.441) points to the degree of kyphotic posture, characterized by rounded shoulders forward, with the nose protruding in front of the sternum (chest bone). This can be integrated with the connection between the head and abdomen, as both correlations equally point to the same issue. The American Orthopedic Association reports an annual incidence of musculoskeletal abnormalities in 9.6 million children under the age of 19 (Sudo H., Kokabu T., Abe Y., 2007). The correlation results also detect connections between scoliosis posture and the head, abdomen, and feet. This can rely on the kinetic chain, where irregularities in one body region cause compensations in other areas. The head plays a key role in maintaining balance and aligning with the lower extremities. The muscles of the neck and head are synchronized with the control of the entire body via neural pathways, the vestibular system, and the proprioceptive system. The presence of a connection between the head and feet also suggests that the feet serve as the primary base for body balance, and their interaction with the head is crucial for maintaining proper body posture. Furthermore, this relationship underscores the need for a holistic approach to body posture assessment, as imbalance in one segment of the body can trigger compensatory changes in other areas. Prognosis for scoliosis is generally worse the earlier it develops. Postural scoliosis can lead to actual scoliosis with bone deformities, but this is rare, especially when physical exercises are properly performed, reducing the chance of progression into true scoliosis (Adams et al., 2001). Children are less active, and the atrophied musculature of the abdominal region contributes to the development of increased lordosis, while the opposing muscle groups are stretched, further exacerbating poor posture. Poor lordotic posture in preschoolers is present in about 40% of cases, indicating a growing trend of inactivity in this population. This may result from prolonged improper sitting, which weakens the abdominal muscles (Romanov et al., 2014). Foot deformities, especially flat feet, were identified in 60% of participants. No statistically significant differences were found between genders (Romanov et al., 2014). Paušić (2005) conducted a longitudinal study on a sample of 7-year-old children who had just started school. In the first grade, 51.58% of children had asymmetry in their posture indicators. One year later, this percentage increased to 62.1%. In the first grade, it was shown that 28.4% of children had chest deformities, and after one year,

this percentage increased to 51.6%. It was also suggested that prescribing physical activities could correct some postural abnormalities, including spinal scoliosis, forward head posture, increased lumbar lordosis (Dimitrijević et al., 2022), or knee deformities (Dadfar et al., 2022). Fallen arches in children were present in 47.3% in the first grade, and 60.7% of children in the second grade. A recent scientific study showed two key points: preschoolers indeed show deviations from proper body, spine, leg, and foot development, but these issues can be minimized through swimming (Vranešić-Hadžimehmedović et al., 2024). These findings emphasize the importance of strengthening core stability and abdominal muscles in early interventions aimed at improving or maintaining proper head posture first, and then other parts of the body that follow the integrated system, where different segments influence each other through interconnected muscle chains, ligaments, and joints.

Limitations of the study

Insufficient attention was given to gender differences, and the integration of the results obtained, which were observed as such, could be a barrier to obtaining a more precise perspective of the differences in correlations of the individual treated variables between the female and male populations. The measurements could have been expanded to include standard poor posture types such as kyphotic, lordotic, and scoliotic postures, and their correlation with specific parts of the body. Finally, a larger sample from more different preschools would likely yield more reliable results, but the selection, in that case, of institutions based on their location in urban and less urban areas of Sarajevo, could provide useful information.

Recommendations for future research

The current study should be supplemented with suggestions from the limitations chapter and expanded to different age groups of children and adolescents, as well as to other cantons in the Federation of Bosnia and Herzegovina. The measurements should be conducted using a more precise method that applies new technologies, such as Spine Posture Analysis with Spinal Mouse and 3D optical systems. The alignment of the feet should be assessed using a plantograph for more accurate results and data, which could then be correlated with other parts of the body. Future research could also explore whether targeted strengthening and corrective exercises for the abdominal region might lead to measurable improvements in head posture alignment in preschool-aged children.

Conclusion

The results of this study reveal significant correlations between different postural components in children, with the most notable finding being the moderate correlation between abdominal and head posture (0.536). This suggests that deviations in abdominal posture, commonly linked to weak core muscles or imbalances in the lumbar region, can have a substantial impact on head posture. The growing trend of sedentary behaviour among children, coupled with increased screen time, appears to contribute to postural disorders, with consequences for overall health. Our findings highlight the importance of early interventions aimed at strengthening core muscles and improving abdominal posture, as they could play a crucial role in correcting or preventing head and spine misalignments.

Additionally, the study identified several correlations among other postural areas, such as the connection between head and shoulder posture (0.441) and between foot and leg posture (0.360), suggesting that postural abnormalities in one body segment may lead to compensatory changes in other areas due to the interconnected nature of the musculoskeletal system. These results underline the need for a holistic approach when assessing and addressing postural imbalances, as focusing solely on one area may not be sufficient for optimal outcomes.

Given the limitations, including the lack of focus on gender differences and the small sample size, future research should expand on these findings by incorporating larger, more diverse samples from different regions. It is also recommended that more precise measurement methods, such as Spine Posture Analysis and plantography, be employed for greater accuracy. Further investigation into the effects of specific corrective exercises, especially targeting the abdominal region, on improving overall posture, particularly head alignment, is essential for refining postural health interventions for children.

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