

# Postural state of preschoolers on territory of Ružomberok and Martin, Slovakia

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**Abstract.** Postural disorders are the current problems of the present time and can be monitored in each age group and today they are not rare even among pre-schoolers. Untreated postural disorders can cause spinal deformity, pain, neurological symptoms or disorders of movement patterns. It is therefore extremely important to monitor and assess their occurrence as early as in pre-school age, when posture is still developing and taking the form and, if irregularities are found, take relevant preventive measures. This is the reason we conducted the assessment of posture among pre-schoolers. Within the project Healthy little back carried out in Ružomberok and Martin we examined 111 pre-schoolers aged 5–6. Their posture was assessed using aspxia. The aim of the examination was to determine the posture of body parts and then assess the overall posture. To assess the posture we used a modified methodology of Napoleon Wolanski. Results: 48.65% pre-schoolers with physiologic posture, 36.94% with initial postural disorder and 14.41% with serious postural disorders. Less than half of pre-schoolers have physiological posture and it is therefore necessary to implement preventive measures and programs in kindergartens to avoid the situation to worsen.

**Key words:** postural state, postural disorders, preschoolers, body segments position.

## 1 Introduction

Posture is defined as active position of body segments against external forces, especially gravity. It is part of any position and it is the fundament of movement. It is body position when the joint is correctly centred and is reinforced through a coordinated muscle activity. Muscle balance is a prerequisite for achieving good (physiological) posture and coordinated movement occurs [1].

Good posture is the state of muscular and skeletal balance that protects the body structures from injury or progressive deformity regardless of the attitude (erect, lying, stooping, bending), in which these structures are working or resting [2]. Proper posture does not only ensure proper function of the musculoskeletal system, but also creates conditions for the optimal functioning of internal organs stored in the thoracic and abdominal cavities [3]. When keeping a physiological posture, different segments of the body are in balanced mutual arrangement. Thus, the curvatures of the spine do not exceed normal values, the chest is regularly developed, no deformities can be noticed in lower limbs (no arches) and feet have fully formed longitudinal and transverse arch [3]. The head is in the proper posture in the extended centre line of the body, the neck at the right angle. The arms are lowered backward

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and down, the shoulder blades symmetrical and close to the body. Tails are symmetrical, arms loosely positioned next to the trunk and the pelvis symmetrical in the frontal plane and in a neutral position in the sagittal plane [1].

The correct posture is affected by endogenous factors (heredity, birth defects) and exogenous factors (lack of varied physical activity, long-term sitting at the computer, TV, etc.), which undermine the proper development and cause various disorders. Since endogenous and exogenous factors influence the human body from birth, postural disorders can be observed at any age.

In this study we assessed what the posture is like in pre-schoolers nowadays.

## 2 Methodology

The aim of our study was to find out whether and to what extent posture disorders occur in pre-schoolers, and to evaluate body segments position that directly influences body posture. Posture analysis have been carried out via the project “Healthy little back” under the auspices of the National Sports Centre and the Ministry of Education, Science, Research and Sports of the Slovak Republic. Pre-schoolers were examined in 2015 and 2016. We examined 111 pre-schoolers (50 boys and 51 girls) aged 5 and 6 in the towns of Ružomberok and Martin, Slovakia. According to data published at the Statistical Office of the Slovak Republic [4] and the Ministry of Education, Science, Research and Sports of the Slovak Republic [5], 159 081 pre-school children were registered in Slovakia. The average number of pupils in the class was 19.8. In the Žilina Region, which includes towns Ružomberok and Martin, 21 860 pre-school children were registered. According to Department of Education in the cities of Ružomberok and Martin, the number of pre-schoolers (age 5–6) in both cities was 877. The sample of our study consists of 111 pre-schoolers. Pre-schoolers in our study were without any neurological, orthopaedic, vestibular and other congenital or acquired disorders. These were randomly selected pre-schoolers. To evaluate posture, we used modified Napoleon Wolanski scale. When assessing the posture, respondents were barefoot and in their underwear. There was 1 metre distance between the child and the assessor. We observed 9 body segments: head position, shoulders and shoulder blades position, chest shape, pelvis position, cervical spinal curvature, thoracic spinal curvature, lumbar spinal curvature and arch of the foot. The position of segments was evaluated by number 0 to 3. Physiological position of body segments was numbered by 0, slight incorrect position was numbered by 1 and number 2 means major deviations from the norm (very bad segment position). Points are added up and the overall score is thus calculated. Basing on the total, the respondents were divided into 3 postural categories. The lower the score, the better posture and vice versa [6, 7]. As the Wolanski methodology does not include the assessment of certain segments that we wanted to include in the study (it does not include the pelvis position and also does not assess individual curvature of the spine separately), we modified it. We have also modified criteria for dividing pre-schoolers in posture categories:

**Category A** – body posture score between 0 to 4 points in total. When evaluating the segments, only shoulders, shoulder blades and the arch of the foot position could be assessed within 0, 1 and 2. Other segments had to have the value of 0 or 1.

**Category B** (initial posture disorders) – score between 5 to 12 points. In this category only the shoulders, shoulder blades and the arch of the foot could be assessed within 0, 1 to 2 points, while the other segments had to have the value of 0 or 1.

**Category C** (serious disorders) – score 13 to 18 points, or even in the case that the total of points for the segments is less than 13, but the child was assessed with 2 points from any given reference segments (except shoulders, shoulder blades and arch of the foot).

**Table 1.** Head position.

<b>Head position (n = 111)</b>		
Value	No. of children	%
0	73	65.77
1	38	34.23
2	0	0

**Table 2.** Shoulders position.

<b>Shoulder position (n = 111)</b>		
Value	No. of children	%
0	23	20.72
1	88	79.28
2	0	0

**Table 3.** Shoulder blades position.

<b>Shoulder blades position (n = 111)</b>		
Value	No. of children	%
0	22	19.82
1	89	80.18
2	0	0

**Table 4.** Chest shape.

<b>Chest shape (n = 111)</b>		
Value	No. of children	%
0	97	87.39
1	13	11.71
2	1	0.9

The results were processed in MS Excel and are expressed in tables.

### 3 Results

Table 1 provides an assessment of the head posture. Out of 111 pre-schoolers 73 (65.77%) had a correct head posture, in 38 pre-schoolers (34.23%) the head was slightly advanced. We found no significant advances of the head.

Table 2 shows the results in assessment of the position of shoulders. Physiological position was assessed in 23 students (20.72%). Mild ante-version was observed in 88 pre-schoolers (79.28%). No significant ante-version has been observed.

As shown in Table 3, 22 pre-schoolers (19.82%) had physiological position of the shoulder blades, which means that they were close to the body with their edges not protruding. 89 studied pre-schoolers (80.18%) had slightly protruding shoulder blades. Significant protruding has not been observed in any of the pre-schoolers.

Table 4 shows the shape of the chest. Physiological shape of the chest was observed in 97 pre-schoolers (87.39%). A slight deformity of the chest under expiratory position was observed in 13 pre-schoolers, representing 11.71%. Severe deformity of the chest, where we observed inverted sternum was observed in 1 case (0.9%).

Table 5 presents the results of examination of the pelvis in the sagittal plane. 57 pre-schoolers (51.35%) had the pelvis in the sagittal plane in the basic position. 54 pre-schoolers (48.65%) had a mild pelvic anteversion. We did not observe any significant pelvis anteversion, or pelvic retroversion.

**Table 5.** Pelvis in sagittal position.

<b>Pelvis position (n = 111)</b>		
Value	No. of children	%
0	57	51.35
1	54	48.65
2	0	0

**Table 6.** Cervical spine curvature.

<b>Cervical spine curvature (n = 111)</b>		
Value	No. of children	%
0	84	75.68
1	26	23.42
2	1	0.9

**Table 7.** Thoracic spine curvature.

<b>Thoracic spine curvature (n = 111)</b>		
Value	No. of children	%
0	69	62.16
1	32	28.83
2	10	9.01

**Table 8.** Lumbar spine curvature.

<b>Lumbar spine curvature (n = 111)</b>		
Value	No. of children	%
0	51	45.95
1	52	46.85
2	8	7.2

**Table 9.** Arch of the foot.

<b>Arch of the foot (n = 111)</b>		
Value	No. of children	%
0	35	31.53
1	76	68.47
2	0	0

Table 6 shows the state of the cervical spine curvature in pre-schoolers. We examined the impairments of the curvature in the sagittal plane. In the sagittal plane 84 pre-schoolers (75.68%) had a physiological curvature. 26 pre-schoolers (23.42%) had a slightly increased curvature of the first degree. 1 pre-schooler (0.9%) was assessed with significant hyperlordosis of the cervical spine.

Table 7 shows the state of the thoracic spine curvature. We followed the disorders in the sagittal plane. 69 pre-schoolers (62.16%) had a physiological curvature in the sagittal plane. 32 pre-schoolers (28.83%) had a slightly increased curvature of the thoracic spine of the first degree while 10 pre-schoolers (9.01%) had significant second-degree hyperkyphosis of the thoracic spine.

Table 8 shows the state of the lumbar spine curvature. We followed the disorders of the curvature in the sagittal plane. 51 pre-schoolers (45.95%) had had a physiological curvature in the sagittal plane. 52 pre-schoolers (46.85%) had a slightly increased curvature of the lumbar spine of the first degree. 8 pre-schoolers (7.2%) had a significant second-degree lumbar spine hyperlordosis.

**Table 10.** Overall posture assessment.

Category	Number (n = 111)	%
A	54	48.65
B	41	36.94
C	16	14.41

**Table 11.** Evaluation of body segments position.

Evaluation of body segments (the sum of mild and severe disorders)									
	Should. blades	Shoulders	Foot	Lumb. spine	Pelvis	Thor. spine	Head	Cervic. spine	Chest
No of children	89	88	76	60	54	42	38	27	14
%	80.18	79.28	68.47	54.05	48.65	37.84	34.23	24.32	12.61

The last observed segment was the arch of the foot. 35 pre-schoolers (31.53%) had a well-formed arch. 76 pre-schoolers (68.47%) had a slightly fallen arch. A significant flat foot, where almost the entire foot touches the floor, has not been observed.

Table 10 shows overall posture assessment and dividing pre-schoolers to postural categories depended on their postural state.

54 preschool children (48.65%) qualified for **category A** (physiological posture). These were the pre-schoolers, who scored between 0 to 4 points in total. When evaluating the segments, only shoulders, shoulder blades and the arch of the foot position could be assessed within 0 to 2. Other segments had to have the value of 0 or 1.

**Category B** (initial posture disorders) were pre-schoolers whose posture was assessed as slightly incorrect. In this category, we observed 41 pre-schoolers (36.94%) who scored between 5 to 12 points. In this category only the shoulders, shoulder blades and the arch of the foot could be assessed within 0 to 2 points, while the other segments had to have the value of 0 or 1.

**Category C** (serious disorders) were pre-schoolers with severe postural disorders. They were 16 in total that is 14.41%. Category C scored 13 to 19 points, or even in the case that the total of points for the segments is less than 13, but the child was assessed with 2 points from any given reference segments (except shoulders, shoulder blades and arch of the foot).

## 4 Discussion

Poor posture is civilization disease with an increasing tendency. Its occurrence can be seen more and more frequently in pre-school children. This issue has attracted interest of professionals from medical and non-medical fields, physical education, pedagogy and sport, since poor posture and posture disorders are frequent indicators of health problems in children [6]. Postural insufficiency in children is also considered as a risk of back pain [8]. Professionals describe poor posture as the pandemic of modern age. "Poor posture is one of the diagnosis, which falls into the category of posture disorders. It is a very topical issue as changes in posture, whether functional or later even structural are the pandemic of modern age." [9]. According to the results of our study, we can claim that postural disorders are serious problems of the children in preschool age. In our study, less than half of pre-schoolers (48.65%) had a physiologic posture and fell into category A. The remaining part of pre-schoolers (51.35%) had visible postural disorders. Of this group, 36.94% had initial postural disorders and were included in category B, while 14.41% of pre-schoolers had significant posture disorders and were included in category C. As the physiologic posture is result of proper segments position, we evaluated which body segments were in pathologic position and had negative influence to overall posture. Results are shown in Table 11.

Table 11 presents pathologic positions of body segments in pre-schoolers. Pathologic positions were results of the sum of mild disorders (numbered by 1) and severe disorders (numbered by 2). As we can see, we found postural disorders in all body segments that we observed. We found shoulder blades, shoulders, arches of the foot and lumbar spine curvatures as the most critical body segments. Pathological position of these body segments exceeded 50%. Pelvis position was also critical. We found deviations in 48.65% pre-schoolers. Less deviation (12.61%) was assessed in chest shape. Results of our study were compared with the result of authors dealing with the same issue in the other countries. Milišević, Obradović examined 379 pre-schoolers in Srbija. They found pathologic position in 8 body segments. Pathologic positions were found in: shoulder blades 70.44% (267 children), shoulders 69.4% (263 children), arches of the foot 68.39% (259 children), head 68.07% (258 children), abdomen 65.69% (250 children), lower extremities 41.95% (159 children), chest 24.54% (93 children) and back bone curvatures 19.77% (75 pre-schoolers)[6]. Sabo evaluated postural state in 1259 pre-schoolers in Novi Sad, Vojvodina. His results were the following: 828 (65.8%) pre-schoolers had pathologic position of the abdomen, pathologic position of shoulders was found in 659 (52.4%) pre-schoolers, incorrect position of shoulder blades was observed in 577 (45.9%) children, 553 (44%) pre-schoolers had pedes plani, 427 (33.9%) children had lower extremities deviation, 414 (32.9%) pre-school children had pathologic position of their head, 257 (20.4%) children had pathologic back bone curvatures and 110 (8.8%) children had chest deviation [10]. In the village of Berane, Montenegro observed posture and motor system in pre-schoolers and found disorders in 40.86% children [11]. 91 (64.53%) children of this group had pedes plani, chest deformities were found in 30 (21.27%) children, 10 (7.09%) children had scoliosis, 5 (3.54%) children had hyperkyphosis and 5 (3.54%) children had lower extremities deformities. In Belegrade, Srbija were examined 212 pre-schoolers and 99 (46.7%) of them had postural disorders [12].

Last but not the least we were interested in the state of the spine. We wanted to assess whether the position of the spine in pre-schoolers is impaired and which are the most critical sections of the spine. The best results were seen in the curvature of the cervical spine. Up to 75.68% of pre-schoolers had normal values. When we assessed the thoracic spine, 62.16% pre-schoolers had physiological curvature, 28% had mild hyperkyphosis and 9.01% pre-schoolers significant hyperkyphosis. The most serious impairment was observed in the lumbar spine segment, where only 45.95% pre-schoolers had physiological curvature, 46.85% had mild hyperlordosis and 7.2% had significant hyperlordosis. In thoracic and lumbar spine segment we observed deformity in the frontal plane – scoliosis. Nine pre-schoolers had scoliosis in thoracic segment while 8 in the lumbar segment. Milosevic, Obradović [6] examined the condition of the spine in 185 boys and 148 girls. Out of the 185 boys 28 had a slight curvature of the spine impairment which makes 15.1% and one had significant spinal deformity (0.5%). 45 out of 148 girls had a slight curvature of the spine impairment (23.2%) and one girl had a significant spinal deformity, which represents 0.5%. Romanov et al. [13] examined pre-schoolers in the territory of Novi Sad. They assessed postural disorders of the spine using computer technology Spine Scan. Based on the results they highlight the worrying situation concerning the spine in pre-schoolers, as in 70% they confirmed the impairments of the curvature of the spine. These impairments were recorded in the frontal as well as in the sagittal plane.

Postural disorders and spinal deformities are among the most common diseases in children and adolescence age [14]. The reason is reduced motor activity, prolonged staying in front of the computer, inappropriate diet, disproportionally long time spend in sitting compared to movements activities [14, 15]. Nowadays lifestyle of children and their families is characterised by the lack of motion, which is the reason for postural disorders development.

This phenomenon is described as modern population's hypokineses. Hypokineses, according to Romanov, is the time spent sitting or lying in front of a TV, computer, tablet or mobile phone but also driving children to kindergartens, using lifts, etc. [13]. Therefore, hypokineses leads to improper posture in childhood and become causes of health issues in adulthood.

According to professional literature, the frequency of postural disorders can be successfully reduced by the implementation of prevention programs in kindergartens. These programs should include daily health and corrective exercises, a variety of physical activities and games, practice gross motor skills, practicing proper sitting, and standing or walking. This would promote healthy development of posture in children during their day in the kindergarten [16]. Except the preventive programs in the kindergarten, family is also important in postural disorders prevention. Parents should regulate to their children time spent in the sitting position and support daily movement activities and sport in their family.

## 5 Conclusions

The aim of the study was to identify the postural disorders and spine deformities in the pre-schoolers. Monitoring and assessment of the body posture in children allows us to identify the prevalence of these diseases and allows professionals from the medical and non-medical departments to intervene in time and develop adequate prevention programs for children. Early identification of postural disorders and proper diagnostics can stop its further progression. As in modern medicine, and thus in rehabilitation, is placed on the prevention of civilization diseases, where postural disorders and spinal deformities belong to, the monitoring of posture and spine of children in pre-school age should be popularized and applied in common practice.

## References

- [1] P. Kolář, et al., *Rehabilitace v klinické praxi*. (Galén, Praha, 2009)
- [2] P. Jundi Penha et al., *Clinics* **60**, 9–16 (2005)
- [3] B. Protić – Gava, 5<sup>th</sup>. Int. Conf. Sports Sci. and Health, 9–16 (2015)
- [4] Statistical Office of the Slovak Republic [document on the internet, cited 2017 Jan. 13]. Available from: <http://archiv.statistics.sk/html/showdoc.dodocid=37210.html>
- [5] Ministry of Education, Science, Research and Sports of the Slovak Republic, [document on the internet, cited 2017 Jan. 13]. Available from: <http://www.minedu.sk/analyza-situacie-%E2%80%93-kapacity-materskych-skol/>
- [6] Z. Milošević, B. Obradović, *Gl. Antrop. Dr. Sr.* **43**, 301–309 (2008)
- [7] E. Beganović, et al., *Sport Mont.* **34**, 53–61 (2012)
- [8] J.F. Mahlknecht, *Z. Orthop, Unfall.* **145**, 338–342 (2004)
- [9] V. Janda, *IGA MZ ČR* 5390–3, 2011
- [10] E. Sabo, *Fiz. kul.* **60**, 157–164 (2006)
- [11] Joksimović et al., *Balneolimat.* **38**, 88–89 (2005)
- [12] V. Miličević et al., *Balneolimat.* **38**, 86–87 (2005)
- [13] R. Romanov, et al., *TIMAS Acta* **8**, 129–135 (2014)
- [14] B.Z. Adar, Risk factors of prolonged sitting and lack of physical activity in relate to postural deformities, muscles tension and backache among Israeli children. [document on the internet, cited 2017 Jan. 13]. Available from: [http://phd.semmelweis.hu/mwp/phd\\_live/vedes/export/benzion.e.pdf](http://phd.semmelweis.hu/mwp/phd_live/vedes/export/benzion.e.pdf)
- [15] S. Mitova, *Res. Kinesiolog.* **43**, 21–24 (2015)
- [16] R. Rusnak, et al., *Zdravotné cviky pre deti predškolského veku*. (OZ Za zdravší život, Bratislava, 2014)