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REVIEW PAPER

Postural status of preschool children: A narrative review

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Abstract

The number of children with postural disorders is constantly increasing. The aim of this review is to analyze the research that studied the postural status of preschool children in the period from 2000 to 2022 in the territory of Serbia. We collected a total of 15 surveys. The analysis of the presented research showed that the postural status of preschool children in Serbia is not at a satisfactory level. "Bad head posture", "bad shoulder posture", "bad scapula posture" and "bad abdominal posture" are present in over 30% of children. It is similar with kyphotic, lordotic and scoliotic bad posture. It is necessary to take preventive measures in order to stop the trend of increasing prevalence of preschool children with bad postural status. Also, it is necessary to constantly carry out new research on this topic in order to constantly monitor the state of the postural status of preschool children and react in accordance with the needs.

Keywords: *postural status, preschool children, spinal column deformity*

Introduction

The number of children with postural disorders and flat feet is constantly increasing (Živković, 2009). There are three "critical" periods in a child's development, when they are especially susceptible to posture deviations, namely the child standing up, starting school and the age of puberty (Gadžić, 2019). Postural disorders occur not only in school children, but also in children of preschool age, which coincides with critical periods of growth and development. They can be found in all segments along the spinal column, trunk and lower extremities (Protić-Gava, 2014). Modern lifestyle is the most common cause of bad posture. Children exercise less and spend more time sitting and lying down (hypokinesia). Such habits significantly reduce most of their physical and functional abilities (Dedaj, 2020). The most important role in the formation and maintenance of proper body posture is played by the muscles, which as an active part of the movement apparatus should be strong enough to maintain a balanced body position. Weakness of certain muscle groups, especially the abdominal musculature or excessive and one-sided loading of certain muscles, can cause various disorders in the spinal column, thorax, upper or lower extremities, and especially in the feet (Gadžić, 2019). Changes in the bone-joint system caused by weak and inelastic muscles can lead to various deformities, both functional and structural (Drljačić, Tirić, Đupovac & Arsić, 2016). According to Srakar, bad posture refers to all irregularities in the position, relationship, and shape of the pelvis, spinal column, shoulders and lower limbs, which are not a result of damage to the skeleton or the neuromuscular apparatus, but are result of insufficient and improper muscle function. A common feature of postural disorders is that they disappear due to active muscle stretching (Živković, 2009). With regular corrective exercise, impaired postural status can be corrected, suggesting that exercise should be present in children's daily activities from preschool age (Andrea & Svetlana, 2021). Correct posture is important for proper growth and development (Protić-Gava, 2014; Gadžić, 2019), but also for the proper functioning of internal organs (Gadžić, 2019). Bad postural status does not only have negative consequences on the movement apparatus (Drljačić, Tirić, Đupovac & Arsić, 2016), it also has a harmful effect on the locomotor system, circulation, as well as on the respiratory and digestive systems (Protić-Gava, 2014), i.e. organs of thorax and abdominal cavities (Drljačić, Tirić, Đupovac & Arsić, 2016). The aim of this review is analyze the research that studied the postural

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status of preschool children in the period from 2000 to 2022 in the territory of Serbia.

Method

A descriptive method and theoretical analysis were used for the collection, classification and analysis of targeted research, and the material was searched on: Google, Google Scholar, PubMed and Kobson. The search was limited to works published in the period from 2000 to 2022. Key words used during the search were: postural status, preschool children, and spinal column deformity. References from all papers were reviewed in order to find more studies dealing with this topic. Papers that corresponded to the purpose of the research were taken into consideration

All research is shown in Table 1. In total, we collected 15 studies. The oldest research is Sabo (2006), and the most recent is Civkaroski & Milenković (2022). All research was conducted on the territory of the Republic of Serbia. The largest number of research was conducted on the territory of Vojvodina - four, namely: Novi Sad - 2; Vojvodina - 1; Sombor, Sremska Mitrovica, Bačka Palanka - 1. Then follows: Belgrade -2; Leskovac - 1; Vranje - 1; Užice, Prijepolje, Nova Varoš - 1; Kruševac - 1; Mladenovac - 1; Šabac – 1; Kragujevac – 1; Novi Pazar – 1, while in one survey we were unable to find information about the city where the survey was conducted. The number of respondents in the analyzed works ranged from 50 respondents in the research by Cvetković & Cvetković (2018), to 1259 respondents in the research by Sabo (2006). The total number of respondents included in all works is 5235 children. All research included preschool children aged 3 to 7 years.

Results

Table 1 presents all the research found by chronological age, as well as the results obtained in the research.

Table 1. Research results - list of all papers

SPINAL COLUMN								
Reference	Sample of respondents					Results		
	N	M	F	P	Y	BOYS	GIRLS	Σ
Sabo (2006)	1259	656	603	Vojvodina	3,5-7	Dg1 (174) 13,8% Dg2 (18) 1,4% Dr1 (336) 26,7% Dr2 (10) 0,8% Rgk1 (56) 4,4% Rgk2 (7) 0,6% Dl1 (303) 24,1% Dl2 (6) 0,5% S1 (127) 10,1% S2 (3) 0,2% Dt1 (335) 26,6% Dt2 (67) 5,3% GV-Gv1 (154) 12,2% GV-Gv2 (63) 5%	Dg1 (192) 15,3% Dg2 (30) 2,4% Dr1 (308) 24,5% Dr2 (5) 0,4% Rgk1 (45) 3,6% Rgk2 (2) 0,2% Dl1 (263) 20,9% Dl2 (5) 0,4% S1 (126) 10% S2 (1) 0,1% Dt1 (365) 29% Dt2 (61) 4,8% GV-Gv1 (153) 12,2% GV-Gv2 (57) 4,5%	Dg1 (366) 29,1% Dg2 (48) 3,8% Dr1 (644) 51,2% Dr2 (15) 1,2% Rgk1 (101) 8% Rgk2 (9) 0,8% Dl1 (566) 45% Dl2 (11) 0,9% S1 (253) 20,1% S2 (4) 0,3% Dt1 (700) 55,6% Dt2 (128) 10,2% GV-Gv1 (307) 24,4% GV-Gv2 (120) 9,5%
Sabo (2007)	280	141	139	Sombor, Sremska Mitrovica, Bačka Palanka	4-7	Dg1 (38) 27% Dg2 (9) 6,4% Dr1 (63) 44,7% Dr2 (2) 1,4% Rgk1 (15) 10,6% Rgk2 (3) 2,1% Dl1 (71) 50,4% Dl2 (8) 5,7% S1 (39) 27,7% S2 (1) 0,7% Dt1 (80) 56,7% Dt2 (14) 9,9% GV-Gv1 (27) 19,1% GV-Gv2 (14) 9,9%	Dg1 (59) 42,4% Dg2 (19) 13,7% Dr1 (69) 49,6% Dr2 (1) 0,7% Rgk1 (16) 11,5% Rgk2 (2) 1,4% Dl1 (62) 44,6% Dl2 (2) 1,4% S1 (35) 25,2% S2 (0) 0% Dt1 (85) 61,2% Dt2 (18) 12,9% GV-Gv1 (31) 22,3% GV-Gv2 (12) 8,6%	Dg1 (97) 34,6% Dg2 (28) 10% Dr1 (132) 47,1% Dr2 (3) 1,1% Rgk1 (31) 11,1% Rgk2 (5) 1,8% Dl1 (133) 47,5% Dl2 (10) 3,6% S1 (74) 26,4% S2 (1) 0,4% Dt1 (165) 58,9% Dt2 (32) 11,4% GV-Gv1 (58) 20,7% GV-Gv2 (26) 9,3%
Simov, Minić & Stojanović (2011)	968	/	/	Leskovac	6-7	/	/	Pd1 (528) 54,54% Pd2+ (90) 9,3% Rgk (57) 5,88% K (66) 6,82% L (20) 2,07% S (11) 1,14%
Pavlović (2012)	638	/	/	Užice, Prijepolje, Nova Varoš	6-7	K (12) L (0) S (6) TP (19) SCL (0) GV (1)	K (5) L (2) S (6) TP (8) SCL (1) GV (1)	K (17) 2,66% L (2) 0,62% S (12) 1,88% TP (27) 4,23% SCL (1) 0,15% GV (2) 0,31%
Romanov, Stupar, Međedović & Brkin (2014)	423	213	210	Novi Sad	6-7	K (16) 7,51% L (88) 41,31% S (57) 26,76%	K (13) 6,19% L (77) 36,66% S (45) 21,43%	K (29) 6,86% L (165) 39,00% S (102) 24,11%

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Table 1. Research results - list of all papers

SPINAL COLUMN								
Reference	Sample of respondents					Results		
	N	M	F	P	Y	BOYS	GIRLS	Σ
Stanišić, Đorđević & Maksimović (2014)	60	21	39	Kruševac	6	GV-Gv1 (4) 19,1% GV-Gv2 (1) 4,7%	GV-Gv1 (6) 15,4% GV-Gv2 (0) 0%	GV-Gv1 (10) 16,7% GV-Gv2 (1) 1,6%
Drljačić, Tirić, Đupovac & Arsić (2016)	52	30	22	/	5	/	/	Dg1 (24) 46,2% Dg2 (1) 1,9% Dr1 (31) 59,6% Dr2 (19) 36,5% Rgk1 (6) 11,5% Rgk2 (0) 0,0% Dl1 (26) 50,0% Dl2 (20) 38,5% S1 (10) 19,2% S2 (0) 0,0% Dt1 (28) 53,8% Dt2 (7) 13,5% GV-Gv1 (17) 32,7% GV-Gv2 (13) 25,0%
Bićanin, Milenković, Radovanović, Gajević & Ivanovć (2017)	608	419	189	Belgrade	4-7	L (136) 32,46% K (129) 30,79% Sl (21) 5,08% St (13) 3%	L (38) 19,99% K (57) 30,15% Sl (18) 9,42% St (5) 2,62%	L (174) 28,63% K (186) 30,59% Sl (39) 6,41% St (18) 2,96%
Galić (2017)	120	/	/	Novi Sad	5-7	/	/	Dg1 (6) 5% Dg2 (0) 0% Dr1 (41) 34,16% Dr2 (1) 0,83% Dl1 (21) 17,5% Dl2 (0) 0% Ts1 (23) 19,16% Ts2 (1) 0,83% Pk1 (4) 3,33% Pk2 (0) 0% GV-Gv1 (7) 5,83% GV-Gv2 (0) 0% Dv1 (2) 1,66% Dv2 (0) 0% K1 (9) 7,5% K2 (0) 0% L1 (34) 28,33% L2 (1) 0,83% Rgk1 (5) 4,16% Rgk2 (0) 0%
Cvetković & Cvetković (2018)	50	/	/	Mladenovac	6-7	/	/	L1 (26) 52% L2 (15) 30% K1 (22) 44% K2 (18) 36%
Maksimović & Lertua (2018)	70	/	/	Šabac	5	/	/	Dg1 (18) 51,4% Dg2 (8) 22.9% Dr1 (19) 54,3% Dr2 (15) 42,9% Rgk1 (9) 25,7% Rgk2 (0) 0% Dl1 (27) 77,1% Dl2 (4) 11,4% KL1 (5) 14,3% KL2 (0) 0% Dt1 (1) 2,9% Dt2 (32) 91,4% GV-Gv 1 (15) 42,9% GV-Gv 2 (14) 40%

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Table 1. Research results - list of all papers

Reference	SPINAL COLUMN							
	Sample of respondents					Results		
	N	M	F	P	Y	BOYS	GIRLS	Σ
Maksimović & Lertua (2018)				Šabac	6,5	/	/	Dg1 (20) 57,1% Dg2 (6) 17,1% Dr1 (24) 68,6% Dr2 (5) 14,3% Rgk1 (8) 22,9% Rgk2 (1) 2,9% Dl1 (26) 74,3% Dl2 (2) 5,7% KL1 (3) 8,6% KL2 (2) 5,7% Dt1 (5) 14,3% Dt2 (22) 62,9% GV-Gv 1 (27) 77,1% GV-Gv 2 (5) 14,3%
					Σ	/	/	Dg1 (38) 54,3% Dg2 (14) 20% Dr1 (43) 61,4% Dr2 (20) 28,6% Rgk1 (17) 24,3% Rgk2 (1) 1,4% Dl1 (53) 75,7% Dl2 (6) 8,6% KL1 (8) 11,4% KL2 (2) 2,9% Dt1 (6) 8,6% Dt2 (54) 77,1% GV-Gv 1 (42) 60% GV-Gv 2 (19) 27,1%
Ivanović, Gajević, Gajić & Atanasov (2018)	68	46	22	Belgrade	7	L 30,43% K 39,13%	L 17,39% K 17,39%	/
Bogdanović, Radenković, Kahrović, Murić & Špirtović (2020)	149	78	71	Kragujevac	6	L>30° (4) 5,13% L>40° (2) 2,56%	L>30° (6) 8,45% L>40° (0) 0%	L>30° (10) 6,71% L>40° (2) 1,34%
Biševac, Mahmutović, Mekić & Dolićanin (2021)	60	29	31	Novi Pazar (karate club)	3-7	S (1) 3,4% K (3) 10,3% L (0) 0%	S (2) 6,5% K (1) 3,2% L (0) 0%	/
Civkaroski & Milenković (2022)	430	/	/	Vranje	6-7	/	/	S (8) 1,86% K (13) 3,25% L (6) 1,39% Ld (150) 34,89%

Note: N - sample of respondents; M - male; F - female; Y - years of age; P - place; Dv1 - bad neck posture, first degree; Dv2 - bad neck posture, second degree; Pd1 - number and percentage of children with one postural deformity; Pd2+ - number and percentage of children with two or more postural deformities; Dg1 - bad head posture first degree; Dg2 - bad head posture second degree; Dr1 - bad shoulder posture first degree; Dr2 - bad shoulder posture, second degree; Rgk - disorder in the development of the thorax; Rgk1 - thorax development disorder first degree; Rgk2 - thorax development disorder second degree; Dl1 – bad scapula posture, first degree; Dl2 - bad scapula posture, second degree; Dt1 - bad abdominal posture, first degree; Dt2 - bad abdominal posture, second degree; Ld - bad posture; KL - kyphosis and lordosis; L>30° - lordotic bad posture with deviation greater than 30°; L>40° - lordotic bad posture with deviation greater than 40°; Ts1 - height triangles, first degree of deviation; Ts2 - height triangles, second degree of deviation; Pk1 - position of the pelvis, the first degree of deviation; Pk2 - position of the pelvis, second degree of deviation; K - kyphotic bad posture; K1 – kyphotic bad posture of the first degree; K2 – kyphotic bad posture of the second degree; L - lordotic bad posture; L1 - lordotic bad posture of the first degree; L2 – lordotic bad posture of the second degree; S - scoliotic bad posture; Sl - scoliotic bad posture in the lumbar region; St - scoliotic bad posture in the thoracic area; S1 - scoliotic bad posture of the first degree; S2 - scoliotic bad posture of the second degree; TP - thorax posture; SCL - Scapulae alatae; GV - genu valgum; GV-Gv1 - genu valgum and genu varum first degree; GV-Gv2 - genu valgum and genu varum second degree.

Head posture

The results shown in Table 1 indicate that the "head posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Drljačić, Tirić, Đupovac & Arsić (2016), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) suggested that in the territory of Vojvodina, 29.1% of preschool children have bad head posture - I degree, while 3.8% of preschool children have bad head posture - II degree. A year later, Sabo (2007) obtained even more

alarming data in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. Data shows that 34.6% of preschool children have bad head posture - I degree, while 10% of preschool children have bad head posture - II degree. Ten years later, Galić (2017) came up with encouraging data. He suggested that in the territory of Novi Sad, 5% of preschool children have bad head posture - I degree, while there were no children with bad head posture - II degree. Unlike Sabo (2006) and Sabo (2007), whose first survey included 1259 and the second one 280 respondents, Galić (2017) had significantly fewer respondents - 120, but the data is certainly much better ten years later. Drljačić, Tirić, Đupovac & Arsić (2016) found that 46.2% of preschool children have bad head posture - I degree, while 1.9% of children have bad head posture - II degree. Alarming data were obtained by Maksimović & Lertua (2018) on a sample of preschool children from Šabac. As many as 54.3% of preschool children have bad head posture - I degree, while 20% have bad head posture - II degree. The authors analyzed the children by age and determined that 51.4% of five-year-old children have bad head posture - I degree, while 22.9% of children of the same age have bad head posture - II degree. Their older friends, aged 6.5 years, are no better, so 57.1% of them have bad head posture - I degree, while 17.1% have bad head posture - II degree.

Shoulder posture

The results shown in Table 1 show us that the "shoulder posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Drljačić, Tirić, Đupovac & Arsić (2016), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) found on a sample of preschool children from Vojvodina that 51.2% have bad shoulder posture – I degree, while 1.2% have bad shoulder posture – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 47.1% of preschool children have bad shoulder posture – I degree, while 1.1% have bad shoulder posture – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) confirm that the situation with head posture in preschool children is alarming. In their research, 59.6% of preschool children have bad shoulder posture – I degree, while 36.5% have bad shoulder posture - II degree. Galić (2017) obtained somewhat better data than Sabo (2006) and Sabo (2007) on a sample of preschool children from Novi Sad, but still not so great. The author determines that 34.16% of preschool children have bad shoulder posture - I degree, while 0.83% have bad shoulder posture - II degree. As with head posture, the most alarming data comes from Šabac. Maksimović & Lertua (2018) who found that 61.4% of preschool children have bad shoulder posture - I degree, while 28.6% have bad shoulder posture - II degree. The authors analyzed the children by age and determined that 54.3% of preschool children have bad shoulder posture - I degree, while 42.9% have bad shoulder posture - II degree. Their older friends, aged 6.5 years, are no better, so 68.6% of them have bad shoulder posture - I degree, while 14.3% have bad shoulder posture - II degree.

Thorax development

The results shown in Table 1 indicate that the "thorax development" of preschool children was investigated by Sabo (2006), Sabo (2007), Simov, Minić & Stojanović (2011), Pavlović (2012), Drljačić, Tirić, Đupovac & Arsić (2016).), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) observed on a sample of preschool children from Vojvodina that 8% of them have a disorder in the development of the thorax – I degree, while 0.8% have a disorder in the development of the thorax - II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 11.1% of preschool children have a disorder in the development of the thorax - I degree, while 1.8% have a disorder in the development of the thorax - II degree. Galić (2017) ten years later, in the territory of Novi Sad, comes to slightly better data. The author determines that 4.16% of preschool children have a disorder in the development of the thorax- I degree, while there are no children with a disorder in the development of the chest – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) obtain similar data as Sabo (2006) and Sabo (2007). The authors suggest that 11.5% of preschool children have a disorder in the development of the thorax – I degree, while there are no children with a disorder in the development of the thorax- II degree. The most alarming data comes again from Šabac. Maksimović & Lertua (2018) showed that 24.3% of preschool children have a disorder in the development of the thorax - I degree, while 1.4% have a disorder in the development of the thorax – II degree. The authors analyzed the children by age and showed that 25.7% of five-year-old children have a disorder in the development of the thorax – I degree, while there are no children with a disorder in the development of the thorax – II degree at that age. Their older friends, aged 6.5 years, are not in a better position, 22.9% of them have a disorder in the development of the thorax – I degree, while 2.9% have a disorder in the development of the thorax- II degree. Simov, Minić & Stojanović (2011) also investigated thorax disorders in preschool children, but they did not classify them by degrees. The authors suggested that 5.88% of children have a disorder in the development of the thorax. Pavlović (2012) also did not classify the disorders according to degrees and he determined on a sample of preschool children from Užice, Prijepolje and Nova Varoš that 4.23% had a disorder in the development of the thorax.

Scapula posture

The results shown in Table 1 indicate that "scapula posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Pavlović (2012), Drljačić, Tirić, Đupovac & Arsić (2016), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) reported that in a sample of preschool children from Vojvodina, 45% have bad scapula posture – I degree, while 0.9% have bad scapula posture – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, and Bačka Palanka. In these cities, 47.5% of preschool children have bad scapular posture - I degree, while 3.6% of children have bad scapular posture – II degree. Galić (2017) ten years later, in the territory of Novi Sad, comes to slightly better data. The author suggests that 17.5% of preschool children have bad scapula posture – I degree, while there are no children with bad scapula posture – II degree. Maksimović & Lertua (2018) found an incredibly high percentage of bad scapula posture among preschool children in Šabac. The authors come to the finding that 75.7% of children have bad scapula posture – I degree, while 8.6% have bad scapula posture – II degree. The authors analyzed the children by age and they suggeste that 77.1% of the children at the age of 5have bad scapula posture – I degree, while 11.4% of them have bad scapula posture – II degree. Seventy three % of the children at the age of 6.5 have bad scapula posture – I degree, while 5.7% have bad scapula posture – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) suggest that in preschool children, scapula posture is one of the biggest problems when it comes to posture. The authors determine that 50% of children have bad scapula posture - I degree, while 38.5% have bad scapula posture – II degree. It is interesting that Pavlović (2012) on a sample of 638 preschool children from Užice, Prijepolje and Nova Varoš found that only 0.15% of them have scapulae alatae.

Abdominal posture

The results shown in Table 1 indicate that the "abdominal posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Drljačić, Tirić, Đupovac & Arsić (2016) and Maksimović & Lertua (2018). Sabo (2006) determined on a sample of preschool

children from Vojvodina that 55.6% have bad abdominal posture – I degree, while 10.2% have bad abdominal posture – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 58.9% of preschool children have bad abdominal posture – I degree, while 11.4% of children have bad abdominal posture – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) suggest that the percentage of children with bad abdominal posture is high. The authors determine that 53.8% of preschool children have bad abdominal posture – I degree, while 13.5% of children have bad abdominal posture – II degree. Interesting data were obtained by Maksimović & Lertua (2018) among preschoolers in Šabac. According to their research, there are more children with II degree (77.1%) than with I degree (8.6%) of bad abdominal posture. The authors analyzed the children by age and identified that 2.9% of five-year-old children have bad abdominal posture - I degree, while 91.4% of them have bad abdominal posture – II degree. 14.3% of the children at the age of 6.5have bad abdominal posture – I degree, while 62.9% have bad abdominal posture - II degree.

Kyphosis

The results shown in Table 1 indicate that the "kyphotic bad posture" of preschool children was investigated by Simov, Minić & Stojanović (2011), Pavlović (2012), Romanov, Stupar, Međedović & Brkin (2014), Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017), Galić (2017), Ivanović, Gajević, Gajić & Atanasov (2018), Cvetković & Cvetković (2018), Biševac, Mahmutović, Mekić & Dolićanin (2021) and Civkaroski & Milenković (2022). Simov, Minić & Stojanović (2011) found that among preschool children in Leskovac, kyphotic bad posture is represented by 6.82%. Pavlović (2012) finds that the situation in Užice, Prijepolje and Nova Varoš is somewhat better, and that 2.66% of preschool children have kyphotic bad posture. Romanov, Stupar, Međedović & Brkin (2014) on a sample of preschool children from Novi Sad obtained similar percentages as their colleagues from Leskovac and determined that 6.86% of children have kyphotic bad posture. The authors performed the analysis by gender and determined that the prevalence of kyphotic bad posture among boys was 7.51%, and among girls 6.19%. Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017) came to the most alarming data on a sample of preschool children from Belgrade and determined that 30.59% of children have kyphotic bad posture. The authors performed the analysis by gender and identified that the prevalence of kyphotic bad posture among boys is 30.79%, and among girls 30.15%. Galić (2017) on a sample of preschool children from Novi Sad obtained similar percentages as his colleagues Romanov, Stupar, Međedović & Brkin (2014) three years earlier and identified that 7.5% of children have kyphotic bad posture. Ivanović, Gajević, Gajić & Atanasov (2018) suggest that kyphotic bad posture is the most prevalent among preschool children in Belgrade. The authors find that 39.13% of boys and 17.39% of girls have kyphotic bad posture. Cvetković & Cvetković (2018) report that 44% of preschool children from Mladenovac have kyphotic poor posture – I degree, while 36% have kyphotic bad posture – II degree. Biševac, Mahmutović, Mekić & Dolićanin (2021) find that 10.3% of preschool boys and 3.2% of girls from Novi Pazar have kyphotic bad posture. Civkaroski & Milenković (2022) identified that the prevalence of kyphotic bad posture in a sample of preschool children from Vranje is 3.25%.

Lordosis

The results shown in Table 1 indicate that the "lordotic bad posture" of preschool children was investigated by Simov, Minić & Stojanović (2011), Pavlović (2012), Romanov, Stupar, Međedović & Brkin (2014), Bićanin, Milenković, Radovanović, Gajević & Ivanovć (2017), Galić (2017), Cvetković & Cvetković (2018), Ivanović, Gajević, Gajić & Atanasov (2018), Bogdanović, Radenković, Kahrović, Murić & Špirtović (2020), Biševac, Mahmutović, Mekić & Dolićanin (2021)) and Civkaroski & Milenković (2022). Simov, Minić & Stojanović (2011) found that among preschool children in Leskovac, lordotic bad posture is represented by 2.07%. Pavlović (2012) finds that the situation in Užice, Prijepolje and Nova Varoš is somewhat better, and that 0.62% of preschool children have lordotic bad posture. Romanov, Stupar, Međedović & Brkin (2014) obtained devastating data on a sample of preschool children from Novi Sad that as many as 39% of children have lordotic bad posture. The authors performed the analysis by gender and determined that 41.31% of boys and 36.66% of girls have lordotic bad posture. Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017) also found alarming data on a sample of preschool children from Belgrade and suggested that 28.63% of the children have lordotic bad posture. The authors performed the analysis by gender and reported that 32.46% of boys and 19.99% of girls have lordotic bad posture. Galić (2017) on a sample of preschool children from Novi Sad obtained similar percentages as his colleagues Romanov, Stupar, Međedović & Brkin (2014) three years earlier and determined that 28.33% of preschool children have lordotic bad posture – I degree, while 0, 83% have lordotic bad posture – II degree. Cvetković & Cvetković (2018), as well as with kyphotic bad posture, obtained high percentages in a sample of preschool children from Mladenovac. The authors found that 52% of children have lordotic bad posture – I degree, while 30% have lordotic bad posture – II degree. Ivanović, Gajević, Gajić & Atanasov (2018) confirm that in Belgrade there is a high percentage of preschool children with lordotic bad posture. The authors found that 30.43% of boys and 17.39% of girls have bad lordotic posture. Bogdanović, Radenković, Kahrović, Murić & Špirtović (2020) found in a sample of preschool children from Kragujevac that 6.71% of children have lordotic bad posture greater than 30° and 1.34% lordotic bad posture greater than 40°. The authors performed the analysis by gender and determined that 5.13% of boys and 8.45% of girls have lordotic bad posture greater than 30°, while 2.56% of boys and 0% of girls have lordotic bad posture greater than 40°. It is interesting that Biševac, Mahmutović, Mekić & Dolićanin (2021) found that there are no children with lordotic bad posture in a sample of preschool children from Novi Pazar. The sample in their research consisted of preschool children who are members of the karate club, so their results must be taken into special consideration. Civkaroski & Milenković (2022) found that 1.39% of children have lordotic bad posture in a sample of preschool children from Vranje. The data from Vranje is encouraging if compared to research on lordotic bad posture in other cities of Serbia.

Kypholordosis

The results shown in Table 1 show us that "kypholordosis" was investigated only by Maksimović & Lertua (2018). The authors determined that 11.4% of preschool children in Šabac have combined kyphotic and lordotic bad posture – I degree, while 2.9% have combined kyphotic and lordotic bad posture – II degree. The authors analyzed the children by age and reported that 14.3% of five-year-old children have combined kyphotic and lordotic bad posture – I degree, while there are no children at this age with combined kyphotic and lordotic bad posture – II degree. Their older friends, aged 6.5 years, are not in a better position. 8.6% of them have combined kyphotic and lordotic bad posture – I degree, while 5.7% have combined kyphotic and lordotic bad posture – II degree.

Scoliosis

The results shown in Table 1 indicates that "scoliotic bad posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Simov, Minić & Stojanović (2011), Pavlović (2012), Romanov, Stupar, Međedović & Brkin (2014).), Drljačić, Tirić, Đupovac

& Arsić (2016), Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017), Biševac, Mahmutović, Mekić & Dolićanin (2021) and Civkaroski & Milenković (2022). Sabo (2006) identified in a sample of preschool children from Vojvodina that 20.1% have scoliotic bad posture – I degree, while 0.3% have scoliotic bad posture – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 26.4% of preschool children have scoliotic bad posture – I degree, while 0.4% have scoliotic bad posture – II degree. Simov, Minić & Stojanović (2011) found that preschool children in Leskovac, as well as with kyphotic and lordotic bad posture, have a significantly lower percentage of scoliotic bad posture compared to their peers from other cities in Serbia, and it amounts to 1.14%. Pavlović (2012) suggests that preschool children from Užice, Prijepolje and Nova Varoš also have a low percentage of scoliotic bad posture, amounting to 1.88%. Romanov, Stupar, Međedović & Brkin (2014) established that the situation with scoliotic bad posture in preschool children in Novi Sad is far worse than in the mentioned cities. The authors come to the data that 24.11% of children have scoliotic bad posture. They also performed the analysis by gender and found that 26.76% of boys and 21.43% of girls have scoliotic bad posture. Drljačić, Tirić, Đupovac & Arsić (2016) found that 19.2% of preschool children have scoliotic bad posture – I degree, while there are no children with scoliotic bad posture – II degree. Bićanin, Milenković, Radovanović, Gajević & Ivanovć (2017) investigated scoliotic bad posture in a sample of preschool children from Belgrade partially, especially for scoliotic bad posture in the lumbar area, and especially for scoliotic bad posture in the thoracic area. The authors found that 6.41% of children have scoliotic bad posture in the lumbar area, while 2.96% of children have scoliotic bad posture in the thoracic area. Also, 5.08% of boys and 9.42% of girls have scoliotic bad posture in the lumbar area, while 3% of boys and 2.62% of girls have scoliotic bad posture in the thoracic area. Biševac, Mahmutović, Mekić & Dolićanin (2021) found that 3.4% of boys and 6.5% of girls have scoliotic bad posture in a sample of preschool children from Novi Pazar. The research was conducted among children who are part of the karate club, so these data should not be considered with certainty. Civkaroski & Milenković (2022) found that 1.86% of preschool children from Vranje had scoliotic bad posture. The data from Vranje, Leskovac Užice, Prijepolje and Nova Varoš is encouraging if compared with research on scoliotic bad posture in other cities of Serbia.

Leg status

The results shown in Table 1 indicate that "leg status" was investigated by Sabo (2006), Sabo (2007), Pavlović (2012), Stanišić, Đorđević & Maksimović (2014), Drljačić, Tirić, Đupovac & Arsić (2016), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) identified in a sample of preschool children from Vojvodina that 24.4% have deviations from the normal shape of the legs – I degree, while 9.5% have deviations from the normal shape of the legs – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 20.7% of children have deviations from the normal shape of the legs – I degree, while 9.3% have deviations from the normal shape of the legs – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) found that 32.7% of preschool children have deviations from the normal shape of the legs - I degree, while 25% have deviations from the normal shape of the legs – II degree. Stanišić, Đorđević & Maksimović (2014) determined on a sample of preschool children from Kruševac that 16.7% have deviations from the normal shape of the legs - I degree, while 1.6% have deviations from the normal shape of the legs – II degree. Galić (2017) obtained slightly better data on a sample of preschool children from Novi Sad than Sabo (2006) ten years earlier. The author showed that 5.83% have deviations from the normal shape of the legs – I degree, while there are no children with deviations from the normal shape of the legs – II degree. Furthermore, Šabac. Maksimović & Lertua (2018) showed that 60% of preschool children have deviations from the normal shape of the legs - I degree, while 27.1% have deviations from the normal shape of the legs – II degree. The authors analyzed the children by age and determined that 42.9% of children aged five years have deviations from the normal shape of the legs - I degree, while 40% have deviations from the normal shape of the legs - II degree. Their older friends, aged 6.5 years, are not in a better position 77.1% of them have deviations from the normal shape of the legs – I degree, while 14.3% have deviations from the normal shape of the legs – II degree. Pavlović (2012) identifiedin a sample of preschool children from Užice, Prijepolje and Nova Varoš that only 0.31% of children have X-legs (Genu valgum), which is encouraging data compared to research in other cities.

In addition to the aforementioned disorders, Galić (2017) found that 3.33% of preschool children from Novi Sad have an irregular pelvic position – I degree, while there are no children with an irregular pelvic position – II degree. In addition to the aforementioned, 1.66% of children have improper posture of the neck – I degree, while there are no children with improper posture of the neck – II degree.

At the end of the review, we can add that Simov, Minić & Stojanović (2011) determined on a sample of preschool children from Leskovac that 54.54% of children have at least one postural deformity, while 9.3% of children have two or more postural deformities. Civkaroski & Milenković (2022) found that 34.89% of preschool children from Vranje had bad posture.

Discussion

The summary of the scientific evidence indicate that "bad head posture" is quite prevalent among preschool children in Serbia and that the prevalence often exceeds 30%. The situation with "shoulder posture" is even more alarming where the prevalence in many studies exceeds 50%. When it comes to "disorder in the development of the thorax" the situation is somewhat better, and the prevalence is between 10 and 20%. Research shows that "bad scapula posture" and "bad abdominal posture" are also very common postural disorders that occur in over 50% of children. When it comes to "kyphotic bad posture," research results diverge. In some studies, the prevalence is below 10%, and some studies show that the prevalence is over 30%. The most alarming data comes from Belgrade and Mladenovac. The prevalence of "lordotic bad posture" also varies from study to study. In Leskovac, Užice, Prijepolje, Nova Varoš, Novi Pazar, Vranje, Kragujevac, the prevalence is below 7%, while in Novi Sad, Belgrade and Mladenovac it exceeds 25%. It's the same with "scoliotic bad posture". The prevalence ranges from 1.14% in Leskovac to 24.11% in Novi Sad. When it comes to "deviation from the normal shape of the legs" in a large number of studies, the prevalence exceeds 20%. These findings indicate that the issue of the postural status in preschoolers in Serbia is alarming.

Sabo (2006) suggested that there are significant differences between the genders in head posture, abdominal posture (boys have better results) and arch of the foot (girls have better arch of the foot). There are no significant differences in the posture of shoulders and scapula, the development of the thorax, the deviation of the spinal column in the frontal plane and the shape of the legs. The author suggests that all deviations from the normal status are in the form of functional deformity, which means that corrective work is required to eliminate them. Sabo (2007) comes to similar results and finds that there are statistically significant differences between the genders in head posture (boys have better head posture) and arch of the foot (girls have better arch of the foot). There are no significant differences in the posture of

shoulders, scapula and abdomen, in the development of the thorax, the deviation of the spinal column in the frontal plane and the shape of the legs. Simov, Minić & Stojanović (2011) suggest that it is the duty of educators in kindergartens and parents at home to instruct children in correct posture when sitting, walking and doing physical activities. Pavlović (2012) believes that physical exercise, and therefore physical education, should be a constant and systematic process applied from an early age. The author states that children in preschool institutions are not covered by adequate professional supervision, but that the way educators work is better than passivity. Romanov, Stupar, Međedović & Brkin (2014) suggest that deviations from the normal postural status are present in a high percentage, and that they are equally represented in the population of respondents of both genders. A significant difference between the genders only occurs for the deviation from the normal status of the spinal column in the frontal plane. When boys are concerned, scoliotic bad posture is significantly more present. The authors believe that the postural status of the examined population of preschool children is worrying. Stanišić, Đorđević & Maksimović (2014) believe that the quantitative results should not be ignored because there is a large number of children (boys and girls) who have a functional stage of deformity in almost all segments of the body, and this represents a potential danger for the formation of structural changes which, to a greater or lesser extent, endanger health, the general functioning of the organism and its ability to work. Drljačić, Tirić, Đupovac & Arsić (2016) believe that the results of their research indicate the necessity of applying systematic exercise in working with children at an early age, which positively affects the postural status of children, in the form of its preservation, but also the elimination of functional deformities that could leave permanent consequences on the child's organism in the later period. Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017) found that additional six-month exercise with preschool children has a positive effect on their postural status. Galić (2017) suggests that more than half of preschool children show a deviation from normal postural status, as well as that there is a statistically significant positive association between the occurrence of minimal neurological dysfunctions and bad body posture in preschool children. Cvetković & Cvetković (2018) determined that there is no relationship between the level of nutrition and kyphotic and lordotic bad posture in preschool children. The authors come to the conclusion that obesity and malnutrition do not have an impact on the occurrence of postural disorders independently, but probably in combination with other factors such as heredity, then physical inactivity, etc. Maksimović & Lertua (2018) state that the postural status of the examined children is not satisfactory, as well as the fact that there is a significant number of structural deformities of the front abdominal wall is worrying. The authors indicate the importance and necessity of measurement, monitoring and evaluation in the physical education of preschool children. Ivanović, Gajević, Gajić & Atanasov (2018) believe that untimely detection of bad posture in preschool children can cause serious health problems in adulthood. Bogdanović, Radenković, Kahrović, Murić & Špirtović (2020) believe that special attention should be paid to prevention, as well as adequate education of employees in preschool institutions. Biševac, Mahmutović, Mekić & Dolićanin (2021) found that regular performance of corrective exercises (strengthening the weakened and stretching the shortened muscles) for six months has a positive effect on certain deformities of the spinal column. Correction of kyphosis was already visible after three months, of scoliosis after six months, while correction of lordosis in the only recorded case was not achieved with corrective exercises. Civkaroski & Milenković (2022) believe that there is a need to raise awareness about spinal column deformities and their consequences, as well as the need to emphasize the importance of good posture from an early age.

Conclusion

The analysis of the presented research showed that the postural status of preschool children in Serbia is not at a satisfactory level. "Bad head posture", "bad shoulder posture", "bad scapula posture" and "bad abdominal posture" are present in over 30% of children. It is similar with kyphotic, lordotic and scoliotic bad posture. It is necessary to take preventive measures in order to stop the trend of increasing prevalence of preschool children with bad postural status. The limitations of this study were the small number of studies on this topic. The authors should conduct more research in this scientific field.

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