

ORIGINAL SCIENTIFIC PAPER

Analysis of postural disorders with preschool and school children at the regional level

Boris Banjevic¹¹Faculty for Sport and Physical Education, University of Montenegro, Niksic, Montenegro**Abstract**

The aim of this work is to collect relevant research from Montenegro and the region, and their adequate analysis and making meaningful conclusions. The selection of works was made on the basis of issues related to the postural status of preschool and school children and youth. The shortlist included 30 works, which dealt with diagnosing postural status, determining the effects of targeted corrective programs, examining differences in posture in children from urban and rural areas (as well as gender) and discovering the interdependence of deformities with certain segments of anthropological status (usually morphological characteristics). The following conclusions were made: according to almost all the results obtained, the postural status is significantly disturbed and endangered in a large number of children; observed changes in the segments of the locomotor system are mostly of the initial stage, ie. functional type; positive changes in posture have been observed under the influence of applied preventive and corrective exercise programs; equal vulnerability of postural status was found among children from urban and rural areas; the greatest differences in posture between the sexes occur during puberty, and they are detected predominantly on the spinal column; changes in the locomotor system are mostly related to the parameters of the longitudinal dimensionality of the skeleton. The obtained results indicate the need for the implementation of studies that would include the diagnosis and application of experimental exercise programs, in order to gain new experiences and knowledge when applying corrective gymnastics exercises in regular physical education classes.

Keywords: *Postural disorders, Preschool children, School children*

Introduction

The number of children with posture problems is drastically increasing every year, as is the number of students complaining of pain in some part of the locomotor system (Lafond et al., 2007). The reasons for this situation are multiple, but they stand out: hereditary factor, insufficient movement and physical exercise, obesity, ignorance of the period of evolution of improper posture, as well as untimely detection of postural disorders (Watson et al., 2002).

Maintaining a correct upright posture is extremely complex, and can only be achieved if the active forces of the organism (muscles) are able to overcome the action of external forces, primarily the forces of gravity (Jovovic, 2008). The scheme of arranging the mechanism of control and regulation of posture can be reduced to: mechanisms from higher levels (motor area of the cerebral cortex) where there is a vision of ideal posture, then to

those mechanisms at the level of the spinal cord where what can be accepted is realized. as a significant role of the central reflex center which, by innervating the descending motor pathways, acts on the spinal mechanisms (Pausic, 2007).

One of the main components of the proper physical maturation of a child is proper posture. From it arise others: motor, functional, psychological, pedagogical, sociological and work. Therefore, a child who has the correct posture, as a rule, has developed anthropomotor abilities, functional characteristics that are reflected in the harmonious relationship and functioning of organs and organ systems, is psychologically stable - that has increased concentration and emotional relief, creates healthy living habits, has improved work discipline and increased tolerance in interpersonal relationships, and his productivity is above the defined average (Lafond et al., 2007).

Correspondence:

**Montenegro
Sport**

B. Banjevic
University of Montenegro, Faculty for Sport and Physical Education Niksic, Montenegro
E-mail: boris.banjevic@gmail.com

In the last two decades, there have been major changes in terms of reducing physical activity in preschool and school children and youth, which has been accompanied by an increase in the number of physical deformities in them. This is indicated by the results of systematic examinations and numerous specialized kinesiological researches that have been realized in our country and environment.

If, as individuals and the social community, our children's priority is the health of our children, and at the same time we do not react to the enormous progression of postural disorders in them, then it absolutely disqualifies us in terms of seriousness, individual and collective responsibility. One of the priority goals of this study is to draw the attention of all relevant actors to the seriousness of this issue.

Method

Criteria for inclusion in the analysis process were related to studies that addressed the issue of postural disorders in preschool and school children and youth from the territory of the former Yugoslavia. The time period taken into account in this context is from 1980. to 2018. The included studies were of a transversal or

longitudinal character, and were published as articles in scientific and other relevant journals. The search for available scientific material was performed using an electronic database of scientific studies, "Google Scholar", using combinations of the following keywords: "postural disorders", "preschool children", "school children", "posture", "deformity", and "spine". Each individual study was reviewed and a selection of 40 eligible studies was made. Later, according to the criterion (that it is the age of preschool and school children and youth), which this study predicted within its main goal, a shortlist of 30 works was made, which were detail analyzed in it.

Results

Table 1 shows 30 studies that addressed the issue of postural disorders in preschool and school children at the regional level.

The analysis of Table 1 established the following: Radisavljevic et al., (1982) determined the status of the arches of the feet in students of different socio-economic backgrounds. The sample consisted of 196 first grade primary school students in Belgrade and the Kraljevo area. The variable lowered foot was taken into account. It was found that 67.6% of students have a lowered foot. Of

Table 1. Studies dealing with the issue of postural disorders in preschool and school children

Authors	Name of the study
Radisavljevic et al., 1982.	Study of the foot status of first grade elementary school students from different socio-economic backgrounds
Jovovic et al., 1995.	Physical deformities of early adolescent students in Montenegro
Jovovic & Marusic, 1996.	Kyphotic and lordotic deviations of the spinal column in school children in Montenegro
Ristic et al., 2002.	Bone and joint deformities in primary school students in the municipality of Bojnik
Zivkovic et al., 2004.	The state of postural disorders and physical deformities of children of younger school age
Niksic et al., 2006.	Relationships between relevant indicators of postural status and lumbar lordosis in juvenile children
Canjak, 2006.	Transversal analysis of the status of wing blades in seventh grade elementary school students
Vlaskalic et al., 2006.	Relationship between anthropometric characteristics and deformities of the locomotor system adolescents
Karaleic, 2006.	Postural status of students higher primary school age
Videmsek et al., 2006.	The analysis of the arch of the foot in three-year-old-children-a case of Ljubljana
Nozinovic et al., 2007.	Relationship between proper posture, spinal deformity and foot deformity
Bogdanovic & Hadzic, 2007.	Influence of program corrective exercise on kyphotic posture in the primary school population
Medojevic & Jaksic, 2007.	Differences in postural disorders between boys and girls aged 7-15 in the territory of Vojvodina
Pausic, 2007.	Construction and evaluation of measurement procedures for the assessment of posture in boys aged 10-13 years
Kosinac & Banovic, 2007.	Association between some indicators of improper posture and scoliosis in juvenile children
Bogdanovic, 2007.	Presence of kyphotic and lordotic bad posture in the school population
Milosevic & Obradovic, 2008.	Postural status of children from Novi Sad preschool institutions aged 7 years
Bogdanovic & Milenkovic, 2008.	Morphological space and postural disorders in younger school age
Trajkovic & Nikolic, 2008.	Analysis of anthropometric measures and postural disorders of children of the 1987 and 2002 generations
Canjak, 2009.	Transversal analysis of lordosis status in sixth grade elementary school students
Protic-Gava & Krneta, 2010.	Postural status of children of younger school age in four districts of Vojvodina
Bogdanovic & Markovic, 2010.	Posture depending on the presence of deformities of the lower extremities
Jovovic & Canjak, 2011.	Prevalence of chest and loaptical disorders in school children of different ages
Simov et al., 2012.	Incidence of poor posture and flat feet in preschool children
Jovovic & Canjak, 2012.	Frequency and structure of postural disorders in young adolescents in Montenegro
Canjak, 2012.	Comparative analysis of the postural status of adolescents in rural and urban environments in Montenegro
Beganovic & Besovic, 2013.	Analysis of body posture in younger school age students in the city of Sarajevo
Lastro et al., 2015.	Influence of physical activity on the posture of school-age children
Protic-Gava et al., 2015	Incidence of postural disorders in relation to adolescents nutritional status
Banjevic & Canjak, 2016.	Effects of the application of corrective exercise on the postural status of children in early adolescence

which: I degree-65.8%, II degree-11.7% and III degree-22.4%. Respondents from rural areas had better arch status; Jovovic et al., (1995) dealt with the status of the locomotor system in young adolescents in Montenegro. The sample consisted of 511 respondents, with an average age of 13.7 years from primary schools in Niksic and Podgorica. The sample of measures included 9 morphological variables and 13 variables with 14 variations for postural status. With a view to the results obtained, scoliosis (68.6%) and lordosis (53%) have been shown to be the most common disorders. A large number of children with deteriorated foot arch status were observed (31.8%); Jovovic and Marusic (1996) assessed the kyphotic and lordotic deviations of the spinal column in school children. Their sample consisted of 511 students from elementary schools in Montenegro (253 female and 258 male) aged in average 13.6. The study examined 6 postural variables. The presence of spinal deviations in the sagittal plane was observed for a significant percentage of examinees (55% of boys and 43.8% of girls). The largest percentage of deviations were milder forms of the disorder; Ristic et al., (2002) dealt with the detection of bone and joint deformities. The study was conducted on a sample of 1219 primary school students in the municipality of Bojnik, while the set of measures included 6 postural variables. It was observed that 425 students (37.11%) had some of the deformities under study. The most common were foot deformities (296 students); Zivkovic et al., (2004) examined the state of postural status in children of younger school age. The research was conducted on the sample of 6112 students from the municipalities of Zajecar, Krusevac and Cacak, while 7 variables of postural status were analyzed. The observed incidence of the deformities was as follows: 1st grade: 45.7% -boys, 32.6% -girls; 2nd grade: 45.4% -boys, 56.2% -girls; 3rd grade: 64.7% -boys, 72.2% -girls; Niksic et al., (2006) dealt with the influence of posture deviation on lumbar lordosis in juveniles. The sample of examinees consisted of 150 male students and 155 female students aged from 6.5 to 8.5 from 4 elementary schools in Split. For the purposes of the study, 14 posture predictors and lumbar lordosis criterion were applied. A significant incidence of physical deformities at this age has been observed. The most important predictors in defining the mentioned criterion were the deformities of the lower limbs (genu valgum) and obesity; Canjak (2006) investigated the status of winged scapula in 120 thirteen-year-old students of both sexes from Niksic. The sample of variables consisted of 2 variables of anthropometric indicators and 1 variable of postural status. The results showed that the disorder in the mildest form had been observed in 40 boys out of 63 (63.4%) and in 23 out of 57 girls (40.3%). Vlaskalic et al., (2006) examined the connection between morphological characteristics and deformations of the movement apparatus. The research included 709 students of both sexes aged 15-18, while 9 variables of anthropometric indicators and 8 variables of postural status were taken into consideration. A high correlation between morphological characteristics and postural disorders, as well as the association between spinal and thoracic deformities were observed. Karaleic et al., (2006) examined the number of spinal disorders in 751 respondents (367 students and 384 students) from grades 5 through 8 of elementary school. For the purposes of the study 3 postural variables were applied. The results showed that 49% of the respondents had some of the examined spinal column deformities. Moreover, out of the 137 subjects with kyphotic posture, 103 were male (75.2%); Videmsek et al., (2006) examined the foot arch status in 127 examinees from 18 kindergartens in Ljubljana. It was found that $\frac{3}{4}$ of children (72%) had fallen arches, 20% were in the category of borderline cases, and the remaining 8% had normal feet; Nozinović et al., (2007) examined the postural status in 743 students aged 15-18 from high schools in Tuzla. Postural status was assessed using 6 vari-

ables. The results obtained showed that 50.23% of examinees had excellent posture, 42.23% had good or very good posture, while 6.54% of the examinees had poor or very poor posture; Bogdanovic and Hadzic (2007) examined the effect of corrective exercise on kyphotic posture. The sample consisted of 434 students of both sexes who attended the fifth grade of primary schools in Kragujevac. For the purposes of the research, 4 postural variables were used to assess kyphosis. It was observed that the number of students who had kyphotic poor posture decreased significantly by the time the final measurements were taken (from 44.7% to 27.18%); Medojevic and Jaksic (2007) examined differences in postural status in boys and girls aged 7 to 15. The respondents were the students from the territory of the larger cities in Vojvodina (340 boys and 255 girls), while 9 postural variables were compared. The results showed that the greatest differences between boys and girls were observed for the ages 9 to 10 in favor of boys, i.e. ages 12 to 13 years in favor of girls; Pausic, (2007) evaluated a new metric instrument for assessing the postural status of 273 boys aged 10 to 13, taking into consideration 15 motoric variables and 6 postural status variables. Factor analysis confirmed the validity of the measuring instrument for assessing posture. A decrease in the results for 5 motoric tests in boys with improper posture was observed. Kosinac and Banovic (2007) examined the postural status of juveniles. The sample consisted of 305 students from 4 elementary schools in Split, while a system of 15 predictor postural variables and scoliosis were applied as a criterion. It was observed that, in statistical terms, children differ significantly in terms of indicators of improper posture. Moreover, the asymmetry of the Lorentz triangle proved to be the most significant predictor of the defined criterion; Bogdanovic, (2007) examined the influence of programmed exercise on lordotic poor posture. The sample consisted of 434 students of both sexes attending the fifth grade of elementary schools in Kragujevac. For the assessment of lordosis, 4 postural variables were applied. It was observed that the experimental exercise program was effective, and that only 4 boys (7.14%) and 14 girls (19.44%) did not manage to successfully correct the spinal disorder classified as poor lordotic posture; Milosevic and Obradovic (2008) assessed the postural status of 377 respondents aged 7 (184 males and 193 females) from the territory of Novi Sad. The obtained results indicate that the boys had good spinal posture, while the posture of other segments was bad or very bad. As for the girls' group, good shoulder girdle posture was observed; Bogdanovic and Milenkovic's area of focus (2008) was postural status and the influence of morphological status on kyphosis and lordosis. For the purposes of the study, 8 morphological variables and 2 postural status variables were considered, while the sample included 434 fifth grade students from the territory of Kragujevac, both male and female. The results indicated that there were certain changes in the thoracic spine in children with higher body and sitting height; Trajkovic and Nikolic (2008) examined the differences in the postural status of different generations of students, i.e. students from the class of 1987 (150 students of both sexes) and students from the class of 2002 (149 students of both sexes), using a system of 2 postural and 10 anthropometric variables. There was a statistically significant difference in the prevalence of scoliosis in 2002 class of students when compared to the other group. In terms of anthropometric parameters, differences were noted for 4 variables; Canjak, (2009) examined the frequency of lordosis in 100 subjects aged 12, taking into consideration 1 variable and using 5 tests. The results indicated that lordosis was present in 56% of cases. The greatest degree of deviation was noted for functional disorders. Cervical lordosis was reported in a comparatively smaller number of cases (5.1%); Using 7 postural variables, Protic-Gava and Krneta (2010) examined the state of posture in 392 subjects of both sexes, aged 7-11, coming

from 4 districts of Vojvodina. It was observed that children of younger school age in some districts of Vojvodina do not differ significantly in terms of gender when it comes to postural status. Bogdanovic and Markovic (2010) examined the prevalence of foot deformities in 651 subjects (310 girls and 341 boys aged 7-14). The obtained data indicate that fallen foot arch was observed for 73% of boys and 65.2% of girls. Most of the disorders were functional in nature; Jovovic and Canjak (2011) examined the incidence of flat feet with regards to the age category. The research was conducted on the sample of 251 examinees (116 boys and 135 girls aged 10,12 and 14) from three elementary schools in Niksic. The results obtained indicate the highest frequency of disorders is in boys (14) -30% and girls (12) -31.5%; Using 8 variables to assess morphological status, Simov et al. (2012) examined the frequency of physical deformities in 968 subjects of both sexes, aged 6 and 7. All the examinees came from the territory of the Leskovac municipality. It was observed that 36% of examinees did not have any kind of deformity, 55% had one deformity and 9% had more than one deformity. Jovovic and Canjak, (2012) assessed the frequency and structure of postural disorders in 315 students aged 13.6 (160 boys and 155 girls) from 23 elementary schools in Montenegro. The system of 10 postural variables has been applied. The distortion of posture with the majority of examinees has been confirmed. It happened that the majority of examinees has the distorted status of the spinal column and scapula; Canjak, (2012) has determined the condition of postural status and the existence of differences in postures between adolescents of rural and urban environment. The research has been performed on 315 examinees of both sexes, of the 13,6 years of age (157 from urban and 136 from rural living environment), by using 10 postural variables with 14 variations. It was determined that the condition of postural status was significantly jeopardized. Flat foot is more frequent with examinees of urban environment. Scoliosis, kyphosis, sunken and pigeon chest, X and O legs have shown different frequency in both sexes from different environments; Beganovic and Besovic, (2013) have studied the irregularities of postures with 60 students of 10-11 years of age from Primary School "Kovacic" in Sarajevo, where they applied 6 postural variables. The following has been determined: by measuring the sagittal curve of the spine (43% irregular posture); by measuring sideways curve of the spine (13% irregular posture); Lastro et al., (2015) have studied the aspects of physical activity to the components of posture with 120 students (10-16 years) from Banja Luka. For studying the level of physical activity and postural status, 6 variables have been taken. The difference was determined in the level of physical activity of the studied subsamples, as well as the effect of different predictors on the set system of dependent variables. Protic-Gava et al., (2015) have evaluated the conditions of postural status and nutrition with 305 adolescents of 11 to 14 years of age, both sexes (158 girls and 147 boys), where 8 indicators of postural status were analyzed, while for the assessment for nutrition the Body Mass Index was calculated. The results have shown that there are no statistical significant differences in the postural status of examinees regarding gender, while this was not the case when we were talking about nutrition level; Banjevic and Canjak, (2016) have examined the efficiency of the impact of correction exercises program to the postural status of 110 students and student of seventh grade in three primary schools in Niksic. The gathering of data included the assessment of postural status (11 variables) and taking anthropometric indicators of examinees (6 variables). It has been determined that they succeeded through the four month experimental treatment to act preventively with appropriate exercises of corrective gymnastics to stop the deterioration of the current condition and the occurrence of new postural disorders.

Discussion

One of the greatest naturalists of all the times, Darwin's predecessor, Lamark, has summed one of the basic laws of science about living beings in one sentence: „the function develops the organ“. It is obvious that today exactly this function is missing, and that such lack leads to numerous problems regarding posture with pre-school and school children and youth. This statement is supported by the obtained results of research represented within the systematic analysis of postural disorders of pre-school and school children.

The research dealt with diagnosis of condition of postural status, by determining the effects of targeted corrective programs, examining differences in the posture with children from urban and rural environment (as well as with reference to gender) and revealing the existence of interdependence of the occurred deformities with certain segments of anthropological status (most frequent morphological characteristics).

All the shown studies have examined the status of postural condition and structure of occurred changes on it. The postural condition is, according almost all obtained results, significantly jeopardized and distorted with the majority of children, which gives the right for these problems to be defined as alarming. The thing that gives a glimpse of hope, is the fact, that the majority of stated changes on the locomotor apparatus is of functional character i.e. initial stage, which represents the so called active stage of deformation in the sense of its stopping and removal. In other words, there is big space for the activation of the mechanisms of corrective gymnastics on the prevention and correction with the majority of diagnosed cases. We should point out that the examined students were mostly of 6 to 14 years of age, and that this represents the period of highest effectiveness of active corrective program implementation. Analysing the obtained results, it is seen that most of the changes are on the muscle and bone and joint system of the shoulder and chest part of the spinal column. The domination of the kyphosis bad posture is easily recognized, rounded back and together with that the existence of winged scapula. We can freely say that this is the most dominant combined change on the locomotor apparatus of children nowadays. In addition, the weakness and insufficiency of paravertebral musculature is clearly recognized, which directly and indirectly leads to negative consequences, and first of all to the occurrence of lumbar lordosis. In majority of cases, the lowering of feet arches is present, which also brings with it certain changes in statics and dynamics of the movement system. As one of the „most inconvenient“ deviations, the deviation of the spinal column in the frontal plane – the so called scoliosis, happens in the minority of cases, but due to complexity of its occurrence, development and form, this occurrence should also be reason for concern. Other types of deformations featured as sunken or pigeon chest, „X“ and „O“ legs, occur rarely, but they, however, shouldn't be neglected. It has been noticed that with a certain number of kids occur the so called complexes of joint changes, which include the existence of two or more deformations on the locomotor apparatus. A great neglect and system partial interdependence of negative changes is evident with them, which more or less have been supporting one another, both in the process of occurrence and development and later in progression. This is the detail which is very important for the point of view about inevitability of the timely effect in the sense of stopping it, first of all negative causes, and then as well the progress of the occurrence itself. If this does not happen, we shall have more and more children with the complex problem, which, as such, in the majority of cases, unfortunately, can only be stated.

Three significant researches which dealt with identifying the effects of activities of target corrective treatments (Bogdanovic and Hadzic, 2007; Bogdanovic, 2007; Banjevic and Canjak, 2016).

The results of these studies indicate to the statement that certain positive changes have occurred. Mostly, there were improvements in posture, which didn't lead to the increase of the number of diagnosed changes compared to the initial taking of data. When we are talking about the ultimate stages or higher levels of distortion in posture, reasonably there was no progress. However, it has been determined that such conditions didn't have progression and that with it they didn't draw the occurrence of some of other types of deformation. The results obtained in this way are absolutely understandable if we take in consideration the limits that had effect on the more effective program application. Here, first of all, we think about the limitation of a number of available lessons, lack of time within them, non-incorporation of corrective programs in regular teaching, the loss of continuity due to various circumstances, adequate unpreparedness of qualified personnel, the impossibility of individual work and work in smaller groups etc.

One interesting study (Canjak, 2012) which related to the examination of differences in posture with students of urban and rural environment, has given for theory and practice several significant factual thesis. With the overview of comparative analysis of some morphological characteristics, certain differences were registered which mostly related to a significantly higher level of subcutaneous fat tissue with children of urban environment. Apart from the existence of certain differences, we can say that in overall analysis, there is equal problem both in urban and rural environment with reference to the occurrence and development of certain disorders on the segments of the movement apparatus. It was sometimes inconceivable that in the rural region so much distortion could be registered with reference to posture, as it was the case some years ago when this important study was made. Therefore, it is clear that even in rural region the „sitting“ way of life is more and more prevailing with the majority of younger population, that has as well as the urban mostly accepted the means of the modern technological world. In addition, a great presence of mechanisation is evident which greatly contributed to the reduction of physical work in the village, and in that sense also the engagement of children in some of those forms of such activities. On the other hand, it is superfluous to speak about negative effects of activities of numerous factors on children from urban environment. When we add to that the unhealthy eating habits and an increasing number of children with overweight, then, it is clear why the actuality of this topic should be raised to the highest possible level.

The majority of the shown researches has dealt with, among other things, differences in postures between the students of masculine and feminine gender. One research has been typical because of this fact (Medojevic and Jaksic, 2007). Essentially, it was shown that there were no differences at the level of statistical significance, except for the periods of children entering the puberty when due to intensive hormonal activity and the overall changes in the functioning of the body, there happened the increase of longitudinal skeleton dimensionality, which caused the occurrence of negative changes on the movement apparatus to a greater degree. Since with genders, these periods of maturity differ, thus the differences are evident in them in the condition and structure of changes in the majority of cases on the spinal column itself.

In certain studies during the assessment of the postural status, taking of anthropometric parameters has been performed, and thus the relations of their causes and consequences were examined with the occurred changes on the locomotor apparatus. Mostly, as in the study of Bogdanovic and Milenkovic from 2008, the connection with longitudinal skeleton dimensionality has been established (body height and sitting height). The connection was expressed especially with changes on the chest part of the spinal column, most of all in sagittal plane. The results obtained in

this way are understandable bearing in mind the age of examined children which mostly related to critical periods for the occurrence of some types of deformation.

Based on the analysis of the results of the said studies, we can state a very serious condition with reference to postural disorders with us and in the region. The fact is that the problem exists for a longer period of time and it is not resolved in adequate way, due to which it progresses, which eventually leads to serious consequences with reference to the health of school children and youth. The process of solving the problem is complex, but with the planned and decisive actions of relevant subjects of the system, it would have to give adequate results. In those actions, the experts of kinesiology i.e. kinesitherapy should be recognized as the key link, who must be the driving force at the beginning of solving the problem. Therefore, that initial potential must cover the application of experimental exercise program in our schools so that we would not only confirm the results of the so far studies, but also gain new experience and knowledge when working on this issue. However, opinions must be intensively exchanged when talking about the complexity of further activities, ways of incorporation of the corrective exercise program in regular teaching, solving the problem of qualified personnel etc., by using numerous feedback obtained by making the conclusion from applied kinesiology studies.

References

- Banjevic, B., & Canjak, R. (2016). Effects of the application of corrective exercise on the postural status of children in early adolescence. Unpublished scientific paper. Podgorica: Ministry of Education of Montenegro.
- Beganovic, E., & Besovic, M. (2013). Analysis of body posture in younger school age students in the city of Sarajevo. *Sports logos*, 10, 25-33.
- Bogdanovic, Z. (2007). Presence of kyphotic and lordotic bad posture in the school population. II International Conference "Management in Sport", Proceedings 4, 76-83.
- Bogdanovic, Z., & Hadzic, R. (2007). Influence of program corrective exercise on kyphotic posture in the primary school population. *Sport Mont*, 6(15-16-17) 538-544.
- Bogdanovic, Z., & Milenkovic, S. (2008). Morphological space and postural disorders in younger school age. *Glasnik ADS*, 43, 371-378.
- Bogdanovic, Z., & Markovic, Z. (2010). Posture depending on the presence of deformities of the lower extremities. *Glasnik ADS*, 45, 403-409.
- Canjak, R. (2006). Transversal analysis of the status of wing blades in seventh grade elementary school students. Unpublished diploma thesis. Niksic: Faculty of Philosophy.
- Canjak, R. (2009). Transversal analysis of lordosis status in sixth grade elementary school students. Unpublished professional paper. Podgorica: Ministry of Education of Montenegro.
- Canjak, R. (2012). Comparative analysis of the postural status of adolescents in rural and urban environments in Montenegro. Unpublished master's thesis. Niksic: Faculty for sport and physical education.
- Jovovic, V. (2008). Corrective gymnastics with kinesitherapy. Nikšić: Faculty of philosophy.
- Jovovic, V., Marusic, R., & Mijanovic, M. (1995). Physical deformities of early adolescent students in Montenegro. *Physical culture*, 1(2), 19-28.
- Jovovic, V., & Marusic, R. (1996). Kyphotic and lordotic deviations of the spinal column in school children in Montenegro. Proceedings of the Symposium "Arandjelovac 96", 8, 145-151.
- Jovovic, V., & Canjak, R. (2011). Prevalence of chest and looptical disorders in school children of different ages. *Sport and health*, 2(1), 140-146.
- Jovovic, V., & Canjak, R. (2012). Frequency and structure of postural disorders in young adolescents in Montenegro. International congress "Anthropological aspects of sports and physical education", Proceedings, 3, 113-119.
- Karelic, S. (2006). Postural status of students higher primary school age. *Glasnik ADS*, 41, 257-260.
- Kosinac, Z., & Banovic, I. (2007). Association between some indicators of improper posture and scoliosis in juvenile children. *Life and school*, 53, 37-38.
- Lastro, D., Ivetic, V., Spasojevic, O., & Jandric, S. (2015). Influence of physical activity on the posture of school-age children. *Glasnik ADS*, 50, 79-87.
- Lafond, D., Descarreaux, M., Normand, M.C., & Harison, D.E. (2007). Postural development in school children: a cross-sectional study. *Chiropractic &*

- Osteopathy, 15(1), 1740-1746.
- Medojevic, S., & Jaksic, D. (2007). Differences in postural disorders between boys and girls aged 7-15 in the territory of Vojvodina. Novi Sad: Faculty of sport and physical education.
- Milosevic, Z., & Obradovic, B. (2008). Postural status of children from Novi Sad preschool institutions aged 7 years. *Glasnik ADS*, 43, 301-309.
- Niksic, N., Kosinac, Z., & Srzic, M. (2006). Relationships between relevant indicators of postural status and lumbar lordosis in juvenile children. Proceedings of the 16th summer school of kinesiology of the Republic of Croatia, 7, 164-169.
- Nozinovic, N., Mikic, B., & Mehinovic, J. (2007). Relationship between proper posture, spinal deformity and foot deformity. *Sport*, 4(1), 88-93.
- Pausic, J. (2007). Construction and evaluation of measurement procedures for the assessment of posture in boys aged 10-13 years. Unpublished doctoral dissertation. Zagreb: Faculty of kinesiology.
- Protic-Gava, B., Krneta, Z., Boskovic, K., & Romanija, R. (2010). Postural status of children of younger school age in four districts of Vojvodina. *Glasnik ADS*, 45, 375-383.
- Protic-Gava, B., Scepanović, T., & Batez, M. (2015). Incidence of postural disorders in relation to adolescents nutritional status. *Sport Mont*, 13(43-44-45), 245-251.
- Radisavljevic, M., Koturović, L., & Arandjelovic, M. (1982). Study of the foot status of first grade elementary school students from different socio-economic backgrounds. *Physical culture*, 5, 446-469.
- Ristic, V., Markovic, V., & Ljubic, M. (2002). Bone and joint deformities in primary school students in the municipality of Bojnik. *Actamedica Mediana*, 3, 63-67.
- Simov, S., Minic, S., & Stojanovic, O. (2012). Incidence of poor posture and flat feet in preschool children. *Apollinem Medicum et Aesculapium*, 9(2), 5-8.
- Trajkovic, S., & Nikolic, M. (2008). Analysis of anthropometric measures and postural disorders of children of the 1987 and 2002 generations. *Glasnik ADS*, 43, 386-391.
- Videmsek, M., Klopčič, P., Stihec, J., & Karpljuk, D. (2006). The analysis of the arch of the foot in three-year-old-children-a case of Ljubljana. *Kinesiology*, 38(1), 78-85.
- Vlaskalic, Z., Bozic-Krstic, V., Obradovic, D., & Srdic, D. (2006). Relationship between anthropometric characteristics and deformities of the locomotor system adolescents. *Glasnik ADJ*, 41, 213-221.
- Zivkovic, D., Milenkovic, S., & Drobnjak, D. (2004). The state of postural disorders and physical deformities of children of younger school age. *Sport Mont*, 2(2-3), 421-426.
- Watson, K.D., Papageorgiu, A.C., Jones, G.T., Symmons, D.P., Silman, A.J., & Macfarlane, G.J. (2002). Low back pain in schoolchildren: occurrence and characteristics. *Pain*, 97(1-2), 87-92.