FACTA UNIVERSITATIS
Series: **Physical Education and Sport** Vol. 5, Nº 2, 2007, pp. 139 - 152

Review Paper

REVIEW OF NATIONAL AND INTERNATIONAL RESEARCH STUDIES IN POSTURAL DEFORMITIES: THE PERIOD FROM 2000 TO 2007

UDC 613.71/.72

Tijana Purenović *

Faculty of Sport and Physical Education, University of Niš, Serbia
E-mail: tijanapurenovic@gmail.com

Abstract. *Postural status aberrations in children and youth represent a global and current problem, and as such attract enormous attention on the part of national and international experts in different fields. It is quite natural to expect different approaches and different results of national and international researchers in this area; therefore, the aim of this research is to define these differences in national and international research methods and methodologies and thus obtain results. The research encompassed 50 studies (25 national and 25 international ones), and they were selected according to the established criteria. By analyzing and comparing these research studies, a conclusion was drawn that there are differences in the use of research methodology – Serbian authors have mainly used less objective methods for the assessment of the postural status of their subjects, and foreign authors have, on the other hand, greatly preferred more objective methods. However, when talking about research results regarding postural deformities defined by national and international authors, we cannot state any significant differences. Namely, both national and international authors have reached, in most cases, the same conclusions – the existence of a correlation between obesity and lower limb deformities, body height and foot status, scoliotic bad body posture and body mass, greater engagement of one hand and spinal column deviation on the frontal plane, etc.*

Key words: *postural status, schoolchildren, athletes, asymmetric sports, work methodology*

1. INTRODUCTION

Bad body posture gives rise to the development of body deformities. Moreover, if certain corrective measures are not taken in due time, degenerative changes will develop,

Received May 22, 2007
* The author is a Ministry of Science - Serbia stipend, engaged in the research project of the Institute of Sociology at the Faculty of Philosophy in Niš

not just in muscles but in ligaments and bone tissue as well. Therefore, it is never too late to warn children about the constant harmful effects of certain factors and bad habits, especially when it comes to developing children. Unfortunately, in spite of a continuous education of groups prone to postural deformities (school-age children), and despite initiating certain preventive and therapeutic caution measures, one can regrettably state that bad body posture is almost unavoidable and hard to eradicate.

What draws one's attention are disturbing global data on bad body posture evident in all countries and in all walks of life, among the poor and the rich, the educated and the illiterate, the healthy and the sick, the sedentary and those with athletic build, among people of all races, genders and ages. This very phenomenon of the omnipresent bad body posture and body deformities poses the need to dwell on this topic and engage the attention of scientists working in different fields (pedagogues, physical education teachers, orthopedics specialists, sports medicine physicians, ergonomics-related practitioners, etc.) both in the area of prevention and treatment. However, not all of them have the same conditions and possibilities to successfully prevent and solve these problems. The important question is what is the position of our national experts, who are from a country in transition, as compared to the position of their international colleagues, i.e. authors from: Bosnia and Herzegovina (Ostojić et al., 2006), Croatia (Rubeša et al., 2006), Bulgaria (Tanchev et al., 2000), Greece (Grivas, Arvanti et al., 2002; Grivas, Samelis et al., 2002; Korovessis et al., 2004; Grivas et al., 2006), Turkey (El et al., 2006), Austria (Pfeiffer et al., 2006), Italy (Monteleone et al., 2005), France (Wodecki et al., 2002), Sweden (Widhe, 2001), Russia (Balashova et al., 2004), China (Chow et al., 2005; Leung et al., 2005), Korea (Yoo et al., 2001), USA (Wojtys et al., 2000; Michelson et al., 2002; Cote et al., 2005), Canada (Lafond et al., 2007), Brazil (Pinto Ribeiro et al., 2003; Penha et al., 2005; Sa Pinto et al., 2006) and Australia (Burns et al., 2005; Mickle et al., 2006).

All these facts have initiated our research interest into the analysis of recent papers on the postural deformities in children and youth, athletes and non-athletes. The research problem of this paper is a comparison of the applied work methodology and the obtained results in the area of postural deformities studied by national and international authors in the period between 2000 and 2007.

2. METHODS

Literature search

Studies written by our national authors were selected from the proceedings of the national scientific conferences and other scientific literature, and studies written by international authors were obtained by means of the Scholar Google search engine and were prompted by the following key words: postural status, postural deformities, scoliosis, kyphosis, lordosis, genu valgum, genu varum, flatfoot, pes planus, schoolchildren, athlete(s), swimmer(s), volleyball player(s), football player(s), tennis player(s), skier(s) and gymnast(s). The search was limited to studies on humans, published in English, Spanish or in French and in the interval from January 2000 up to March 2007. References of retrieved studies and of relevant scientific papers were checked to identify additional studies with the same research subject.

Study selection

The choice was made according to the authors' personal preferences based on the title, keywords and abstract, and reports on the studies were included only if they met the following inclusion criteria: postural deformities, postural status of schoolchildren, postural status of athletes, postural deformities in asymmetric sports.

Methodological quality and data extraction

The methodological quality of the studies included in this paper is very low. All the data on the research problem, samples and the variables as well as the methods and the obtained results of the selected papers are extracted and summarized, and the final impression is that the studies and papers are heterogeneous.

3. RESULTS

If we take into consideration methods of assessment of the subjects' postural status, then we could compare most of the national studies with only two international ones (Pinto Ribeiro et al., 2003; Penha et al., 2005). But in this case we will compare the results regardless of the applied methodologies.

When comparing the results of studies investigating spinal column postural deformities (Table 1), one can notice the following: in children aged 7 – 10 lordotic bad body posture is percentage-wise more prominent in Brazilian children (57.25%) (Penha et al., 2005), in comparison to children from Serbia (33.5%) (Milenković et al., 2003), and when speaking about kyphotic bad body posture, the situation is reverse – this spinal column deformity on the sagittal plane is more prominent in children from Serbia (51.4%) (Milenković et al., 2003), in comparison to Brazilian children (33.75%) (Penha et al., 2005). Deviation of the spinal column on the frontal plane in athletes has mainly been researched by foreign authors, and when reviewing the results, one can notice that the samples consisted of participants in asymmetric sports: rhythmic gymnastics – 12% (Tanchev et al., 2000), badminton – 35.8% (Balashova et al., 2004), volleyball – 51.7% (Yoo et al., 2001), indoor soccer – 62% (Pinto Ribeiro et al., 2003), swimming – 62.4% (Balashova et al., 2004) and archery – 83.3% (Balashova et al., 2004).

When researching postural status of the lower limbs (Table 2), Jovović (2005) and a group of Brazilian authors (Sa Pinto et al., 2006) agreed on the significant correlation between obesity and leg deformities. Two groups of foreign authors do not agree on the status of athletes' feet and injuries – a group of authors from Australia (Burns et al., 2005) consider triathlons with foot supination four times more prone to injury , while a group of American authors (Michelson et al., 2002) do not consider the flatfoot deformity as a predisposition for later lower limb injuries.

Comparing the results in Table 3, one can notice that Jovović (2005) and a group of authors from Italy (Monteleone et al., 2005) have reached the same conclusion – that body height and foot status correlate, and groups of authors from Serbia (Stojanović et al., 2005) and Greece (Grivas, Arvanti et al., 2002) have concluded that scoliotic bad body posture correlates with body mass. In addition, authors from Serbia – Bogdanović (2003) and Stojanović et al. (2005) agree that body height can lead to the presence of kyphotic bad body posture, while Jovović (2005) and Živković et al. (2005) did not find a

significant correlation between postural and anthropometric areas. When relating postural deformities and motor abilities, Madić (2006) and Vukanić (2006) conclude that motor skills and foot status correlate.

Table 1. Review of the results for national and international research studies: Postural deformities of the spinal column

<table>
<tr><th colspan="3">National research studies</th><th colspan="3">International research studies</th></tr>
<tr><th>LLD</th><th>KLD</th><th>SLD</th><th>LLD</th><th>KLD</th><th>SLD</th></tr>
<tr><td></td><td>(Bogdanović, 2003) 52.12% of pupils 11 years of age (20.84% of girls and 31.27% of boys)</td><td rowspan="4"></td><td colspan="2" rowspan="2"></td><td>(Tanchev et al., 2000) – 12% rhythmic gymnasts</td></tr>
<tr><td colspan="2">(Karaleić, 2003) – 54.9% of girls 11 years of age (basketball training had a positive effect on the correction of LLD)</td><td>(Yoo et al., 2001) – 51.7% of high school volleyball players</td></tr>
<tr><td colspan="2">(Milenković et al., 2003) – 56.4% of children, 7-10 years of age</td><td>(Pinto Ribeiro et al., 2003) – 62% of indoor soccer players, 9-16 years of age</td><td colspan="2"></td></tr>
<tr><td>(Milenković et al., 2003) – 33.5% of children, 7-10 years of age</td><td>(Milenković et al., 2003) – 51.4% of children, 7-10 years of age</td><td colspan="3"></td></tr>
<tr><td></td><td>(Milenković et al., 2004) – 4% of children, 11-14 years of age</td><td>(Milenković et al., 2004) – 7.8% of children, 11-14 years of age</td><td colspan="2"></td><td>(Balashova et al., 2004) – 35.8% of badminton players; 83.3% of archers; 62.4% of swimmers; 66.7% of nonathletes</td></tr>
<tr><td>(Bogdanović, 2005a) 30.43% of pupils, 11 years of age</td><td>(Bogdanović, 2005a) 43.14% of pupils, 11 years of age</td><td></td><td>(Penha et al., 2005) 7 years – 55%; 8 years – 61%; 9 years – 52%; 10 years – 61%</td><td>(Penha et al., 2005) 7 years – 21%; 8 years – 27%; 9 years – 45%; 10 years – 42%</td><td>(Penha et al., 2005) 7 years – 36%; 8 years – 45%; 9 years – 52%; 10 years – 48%</td></tr>
<tr><td colspan="2"></td><td>(Krsmanović & Bigović, 2006) 30.2% of children, 7-11 years of age</td><td colspan="2" rowspan="2"></td><td rowspan="2">(Ostojić et al., 2006) 33.4% of children, 7-14 years of age</td></tr>
<tr><td>(Purenović, 2006) 67.6% High school for the study of Music, children 15-19 years of age</td><td>(Purenović, 2006) 42.6% High school for the study of Music, children 15-19 years of age</td><td>(Purenović, 2006) 83.8% High school for the study of Music, children 15-19 years of age</td></tr>
</table>

Legend: (LLD) – lordotic bad body posture, (KLD) – kyphotic bad body posture, (SLD) – scoliotic bad body posture

Table 2. Review of the results for national and international research studies: Postural deformities of the lower limbs

<table>
<tr><th colspan="5">National Research Studies</th><th colspan="5">International Research Studies</th></tr>
<tr><th colspan="10">A) Postural deformities of the legs</th></tr>
<tr><th colspan="2">Knock knees</th><th colspan="3">Bowleg</th><th colspan="2">Knock knees</th><th colspan="3">Bowleg</th></tr>
<tr><td colspan="2">(Jovović, 2005) – 14 year old children with above average body height and weight</td><td colspan="3" rowspan="2"></td><td colspan="2">(Pinto Ribeiro et al., 2003) 58% indoor soccer players, 9-16 years of age</td><td colspan="3">(Pinto Ribeiro et al., 2003) 16% indoor soccer players, 9-16 years of age</td></tr>
<tr><td colspan="2"></td><td colspan="2">(Penha et al., 2005) – girls 7 yrs. – 64%; 8 yrs. – 58%; 9 yrs. – 58%; 10 yrs. – 45%</td><td colspan="3"></td></tr>
<tr><td colspan="5"></td><td colspan="5">(Sa Pinto et al., 2006) – there is a statistically significant correlation between obesity and leg deformities</td></tr>
<tr><th colspan="10">B) Postural Deformities of the Feet</th></tr>
<tr><th>Flatfoot</th><th>Cavus</th><th>Pron.</th><th>Supin.</th><th></th><th>Flatfoot</th><th>Cavus</th><th>Pron.</th><th>Supin.</th><th></th></tr>
<tr><td>(Živković et al, 2003) boys, 7-10 years of age</td><td>(Živković et al., 2003) girls, 7-15 years of age</td><td colspan="2"></td><td></td><td>(Michelson et al., 2002) – in athletes in team sports being flatfooted is not a predisposition for later lower limb injuries</td><td colspan="4"></td></tr>
<tr><td>(Jovović, 2005) 14 year old children with above average body height and weight</td><td colspan="4" rowspan="2"></td><td colspan="3" rowspan="2"></td><td>(Burns et al., 2005) triathletes with supinated foot type, during the competition season, have fourfold increased risk of overuse injury</td></tr>
<tr><td>(Sabo, 2006b) – better foot arch is manifested among girls, 4-7 years of age; 50% children with lesser, and 0.4% with bigger exceptions</td><td colspan="2">(Cote et al., 2005) the stability index is greater in the group of subjects with pronated foot type compared to those with supinated foot type</td></tr>
<tr><td colspan="5" rowspan="4"></td><td colspan="5">(Leung et al., 2005) 15-20% children, 4 – 18 years of age</td></tr>
<tr><td colspan="5">(El et al., 2006) 82.8% children, 9 years of age</td></tr>
<tr><td colspan="5">(Pfeiffer et al., 2006) 3 yrs. – 54%; 6 yrs. – 24%; 36% of girls and 52% of boys, 3-6 years of age</td></tr>
<tr><td colspan="5">(Rubeša et al., 2006) 60% basketball players, 13-15 years of age</td></tr>
</table>

Legend: (PRON) – pronated foot type, (SUPIN) – supinated foot type

Table 3. Review of the results for national and international research studies: Postural deformities and anthropological status

National Research Studies	International Research Studies
A) Postural deformities – anthropometric characteristics	
(**Bogdanović, 2003**) – the influence of body height on the presence of KLD is most characteristic for boys in the height group of 150-155cm (40.38%), and for girls in the height group of 145-150cm (36.5%); 11 years old	(**Grivas, Arvanti et al., 2002**) there are no statistically significant differences in body weight and height of children with or without SLD
(**Jovović, 2005**) – there is no statistically significant intercorrelation between these two areas, but the author points out that 13 year old boys with above average body height and body mass, are more liable to postural deformities and body deformities, especially knocked knees and being flatfooted	(**Monteleone et al., 2005**) foot morphology is in correlation with the body mass index
(**Stojanović et al., 2005**) – in 11 years old children KLD is in a significant correlation with the longitudinal dimensionality of the skeleton, especially with body height and leg length; subcutaneous fat tissue is in a positive correlation with LLD, and the parameters of the circular dimensionality (abdomen and chest circumference and body mass) are in a positive correlation with KLD and SLD	
(**Živković et al., 2005**) – in 13 year old girls there is no statistically significant correlation between these two areas, but on does exists for the boys	
B) Postural deformities – motor abilities	
(**Krsmanović & Bigović, 2006**) – there are no statistically significant differences in the flexibility of the spinal column of pupils with or without SLD; 7-11 years of age	
(**Madić, 2006**) – subject groups in relation to the differences in postural status of the head, shoulders and shoulder blades, did not differ statistically in motor status; subject groups defined in terms of the differences in chest, abdomen, legs and feet status did differ in a statistically significant manner in motor status (in favor of the subjects without these deformities); 4-7 years of age	
(**Vukanić, 2006**) – there is a statistically significant relation between the explosive power of legs and speed and different foot status; there is a significant relation of the explosive power of legs and lowering of the foot arch; subjects with and without flat feet were approximately successful in the standing long jump test, and in the three step jump from a standing position test and subjects without this deformity were more successful in the standing and dash high jump test ; 11-14 years of age	
C) Postural deformities – anthropometric characteristics – motor abilities	
(**Milenković, 2002b**) after one year of tennis school, there was no worsening of the SLD and increase of flat feet in the group of male athlete, and in the group of male non-athlete there was; there are differences in the motor area and in the circular dimensionality of the skeleton; male athlete have lower values of abdominal and back tissue folds, their shoulder area flexibility and explosive power has been improved and their longitudinal arch foot has been strengthen; 9 years of age	(**Widhe, 2001**) the posture of 90 children changed significantly during the 10-year study period: KLD and LLD increased, the total sagittal mobility of the spine decreased significantly; occasional lower back pain was reported by 38% of the children, but back pain was not related to posture, spinal mobility or physical activity

Legend: (LLD) – lordotic bad body posture, (KLD) – kyphotic bad body posture, (SLD) – scoliotic bad body posture

Table 4. Review of the results for national and international research studies: The influence of some factors on the presence of postural deformities

National Research Studies	International Research Studies
A) Postural deformities and obesity	
(**Jovović, 2005**) – obese children are more inclined to suffer from postural deformities and body deformities, especially knock knees and flat feet; 14 years of age	(**Monteleone et al., 2005**) The footprint morphology of children is related to their body mass index, 6-11 years old
	(**Mickle et al., 2006**) obese 4 year old children experience significantly higher pressure to their midfoot, which leads to bony fatigue and soft tissue damage
	(**Pfeiffer et al., 2006**) The body weight of 3-6 year old children has an influence on the prevalence of flat feet
	(**Sa Pinto et al., 2006**) – there is a higher frequency of at least one osteoarticular manifestation in obese children (55%) compared to children with normal body weight (23%), at a statistically significant level; there is a statistically significant association between obesity and knock knees and bowleg
B) Postural deformities and manner of backpack carrying	
(**Bogdanović, 2005a**) – KLD is most prominent in the group of pupils carrying a backpack on both shoulders (17.65% girls and 27.61% boys); the biggest number of postural deformities is in the group of pupils carrying backpack on both shoulders; 11 years of age	(**Korovessis et al., 2004**) dorsal pain increases with increasing backpack weight; the manner (one versus both shoulders) of backpack carrying does not correlate either with dorsal or lower back pain; 9-15 years of age
(**Purenovic, 2006**) – 92% of music students who carry their instrument suitcase hanging on one shoulder or in their hand have SLD, and 72.7% of music students who carry their instrument suitcase hanging on both shoulders have KLD; 15-19 years of age	(**Chow et al., 2005**) – backpack loading has a similar effect on the pulmonary function of both normal and SLD schoolgirls, but all pulmonary parameters are found to be significantly lower in the SLD than in normal girls; a significant decrease in forced vital capacity and forced expiratory volume is found with increasing backpack load; 11-12 years of age
C) Postural deformities and handedness	
(**Milenković et al., 2004**) – left handedness among 11-14 year old children is correlated to SLD (for girls) in a statistically significant maner; there is no significant correlation between left handedness and KLD (for both genders)	(**Grivas et al., 2006**) – a significant statistical correlation of trunk asymmetry and handedness was found in the group of SLD children with asymmetry 2–7° (in the thoracic part); 6-18 years of age
D) Postural deformities and sex maturity of girls	
	(**Grivas, Samelis et al., 2002**) – 36.5% of nonscoliotic girls and 73.33% of scoliotic girls had menarche; 61% of menarche positive scoliotic girls have scoliosis dexter, while 64.3% of menarche negative scoliotic girls have scoliosis sinister (at statistically significant level); there is no statistically significant difference between scoliotic and nonscoliotic girls with menarche (when the respective ages of menarche are compared); there is a significant difference between menarche positive and menarche negative scoliotic girls in relation to the presence of scoliosis dexter and scoliosis sinister; 7-18 years of age

Legend: (KLD) – kyphotic bad body posture, (SLD) – scoliotic bad body posture

Analyzing the results in Table 4, one can notice that Jovović (2005) and some groups of foreign authors (Monteleone et al., 2005; Pfeiffer et al., 2006) agree that obesity can influence the occurrence of the flatfoot deformity. The same local author (Jovović, 2005) agrees with the authors from Brazil (Sa Pinto et al., 2006) that obese children have a greater predisposition for knock knees. The weight and manner in which a backpack is carried is one of the harmful factors inducing postural status deformity in school-age children. Bogdanović (2005a) and Purenović (2006) have found a correlation between the manner of backpack carrying and the postural status – kyphotic bad body posture is most prominent in children carrying backpack on both shoulders. Foreign authors have mainly focused their attention on the harmful effects of backpack weight and have reached a conclusion that it produces a negative influence on the functioning of the respiratory system (Chow et al., 2005), and induces back pain (Korovessis et al., 2004). Handedness, i.e. the more prominent engagement of one hand, correlates with the deviation of the spinal column on the frontal plane (Milenković et al., 2004; Grivas et al., 2006).

4. DISCUSSION

More than 700 references were identified in the literature search, and about 600 were eliminated based on their title and abstract. In a detailed review of 100 studies, 50 were isolated – 25 national and 25 international studies met the selection criteria and were, therefore, analyzed further.

Of all of the selected studies four are longitudinal (Milenković, 2000, 2002a, 2002b; Widhe, 2001), and all the others are cross-sectional. When considering the sample it can be said that the postural status in school-age children is researched the most, in a total of more than 35 studies (Milenković, 2000, 2002a, 2002b; Widhe, 2001; Grivas, Arvanti et al., 2002; Grivas, Samelis et al., 2002; Bogdanović, 2003, 2005a, 2005b; Karaleić, 2003; Milenković et al., 2003; Švraka et al., 2003; Živković et al., 2003, 2005; Korovessis et al., 2004; Milenković et al., 2004; Chow et al., 2005; Cote et al., 2005; Jovović, 2005; Leung et al., 2005; Milenković & Stojanović, 2005; Monteleone et al., 2005; Penha et al., 2005; Stojanović et al., 2005; Čojbašić, 2006; El et al., 2006; Grivas et al., 2006; Jovović & Čanjak, 2006; Krsmanović & Bigović, 2006; Ostojić et al., 2006; Purenović, 2006; Rubeša et al., 2006; Sa Pinto et al., 2006; Vukanić, 2006; Lafond et al., 2007), then came sports population (Tanchev et al., 2000; Wojtys et al., 2000; Yoo et al., 2001; Michelson et al., 2002; Milenković, 2002b; Wodecki et al., 2002; Pinto Ribeiro et al., 2003; Stojanović, 2003; Balashova et al., 2004; Burns et al., 2005; Milenković & Stojanović, 2005), and the least attention was paid to the youngest, i.e. pre-school age children (Madić, 2006; Mickle et al., 2006; Pfeiffer et al., 2006; Protić-Gava et al., 2006; Sabo, 2006a, 2006b). As for the number of subjects encompassed by the research, the greatest number of studies have up to 1000 subjects (Milenković, 2000; Michelson et al., 2002; Bogdanović, 2003, 2005a, 2005b; Milenković et al., 2003; Stojanović, 2003; Švraka et al., 2003; Živković et al., 2003, 2005; Burns et al., 2005; Jovović, 2005; Milenković & Stojanović, 2005; Penha et al., 2005; Čojbašić, 2006; El et al., 2006; Jovović & Čanjak, 2006; Krsmanović & Bigović, 2006; Pfeiffer et al., 2006; Protić-Gava et al., 2006; Sabo, 2006b; Stojanović et al., 2005; Vukanić, 2006), then come the studies with 100 and less subjects (Tanchev et al., 2000; Widhe, 2001; Milenković, 2002a, 2002b; Wodecki et al., 2002; Karaleić, 2003; Pinto Ribeiro et al., 2003; Balashova et al., 2004; Cote et al., 2005;

Mickle et al., 2006; Purenović, 2006; Rubeša et al., 2006; Sa Pinto et al., 2006), and the least number of studies have big samples of subjects – more than 1000 (Wojtys et al., 2000; Yoo et al., 2001; Grivas, Arvanti et al., 2002; Grivas, Samelis et al., 2002; Korovessis et al., 2004; Milenković et al., 2004; Leung et al., 2005; Monteleone et al., 2005; Grivas et al., 2006; Madić, 2006; Ostojić et al., 2006; Sabo, 2006a; Lafond et al., 2007).

Most of the studies researched postural deformities of the spinal column on the sagittal plane (Wojtys et al., 2000; Widhe, 2001; Wodecki et al., 2002; Bogdanović, 2003, 2005a, 2005b; Karaleić, 2003; Milenković et al., 2003; Pinto Ribeiro et al., 2003; Stojanović, 2003; Švraka et al., 2003; Živković et al., 2003; Korovessis et al., 2004; Milenković et al., 2004; Penha et al., 2005; Stojanović et al., 2005; Čojbašić, 2006; Protić-Gava et al., 2006; Purenović, 2006; Lafond et al., 2007) and the frontal one (Milenković, 2000, 2002a, 2002b; Tanchev et al., 2000; Yoo et al., 2001; Grivas, Arvanti et al., 2002; Grivas, Samelis et al., 2002; Milenković et al., 2003; Stojanović, 2003; Švraka et al., 2003; Živković et al., 2003, 2005; Balashova et al., 2004; Milenković et al., 2004; Chow et al., 2005; Jovović, 2005; Milenković & Stojanović, 2005; Penha et al., 2005; Stojanović et al., 2005; Čojbašić, 2006; Grivas et al., 2006; Krsmanović & Bigović, 2006; Madić, 2006; Ostojić et al., 2006; Purenović, 2006; Sabo, 2006a, 2006b). The next problem the authors focused on is the flatfoot deformity (Milenković, 2000, 2002a, 2002b; Michelson et al., 2002; Švraka et al., 2003; Burns et al., 2005; Cote et al., 2005; Jovović, 2005; Leung et al., 2005; Monteleone et al., 2005; El et al., 2006; Mickle et al., 2006; Pfeiffer et al., 2006; Rubeša et al., 2006; Sabo, 2006a, 2006b; Vukanić, 2006), and the least of them dealt with the leg (Pinto Ribeiro et al., 2003; Stojanović, 2003; Jovović, 2005; Penha et al., 2005; Sa Pinto et al., 2006) and winged shoulder blade problem (Jovović & Čanjak, 2006).

When talking about the applied methods we can conclude that the quality is not at the expected level, especially when it comes to studies by Serbian authors. They have mostly evaluated postural status by means of somatoscopy and somatometrics (Bogdanović, 2003, 2005a, 2005b; Karaleić, 2003; Stojanović, 2003; Živković et al., 2003, 2005; Milenković et al., 2004; Jovović, 2005; Milenković & Stojanović, 2005; Stojanović et al., 2005; Jovović & Čanjak, 2006; Purenović, 2006), and the two further studies, apart from the mentioned ones, have applied some other methods for the estimation of the postural status, such as the bending test, voluntary muscle contraction test, hanging position test (Jovović, 2005; Jovović & Čanjak, 2006). Body posture was evaluated in five national papers by the Napoleon Volansky method (Krsmanović & Bigović, 2006; Madić, 2006; Protić-Gava et al, 2006; Sabo, 2006a, 2006b), the same number of papers did not cite their applied method (Milenković, 2000, 2002a, 2002b; Milenković et al., 2003; Švraka et al., 2003), and only one national author (Čojbašić, 2006) has applied a technologically more advanced and more objective spinal column postural status assessment method – a device called the photo-visual indicator. Foot status has been mainly assessed by Serbian authors by means of pantography.

The methodology used by foreign authors, on the other hand, is much better. Most foreign studies report using the scoliometer and kyphometer for the measurement of spinal column deviation on the frontal and sagittal planes (Widhe, 2001; Yoo et al., 2001; Grivas, Samelis et al., 2002; Korovessis et al., 2004; Grivas et al., 2006); two studies report defining postural status by means of radiography (Tanchev et al., 2000; Wodecki et al., 2002); five studies report some other methodology being used in the evaluation of

postural status, such as the bending test (Yoo et al., 2001; Grivas et al., 2006), Cobb's method (Chow et al., 2005), the stereographic method (Wojtys et al., 2000), and the Biotonix postural analysis system (Lafond et al., 2007). Apart from national authors, only the authors from Brazil used somatoscopy, (Pinto Ribeiro et al., 2003; Penha et al., 2005), and four studies did not even report any postural status assessment method (Grivas, Arvanti et al., 2002; Mickle et al., 2006; Ostojić et al., 2006; Sa Pinto et al., 2006).

Both the authors from Serbia and the authors from other countries have most frequently investigated relations between postural status and anthropometric characteristics (Widhe, 2001; Grivas, Arvanti et al., 2002; Milenković, 2002b; Bogdanović, 2003; Milenković et al., 2004; Jovović, 2005; Monteleone et al., 2005; Stojanović et al., 2005; Živković et al., 2005) and the influence of postural deformities on the motor abilities of the subjects – this was found in six papers of national authors (Milenković, 2002a, 2002b; Karaleić, 2003; Krsmanović & Bigović, 2006; Madić, 2006; Vukanić, 2006). Foreign authors have, on the other hand, focused their attention on the influence of postural deformities of the spinal column on functional abilities (Chow et al., 2005). They are also interested in the influence of obesity, i.e. the state of being overweight, on the postural status of the studied subjects (Jovović, 2005; Monteleone et al., 2005; Mickle et al., 2006; Pfeiffer et al., 2006; Sa Pinto et al., 2006), then the influence of the manner in which they carried a backpack and the influence of the backpack load on body posture (Korovessis et al., 2004; Bogdanović, 2005a; Chow et al., 2005; Purenović, 2006), handedness and the postural status of the spinal column (Milenković et al., 2004; Grivas et al., 2006), and also sex maturity of the female subjects with and without scoliotic bad body posture (Grivas, Samelis et al., 2002).

After reviewing the selected studies, one can state that the authors' interests are primarily directed towards gender differences (Wojtys et al., 2000; Milenković, 2002a; Bogdanović, 2003; Milenković et al., 2003; Živković et al., 2003, 2005; Milenković et al., 2004; Jovović & Čanjak, 2006; Pfeiffer et al., 2006; Sabo, 2006a, 2006b), age differences (Milenković et al., 2003; Stojanović, 2003; Živković et al., 2003; Milenković & Stojanović, 2005; Pfeiffer et al., 2006; Lafond et al., 2007), and differences between athletes and non-athletes – one national (Milenković, 2002b) and three foreign authors' studies (Yoo et al., 2001; Wodecki et al., 2002; Balashova et al., 2004).

5. CONCLUSION

On the basis of the 25 national and 25 international studies in the area of the postural deformities which have been reviewed and analyzed, the following conclusion can be reached:

Bearing in mind that 95% of the national authors use subjective methods and tests for the assessment of postural status, and especially the spinal column, whereas most of the foreign authors (80.95%) apply much more objective methods, it can be concluded that there are differences in the applied methodologies when considering authors from Serbia and authors from other world countries, i.e. foreign authors in this case are in a more advantageous position. By analyzing and comparing the obtained results in the papers of both national and international authors, one can notice that both have obtained similar results and reached similar conclusions.

REFERENCES

1. Balashova, E.R., Pleshchinskii, I.N. & Eremeen, A.M. (2004). Motor and autonomic asymmetries in athletes with different specializations. *Human Physiology*, 30 (5), 591-595.
2. Bogdanović, Z. (2003). Kifotično loše držanje kod učenika V razreda i njihova zavisnost od visine tela (Kyphotic bad body posture in the fifth grade pupils and their dependence on body height). In D. Živković (Ed.), *Proceedings of "Fis-communications 2003"*, (pp. 303-306). Nis: Faculty of Physical Education.
3. Bogdanović, Z. (2005a). Prisustvo kifotičnog i lordotičnog lošeg držanja tela u zavisnosti od načina nošenja školske torbe (Manifestation of kyphotic and lordotic bad body posture influenced by backpack carrying type). In S. Joksimović (Ed.), *Proceedings of "Fis-communications 2005"*, (pp. 59-65). Nis: Faculty of Physical Education.
4. Bogdanović, Z. (2005b). Kifotično i lordotično loše držanje kod osnovnoškolske populacije u zavisnosti od nivoa obrazovanja oca (Kyphotic and lordotic bad body posture in elementary school-age population in relation to the educational level of the father). In S. Joksimović (Ed.), *Proceedings of "Fis-communications 2005"*, (pp. 358-364). Nis: Faculty of Physical Education.
5. Burns, J., Keenan, A.M. & Redmond, A. (2005). Foot type and overuse injury in triathletes. *Journal of the American Podiatric Association,* 95 (3), 235-241.
6. Chow, D.H.K., Ng, X.H.Y., Holmes, A.D., Cheng, J.C.Y., Yao, F.Y.D. & Wong, M.S. (2005). Effects of backpack loading on the pulmonary capacities of normal schoolgirls and those with adolescent idiopathic scoliosis. *Spine*, 30 (21), 649-654.
7. Cote, K.P., Brunet, M.E., Gansneder, B.M. & Shultz, S.J. (2005). Effects of pronated and supinated foot postures on static and dynamic postural stability. *Journal of Athletic Training*, 40 (1), 41-46.
8. Čojbašić, M. (2006). *Corrective effects of the preventive-rehabilitative apparatus on the postural deformities of the spinal column in the school-age population.* Master thesis, Nis: Faculty of Physical Education.
9. El, O., Akcali, O., Kosay, C., Kaner, B., Arslan, Y. & al. (2006). Flexible flatfoot and related factors in primary schoolchildren: a report of a screening study. *Rheumatology International*, 26 (11), 1050-1053.
10. Grivas, T.B., Arvanti, A., Maziotou, C., Manesioti, M.M. & Fergadi, A. (2002). Comparison of body weight and height between normal and scoliotic children. *Studies in health technology and informatics*, 91, 47-53.
11. Grivas, T.B., Samelis, P., Pappa, A.S., Stavlas, P. & Polyzois, D. (2002). *Menarche in scoliotic and nonscoliotic Mediterranean girls. Is there any relation between menarche and laterality of scoliotic curves?* Retrieved february 5, 2007, from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi
12. Grivas, T.B., Vasiliadis, E.S., Polizois, V.D. & Mouzakis, V. (2006). Trunk asymmetry and handedness in 8245 schoolchildren. *Pediatric Rehabilitation*, 9 (3), 259-266.
13. Jovović, V. (2005). Interkorelacija varijabli morfoloških dimenzija i posturalnog statusa kod 13-ogodišnjih dečaka (Intercorrelation of the variables of morphological dimensions and postural status in 13 year old boys). In Z. Gavrilović (Ed.), *Yugoslavian Anthropological Association Gazette*, (pp. 67-74). Belgrade: Yugoslavian Anthropological Association.
14. Jovović, V. & Čanjak, R. (2006). Transverzalna analiza učestalosti krilastih lopatica kod 13-ogodišnjih učenika različitih urbanih sredina (Transversal analysis of the frequency of winged shoulder blades in 13 year old pupils in different urban settings). In G. Bala (Ed.), *Proceedings of "Anthropological status and physical activity of children and youth"*, vol. 40, (pp. 107-113). Novi Sad: Faculty of Sport and Physical Education.
15. Karaleić, S. (2003). Uticaj košarke na kifotično i lordotično loše držanje i motorički status devojčica (The influence of basketball on kyphotic and lordotic bad body posture and motor status of girls). In D. Živković (Ed.), *Proceedings of "Fis-communications 2003"*, (pp. 291-294). Nis: Faculty of Physical Education.
16. Korovessis, P., Koures, G. & Papazisis, Z. (2004). Correlation between backpack weight and way of carrying, sagittal and frontal spinal curvatures, athletic activity and dorsal and low back pain in schoolchildren and adolescents. *Journal of Spinal Disorders & Techniques*, 17 (1), 33-40.
17. Krsmanović, T. & Bigović, M. (2006). Relacije gipkosti i devijacija kičmenog stuba u frontalnoj ravni (Relations of flexibility and deviation of the spinal column on the frontal plane). In G. Bala (Ed.), *Proceedings of "Anthropological status and physical activity of children and youth"*, vol. 40, (pp. 193-200). Novi Sad: Faculty of Sport and Physical Education.
18. Lafond, D., Descarreaux, M., Normand, M.C. & Harrison, D.E. (2007). *Postural development in school children: a cross-sectional study.* Retrieved february 23, 2007, from http://www.chiroandosteo.com/content/15/1/1

19. Leung, A.K.L., Cheng, J.C.Y. & Mak, A.F.T. (2005). A cross-sectional study on the development of foot arch function of 2715 Chinese children. *Prosthetics and Orthotics International*, 29 (3), 241-253.
20. Madić, D. (2006). Relacije motoričkog i posturalnog statusa dece predškolskog uzrasta u Vojvodini (Relations of motor and postural status in pre-school children in Vojvodina). In G. Bala (Ed.), *Proceedings of "Anthropological status and physical activity of children and youth"*, vol. 40, (pp. 185-191). Novi Sad: Faculty of Sport and Physical Education.
21. Michelson, J.D., Durant, D.M. & McFarland, E. (2002). The injury risk associated with pes planus in athletes. *Foot & ankle international*, 23 (7), 629-633.
22. Mickle, K.J., Steele, J.R. & Munro, B.J. (2006). Does excess mass affect plantar pressure in young children? *International Journal of Pediatric Obesity*, 1 (3), 183-188.
23. Milenković, S. (2000). Determining differences in postural, anthropometric and kinesics area of III grade primary schoolchildren at the beginning and at the end of a school year. *Facta Univ Phys Educ Sport*, 1 (7), 39-48.
24. Milenković, S. (2002a). Uticaj programiranog vežbanja teniske škole na položaj kičmenog stuba u frontalnoj ravni i stopalo kod učenika III razreda osnovne škole (Influence of programmed exercises in tennis school on the spinal column status in the frontal plane and foot in the third grade elementary school pupils). In R. Popović (Ed), *Proceedings of "Fis-communications 2002"*, (pp. 100-105). Nis: Faculty of Physical Education.
25. Milenković, S. (2002b). Razlike telesnog statusa učenika sportista (tenisera) i učenika nesportista III razreda osnovne škole (Differences between the body status of athletes (tennis players) and the third grade elementary school pupils – non-athletes). In R. Popović (Ed.), *Proceedings of "Fis-communications 2002"*, (pp. 286-290). Nis: Faculty of Physical Education.
26. Milenković, S. & Stojanović, J. (2005). Skoliotično loše držanje kod sportista i nesportista učenika mlađeg školskog uzrasta (Scoliotic bad body posture in athletes and non-athletes younger school-age children). In S. Joksimović (Ed.), *Proceedings of "Fis-communications 2005"*, (pp. 342-346). Nis: Faculty of Physical Education.
27. Milenković, S., Živković, D., Milijić, S., Ignjatović, I. & Pavlović, Z. (2003). Stanje posturalnih poremećaja i telesnih deformiteta dece mlađeg školskog uzrasta u opštinama Zaječar, Kruševac i Čačak (Status of the postural deformities and body deformities in younger school age children in communities Zaječar, Kruševac and Čačak). In D. Živković (Ed.), *Proceedings of "Fis-communications 2003"*, (pp. 320-324). Nis: Faculty of Physical Education.
28. Milenković, S.M., Kocijančić, R.I. & Belojević, G.A. (2004). Left handedness and spine deformities in early adolescence. *European Journal of Epidemiology*, 19 (10), 969-972.
29. Monteleone, G., Promenzio, L. & Gabrielli, A. (2005). Epidemiological study on flatfoot in children: a large survey including thousands of subjects from different Italian regions. *Journal of Bone and Joint Surgery – British Volume*, 88 (3), 418.
30. Ostojić, Z., Kristo, T., Ostojić, L., Petrović, P., Vasilj, I. & al. (2006). Prevalence of scoliosis in schoolchildren from Mostar, Bosnia and Herzegovina. *Collegium Antropologicum*, 30 (1), 59-64.
31. Penha, P.J., Joao, S.M.A., Casarotto, R.A., Amino, C.J. & Penteado, D.C. (2005). Postural assessment of girls between seven and ten years of age. *Clinics*, 60 (1), 9-16.
32. Pinto Ribeiro, C.Z., Hanai Akashi, P.M., Camargo Neves, S.I. & Pedrinelli, A. (2003). Relationship between postural changes and injuries of the locomotor system in indoor soccer athletes. *Revista Brasiliera de Medicina do Esporte*, 9 (2), 98-103.
33. Pfeiffer, M., Kotz, R., Ledl, T., Hauser, G. & Sluga, M. (2006). Prevalence of flatfoot in preschool-aged children. *Pediatrics*, 118 (2), 634-639.
34. Protić-Gava, B., Čokorilo, R. & Karanov, B. (2006). Socijalni status roditelja i posturalni status predškolske dece Vojvodine (Social status of the parents and the postural status of pre-school age children in Vojvodina). In G. Bala (Ed.), *Proceedings of "Anthropological status and physical activity of children and youth"*, vol. 40, (pp. 213-218). Novi Sad: Faculty of Sport and Physical Education.
35. Purenović, T (2006). Razlike u posturalnom statusu kičmenog stuba između učenika instrumentalista Srednje muzičke škole u Nišu (The differences in postural status of spinal column between pupils musicians from Music High School in Nis). In D. Petković (Ed.), *Proceedings of "Fis-communications 2006"*, (pp. 280-284). Nis: Faculty of Sport and Physical Education.
36. Rubeša, D.J., Zidar, D. & Ribičić, G. (2006). Pes planus kao jedan od ograničavajućih čimbenika lokomotornog statusa kod djece srednješkolske dobi za izbor u poziv policijske struke (Pes planus as one of the limiting factor of the locomotor status in high school age children when selecting police force jobs). In G. Bala (Ed.), *Proceedings of "Anthropological status and physical activity of children and youth"*, vol. 40, (pp. 201-206). Novi Sad: Faculty of Sport and Physical Education.

37. Sabo, E. (2006a). Posturalni status dece predškolskog uzrasta na teritoriji AP Vojvodine (Postural status of the pre-school children on the AP Vojvodina territory). In G. Bala (Ed.), *Proceedings of "Anthropological status and physical activity of children and youth"*, vol. 40, (pp. 97-100). Novi Sad: Faculty of Sport and Physical Education.
38. Sabo, E. (2006b). Posturalni status dece predškolskog uzrasta na teritoriji opštine Sombor, Sremska Mitrovica i Bačka Palanka (Postural status of the pre-school children on the territory of Sombor, Sremska Mitrovica and Bačka Palanka community). In G. Bala (Ed.), *Proceedings of "Anthropological status and physical activity of children and youth"*, vol. 40, (pp. 101-105). Novi Sad: Faculty of Sport and Physical Education.
39. Sa Pinto, A.L., Barros, H.P.M., Radu, A.S., Villares, S.M.F. & Lima, F.R. (2006). Musculoskeletal findings in obese children. *Journal of Pediatrics and Child Health*, 42 (6), 341-344.
40. Stojanović, S. (2003). *Definition of structure and differences in anthropometric and postural status in water polo players.* Master thesis, Nis: Faculty of Physical Education.
41. Stojanović, S., Živković, D., Achileas, P., Christodoulos, S. & Kafentarakis, J. (2005). Interrelatedness of the postural deformities in spinal column with anthropometric dimensions in the fifth grade elementary school children. In S. Joksimović (Ed.), *Proceedings of "Fis-communications 2005"*, (pp. 124-128). Nis: Faculty of Physical Education.
42. Švraka, N., Živković, D., Kafentarakis, J. & Christodoulos, S. (2003). Relacije između spuštenosti svoda stopala i posturalnih poremećaja na kičmenom stubu (Relations of the lowering of the foot arch and the postural defromities in spinal column). In D. Živković (Ed.), *Proceedings of "Fis-communications 2003"*, (pp. 352-356). Nis: Faculty of Physical Education.
43. Tanchev, P.I., Dzherov, A.D., Parushev, A.D., Dikov, D.M. & Todorov, M.B. (2000). Scoliosis in Rhythmic gymnasts. *Spine*, 25 (11), 1367-1372.
44. Vukanić, I. (2006). *Relations of the explosive power of legs and speed to differing foot status in the elementary school-age children.* MA thesis, Niš: Faculty of Physical Education.
45. Widhe, T. (2001). Spine: posture, mobility and pain. A longitudinal study from childhood to adolescence. *European Spine Journal*, 10 (2), 118-123.
46. Wodecki, P., Guigui, P., Hanotel, M.C., Cardinne, L. & Deburge, A. (2002). *Sagittal alignment of the spine: comparison between soccer players and subjects without sports activities.* Retrieved February 6, 2007, from http://www.masson.fr/masson/porta/bookmark
47. Wojtys, E.M., Ashton-Miller, J.A., Huston, L.J. & Moga, P.J. (2000). The association between athletic training time and the sagittal curvature of the immature spine. *American Journal of Sports Medicine*, 28, 490-498.
48. Yoo, J.C., Suh, S.W., Jung, B.J., Hur, C.Y., Chae, I.J. & al. (2001). Asymmetric exercise and scoliosis: a study of volleyball athletes. *Journal of Korean Orthopedic Association*, 36 (5), 455-460.
49. Živković, D., Stojanović, S., Christodoulos, S. & Kafentarakis, J. (2005). Relacije morfoloških karakteristika i skoliotičnog lošeg držanja kod školske dece (Relations of morfological characteristics and scoliotic bad body posture in school-age children). In S. Joksimović (Ed.), *Proceedings of* "*Fis-communications 2005*", (pp. 129-132). Nis: Faculty of Physical Education.
50. Živković, D., Švraka, N., Kafentarakis, J. & Christodoulos, S. (2003). Posturalni poremećaji učenika i učenica osnovnih škola (Postural deformities in elementary school-age female and male pupils). In D. Živković (Ed.), *Proceedings of* "*Fis-communications 2003*", (pp. 347-351). Nis: Faculty of Physical Education.

PREGLED DOMAĆIH I INOSTRANIH ISTRAŽIVANJA IZ OBLASTI POSTURALNIH POREMEĆAJA: PERIOD OD 2000. DO 2007. GODINE

Tijana Purenović

Aberacije posturalnog statusa dece i omladine su globalni i uvek aktuelni problem svih zemalja u svetu, a u prilog tome govori i velika zainteresovanost i domaćih i inostranih stručnjaka raznih oblasti. Realno je očekivati razlike u načinu, ali i u rezultatima rada istraživača sa naših prostora i istraživača iz drugih krajeva sveta, kada je reč o ovoj problematici, te je stoga, cilj ovog istraživanja

da se ustanove iste između studija domaćih i inostranih autora upoređivanjem metodologije rada i rezultata do kojih su došli. Istraživanjem je obuhvaćeno 50 studija (25 domaćih i 25 inostranih), a selekcija istih je izvršena poštovanjem odgovarajućih kriterijuma. Analizom i poređenjem studija obuhvaćenih ovim istraživanjem, zaključeno je da postoje razlike u metodologiji rada – autori iz Srbije su najčešće primenjivali manje objektivne metode za procenu posturalnog statusa ispitanika, a inostrani autori, sa druge strane, objektivnije metode. Međutim, kada je reč o rezultatima studija o stanju posturalnih poremećaja, koje je ustanovljeno od strane, kako domaćih, tako i inostranih autora, ne može se govoriti o postojanju velikih razlika. Naime, i domaći i inostrani autori su, u većini slučajeva, došli do istih zaključaka – postoji značajna povezanost gojaznosti sa deformitetima donjih ekstremiteta, telesna visina i status stopala su u korelaciji, skoliotično loše držanje tela je u korelaciji sa telesnom masom, veće angažovanje jedne ruke je povezano sa devijacijom kičmenog stuba u frontalnoj ravni, i dr.

Ključne reči: *posturalni status, deca školskog uzrasta, sportisti, sportovi asimetrije, metodologija rada*