Trend Projections of Body Deformities Occurrence between the ages of 5 and 12, Metrically Objectified and Estimated by 3D Postural Status Screening

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Contents

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Trend Projections of Body Deformities Occurrence between the ages of 5 and 12, Metrically Objectified and Estimated by 3D Postural Status Screening

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Abstract

The aim of this paper is comparative analysis of different posture status, recorded for 3D evaluation, in regards to a relatively heterogeneous group of children, with the trend projection of physical deformity development, estimated for n=699 children between the ages of 5 and 12, during the implementation of IPA SpineLab project, financed by European Commission. The samples of 17 variables are '' Contemplas 3D posture compact'' variables recorded following a precise protocol. According to the increasing deviation trend in correlation to vertical zero, an increase in the occurrence of the mean values for most variables is noticeable, which is making the situation in a researched groups much worse, except for the thoracic part of the spine in sagital plane, which according to the physiological curve in this part indicates that from the fifth to the twelfth year of age number of children with kyphotic deviation is increasing. In addition to the status of the spine there is a significant increase in the shape deviation of legs in correlation to the zero value, which is a noticeable increase in children with compromised leg angle, thigh and lower part of leg with a noticeable incline towards valgus position, as well as the knee joint hyperextension.

Key words: **Scoliosis screening, Prevalence rate, Spinal screening, Changing trend, Awareness, Human pose estimation**

Introduction

Current civilisation is characterised by a specific lifestyle. From ecological and kinesiological perspective, living in cities is not a favourable circumstance. Deformities and the present illnesses- overweight and nervous tension are frequent occurrence among the children and youth, who use their free time for the activities which require little or no muscular effort (Prskalo and co-authors, 2010). It is a generally known fact that young people still at an early adolescent age start accepting contemporary lifestyle imposed upon them. Computerisation and the growing impact of internet have taken their toll on the health status of every individual. Childhood and adolescence has been recognised as the critical age for adopting and maintaining the habits of performing physical exercise (Huddleston and co-authors, 2002). Present generations live their lives in a virtual world which affects their health (mental and physical) negatively. Imagination and Virtual Reality is formulated so as to respond to the needs of mass application, it decreases the possibilities of personal creativity and separates an individual from real life and personal initiative by developing unified mentality stereotypes (Andrijašević, 2009).

Contemporary life styles result in an increase of irregular body posture in children and youth. The problem of today is hypokinesia (decreased bodily movement) which leads to unbalanced development of certain muscle groups (Paušić, 2007).

Posture is a descriptive term for the relative position of the body segments during rest or activity. The maintenance of good posture is a compromise between minimizing the load on the spine and minimizing the muscle work required. (Standring, 2007). Muscles of the leg, pelvis, abdomen and back along with bones, ankles and ligaments participate in maintaining proper posture. In regards to the aforementioned, positive impact of any physical activity along with other healthy life habits, first and foremost adequate nutrition should be promoted through the physical and health education classes in schools.

If one wants to significantly affect the anthropological dimensions of younger school-aged children it is necessary to select physical exercising modes characterised as general, and their application should run with optimum intensity (Aleksić, 2009). The results of annual medical examinations indicate the unsatisfactory status, especially regarding the data attesting to the status of feet, spine, frequent bad posture and increasing percentage of overweight children. At the same time, expert analysis and the results of numerous numbers of research papers demonstrate growing preferences in children practicing sedentary way of life and lacking the habit of performing regular physical exercise. Skeletal system in this age, especially spine and feet demand special attention during education: straightening of the spine, insufficiently developed musculature, irregular sitting position in school benches, easily lead to premature deformations which should be treated on time (Ilić, 2009; Bogdanović te al., 2008).

Human upright position is conditioned by maintaining constant balance between paravertebal muscles and gravity's centripetal force. This game in maintaining the upright position during the human evolution has contributed to the following physiological characteristics: lordosis of the cervical and lumbar region of the spine and kyphosis in thoracic spine section. If these curvatures appear within physiological norms, they are considered regular feature, however if their increase or decrease is noticed, that is regarded to be abnormal (Gajić, 2009). Postural deformities are frequent in children and adolescents. In preschool and early school-aged children functional postural disorders are most common, while in adolescent age structural deformities of spinal column are a characteristic feature (Adzar, 2004; Demeši, 2007). Under the influence of internal and external factors the musculoskeletal system of children in development is susceptible to deformities. The most common deformities during children's development are: kyphosis, scoliosis, lordosis, protuberant and sunken chest, flat feet, winged scapula, "x" (genua valga) and "o" (genua vara) legs.

During one's lifetime there are three significant stages when different samples may lead to posture deformities: Pre-school stage – during the first year a child gradually takes the upright posture and forms physiological spinal curves. If this phase occurs earlier, postural deformity might occur. School stage – starting school a child undergoes great changes, spending a lot of time sitting, carrying heavy school bags may lead to posture deformities. Some of the factors which can contribute to postural disorders are: school bag which weights more than 10 % of child's body weight, carrying school bags over one shoulder, irregularly placed schools bag, etc.

Connection between growth and progression of the spinal curve is the most common starting point when describing the occurrence and development of spinal abnormality. Between the ages of 5 and 10 when the growth slows down there is a less occurrence of postural problems, but when they enter the puberty stage, a rapid deterioration of existing postural characteristics is to be expected, along with the detection of new cases.

Therefore, it is very important to detect postural problems and keep them under control in early years (Kosinac and Banović, 2007).The aim of this work is to compare different posture status, recorded for 3D analysis, in regards to a relatively heterogeneous group of children with trend projection of physical deformities development between the ages of five and twelve.

Methods

Sample

Sample consisted of children from 5 to 12 years of age selected from kindergartens and primary schools located in Sarajevo Canton and Zvornik. The sample group comprised of n=699 boys and girls divided into three age groups (first group: 5-7 years; second group: 8-9 years; third group: 10-12 years).

Variable sample

Variables used for the purposes of this research provide information regarding the posture status, Contemplas 3D posture compact mode. Variable sample consists of 17 variables acquired by ''3D posture compact'' testing protocol. The parameters indicate possible offsets from the zero posture value for all three levels, in which case the deviations of the neutral axis are expressed in centimetres and degrees. Higher values of provided displacements, whether negative or positive, represent the higher level of deformities in subjects. Testing protocol

Mobile laboratory was assembled in those primary schools and kindergartens whose children were tested. In regards to the testing protocol the Contemplas testing equipment required and ideally flat surface. After acquiring an adequate surface Contemplas testing instrument was position on top of it (Image 1) and fixed to the surface so as to avoid displacement during children positioning and to avoid additional space calibration.

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Table 1. Description of variables

Shoulder displacement	Variable expressed in centimetres indicates elevation/depression of the left/right frontal plane. Results with the positive values are in regard to the right shoulder elevation, while the negative values indicate a left shoulder elevation.
Pelvic obliquity	Variable expressed in centimetres displays elevated/lowered left/right pelvic side in frontal plane. Results with positive values indicate the elevation of right pelvic side, and results with negative value indicate the elevation of left pelvic side.
Shoulder rotation	Variable expressed in degrees indicates the rotation in longitudinal axis (transversal plane) of the left/right shoulder. If the results are positive it indicates a rotation of the upper body in which case the right shoulder is placed forward, while negative results indicate a rotation of the upper body in which case the left shoulder is placed forward.
Pelvic rotation	Variable expressed in degrees indicates rotation in longitudinal axis (transversal plane) of the left/right pelvic side. If the results are positive it indicates the rotation in which case the right side of the pelvis is placed forward, while in negative results the rotation of the left side of the pelvis is placed forward.
Trochanter rotation	Variable expressed in degrees indicates rotation of the left/right tronchanter in longitudinal axis (transversal plane). If the result is positive it indicates the rotation of the lower body in which case the right side of pelvis is rotated towards front, while the negative results indicate the front rotation of the left side of pelvis.
Condylus rotation	Variable expressed in degrees indicates the knee rotation in longitudinal axis (transversal plane). If the results are positive, it indicates the front rotation of lateral condylus of the right leg, while the negative results indicate the front rotation of the left lateral condylus.
Malleolus rotation	Variable expressed in degrees indicates the rotation of the axis which runs through malleolus of ankle joint. If the result is positive it indicates the front rotation of the lateral malleoulus of the right foot, while the negative result indicates the opposite rotation.
Sag. Distance cervical spine – sacrum*	Variable expressed in centimetres indicates the distance of the most protruded cervical (neck) vertebra in regards to the vertical line projection of the sacrum (bone at the bottom of the spine) in the sagittal plane. Positive result indicates the increased flexion of the cervical spine, while the negative results indicate the increased extension of the cervical spine.
Sag. Distance thoracic spine – sacrum*	Variable expressed in centimetres indicates the distance of the thoracic spine in regards to vertical line projections of the sacrum (bone at the bottom of the spine) in sagittal plane. Positive results indicate an increase of flexion in thoracic spine, while the negative results indicate an increase in other extension of the thoracic spine . *Higher values in the positive and negative offset do not apply for the variables “Sag. distance cervical, thoracic, lumbar – sacrum”
Sag. Distance lumbar spine – sacrum*	Variable expressed in centimetres indicates the distance of the lumbar (lower) spine in regards to the vertical line projection of sacrum (bone at the bottom of the spine) in sagittal plane. Positive result indicates an increase in lumbar spine flexion, while negative results indicate increase in the lumbar spine extension.
Varus/Valgus left	Variable expressed in degrees indicates the Varus-Valgus alignment angle of the left leg (medial/lateral) at the knee joint.
Varus/Valgus right	Variable expressed in degrees indicates the Varus/Valgus alignment angle of the right leg (medial/lateral) at the knee joint.
Flexion/Extension left	Variable expressed in degrees indicates the hyperextension and flexion of the left leg at the knee joint (sagittal plane). Positive result indicates the left leg flexion, while negative result indicates hyperextension of the left leg.
Flexion/Extension right	Variable expressed in degrees indicates the hyperextension or the flexion of the right leg at knee joint (sagittal plane). Positive result indicates the right leg flexion, while the negative result indicates the hyperextension of the right leg.
Frontal Cervical spine	Variable expressed in centimetres indicates the distance of the cervical spine in frontal plane in relation to the vertical line projection of the sacrum. If the result is positive it indicates the right displacement of the cervical spine, and the negative result indicates the left side displacement.
Frontal Thoracic spine	Variable expressed in centimetres indicates the distance of the thoracic spine in frontal plane in relations to vertical line projection of the sacrum. If the result is positive it indicates the right displacement of the thoracic spine, while the negative result indicates the left side displacement.
Frontal Lumbar spine	Variable expressed in centimetres indicates the distance of the lumbar spine in frontal plane in relation to vertical line projection of sacrum. If the result is positive it indicates the right displacement of the lumbar spine, but if the result is negative it indicates the left side displacement.

Testing protocol

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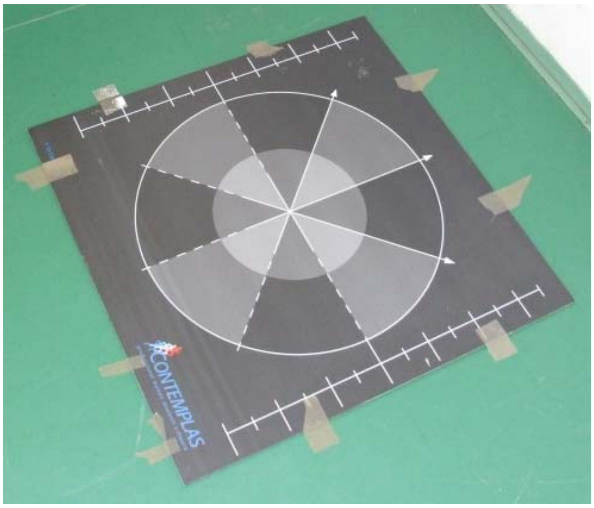


Image 1. Screening surface

3D calibrator was placed on the surface with fluorescent markers attached to it. 3D Calibrator must be exactly placed in the centre of the measuring board (Image 2) and its upper and lower beams along with the vertical beam must be ideally aligned and levelled by the spirit level. The next step is to position a "V" frame supporting three cameras enabling 3D analysis. The camera's distance from the centre of the measuring board must be at least 2 metres and 15 centimetres (Image 3). The images taken by the camera needs to be sharpen in the software programming in order to start the space calibration. After the calibration has been concluded, the 3D Calibrator is packed away and the testing can be initiated.

Next is the preparation and placement of fluorescent markers on the subjects. Markers are placed on specific points of the subject's body which only need to wear their underwear. Considering that this testing protocol was the one specified by the „3D Posture Compact", it was necessary to apply 14 markers for each subject (image 3). The following represent the body points of marker placement: acromion (left and right), cervical spine, thoracic spine (kyphosis), lumbar spine (lordosis), crista iliaca posterior superior (left and right), sacrum, trochanter major (left and right), condylus laterallis (left and right), malleolus laterallis (left and right). The subject is placed on the measurement board so as to have his/her back to the cameras, with feet placed parallel and in hip width apart, where the axis along

Image 2. Calibration frame

the centre of the malleoulus must be paralleled with the horizontal line at the measuring board (frontal plane). The subject is then instructed to take an upright position, look straight, relax his/her arms along his/her body and then the screening takes place for 12 seconds but not after the 18th

Image 3. „V" Camera Frame

second of positioning. The comfort criterion adopts assumptions in terms of pose equilibrium, while the shading criterion eliminates the ambiguities of postures taken into account the image illumination. One can emphasise that the removal of ambiguous 3D poses related to a single image is the main focus of posture analyses (Dihl, Raupp and Musse 2014). After screening the markers are removed from the subjects and placed on the following subject to be tested. The process of assembly and testing instrument calibration is repeated every time the location is changed, specifically with each new schools and kindergarten where the testing is to take place.

Data analysis method

Results were processed in IBM SPSS 22 software package. Descriptive indicators were calculated for the entire group and for the special age groups. Projection trends of physical deformity occurrence were established for all three age group subjects. In order to determine the significant difference of each variable for the observed children groups, ANOVA test was applied.

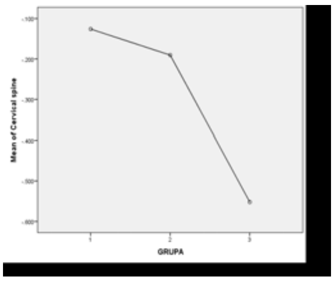
Results

Entire group of subjects was divided into three smaller groups. Each assigned with an individual mean value of results. The parameters indicate a posture image offset from zero value for which purposes the horizontal, vertical and rotational offsets represented in centimetres were valorised and illustrated in degrees as offsets from the neutral axes in the observed plane. Considering frontal plane only, analysis reveals no differences between groups but '3D deformity'. On the contrary, transversal plane analysis, which combines sagittal and frontal information, delivers more relevant information than only an analysis of sagittal plane (Steffen et al., 2010). Higher negative and positive offset values assume a higher degree of deformities in subjects. Three variables which offer data on spinal column from a sagittal point of view are following I group mean=2.1093; II group mean=2.5161; III group mean=3.2131 and for cervical spine I group mean -0.9522; II group mean -0.5871; III group mean -0.3426 for thoracic spine I group mean 1.9232; II group mean 2.5354; III group mean 2.9714, and for the lumbar spine the data observed are assumed to have "normal" offset values. The values are conditioned by the physiological curves of the cervical, thoracic and lumbar spine in regards to the distance from the most protruded part of the sacrum. Results for this posture are observed separately along with the designated criteria attesting to the spinal status in sagittal plane. According to the statistical result analysis, a trend of physical deformities development was projected for children between the ages of five and twelve. Concerning the identifiable indicators (Table 2, Graph. 1) „0"offsets for all segments in regards to the frontal plane are I group mean -0.1261; II group mean -0.1905; III group mean -0.5521 for the cervical spine; I group mean -0.3294; II group mean -0.4104; III group mean -0.6198; for thoracic spine; I group mean -0.1417; II group mean -0.1707; III group mean -0.2428 for lumbar spine.

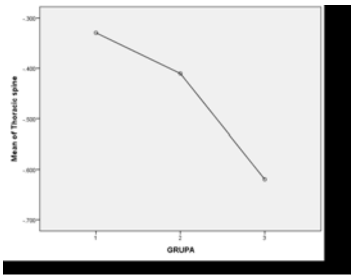
Table 2. Descriptive data 3D variables

Descriptives						
		N	Mean	Std. Devi.	Min.	Max.
Shoulder displacement	1	235	.29190	.9731	-3.915	3.171
	2	277	.38039	.8581	-2.109	2.825
	3	187	.26484	.9035	-3.306	2.649
	Total	699	.31973	.9103	-3.915	3.171
Trochanter rotation	1	235	-1.41462	6.5834	-22.127	18.108
	2	277	-2.07751	6.4147	-26.224	15.489
	3	187	-.57616	6.7412	-30.703	24.468
	Total	699	-1.45300	6.5781	-30.703	24.468
Condylus rotation	1	235	-1.85237	4.7641	-17.489	8.865
	2	277	-2.74005	4.6818	-19.671	11.308
	3	187	-1.51936	6.7448	-17.829	28.474
	Total	699	-2.11505	5.3546	-19.671	28.474
Distance cervical spine - sacrum	1	235	2.10928	1.9780	-2.798	13.243
	2	277	2.51610	2.1175	-2.535	10.284
	3	187	3.21313	2.713076	-2.510	10.657
	Total	699	2.56580	2.2868	-2.798	13.243
Distance thoracic spine - sacrum	1	235	-.95225	1.6727	-6.227	7.263
	2	277	-.58713	1.702029	-5.322	4.617
	3	187	-.34262	2.145789	-5.114	5.129
	Total	699	-.64447	1.835247	-6.227	7.263

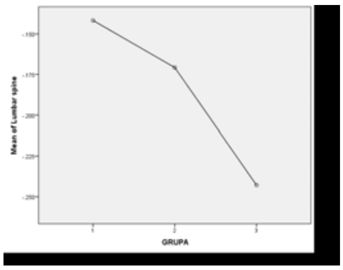
Distance lumbar spine - sacrum	1	235	1.92322	.956412	-.440	4.640
	2	277	2.53542	1.025566	-.176	5.964
	3	187	2.97144	1.254706	-.497	7.065
	Total	699	2.44625	1.145082	-.497	7.065
Varus/Valgus left	1	235	.70543	2.943345	-10.347	8.060
	2	277	1.04376	3.047525	-6.639	19.527
	3	187	1.31965	2.764389	-8.098	8.921
	Total	699	1.00382	2.944553	-10.347	19.527
Varus/Valgus right	1	235	.37001	2.936426	-7.805	8.091
	2	277	.44627	2.927892	-9.062	6.555
	3	187	1.73250	2.958429	-6.339	8.865
	Total	699	.76473	2.992705	-9.062	8.865
Flexion/Ext left	1	235	-2.97121	7.679945	-26.507	18.198
	2	277	-1.25083	8.120360	-60.962	23.080
	3	187	.12198	7.047340	-16.098	27.388
	Total	699	-1.46195	7.780631	-60.962	27.388
Flexion/Ext right	1	235	1.03502	8.526294	-25.502	28.874
	2	277	-1.60483	7.065437	-26.096	21.824
	3	187	-1.97567	7.837679	-21.062	27.122
	Total	699	-.81654	7.889290	-26.096	28.874
Cervical spine	1	235	-.12606	.980288	-2.268	3.203
	2	277	-.19052	.989148	-3.233	2.659
	3	187	-.55213	1.036711	-3.524	3.174
	Total	699	-.26559	1.013028	-3.524	3.203
Thoracic spine	1	235	-.32937	.840363	-2.356	2.165
	2	277	-.41037	.698497	-2.222	1.675
	3	187	-.61979	.830848	-2.888	2.763
	Total	699	-.43916	.791677	-2.888	2.763
Lumbar spine	1	235	-.14171	.370090	-1.160	1.299
	2	277	-.17076	.366967	-1.721	1.098
	3	187	-.24284	.441628	-1.666	1.882
	Total	699	-.18028	.390798	-1.721	1.882



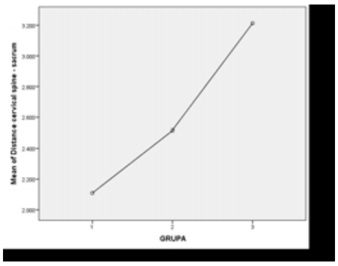
Spine, front. Cervical



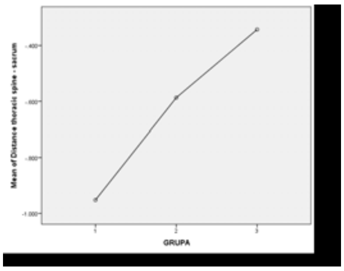
Spine, front. Thoracic



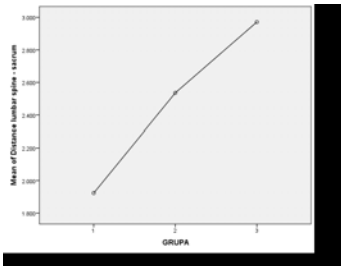
Spine, front. Lumbar



Spine, sag.. Cervical



Spine, sag. Thoracic



Spine, sag. Lumbar

Graph 1. Graphical representation of mean value trends of spinal offsets for three age groups (group 1: 5-7y; group 2: 8-9y; group 3: 10-12y)

The application of ANOVA statistical method (table 2.) when different subject age groups are compared, indicates a significant difference from $p \leq 0.00$ to $p \leq 0.026$, in offset values in regards to the vertical position for the spinal column parameters and leg parameters. The result relates to the offsets of physiological curves in the sagittal plane.

Table 3. ANOVA

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Distance cervical spine - sacrum	Between Groups	128.021	2	64.010	12.649	.000
	Within Groups	3522.236	696	5.061		
	Total	3650.257	698			
Distance thoracic spine - sacrum	Between Groups	40.210	2	20.105	6.056	.002
	Within Groups	2310.747	696	3.320		
	Total	2350.957	698			
Distance lumbar spine - sacrum	Between Groups	118.070	2	59.035	51.544	.000
	Within Groups	797.156	696	1.145		
	Total	915.226	698			
Varus/Valgus left	Between Groups	40.018	2	20.009	2.316	.099
	Within Groups	6011.915	696	8.638		
	Total	6051.933	698			
Varus/Valgus right	Between Groups	239.846	2	119.923	13.884	.000
	Within Groups	6011.639	696	8.637		
	Total	6251.486	698			
Flexion/Ext left	Between Groups	1016.794	2	508.397	8.580	.000
	Within Groups	41238.883	696	59.251		
	Total	42255.677	698			
Flexion/Ext right	Between Groups	1229.023	2	614.512	10.131	.000
	Within Groups	42215.124	696	60.654		
	Total	43444.147	698			
Cervical spine	Between Groups	21.491	2	10.745	10.764	.000
	Within Groups	694.815	696	.998		
	Total	716.306	698			
Thoracic spine	Between Groups	9.163	2	4.582	7.445	.001
	Within Groups	428.310	696	.615		
	Total	437.473	698			
Lumbar spine	Between Groups	1.106	2	.553	3.650	.026
	Within Groups	105.494	696	.152		
	Total	106.601	698			

Discussion

Analyses of offsets and rotations which are expressed in centimetres for offsets and degrees for rotations, did not reveal high degree result if compared to the physical height of the subjects. In the screening records all the segments include offsets, indicating that all the three age groups have offsets in relation to the proper posture status.

Entire research was conducted focusing on the spinal column status of the subjects, for that reason the results emphasize the frontal and sagittal perception of the spine. If we follow the increase trend of zero vertical offset, the increase of mean values is noticeable for all the variables, apart from sagittal perspective of the thoracic spine, which according to physiological curve in that spinal section indicates that the number of children with kyphotic offset between the ages of five and twelve is increasing. The Scoliosis Research Society has recommended annual screening of all children age 10–14 years; the American Academy of Orthopaedic Surgeons has recommended screening girls at the ages of 11 and 13 years and boys age 13 or 14; and the American Academy of Paediatrics has recommended routine screening at ages 10, 12, 14, and 16 years. The Bright Futures guidelines recommend noting the presence of scoliosis during the physical examination of adolescents and children who are at least 8-years-old (Seung – Woo, at al. 2011). This research was conducted with children of younger age (5 – 12 years) since in their case it is possible to greatly affect the postural status corrections.

The calculated trend projection of postural deformities development increases as the subjects are older, regardless of the growth of negative or positive offset values in regards to zero values. The analysis results regarding the scoliosis of the spinal column are particularly important. Scoliosis is a complex three-dimensional (3D) deformation of the spine and rib cage that produces cosmetic asymmetries of the trunk, which represent the main complaints of patients (Gignac at al., 2000).

Apart from the spinal column status, there is a significant offset increase in regards to zero value of leg shape, with an increase in the number of subjects with a disturbed relationship angle between upper leg and lower leg, in which case there is an incline towards the valgus position, as well as hyperextension in the knee joint. Children with such diagnosis have potential difficulties when walking and that segment is very important for the overall postural analysis. Scoliosis patients and patients with valgus legs deformities showed significant but slight modifications in gait, even in cases of mild scoliosis. With the naked eye, one could not see any difference from controls, but with powerful gait analysis technology, the pelvic frontal motion (right–left tilting) was reduced, as was the motion in the hips and shoulder. (Mahaudens at al., 2009).

Once the matrix consisting of all research data was created, it became evident that the applied testing protocol consisting of computer outputs if reversed for the purposes of explaining someone's posture status excluding specific physical deformities by data valorisation, would not produce a precise insight in all the deformities from the sagittal perspective. For that reason 3D result outputs consisting of rotations and offsets were discussed along with necessary insight into the posture result imagery, clustered as numerical data.

Conclusion

It is evident that the trend projection of physical deformities occurrence is statistically significant for the parameters of the spinal column results in relations to scoliosis, kyphosis and lordosis with an increase in an offset from the "proper" posture for children of the two older age groups in relation to children of the youngest age group (5-6 years). In addition, such trend was recorded for the angle status of upper leg in relation to the lower leg, reflecting in a significant increase in number of children with "x" legs. When a child starts attending first to fifth grade primary school his/her posture status worsens.

Therefore, the scientific contribution of the research conducted in Sarajevo schools and kindergartens made possible due to European Commission funding, is reflected in the possibility of clear and concise physical deformity valorisation, assisted by modern kinematic procedures with the purpose of designing the total results matrix indicating the postural status of the assigned population. The possibility of predicting the deformity occurrence trend, represent the baseline for gaining direct benefits in a form of potential, individual programmes for treating or decreasing registered physical deformities. Application of technological solution for assessing the posture status ("Contemplas 3D posture compact"), for all three subject age groups is extremely adequate for obtaining the individual analysis results which will serve as a baseline for planning and programming corrective procedures for the purpose of treating and decreasing physical deformities.

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The Effects of Specific Balance Training on the Stability Level of Young Basketball Players

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Summary

The aim of this research was to examine the effects of specific balance training on stability level of young basketball players (n=14; chronological age 14-15 years). Testing and SBT program was conducted during the competition season for young basketball players. For the purposes of this research, i.e. the assessment of stability level (Biodex Balance System), three variables were used in order to determine neuromuscular ability of maintaining dynamic bilateral and unilateral postural stability on a static and unstable surface. Difference between two measuring points and their correlation before and after the SBT program implementation was analysed by univariate parametric test determining differences – student t-test for dependable samples. Differences between initial and final status (sig.=.01 and .05) indicate that SBT program including specific content, training aids, load intensity and extensity, total volume, organisation and training method have effectively contributed to the stability level of young basketball players.

Key words: **stability index, specific program, basketball players**

Introduction

Movement requirements in basketball depend on a range of internal and external factors. Basketball abounds in a number of complex motions, requiring the acquired movement structure to be integrated into situational game requirements which are unpredictable and variable. Apart from coordination, explosive strength, central stability and other factors, the prerequisite for changing directions after stopping and a safe landing after the jump, is achieved by stable leg positioning. *Šimek, Milanović and Jukić (2007)* determine the changes in the agility level and the type of explosive strength for jump performance after completing proprioceptive training program. During speed-explosive movements, the athlete is not always able to control his/her own movement at a given time. Good physical stability affects the movement quality which can probably protect the athlete from possible injuries. Likewise, during the last couple of years due to unstable training and competition surfaces, balance training in basketball is gaining more popularity as an additional exercise for athletes *(Panwar et al., 2014).*

Maintaining balance has been made increasingly difficult when establishing contact with the opponent, along with air resistance, friction and gravity forces which likewise affect maintaining stable posture *(Retert, 2010)*. According to the previously mentioned author, if the training is more specific and extensive, an athlete will have better balance and stability during performance.

Proprioceptive stimuli can assist athletes in performing efficient and safe movements on a subconscious level. *Eils and Rosenbaum (2001)* state that a multi-station proprioceptive exercise program can be recommended for prevention and rehabilitation in case of ankle joints injuries, and according to (*Kraemer & Knobloch, 2009*) specific balance training reduces the frequency of injuries regarding anterior cruciate ligament and ankle joints. Training consisting of proprioceptive exercise program can effectively stabilize an unstable joint using muscle and postural control *(Zouita et al., 2013).*

Proprioceptive exercises should be an integral part of conditional training in sport games. *Alić (2012)* states that additional improvement was achieved in regards to the current situation of the footballers U-18 balance level, based on a three month long specific proprioceptive training. Positive effects of proprioceptive training program on the stability level in students of sport and physical education were determined in research conducted by *Kazazović and co-authors (2007), and Šebić et al. (2007).*

Following the assumption (H) which states that the six month long training program will produce positive changes in the balance abilities of young basketball players, one can conclude that the aim of this research is to establish the effects of six week specific balance training program (SBT) on the level of stability in young basketball players.

Results of this paper might be used as additional segment and more inclusive integration of the balance training, if taking into account the general conditional preparation of young athletes.

Methods

Subjects

Sample consisted of 14 young basketball players. Chronological age of the subjects was 14 – 15 years. Overall training process lasted for about 5 years. Subjects were clinically healthy during the testing procedures. Testing procedure and SBT program was conducted during competition season in which case subjects participated in regular training sessions six times per week for 60-90 minutes.

Tests

For the purposes of this research 3 variables were used in order to assess the level of stability *(Biodex Balance System SD, 2006.):*
Overall Stability Index (OIS);
A/P Stability index (APIS) and
M/L Stability Index (MLIS).

Biodex Balance System SD application enabled determining individual neuromuscular control by quantifying the abilities of maintaining dynamic bilateral and unilateral postural stability on a static and unstable surface.

Characteristics of a specific balance training (SBT)

Tables 1, 2, 3, 4 and 5 demonstrate the most significant SBT program information (general notes, exercise description, load distributions, technical aids and a total number of performed activities), which was conducted on young basketball players categorised by age groups U-14 and U-15.

Table 1. General Information on SBT

Period of the season	Competition
Total duration of the program	6 weeks
Training frequency	4 trainings per week
Part of the training	Introduction and preparatory phase
Duration of balance stimulus	15-20 minutes

Table 2. Description of SBT exercises

1.	**SK, PS, Z on the: a) D-N leg; b) PV D-N leg.**
2.	**SK, PS, Z on the: a) D-N leg; b) ZV D-N leg.**
3.	**SK, PS, Z in small groups on the: a) D-N leg; b) the game “who’s faster”D-N leg; c) the game “tickling the palms” D-N leg.**
4.	**SK, PS, Z in pairs on the: a) D-N leg; b) lean on the back of partners D-N leg; c) lean on the side of partners D-N leg.**
5.	**SK, dribbling L, PS, Z on the: a) D-N leg; b) PV and ZV D-N leg; c) L rotation on the hand D-N leg.**
6.	**RP, B D-N leg: a) keeping between the forehead; b) holding L between breasts of partners; passing L with two hands from the chest; d) passing L from behind.**
7.	**SBD On feet: a) ONN; b) OLD.**
8.	**SBD, hands up: a) ON, ONN i OLD; b) D-N leg ONN and OLD.**
9.	**SBD D-N leg: a) ONN/ passing L from the chest; b) OLD/manipulation L.**
10.	**SBD ON: a) ONN touching of laterally spaced racks; b) OLD touching racks that are set forward and back.**
11.	**RP, SBD ONN i OLD: a) reception and passing L with two hands from the chest; b) passing L with two hands above the head with reception and L feint.**
12.	**Jump with feet on balance board, B: a) ONN; b) OLD.**
13.	**Standing on the ball: a) ON; b) D-N leg.**
14.	**Standing D-N leg / free leg simulating the skating step: a) eyes open; b) eyes closed.**
15.	**PV, from bent position touch the ground, and again stand up: a) D leg; b) N leg.**
16.	**RP, touching and reception with medical ball (1kg): a) D leg; b) N leg.**

D-N: dominant and non-dominant leg; SBD: standing on the balance board; SK: free movement; PS: change of direction; Z: stopping; L – ball; ONN: axle forward and backward; OLD: axle left and right; B: balance; PV: front balance; ZV: rear balance; RP: exercise in pairs; ON: both legs

Table 3. Distribution of load SBT (modified according Alić, 2012)

Type and order of execution the exercises	Extensity		Intensity	Rest		Character of exercise
	Duration (s)	The total number of series		Time rest (s)	Rest mode	
1a; 1b	10	15	N	20	Ak	Ad
2a; 2b	10	15	N	20	Ak	Ad
3a; 3b; 3c	10	15	N	20	Ak	Ad
4a; 4b; 4c	10	15	N	20	Ak	Ad
5a; 5b; 5c	15	15	N/S	25	Ak	Ad + rzv
6a; 6b; 6c; 6d	15	15	N/S	25	Ak	Ad + rzv
7a; 7b	15	15	N/S	25	Ak	Ad + rzv
8a; 8b	15	15	N/S	25	Ak	Ad + rzv
9a; 9b	20	15	S	30	Ak	Rzv
10a; 10b	20	15	S	30	Ak	Rzv
11a; 11b	20-30	15	S	30	Ak	Rzv
8a; 8b; 9a; 9b	20-30	15	S	30	Ak	Rzv
10a; 10b; 11a; 11b	30	12	S	30	Ak	Rzv
12a; 12b; 16a; 16b	30	12	S	30	Ak	Rzv
15a; 15b	30-40	12	S/V	40	Ak	Rzv
10a; 10b; 11a	30-40	12	S/V	40	Ak	Rzv
13a; 13b; 15a: 15b	40	10	S/V	50	Pa	Rzv
6a; 6b; 12a; 12b	40	10	S/V	50	Pa	Rzv
7a; 7b; 10a; 10b	40-50	10	S/V	50-60	Pa	Rzv
12a; 12b; 14a; 14b	40-50	10	S/V	50-60	Pa	Rzv
1a; 1b; 16a; 16b	30	10-15	N/S	20-30	Ak	Od
2a; 2b; 15a; 15b	30	10-15	N/S	20-30	Ak	Od
3a; 3b; 13a; 13b	30	10-15	N/S	20-30	Ak	Od
4a; 4b; 12a; 12b	30	10-15	N/S	20-30	Ak	Od

Ak: Active; Pa: Pasive; Ad: Adaptation; Rzv: Development; Od: Maintenance; N: Low; S: Middle; V: High.

Table 4. Technical equipment

Balance boards	NN Axles and lateral
Balls	Basket and medical (1kg)
Racks	Vertical racks (1,5m)

Table 5. Total number of activities

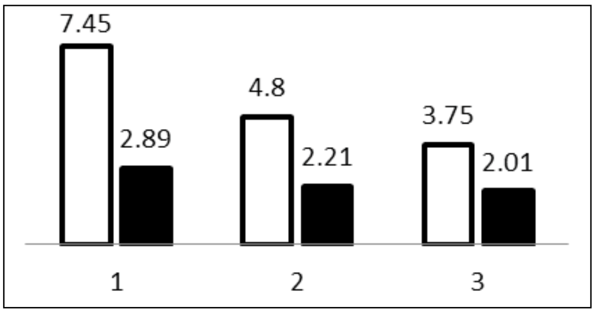
Testing / Initial and final	2
Balance training - proprioception	24
Club training, regular training	30
Active rest, prepares for competition	6
Official games	6

Statistical analysis

For the analysis of the results obtained during the initial and final measurements, following descriptive values were calculated: arithmetic mean (*m*), standard deviation (*SD*) and variation coefficient (*CV*). Differences between two measuring points and their correlation was analysed by univariate parametric test determining differences – student t-test for dependable samples. The results were processed in statistical software package IBM SPSS 22 Statistic.

Results

Once we compare descriptive parameters of tests for balance assessment in their initial and final status (table 6 and 7), differences in *m* values become noticeable. Lower values in final measurement stages indicate better results after the completion of SBT program. The highest range of m values for all the variables was noticed in OIS test, so one can assume that SBT has contributed the most to the development of overall stability. However such assumptions need to be verified by *t-test.* The analysis of central tendency and variability results in their initial and final status, and based on subsequent calculation of CV value, revealed heterogenic results in tested subjects. Coefficient of variation is a relative measure of deviation which represents the correlation between arithmetic mean and standard deviation expressed in percentages. In order to satisfy the homogeneity requirements, this parameter should not exceed the threshold limit value of 30%, which is a conventional threshold limit value specific for homogeneous properties in kinesiological research. For both measurements, the CV value of all treated variables is above the acceptance limit (55%-75%). Results demonstrated in table 8 indicate statistically significant differences for all the treated variables with 1% and 5% conclusion error.



Graph 1. Relations of arithmetic means between initial and final states (lower M represent better values)

Table 6. Descriptive indicators of the initial state

Varijabla	M	SD
OIS	7.45	5.60
APIS	4.80	3.15
MLIS	3.75	2.46

Table 7. Descriptive indicators of the final state

Variable	M	SD
OIS	2.89	1.79
APIS	2.21	1.22
MLIS	2.01	1.19

Table 8. Student T - test for paired samples

Pair	Var iable	t	df	Sig.
Pair 1	OIS1 - OIS2	2.923	13	.012
Pair 2	APIS1 - APIS2	2.967	13	.011
Pair 3	MLIS1 - MLIS2	2.228	13	.044

Discussion

Factors based on nerve processes, space and balance ability of a human are still insufficiently explained. Variability of tests for the purposes of balance assessment has been noticed even in this research. Information received by outside surrounding and registered by receptors of vestibular and proprioceptive apparatus, and visual and hearing analysers can influence in different ways the regulation and coordination of muscle tonus responsible for balance in athletes. Proprioceptive feedback is significant in both conscious and subconscious control of common physical activities during movement *(Ergen & Ulkar, 2008).* Posture correction at the most urgent moment probably depends on the control and contraction intensity regulation as well as muscle relaxation.

With certainty higher than 99 %, that is 95 % one can claim that the SBT program conducted during the competition season with specific content, training aids, intensive and extensive load, overall volume, training methods and organisation resulted in effective impact on the level of stability in young basketball players. Assumption is that the designed program with all its specificities in movement structure affects the anticipation quality, change and posture correction. All the above stated contributes to achieving a more stable position. Proprioception is transferred to all levels of central nervous system *(Riemann & Lephart, 2002).* Implemented content focusing on rapid establishment of balanced posture after previously inducing general instability can affect the contractions for a certain group of muscles which maintain the projection of the body's centre of gravity above the support surface. Process of achieving stability is related to mutual work between ligaments and muscles along with a complex network of neural connections which link all the elements above *(Salva-Coll et al., 2013).*

Establishing balance when the support surface is of a smaller size and with constant variations of pelvic height changes conditioned by unpredictive circumstances, resulted in progressive increase of load intensity. A well established balance enables the players to control their body in static and dynamic positions while at the same time protecting them from falling and injuries which might occur during fast movements *(Panwar etal., 2014)*. It is a generally known fact that the difficulty of maintaining stable posture is mostly conditioned by the size of the support surface, height of the body's centre gravity and the position of unrestrained body parts. In basketball the balance is a very important ability for young players, especially due to its application during one-to-one defensive actions, which requires ability to control one's own body in order to reduce errors *(Mahmoud, 2011).* In complex circumstances establishing and maintaining position while at the same time manipulating a basketball (dribbling, passing the ball from different positions), the body needs additional corrections and adjustments at the given situations, which makes it much more difficult to maintain stability. The balance is a very delicate ability which requires good kinesthetic sense, good evaluation of aim parameters and kinesthetic movement control on a specific path, as well as concentration time *(Malacko and Rađo, 2004).*

SBT program should not be regarded as an isolated unit, but as an integral segment of the overall athlete sport preparation. One can assume that the SBT program can efficiently influence the movement coordination, body's central stability and the strength of ankle ligaments and muscle tendons. Apart from the effects SBT program has on the stability level, positive effects can be achieved at a motor coordination level *(Šebić et al., 2007). Zemková & Hamar (2010)* conclude that the combination of *agility - balance* training one can improve dynamic balance, not only by visual control but even in closed-eyes circumstances. For the coaches it is very important to plan training programs, which will combine balance exercises with specific reactive tasks, in order to apply them as means for neuromuscular athlete performance.

Conclusion

Results of this paper indicate that the designed SBT program produced positive effects on the stability level in young basketball players. The most probable conclusion is that the efficient transfer of the sense of ankle positioning and a fast reply of the muscle-ankle connectors – effectors is induced by the specific content. Optimum content for the stability development of ankles are most probably those which are formed in accordance to structural, biomechanical and functional analysis of the basketball game. However, in this research it was difficult to conclude whether the maximum of SBT program was achieved. Rapid growth and development of the treated age category U-14 and U-15 can in addition worsen the coordination and balance abilities. The flaw of this research is the lack of experimental group which would probably offer much clear explanation to the problem at hand. Benefits of this SBT program are the possibilities of simple organisation; it can be conducted in different locations with the help of cheap and available equipment. For the future research it would interesting to examine the effects of combined strength SBT training at a level of stability and agility, along with experimental and control group testing, for the purpose of contributing to time-effective training procedures.

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Levels and structural differences of morphological characteristics and motor abilities among boys, classified according to the level of overall stability index (OSI)

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Summary
The aim of this paper is to classify the levels and structures of motor and morphological specifics, which affect the overall stability index coefficient (OSI) using Biodex Balance System. A sample of 31 boys aged 12, 05 ± 1, 51 were classified into three qualitative groups by the OSI mean and standard deviation (SD) results. Multivariate analysis of variance (MANOVA) revealed the existence of differences and statistical significance in morphological and motor abilities between groups. Based on the results of MANOVA there is a highest level of significance when classifying into the groups. Univariate F test found the greatest difference between the groups in variable of body mass (AMAS, p – 0,003). Leven's test for heterogeneity of variance determined differences between groups in: body height (AVIS, p - 0,01); lengthwise standing on the balance bench with left foot (MRUUL, p – 0,037); lengthwise standing on the balance bench with right foot (MRUUD, p – 0,003); lengthwise standing on the balance bench with both feet (MRUB, p – 0). LSD post hoc test found differences between two groups in three ball slalom with feet (MKP3N, p – 0,045) and agility assessing test (MTTEST, p – 0,034). The results of the research can be used for selecting and choosing talented boys for complex sports, in which dominates agility, coordination and balance, while using the stability index coefficient, height and weight.

Key words: **stability index, morphological characteristics, balance, coordination, agility**

Introduction

Motor skills foundations are based on the mechanisms of neural excitation. Manifestation of higher level of nerve – motor control while at kid's age, may suggest the existence of top prepositions for achieving high sports accomplishment. For a toddler to walk, it is necessary to stand first, and by analogy, immobilization of the elderly occurs for the same reason as the beginning of walking - balance. Balance is the basis for performing dynamic movements of the whole body, such as throwing, jumping and running. Movements in structure of dynamic chains are based on the stabilization of the joints, which are located closer to the body. Balance is largely dependent on the capabilities of the nervous system to react to the slightest stimuli as well as the vestibular apparatus, which detects the slightest changes in the disruption of stability – sensory integration (Ayres et al., 1980; Latash et al., 2010). To maintain balance, in addition to detection, intramuscular coordination of stabilizer muscles is also needed. Coordination and balance, as motor abilities, are closely related. Coordination and agility are classified as a mechanism for structuring movements, while balance participates in work of the mechanism for synergistic regulation and tone regulation (Gredelj, 1975). These three aforementioned motor abilities are the leading abilities in previously mentioned mechanisms for movement regulation. It can be said that an individual has a good coordination if he moves easily and if time and order of his actions are well controlled. Coordination represents motor intelligence (Fleishman, 1955.). According to (Malacko & Rađo, 2004), coordination abilities are structured in several subspaces of which balance represents main. Sensitive period for coordination development among boys, by majority of authors, is from ages 7 to 14, while sensitive period for balance development among boys is from ages 10 to 11 (Bompa, 1999). As motor abilities, coordination and balance in sports selection take a very important role. Coordination and balance are highly innate motor abilities and expressing qualities of these abilities may suggest a great genetic potential for sports. Successful performing of complex agile movements, which can be found in sports, may be associated with frequent changes of positions of center of body's gravity (OCCT) which disrupts body balance. Agile movement ability largely depends of the equilibrium position of the body, apropos balance as a motor ability (Francis, 1997). This paper will contribute to a better understanding of the relationship between agility and coordination of children, as a selective value for complex sports. The research goal is the comparative analysis of the levels and structures of balance, coordination and agile qualities of boys with different levels of stability index.

Results of this research may offer a set of field balance, coordination and agility tests that describe overall stability index, which may suggest latent characteristics of coordination abilities system.

Methods

Sample

A sample of 31 boys aged 12,05 ± 1,51 were classified into three qualitative groups on the score of the overall stability index (OSI) results. All subjects were healthy without knee or ankle injuries, or any neurological conditions, which could influence results while measuring OSI. All respondents are engaged in football training from 1 to 3 years.

Postural stability assessment protocol

Stability index coefficient was measured by Biodex Balance System (BBS Model 945 – 300, Biodex Medical Systems; Shirely, New York) at the level 4 (range from 1 to 8 – most difficult, least difficult) protocol stability, and based on level tilting, the overall stability index coefficient was expressed in numerical character (OSI) (Arnold, 2005.). Protocol for general postural stability - dynamic bilateral stance assessment, means a dual test of 20 seconds (Biodex Medical System, 2006; Nevitt et al., 1991). For each subject identical protocol of 3 trials of 20 seconds and 30 seconds rest period at level 4 difficulties were implemented for determining overall balance index (OSI) (Arnold & Schmitz, 1998). For each repeated attempt, the exact foot position was re-entered. Lower score value means better result. Group classification (GC) was made on the results of mean values and standard deviation (SD) of the overall stability index (OSI) for whole sample of subjects tested. First group consist boys with results within –2 SD of mean values – group above average results (AA) n = 5, or 16,1% of respondents. The second group summarizes results within ±1 SD of mean values – average results (A) n = 20, or 64,5% of respondents. Third group included results within +2 SD of mean values – group below average results (BA) n = 6, or 19,3%. In this sample of subjects were not found any extreme result - ±3 SD.

Morphological characteristics

Morphological – anthropometric characteristics were represented by two variables: standing body height (AVIS), measured with anthrop meter by Martin and body mass (AMAS), measured with calibrated scale Tanita BC420SMA (Tanita Corp; Tokyo, Japan) with a precision of ±0,1 kg.

Motor abilities

Motor – balance abilities were estimate with stopwatch, three times measured, where time starts when subject establishes balance and ends by falling off the balance bench. Maximum score achieved may be 60 seconds. Measured variables (n = 6) were:

a. MRPUL – transverse standing on the balance bench with left foot;
b. MRPUD – transverse standing on the balance bench with right foot;
c. MRUUL – lengthwise standing on the balance bench with left foot;
d. MRUUD – lengthwise standing on the balance bench with right foot;
e. MRUB – lengthwise standing on the balance bench with both feet;
f. MRPB – transverse standing on the balance bench with both feet.

Motor coordination – agility abilities were measured by stopwatch, with three repetitions for each, expressed by test variables (n=3):

a. MKP3R – three ball slalom with hands between the cones;
b. MKP3N – three ball slalom with feet between the cones;
c. MTTEST – T test for assessing agility by Bloomfield et al. (1994.).

Statistical analysis

All data are featured as a Means and SD. Data analysis was conducted with help of software package SPSS 22.0 (IBM corp.) and Excel (Microsoft corp.). For all variables, measures of central tendencies and data distribution were calculated and Kolmogorov – Smirnov test for normality of distribution. Multivariate analysis of variance (MANOVA) was used to determine the existence of differences in results, between groups of boys, classified according to the stability index (OSI). Multivariate tests validated statistical significance of classification into the groups and result differences. Fisher's LSD post – hoc test was used to determine statistically significant differences between groups within each of the variables, at statistical level of $p < 0,05$. Obtained results were standardized and displayed in Z values chart.

Results

Based on the results of the measures of central tendencies and data distribution, as well as the K-S test, it was found that all data were within limits of normal distribution. MANOVA of groups formed according to the overall stability index (OSI) within variables of the morphological characteristics and motor abilities obtained mean values for each group (Table 1).

Table 1 Average value of morphological characteristics and motor skills by groups classified by the score value of the overall stability index (OSI)

GC		Mean	SD		Mean	SD		Mean	SD
	AA	1,28	,11		158,20	9,90		50,64	18,95
	A	2,35	,6		164,10	11,94		50,97	12,15
	BA	4,63	,23		171,66	4,18		73,90	12,11
OSI	*Sample*	2,62	1,18	**AVIS**	164,61	11,10	**AMAS**	55,35	15,85
	AA	9,44	4,47		12,38	12,62		23,75	24,57
	A	7,32	4,18		11,45	7,93		23,28	19,50
	BA	5,23	2,58		5,24	3,43		7,37	6,94
MRPUL	*Sample*	7,26	4,06	**MRPUD**	10,4	8,36	**MRUUL**	20,5	21,99
	AA	24,65	23,02		17,62	12,86		14,89	12,38
	A	16,72	15,12		10,87	6,01		14,29	5,81
	BA	5,03	2,63		6,08	2,42		3,51	1,24
MRUUD	*Sample*	15,74	15,92	**MRUB**	14,3	11,55	**MRPB**	12,59	11,06
	AA	29,03	5,80		39,83	11,46		9,34	,67
	A	29,56	5,76		48,06	8,66		9,85	,65
	BA	30,74	3,85		51,32	10,84		10,05	,79
MKP3R	*Sample*	29,41	5,33	**MKP3N**	43,28	11,60	**MTTEST**	9,56	,73

Table 2 represents results of the multivariate tests for classifying into groups based on the overall stability index, within the space of morphological characteristic and motor abilities variables. All tests show the highest level of statistical significance ($p<0,01$) for classification into groups by overall stability index.

Table 2 Multivariate tests for determining the statistical significance of differences between groups

Test	*Value*	*F*	*Error df*	*Sig.*
Pillai's Trace	1,312	2,857	36,000	,000
Wilks' Lambda	,064	4,164	34,000	,000
Hotelling's Trace	8,683	5,789	32,000	,000
Roy's Largest	7,949	11,924	18,000	,000

Table 3 represents the results of univariate F – test which determined the statistical significances of differences between groups within the morphological characteristics and motor abilities variables. Based on the test results, it can be concluded that within the morphological characteristics space, statistically significant differences exist in variable body mass AMAS p – 0,003 for at least between two groups.

Within the area of motor abilities manifest variables, there were no differences found between the groups at statistically significant level. Other variables showed no statistically significant differences when classifying into groups, but results were close to limit values.

Table 3 Univarite F test for differences between classified groups

	F	*Sig.*
AVIS	2,24	,126
AMAS	7,20	**,003**
MRPUL	1,53	,234
MRPUD	1,49	,243
MRUUL	1,36	,273
MRUUD	2,38	,111
MRUB	2,89	,072
MRPB	2,82	,077
MKP3R	,19	,822
MKP3N	2,92	,070
MTTEST	3,01	,066

Leven's test for heterogeneity of variance (Table 4) was further used to find statistically significant differences among groups, in the area of manifest variables. Variables AVIS, MRUUL, MRUUD and MRUB show that the presumption of variance equality of their changeable was disturbed, and also present a higher level of statistically significant heterogeneity of variance of p – 0,05. Based on this, it can be concluded that the groups classified by the level of OSI, differ statistically significant precisely in these variables.

Table 4 Levene's Test for heterogeneity of group variance within the space of morphological and motor manifest variables

	F	*Sig.*
AVIS	5,46	0,01
AMAS	0,58	0,564
MRPUL	1,04	0,366
MRPUD	1,99	0,156
MRUUL	3,71	0,037
MRUUD	7,02	0,003
MRUB	10,1	0
MRPB	3,27	0,053
MKP3R	0,11	0,894
MKP3N	0,2	0,816
MTTEST	0,24	0,791

Post – hoc LSD test determined statistically significant difference between groups, and separately within each of the variable. Table 5 presents statistically significant differences of groups based on stability index (OSI) within area of morphological and motor variables. In addition to the previously determined differences, LSD test showed statistically significant differences between the two groups in variables MKP3N and MTTEST, which were not determined on higher levels of multivariate analysis by F – test and Leven's test of variance heterogeneity.

Table 5 Post hoc LSD test for identifying size of differences

			Mean D.	*Sig.*	*95% CI*	
AVIS	AA	BA	-13,47	**,046**	-26,7	-,23
	AA	BA	-23,26	,008	-39,8	-6,7
AMAS	A	BA	-22,94	,001	-35,6	-10,2
MRUUD	AA	BA	19,62	,042	,72	38,5
MRUB	AA	BA	11,54	,031	1,2	21,9
MRPB	AA	BA	11,38	,027	1,4	21,3
MKP3N	AA	BA	-11,48	,045	,29	22,7
MTTEST	AA	BA	-,71	,034	-1,4	-,06

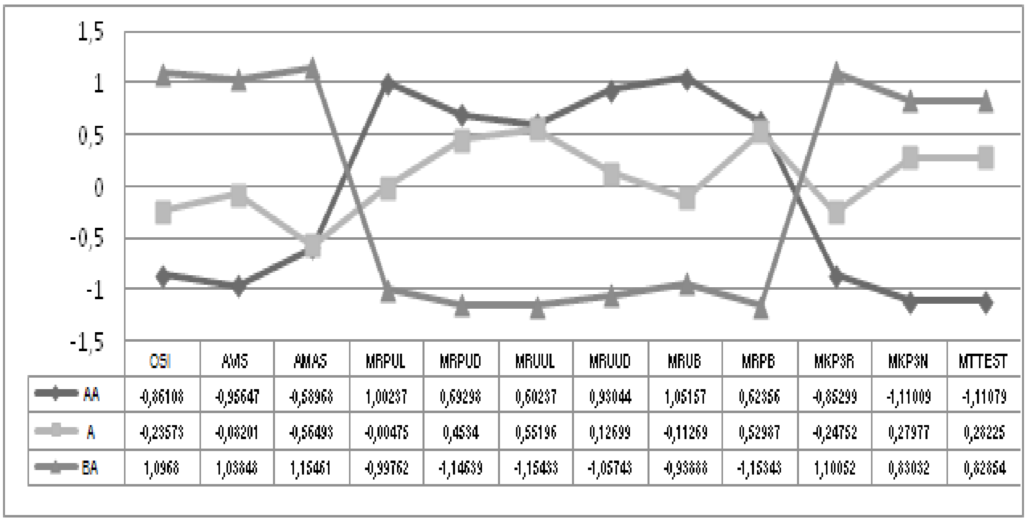
Mean values results of all manifest variables were recorded to a matrix, and calculated standard Z values for each group. Based on the Z matrix values, a Z graph was formed (Figure 1.), which presents differences between groups classified on the basis of stability index, in the areas of morphological and motor manifest variables. According to the Z graph of achieved results for groups, there are easily noticeable qualitative differences between groups formed by the stability index. Based on the chart, it can be concluded that the respondents with a higher level of overall stability index (OSI) have better results in agility and coordination tasks. It is important to note that lower values for coordination and agility tests represent better achievement in abilities (inversion results). In the space of balance abilities, a higher value represents better results.

On the basis of mean values, it was determined that in the area of morphological variables, body height (AVIS) variable showed that the above average (AA) group was 13,47cm shorter than the below average group (BA), which was statistically significant.

Compared to the average group (A), subjects were shorter on average 6,1cm, without any statistical significance. In the space of the morphological variables, body mass variable (AMAS) within above average group (AA) showed less body mass for average of 23,26kg than the below average group (BA), with statistical significance. Group of average respondents (A) had a lower body mass for average of 22,94 kg than the below average group (BA).

In the space of motor balance abilities, for lengthwise standing on the balance bench with left foot – MRUUL, the above average group scored for average of 16,33sec better than the below average group (BA). The above average group (AA), also scored a better result than the below average group within variable MRUUD – lengthwise standing on the balance bench with right foot. The above average group (AA) scored for average of 7,63sec less than the average

Figure 1. Graph of Z group values within morphological and motor manifest variables



group (A), on average of 19,62sec less than the below average group (BA). There are noticeable differences within all three groups for variable MRUB - lengthwise standing on the balance bench with both feet. Statistically significant difference between the above average (AA) and below average (BA) groups, with a difference of average 11,54 sec. Statistically significant differences were detected within variable MRPB – between groups above average (AA) and below average (BA) for average score of 11,38sec. Within coordination abilities, a significant difference between the above average (AA) and below average (BA) groups was determined for variable MKP3N - three-ball slalom with hands, or 11,48 sec in favor of the above average group (AA). Significant difference was found in MTTEST – T test for assessing agility, where the above average group (AA) achieved better score on average of 0,71 sec than the below average (BA) group.

Discussion

In a sample of 59 men, 17,4 to 63,8 kg/m^2, Hue (Hue et al., 2007.) determined, using regression analysis that a larger body mass has a negative effect on overall stability index. Similar results found Goulding (Goulding et al., 2003.), on a sample of 93 men aged 10 – 21 years. Most authors and studies results revile that excess of body mass – high BMI negatively affects the mechanisms responsible for maintaining a high level of postural stability (McGraw et al., 2000.). Results of this study also show differences in total body mass between groups, where above average results (AA) have a much lower total body mass than the below average (BA) group of respondents, based on the overall stability index, so that higher body weight directly contributes to worse postural balance, resulting a worse expression of motor skills.

Body height highly correlates with lateral stability of the knee joint and postural balance (Kejonen et al., 2003.). The results were obtained using tensiometric platform, on a sample of 100 respondents (50 male, 50 female), through regression analysis of anthropological measures of lower extremities, height and weight of subjects. Results of this study show that respondents of above average group (AA) have a lower body heights and have a better quantitative score of overall stability index (OSI) than the below average group (BA) who are taller.

In a sample of 21 amateur soccer players, aged 26 $\pm$ 3,3 years, with weight of 74,6 $\pm$ 8,5kg and height of 176,8 $\pm$ 6,1cm, Gstöttner (Gstöttner et al., 2009) investigated the differences between the levels of stability between dominant and non-dominant legs. Stability level was determined using Byodex balance system (BB) and Terax System. Differences were determined using student T test. Lack of significant differences between the scores of legs stability was found, with a slight tendency to greater stability in the non – dominant leg. Statistical differences were not found in the medial – lateral stability, p - ,23. Results of this research have actually found biggest differences between above average and below average groups, within tests of unilateral character for medial – lateral stability. Guided by previous research and the results gain in this, it can be concluded that there are individually small differences of unilateral stability, but they are significantly expressed between subjects with different levels of overall stability index (OSI).

Complexity of the management mechanism of the central nervous system issues for coordinating movements was research subject for many scientists (Sahan, 2009.). The largest research contribution for exploring the impact of CNS to establishment of the movement, gave Bernstein who formed the so – called „Bernstein problem“ (Latash, 2004.). Hatzitaki (Hatzitaki et al., 2002.) determined relations between balance and coordination and visual information processing, on a sample of respondents aged 11 – 13 years. Test consisted of balancing on one foot on the platform, which measures deviations and changes when in balanced position, while subjects were performing different tasks. Research results show high correlation between static balancing on one leg with receiving and processing information, which is essential for establishing basic stability control. Influence and relation of coordination with postural stability, studied by Wong (Wong et al., 2001.) using a sample engaged in Thai Chi, aged 2 – 35 years (n = 35) and control group (n = 14). Using tests for dynamic and static balance, he established the existence of differences in levels of postural balance between those engaged in Thai Chi and control groups, especially when performing complex balance tests. There was no high influence of age duration in sport to a postural balance. Author concludes that complex coordination training, as found in Thai Chi, helps maintaining the level of balance abilities, and that coordination training has acute effects on increasing postural stability. Given that coordination is closely related to body stability and agility, which depend on processing visual information, results of this research confirmed former findings. In fact, the largest group results differentiation, above average (AA) and below average (BA), by the quality of the overall stability index (OSI), have been found within test for legs coordination – MKP3N and legs agility (MTTEST), in the area of coordination and agility.

It is obvious that a higher level (lower overall stability index coefficient) of steady quality, positively affects situational manifestation of balance, coordination and agility. Boys classified into average and above average groups, based on OSI, state better results in solving complex motor coordination tests in continuity and better proprioceptive abilities also. These groups of boys also have a lower body weight and height, which is associated with researches of other authors who have proved with scientific methods that those with lower body mass and height have better coordination – balance abilities. Result were also confirmed by multivariate test for significance of classifying into groups (Table 2), showing the greatest statistical differences between groups.

Conclusion

The results obtained by measuring the stability index using Byodex Balance System (BBI), morphological characteristics and motor abilities: balance, coordination and agility, have valid and usable value, considering respect of protocol for measuring and using valid measuring methods. Boys aged 10 – 14 years, divided into groups depending on their level of overall stability index, significantly differ in morphological characteristics and balance and coordination abilities. Boys classified as above average (AA) are smaller in height with lower body mass, and score better results in field test for unilateral medial – lateral balance, legs coordination and legs agility. Considering the high level of differentiation potential of boys with high overall stability index, set of variables for assessing morphological characteristic and motor abilities applied in this research, can be a partial contribution for forming models of selecting boys for sports (almost all sports) dominated by neuro muscular apparatus abilities and movement regulation mechanisms. It should be noted that all tests are field feasible. Stability index is a great indicator for selecting boys into complex sports.

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The Effects of Elementary School Students' Feet Deformity Removal Program

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Summary
Children in their motional activities have more and more contents of static nature, or even contents od dynamical nature that are not of sufficient quality to cause the appropriate transformation of the anthropological status. Because of a lifestyle like that, feet deformities occur, and they can cause pain in the lower extremities, disrupt the normal structure in relations of the lower extremities (X or O legs) and even cut back the child's desire for further excercising of motional/sports activities. The goal of this research is to determine the effects of deformity removal program on samples of boys and girls at the age of 10 and 11. The analysis of determining the deformities was performed by Mayer's method for valuation of feet posture at a total sample of 85 examinees, and the statistical verification of the reaction to the program was performed with the use of T – test for the dependent samples. The results obtained during the research have shown that the corresponding program may affect the reduction or removal of the analysed deformity. The program applied to this research can be recommended for further work and use on populations similar or identical anthropological features.

Key words: **Hypokinesia, Programmed excercise, Transformation processes**

Introduction

The trend of reduced movement of children is causing the increase of obesity in children's and adolescent age, resulting in overweight and occurence of different disorders in body posture (Yosinaga et al., 2002). One of the disorders that also appears as a result of reduced movement of children is feet deformity (Cousins et al., 2013). Child's foot is made of many muscles, tendons, neurovascular elements, ligaments and 26 and 32 articular surfaces (Mauch, 2007). The functions of feet are the function of passive-static load by standing and the active elastic-dynamic function by moving in space (Mađarević and Mustafičić, 2010). These two seemingly opposite functions (stability and elasticity) are achieved thanks to vaulting that are determined according to the points that are most exposed to the pressure. Those are: heel, the head of the first and the fifth metatarsus. When the points between these bones are connected, three vaults are obtained: longitudinal inner vault, longitudinal outer vault and transverse vault. The height of the longitudinal vaults is determined by the bone shape, the muscle strength and the resistance of the ligaments (Morrison et al., 2007). A baby is born with flat feet, and the feet vaults are not formed until the baby's first steps (Hadžikadunić and Balta, 2000; Hadžikadunić and Mađarević, 2004). The feet vaults should be fully formed until the age of three. A well developed feet vault is characterised by: pear-shaped form of the heel, the front part of the feet connected to the heel with a narrow connector, noticeable angle at the transition from the connector to the front part of the feet and clear prints of all five fingers. Deformities in the structure or the shape of one foot bone are causing disorder in the function of the foot. These malformations are progressively increasing during the growth and cause secondary changes (Antropova and Koljcova, 1986) on the contiguous and distant segments (knee, hip, spine). The circle of the occurrence of feet deformity starts with the change of shape and position of the feet, because of the load oftenly cause by walking, and so the feet shape changes functionally, aesthetically and structurally (Kovač and Smajlović, 2006; Jovičić, 2007). Functionally disturbed feet that do not carry any load, have a regular shape and all the vaults can clearly be seen. Only in the support the lowering of the vaults occurs. In this research the feet deformity is determined by taking the plantogram – a barefoot footprint, after which there has been an evaluation of the deviation of foot posture, done with Mayer's method. After determining the deformity, a program for reducing on removing it has been used, which showed the effects of the conducted excercise program, which was the goal of this research.

Methods

Examinee sample

The analysis of children's feet posture is conducted on a sample of (n=40) boys and (n=45) girls at the age of 10 and 11. All the examinees have approached the same footprint measurement – plantogram. The parents have been introduced to the purpose and the method of the testing and they have aggreed to the realisation of this research.

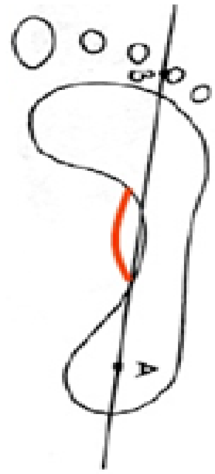
Sample of variables

The variable used for determining the feet deformity was obtained measuring the deviation of the middle part of the foot from the drawn Mayer's line (Cvjetičanin, 1993, pg.23). The result is registered in milimeters (mm). The measuring is done before (initially) and after (finally) the conducted excercise program.

The decription of the measuring technique

One of the method for feet deformity diagnosis is taking colour footprints and transferring it to the paper. In that way, the shape of the foot is coppied at full support and we get a two-dimensional print (the examinees step with their dominant foot on a provided paint-soaked pad and they performe the appropriate pressure, and they do the same thing on a blank paper). Based on the print, the degree of the lowered foot is being determined. Mayer's method for determining the feet deformity is used to determine the deformity (Cvjetičanin, 1993, pg.23). The valuation is done as follows: the measurer draws a line from the middle of the heel print to the medial edge of the forth toe (AB line) and then the measuring of the deviation of the foot vault is done which is recorded in milimeters (Picture 1). In case that the width of the middle narrow part of the footprint exceedes Mayer's line on the medial side, the examinee has a lowered foot. If the part of the foot is set before Mayer's line, then we have a enlarged foot vault. Because of the simplicity and possibility of discovering the deformation in the early phase, this method is most easily acceptable for routine determining of lowered feet (Trošt et al., 2005). The results of the measurement are necessarily told to the examinee.

Picture 1. Schematic overview of the evaluation – Mayer's method



A program for removing or reducing feet deformity

Excercises for removing or reducing feet deformity were applied every day, in a period of one hundred (100) days. Excercises were divided into two periods of day: forenoon, when first to seventh excercise are applied for a period of three minutes each (21 minutes in total) and afternoon when eight to fourteenth excercise are applied for a period of three minutes each (21 minutes in total). Therefore, total daily excercising lasted for forty-two (42) minutes. To avoid the monotony of the excercising, different excercises before noon and after noon are deliberately applied (Nemec and Nemec, 2009; Malešević and Milijević, 1983). Considering that only strong enough and regularly performed excercises can give satisfactory results (Karaiković, 1986) and in order to avoid the formal approach to the realization of excercises, children and their parents are introduced to the regular way of performing the excercises (Findak and Stella, 1985). To parents who previously approved conducting the excercise program, the importance of the supervision that they have to conduct during the realization of excercising was specifically emphasized. All the students, no matter their degree of deformity, were provided with the same excercise program (Table 1).

Table 1. The excercise program for removing or reducing feet deformity

	EXCERCISE DESCRIPTION	DURATION	APPOINTMENT
1.	The excercise begins with the flexion of the toes, and then fan-shaped expansion. Toes are intermittently expanded and shrunken.	3 min	07:15 to 07:36
2.	A rope that has 1 cm diameter and is 1 m long is placed on the ground. Toes are lifted and expanded ansd the rope is reached that then goes under the feet. This motion is repeated until the whole rope is pulled over. It is excercised with both legs at the same time.	3 min	07:15 to 07:36
3.	The excerciser walks on the front part of his feet, while his heels are lifted above ground.	3 min	07:15 to 07:36

4.	The excerciser bends his toes and feet (convulses them) and he moves back and forth that way.	3 min	07:15 to 07:36
5.	Sitting on the ground, resting hands behind the back and legs bended in the knee. Feet are on the ground. We lift one leg and intermittently touch the knee of the other bended leg first with toes and then heel.	3 min	07:15 to 07:36
6.	The excerciser grabs the rope of 1 cm diameter and 1 m long using the toes of one foot and lifts it up. While holding it up, he tries to take the rope with the toes of his other foot.	3 min	07:15 to 07:36
7.	A paper tissue is fixated with one foot, while it is being ripped in many small pieces by the other foot.	3 min	07:15 to 07:36
8.	We grab a pencil with each of our feet and act like we are knitting.	3 min	16:00 to 16:21
9.	We scatter popcorns, marbles, small toys around the ground. They are lifted from the ground with toes. Right leg to the left arm and conversely.	3 min	16:00 to 16:21
10.	While standing, intermittently, we place foot by foot on a tennis ball, we transfer the weight of our body on the ball, rubb it on the ground, squeeze it and roll it. First one foot, and than the other.	3 min	16:00 to 16:21
	While holding small toys with his toes, the excerciser walks on his heels. It is important that the toys don't fall on the ground.	3 min	16:00 do 16:21
12.	The pencil is placed between the big toe and the toe next to it. We fixate the paper with the other leg. The task is to draw an optional object.	3 min	16:00 to 16:21
13.	On the ground we place a rope of 1 cm diameter and 1 m long. The excerciser walk on it on the front part of his foot.	3 min	16:00 to 16:21
14.	Place a hoop on the ground (standard shape and size). While walking on it, the excerciser is balancing like he is walking on a rope.	3 min	16:00 to 16:21

Data processing methods

For determining the effects of program for removing children's feet deformity, T – test was used for dependent samples on a level of statis significance on a level of $p \leq ,05$. The results were processed in a program package IBM SPSS 22 for Windows.

Results

The results of T-test for dependent samples – boys (Table 2), that was realized as an extracurricular activity, have shown positive effects of the conducted program in a duration of 100 days. The results clearly show that the deviation from Mayer's line in the final measurement had decreased by 2 mm, which shows statistically significant changes on the level $p \leq 0,001$.

Table 2. T test for dependent samples, Boys/Boys before and after programs

	Mean	S. D	S.E.D	t	df	Sig.
Initial measuring	,06	0,53	,004	3,50	36	,00
Final measuring	,04	,029	,004	3,50	36	

Mean - average value, SD - standard deviation, SED - Std. Error Difference, t-Degrees of liberty, df – Difference, Sig- Significance of differences between the groups

The results of the T-test for dependent samples – girls (Table 3) have also shown positive effects of the conducted program. The duration of the proram realization is 100 days and it was realized as an extracurricular activity. It is noticeable that the deviation from Mayer's line in the final measuring has decreased in 3 mm, which shows the statistically signicifant changes in feet posture, on a statical level of $p \leq 0{,}001$.

Table 3. T – test for the dependent samples Girls/Girls before and after programs

	Mean	S. D	S.E.D	t	df	Sig.
Initial measuring	,05	,047	,004	2,90	32	,00
Final measuring	,02	,023	,004	2,90	32	

Mean - average value, SD - standard deviation, SED - Std. Error Difference, t-Degrees of liberty, df – Difference, Sig- Significance of differences between the groups

Discussion

The defined goal of this research by which the effect of feet deformity removal program was supposed to determine is confirmed. Before the excercising it is found that feet deformity is present with boys so that, out of 40 examinees, 37 of them have a deformity, while in the population of girls, out of 45 examinees, 33 of them have a registered disorder in feet posture. These feet deformity relations, related to gender and age, are also defined in a research conducted by Bokan and Borković (2006) and also in a research conducted by Mihajlović et al. (2008) where it was found that a slightly higher number of male examinees have a conspicuous disorder in feet posture. After determining that both populations have changes on their feet, the practice of feet deformity removal program has been approached. Both with boys and girls, no matterwhat degree of deformity they were specified, same activities have been used. After the realization of the progeam, which was supported by their parents in a way that they have given a written consent that they will and have actively supervised everyday excercising, and after the expiration of the 100 days period, we approached re-taking the footprints. Statistical indicators have confirmed that there has been a decrease both the magnitude and the number of deformities, which is in accordance with the results of a research by Kendović et al. (2007) which also confirmed that the number of deformities is decreasing with the passing of excercise time and children's growth. In the conducted research, the effects of the program are successful for both populations. The program is applyable also for a sample that Medojević and Jakšić (2007) treated in their research, by which the differences between the number and the kind of deformities with male and female population were established, and where it had to be reacted in a right way of removing or reducing them. Reducing or removing feet deformity, which occurs as a result of this program will positively affect also the development of children's motor skills because De Toia et al. (2009) have found that there is a connection between violated anthropometry and motor skills of preschool children population. Positive effect was created with the applied program equally with boys and girls, and the same one can be used to remove or reduce feet deformity with both genders, which is similar to the conclusions in the research by Mihajlović et al. (2010). Pfeiffer et al. (2006) have concluded in their research that the program for reducing and removing feet deformity can be preventively used, therefore in this research too the conducted program can be recommended for preventive action.

Conclusion

There is a continuated need to educate parents, but also the teachers, in the field of noticing and recognizing body deformities. If both of them notice their presence on time (while they are in the phase of funktional disorder) the posibility of rehabilitation is bigger and the entire procedure is more efficiant. It is good if the deformity is noticed during the teaching process, and the teacher recommends a program that would bi realized during the curricular or extracurricular activities. It is also possible that the parent is the first one to notice the deformity and signalized it to the teacher in time. Then a certain program can be made, that is, like in this research, realized under the control of the parents in the form of an extracurricular activity. In both cases, the principal of unified action is fulfilled, which besides the preventive nature also has an effect of increasing the whole motional activity of the children.

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Embedding Quality Assurance in Doctoral Education (EQADE)

In an attempt to bridge the gap between the current state of affairs in Bosnian- Herzegovinian (BiH) higher education (HE) and research and European good practice, the project Embedding Quality Assurance in Doctoral Education (EQADE) is primarily targeted at installing more effective quality assurance (QA) structures by designing and offering doctoral programs at all public universities in BiH. The project specifically focuses on quality management and administration of doctoral education at the level of universities. A priority was aimed at the development of consistent quality standards in doctoral education on a university-wide basis and on the level of BiH. In order to introduce and establish a new system of III cycle study programs, aligned with Bologna Principles, ENQA Standards in QA and, most importantly, Salzburg Principles, the project methodology relies on the following three phases which roughly correspond to respective project years:

Phase I – the first project year was largely dedicated to building institutional capacities of eight BiH universities for (a) enhanced promotion of doctoral education and research and (b) accepting and installing new modes of developing and delivering doctoral education. This phase entailed maximum engagement of university stakeholders, both internal (administrative staff, teaching staff, management and students) and external (ministries of education, BiH Agency for Development of Higher Education and Quality Assurance (HEA), etc.).

Phase II – the second project year mostly focused on the conceptualization, formulation and acceptance of quality standards and procedures in doctoral education within the BiH academic community. This project phase presupposed active participation of HEA and involved ministries of education for the purpose of assuring wider acceptance of standards and their official adoptions by relevant public authorities. Furthermore, dissemination of project results, or more concretely, promotion of standards played a significant role in this project phase with an aim to better prepare the overall BiH academic community for external program evaluations and accreditations in doctoral education.

Phase III – the final project year is devoted to “testing” the previously developed methodologies and structures through the preparation and external evaluation of eight new PhD programs.

Wider Objective:

Promotion and support to development of state-of-the-art doctoral education at public universities in Bosnia and Herzegovina in line with Bologna Process action lines and Strategy for Development of Science in BiH 2010-2015.

Specific Project Objectives:

1. Integration and more Efficient Management of Doctoral education at eight public BiH universities by the end of 2013

2. Formulation and adoption of Quality Standards in Doctoral Education at university and state level by the end of 2013

3. Development of one doctoral program per university (eight pilot projects) aligned with adopted procedures and quality standards by the end of 2014

Criteria and Indicators for Internal and External Quality Assurance in Doctoral Education

In the last 14 years the Higher Education (HE) sector has been in a continuous period of reform, especially since 2003 when BiH signed the Bologna Declaration. A multitude of structural modifications have taken place: curricular development in line with Bologna action lines, introduction of internal quality assurance (QA) systems and processes, and so forth. One large segment which remains to be confronted in the upcoming period is the restructuring of the third study cycle education, such as doctoral education.

Doctoral education was formally incorporated as the third cycle in the Bologna discussions in 2003, following an EUA project that identified the need to bring changes to Doctoral education, and the EUA Bologna Seminar in Salzburg that identified common principles for that level (EUA 2005), the results of which were included in the 2005 Bergen Communiqué[1].

The Bologna process promotes and recognizes autonomous integrated universities. On the other hand, BiH universities carry a legacy from the preceding Socialist system in which university administration was highly decentralized. Although the process of institutional integration was completed at eight public universities, until today PhD education remains fragmented and centered solely on faculties and departments, rather than universities. Such disintegrated educational structures lead to dissolution of researchers and mentors, as well as to a lack of systematic and strategic approach to institutional research. PhD education is typically implemented by small groups of professors from the same scientific discipline and such programs are largely based exclusively on mentorship schemes rather than multidisciplinary programs. Hence, the BiH Higher Education Institutions (HEIs) fail to meet the needs of their fast-changing labor market and society. Universities as institutions need to take responsibility and ensure that the doctoral programs and research trainings they offer become designed to meet contemporary demands and include appropriate professional career development opportunities.

A proper strategy with a clear vision and mission, which incorporates the international dimension, will be of significant support to all universities in pursuance of reaching common European Higher Education Area (EHEA) initiative. Rich diversity of doctoral programs in Europe – including joint doctorates - is strength which has to be underpinned by quality and sound practice[2].

In order to be accountable for the quality of doctoral programs, EQADE project served as a powerful instrument in the support of Higher Education institutions in BiH who contributed to the development of Criteria and Indicators based on institutional priorities such as individual progression, net research time, completion rate, transferable skills, career tracking and dissemination of research results for early stage researchers, taking into consideration the professional development of the researcher as well as the progress of the research project[3].

These criteria and indicators are the result of all above mentioned need. Doctoral education and research in general, have lost their appeal. Lack of attractive doctoral programs negatively affects internal fluctuations of qualified staff from knowledge production into public administration and international organizations in effect causing a long-term deficit in high-potential research personnel.

Criteria for Quality Assurance of PhD studies in BH

1. Institutional strategies and policies
2. Organization and structure
3. Resources and funding
4. Educational objectives and competences
5. Admission policy
6. Curriculum
7. Mentoring
8. PhD thesis and original research
9. Student assessment
10. Internationalization
11. Evaluation of the program

More deteailed information : http://eqade.com/

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Material should be written in MS WORD text editor, font Times Roman, 12. Paper should not exceed 16 pages with double spacing including tables, illustrations and references. It should then be printed on one side with large margins (2,5 cm).
The order of the text should be as follows:

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Text: Text should be divided in following sections - headlines: Introduction, Methods (including participants, apparatus and procedures), Results, Discussion, Conclusion and References. All pages should be numbered consecutively commencing with the title page. Do not import tables or figures in text.

Introduction: state the problem, subject, and aim of their research as well as the relevant findings of prior research.

Method section includes detailed description of research. It precisely states the: participants, phenomena or objects under observation - research as well as the apparatus and procedure. Any statistical method must be stated, and any not in common use should be fully described or supported by references.

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