SPORTLOGIA

2/2015
June 2015

SportLogia
Vol.11, Issue 1, June 2015.

CONTENT

SportLogia
2015, 11(1), 1–10
e-ISSN 1986-6119

www.SportLogia.com

SCOLIOSIS AND SPORT

Slavica Đ. Jandrić[1]

[1]School of medicine, University of Banja Luka, Bosnia and Hrezegovina

EDITORIAL ARTICLE
OWERVIEV PAPER
doi: 10.5550/sgia.151101.en.001J
UDC: 616.711:796

SUMMARY

In the course of growth and development, affected by various internal and external factors, various postural disorders may occur, especially in school-age children. Scoliosis is defined as a lateral curvature of the spinal column in the coronal plane, but the disorder actually occurs in three dimensions. The prevalence of scoliosis is from 2% to 3%, and it is the highest in patients in the 12-14 age range, affecting girls more than boys at a ratio of 2:1. Functional scoliosis occurs more frequently than structural scoliosis. Idiopathic scoliosis is structural scoliosis which has no definite cause; it may progress and affect the function of internal organ systems and occurrence of back pain. Annual children's medical check-ups and early detection of scoliosis are essential for treatment of scoliosis. Treatment depends on the size and progression of the curve, skeletal maturity, scope of physical therapy and observation. The potential association between adolescent idiopathic scoliosis and sports is still insufficiently researched. Young athletes may have spinal deformities which are not related to any sports activity or may be potentially associated with the sport they practise. The International Scientific Society on Scoliosis Orthopaedic and Rehabilitation Treatment has come up with the guidelines for sports activities in children with scoliosis. This association does not recommend sport for treatment of idiopathic scoliosis. Sports activities are recommended due to their specific useful effects in the psychological, neuromuscular and general aspect of health in patients with scoliosis, even in patients during the treatment with spinal orthoses. In patients with a high risk of scoliosis progression, it is recommended to avoid competitive activities with a higher degree of mobility of the spinal column.

Key Words: posture, prevention, scoliosis, sport, treatment.

INTRODUCTION

In the course of growth and development in childhood, and later as well, various postural disorders may occur, especially in school-age children. These disorders are affected by various internal and external factors. The modern way of life is one of the factors that reduce physical activity of children, which may have repercussions on the locomotor system. On the other hand, different sports may have both positive and negative implications on the musculoskeletal system and cause various postural disorders.

Posture. The term posture refers to position of the body as a whole, with all its domains, and with an important role of psychological, kinesiological, biomechanical and physiological implications. This complexity has provoked lack of consensus and much disagreement about the definition, diagnosis, means and methods of treating various postural disorders.

In anatomical terms, posture depends on the interaction of skeletal, muscular and noncontractile connective structures (including fascia, tendons and ligaments). The principles of normal posture include optimal loading of the skeletal system, balance between antagonistic muscle groups and optimal activity of internal organs. In postural disorders, there is an imbalance in the loads imposed on different areas. As long as the loading is within physiological limits, the changes are considered reversible. When the loading exceeds normal physiological limits over prolonged periods of time, structural changes occur in the skeletal bones, and impairment of this type is irreversible

(Górecki et al., 2009; Łabaziewicz, 2008). Long-term postural disorders may impair the normal functioning of internal body systems and cause back pain.

The spinal column makes the axis of the body and supports the whole skeleton. Vertebral bodies are bound together by the fibrocartilaginous discs and two longitudinal ligaments – anterior and posterior. Ligg. flava, thick and strong ligaments connecting the arches of two adjacent vertebrae are of great importance during spinal column extension and unburdening back muscles. Physiological curves of the spinal column give it a double "S" shape in the sagittal plane. They depend on the position of pelvis and sacrum in the body, and their distinctiveness is related to gender as well. In adults, the spinal column is slightly curved in a lateral direction to the right side, particularly in the thoracic region, therefore we talk about thoracic dextroscoliosis, which occurs due to incomplete symmetry of the body and more developed right hand (or left hand in left-handers).

The spinal column ensures the upright position, as well as motion of head, neck and trunk. At the same time, it serves as the base of numerous strong muscles of shoulder and pelvic girdle, which are important, apart from maintaining the upright position and good posture, for motion of upper and lower extremities. The whole spine behaves as a single joint. Moves are made around three main axes: anteflexion and retroflexion around the frontal axis, lateroflexion around the sagittal axis, and rotation around the vertical axis. The range of motion differs in separate parts of the spinal column.

The body constantly resists the force of gravity, and, in mechanical sense, maintains balance of forces. The active force which the organism uses to maintain the physical position in space is muscles. The spinal column is affected by the muscles which ensure the upright position of the body and take part in movement. The primary function of muscles includes support, stabilisation and mobility of the spinal column. In studying spinal deformities, particularly important is the role of deep muscles of the back and posterior cervical muscles (extensor muscles of the spinal column), m. quadratus lumborum (spine lateral flexor) and m. psoas major (thigh and spinal column flexor). The abdominal muscles bend and rotate the spine. The antagonistic activity of abdominal and back muscles ensures the upright position of trunk and its balance during walking. *The superficial group* of broad muscles serves for motion of upper extremities and ribs (m. trapesius, m. latissimus dorsi, m. levator scapulae, m. rhomboideus). *The group of deep muscles of the back* consists of eight muscles (m. splenii capitis et cervicis, m. erector spinae, m. spinalis, m. transversospinalis, mm. interspinales, mm. intertransversarii and mm. coccygei). Deep muscles of the back fasten the spine to the bony pelvic ring like a strong elastic ribbon. The erector spinae tension is important for every move of trunk and head, for every step and change of the body position. When the spine bends sideways, m. iliocostalis and m. quadratus lumborum have a stronger effect. M. iliopsoas is the main flexor of the thigh towards the pelvis in the hip region.

Postural disorders and scoliosis

The most common postural disorders are postural disorders of the spinal column (scoliosis, kyphosis, lordosis) and postural disorders of lower extremities. The results of a research on the identification of prevalence and the main risk factors of bad posture in school-age children in the Czech Republic revealed that 38.3% of the children were diagnosed with bad posture, more frequently in the boys. The children with bad posture complained more frequently of a headache and pain in the region of cervical and lumbar segment of the spinal column. On the average, they participated in sports activities 4 hours a week, and they watched television and/or used computers and played computer games 14 hours a week. Twenty percent of the children included in the research did not participate in any sports. The authors came to the conclusion that in the group of children who did not participate in any sports the probability of bad posture was much higher than in the children who participated in some sport (Kratenová, Zejglicová, Malý, & Filipová, 2007). Sedrez, Da Rosa, Noll, Medeiros, and Candotti (2015) report that a lifestyle may be associated with postural disorders. In this research conducted in Brazil, the prevalence of postural disorders was 79.7%, out of which 47.5% had changes in the coronal plane and 61% in the sagittal plane. Significant association was revealed between the presence of scoliosis and participation in competitive sports, as well as with the sleep time longer than 10 hours.

Scoliosis is defined as a lateral curvature of the spinal column in the coronal plane, but the disorder actually occurs in three dimensions (3D): apart from a lateral curvature in the coronal plane, there is also rotation (motion around the longitudinal axis in the transverse plane) and torsion (twisting of a part of a vertebral body towards another one, and a change of profile in the sagittal plane). The level of scoliosis prevalence may vary significantly in relation to the definition which is applied and to the population

observed. If scoliosis is defined as a curvature greater than 10º of Cobb angle, the prevalence is 2-3%, and when a lower Cobb angle is taken (e.g. 6° and higher), significantly higher prevalence of scoliosis is registered – the level of 4.5% (Rogala, Drummond, & Gurr, 1978). The prevalence is higher in patients in the 12-14 age range, and it affects girls more than boys at a ratio of 2:1 (Stirling et al., 1996).

Scoliosis is classified in terms of aetiology, pattern of the skeletal structure of the spinal column, correction of curvature, localisation, angle of curvature, type, direction of curvature and age in which deformity is detected. In terms of origin, scoliosis may be of unknown (primary or idiopathic) or known origin (secondary). The University of Washington classifies scoliosis into non-structural (postural and compensatory), temporary structural (sciatic, hysterical and inflammatory) and structural scoliosis. Structural scoliosis may be congenital and acquired. The most common structural scoliosis is idiopathic (70-80%). In terms of correctibility (flexibility), scoliosis may be divided into functional (flexible) and structural (rigid) scoliosis.

In functional scoliosis there are no structural changes on the skeleton system, it occurs more frequently, curves are not fixed, and it is characterised solely by a lateral curvature of spine without rotation of vertebrae and trunk asymmetry. It is easy to correct it passively, particularly in body suspension, by trunk anteflexion, voluntary contraction of spine extension muscles, standing position test or manually, and it has a better prognosis as well (Taft & Francis, 2003). In a forward bend test, it does not reveal a rib hump. Habitual scoliosis is also in this group. The cause of its occurrence is multifactorial. The spinal column which is already insufficient is affected by negative external influences (bad habits, improper sitting, carrying a schoolbag etc.). It is important to control postural scoliosis and maintain a mobile state of the locomotor system, along with strengthening postural muscles and correction of posture until the process of growing up ends. In many cases, untreated functional scoliosis may progress to severe rigid diseases. Due to its frequency and correctibility, postural scoliosis is a genuine subject of interest and work of educators and teachers of physical culture and sport in schools (Jovović, 2008). Compensatory scoliosis is caused by a static disorder (leg length discrepancy, muscle spasm, congenital hip dislocation, pain related to spinal disc herniation) (Jandrić & Antić, 2006).

Structural scoliosis is characterised by a change in the structure and morphology of vertebral body. It is changed and wedge-shaped, with the top directed towards the concavity of the curve. Spinous processes are directed towards the concavity, and transverse processes are directed dorsally towards the convexity. The changed shape of a vertebra leads to rotation, which becomes particularly visible if the change takes place in the thoracic spine. For that reason, the "rib hump" occurs during forward bending motion of the trunk.

Idiopathic scoliosis. Structural scoliosis of unknown origin is called idiopathic scoliosis [IS], and it is quite common. It may progress along with growing up, and sometimes it may spontaneously disappear. In terms of age at the time of occurrence of idiopathic scoliosis, it is classified into infantile, juvenile and adolescent idiopathic scoliosis [AIS]. Infantile idiopathic scoliosis (0-3 years) is more common in boys and is mainly sinistro-convex, in 90% of cases, with rapid progression. Juvenile idiopathic scoliosis in children in the 4-10 age range occurs equally in boys and girls. The primary curve is located in the thoracic spine, and it is more frequently dextro-convex. The earlier it occurs, and the more cranially its primary curve is located, the worse prognosis it has. Children with juvenile idiopathic scoliosis have to be under frequent control of doctors. AIS occurs in children between age 10 and the time they are fully grown. It is more common in girls and it is dextro-convex. It is very progressive and it may deteriorate as much as 10º a year. Adolescence is a period of rapid changes in the organism, with tumultuous hormonal changes and disproportion between bone length and muscle force. Affected by the action of mechanical forces, the spinal column is susceptible to occurrence of various disorders. In this scoliosis, the prognosis is better, because the possibility of its progression is reduced due to the period of stabilisation of the spinal column. The earlier the curve occurs, and the more cranial localisation is, the worse prognosis it has (Jandrić, 2012a).

In terms of shape and localisation, scoliotic curves are classified into: a) thoracic, b) thoracolumbar, c) lumbar, and d) double major curve.

Diagnosis. In scoliosis diagnostics, the methods used are clinical examination, X-ray examination and stereophotogrammetry. Clinical examination observes the spinal column line, position of pelvis, hips, knees, neck and shoulders. Observed are also Lawrence angles and trunk looked at from the front and from the back.

Clinical examination includes basic assessment of posture and body shape (inspection, palpation, conduct of Adam's forward bending test, measuring leg length, measuring range of motion, measuring with a plumb

line), cardiopulmonary status and neurological examination. Stereophotogrammetry determines deformity on the basis of display of symmetry of contours in the region of the back. Using radiography, we determine the degree of curvature, rotation of vertebral bodies and skeletal maturity of the patient.

Prevention and treatment. Examinations of children and sports medical examinations are essential for early detection and treatment of AIS. The American Academy of Orthopaedic Surgeons, Scoliosis Research Society, Pediatric Orthopaedic Society of North America and American Academy of Pediatrics recommend the optimal time for detection of AIS and conduct of screening as follows: two times for girls (10-12 age range) and once for boys (13 or 14 years of age) in 2008. During routine examinations of children and/or school medical examinations, scoliosis screening helps in identification of patients who need monitoring and therapy, while evaluation of the scoliotic curve along with assessment of the degree of skeletal maturity helps in the selection of curvature treatment (Burton, 2013). Multidisciplinary treatment is conducted by means of kinesitherapy, hydrokinesitherapy, occupational therapy, electrotherapy, spinal orthoses, but also of surgical treatment with partial correction and fusion of the primary curve.

Given that kinesitherapy, physical education and sport use the same means – motion, it is understandable that physical education teachers and sports trainers deal with this issue. Physical activity and therapeutic exercises have implications not only on development of morphological forms, but also on development of an organism as a whole. Well-organised physical activity at school age may reduce the number of persons with postural disorders and deformities.

The aim of kinesitherapy is improvement of muscle elasticity, reduction of pathological curves of the spinal column, muscle force increase, improvement of general fitness, and development of a balanced muscular corset for maintaining good posture. Motion and exercise in kinesitherapy are specific and they differ from gymnastics in physical education classes. What makes them specific is selection, initial position, character of exercises and dosing. Kinesitherapeutic programme will produce results within a certain period of time, but in time, by repeating the same exercises, due to monotony, children may lose motivation for the exercises. For that reason, after some time, elements of play or sports may be applied along with the therapeutic motion, with the aim of entertainment, but also of the effect on the spinal column. Selection of these elements depends on the postural disorder, deformity and degree of curvature.

Role of physical activity in the development of musculoskeletal system

Physical activity is very important and desirable in the development of children and their musculoskeletal system, but it requires certain efforts and is not harmless, so upon the doctor's recommendation, it may be discontinued or limited in the event of specific health condition and particular diseases.

We have conducted a research on physical activity of school-age children, presence of back pain and feeling of general good health, as well as of presence of differences between boys and girls in terms of the level of physical activity, on a sample of 98 schoolchildren of the average age of 11.4 years. The results of our research showed that the feeling of worse general health condition and back pain is more common in girls than in boys. An important predictor of the differences between boys and girls at the level of physical activity is the amount of time spent in play. Boys spend more time in outdoor play than girls (Jandric, 2010).

Games and sports may be very close to children, which facilitates their application to a great extent. Sport is recommended as one of the options in multidisciplinary treatment, but at the same time it is considered as a possible causal factor for occurrence of postural disorders, particularly scoliosis. For all those reasons, there are opposing opinions on the issue of scoliosis and sport.

For that reason, the goal of our work was to give an overview of available works on possible association between scoliosis and different sports, to present the results of the latest researches in this field, as well as the results of our own researches, aiming to evaluate and synthesise the existing results, as well as to give certain recommendations for participation of patients with scoliosis in particular sports activities.

METHODS

In our research, we performed a systematic review of literature, articulate articles and meta-analyses which give overviews of the latest findings about the aetiology and manifestation of postural disorders in children, implications of sport and physical activity on their development and health, as well as original articles and reports on the results of researches on possible association between various sports activities and scoliosis. For the research, we used PubMed, Cross References database, Google Scholar Citation index and other available literature.

ROLE OF SPORT IN THE GROWTH AND DEVELOPMENT OF A CHILD'S ORGANISM

Growth and development of children depend on adequate stimulation, with motion as its most important factor. Motion is a basic biological need and it represents a stimulant of growth and development of the organism. It accelerates recovery of deteriorated functions, and produces favourable psychological and social effects as well (Radisavljević, 2001). Back in 1781, Tissot wrote that "motion by its effects substitutes for every therapeutic agent, while all therapeutic agents cannot substitute for motion". Sport, elements of sport, sports games and gymnastics represent one of quite successful methods for maintenance and improvement of health and mental balance, particularly in children and youth.

There are more and more reports on positive effects of kinesitherapy on scoliosis, thereby many people take a position that children with scoliosis up to 30 degrees may participate in specific sports. As a matter of fact, some sports are even recommended. Karski, Kalakucki, and Karski (2007) report on desirable effects of particular sports on the development of children's skeleton. In children with scoliosis, recommended are the sports which engage musculature symmetrically, such as gymnastics, rhythmic gymnastics and swimming, because they are considered to have favourable effects both on prevention and on the state of deformity. Symmetrical performance of exercises at practice uses exercises of mobility, balance, coordination, positional correction, exercises for strengthening trunk flexors and extensors. It is stated that participation in sports may also affect reduction of the lateral spinal curve in children with scoliosis (Mroczkowski & Jaskólski, 2006).

ASSOCIATION BETWEEN SPORTS AND SCOLIOSIS

Young athletes may have spinal deformities which may be present per se and unrelated to any sports activity, or may be potentially associated with the sport they practise. (d'Hemecourt & Hresko, 2012). Due to enormous one-sided loading lasting several years, sport may also have negative implications on the movement system. Potential association between AIS and sports is quite vague (Kenanidis, Potoupnis, Papavasiliou, Sayegh, & Kapetanos, 2010). For all these reasons, there are opposing opinions on the issue of scoliosis and sport.

There are different reports in the literature on the implications of various sports on the prevalence of postural disorders in children. Researches have shown that the postural status is much better in high-class gymnasts and rhythmic gymnasts. The postural status of shooters is deteriorated, and in track and field athletes (high-class athletes competing in throwing disciplines) it is good. Several studies point out that certain sports show increased association with spinal deformities, particularly in adolescent girls (Green, Johnson, & Moreau, 2009; Kenanidis, Potoupnis, Papavasiliou, Sayegh, & Kapetanos, 2008). Nevertheless, patients with adolescent idiopathic scoliosis are still encouraged to engage in some sports activities (Wood, 2002). The highly repetitive nature of sport, amenorrhoea, excessive stress on the immature spine in professional athletes in adolescence and joint hypermobility may coexist during adolescence and be associated with increased incidence of AIS.

It is reported that it is necessary to avoid sports which engage musculature one-sidedly and asymmetrically, such as: rowing, fencing, tennis and track and field throwing disciplines (Pećina, 1982). Swärd (1992) reports that scoliosis is discovered in 80% of athletes with asymmetric loading of trunk and shoulders, such as javelin throwers and tennis players. On the basis of medicine founded on evidence, and in the scope of a systematic review of literature and other authoritative sources and reports, Green et al. (2009) suggested guidelines to health professionals and patients with scoliosis related to participation in physical and sports activities. They report on potential association between elite-level competition in specific sports at an early age and increased prevalence of scoliosis (grade C recommendation).

Rhythmic gymnastics as a sports discipline uses a series of specifically selected exercises which contribute to balanced and harmonic development of the organism as a whole. Symmetrical performance of exercises at practice, which is defined by strict requirements of equal use of both hands in the technique of manipulation of pieces of apparatus, creates a habit of proper body posture in all positions. On the other hand, Tanchev, Dzherov, Parushev, Dikov, and Todorov (2000) report that the incidence of scoliosis is ten times higher in persons who practise rhythmic gymnastics. In a research, Meyer et al. (2008) set the goal to determine the association between the IS type and the physical and sports activity in which they participate. The research included 169 adolescent girls with IS and 100 adolescent girls in the control group, comparable by years of age. They all completed an epidemiological questionnaire which contained infor-

mation on their school and out-of-school physical and sports activities. The adolescents with a double major curve had more physical and sports activity than those with a single major curve. The most frequent activities in both groups were gymnastic activities. Among those who practised gymnastics, there was the greatest number of those with a double major curve. This could be associated with the fact that adolescents with a double major curve are less exposed to biomechanical forces related to scoliosis, which is a condition for better balance control, and those are essential factors in these physical and sports activities.

Damsgaard, Bencke, Matthiesen, Petersen, and Müller (2001) researched primarily anthropometric variables, body composition and development of puberty in children of 9-13 years of age, who participate in competitive sports. They also researched the implications of age, sport, practice (hours spent at practice) and development of puberty (time of experience of menarche) on the body composition and development of puberty. The research included 183 children who practised swimming, tennis, handball and gymnastics. The researchers came to the conclusion that there are anthropometric differences in the body composition in athletes of both genders in different sports, but they are more evident in girls. Most importantly, the authors report that they did not find any implications of practice on the body composition or puberty development, confirming the conclusions of previous reports which say that children in competitive sports are selected on the basis of constitutional factors.

Taking into consideration that the implications of physical and sports activities on IS are still vague, Meyer et al. (2006) conducted a research on the implications of sports activities on scoliosis. The results of the research showed that the patients with IS, regardless of whether they practised gymnastics or not, had a higher degree of joint hypermobility than the persons from the control group. The group who practised gymnastics did not show a higher degree of joint hypermobility than the other groups of interviewees. Children with increased joint hypermobility may decide on gymnastics due to the ability to adapt to the requirements of this sport. Girls with increased joint hypermobility are susceptible to IS. The fact that most of the adolescents with IS engage in gymnastics may be associated with increased joint hypermobility.

A recent research showed that 10 times higher incidence of scoliosis was found in persons practising rhythmic gymnastics (12%) in comparison to the average population (1.1%). Delayed menarche and generalised joint hypermobility are common in rhythmic gymnasts. The authors find that significant physical loading with persistently repeated asymmetric stress on the spinal column which is in the period of growth, is associated with the nature of rhythmic gymnastics. This study identified a special entity of scoliosis associated with rhythmic gymnastics. The results of the study clearly refer to importance of aetiological role of the "dangerous triad": generalised joint hypermobility, delayed maturity and asymmetric spinal loading (Tanchev et al., 2000).

Swimming. Beneficial effects of water, the buoyant force that facilitates movement, symmetric engagement of musculature, overcoming resistance, horizontal position, respiration, those are all benefits provided by swimming as a sport. It is of utmost importance to perform "corrective swimming". Classic breaststroke swimming has the greatest importance in hydrotherapy, because there are a number of modifications useful for treatment of spinal curves arising from it. Propulsion is ensured by symmetric movement of arms and legs. Swimming activates muscles of arms and shoulder girdle, trunk and legs. A recently conducted research aimed at evaluation of implications that regular swimming in school classes has on anthropometric variables and presence of postural deficit in children of 13.4 years of age. One group had, apart from regular classes, additional swimming classes once a week in the course of two years. The difference in body height and BMI between the groups was not significant. In the group with swimming, correction of scoliosis was more evident than in the control group. The authors conclude that along with standard swimming in schools, there should also be a special programme of corrective exercises in water, within the programme of physical education classes (Bielec, Peczak-Graczyk, & Waade, 2013). Swimming is considered to be a complete sport and a treatment option for scoliosis, but recently published results of a research were contradictory to these opinions. The research conducted on a sample of 112 adolescents, who participated in competitive swimming and who were compared to 217 pupils of the same age (12.5 years), showed that swimming is associated with hyperkyphosis, with an increased risk of trunk asymmetry, as well as with increased prevalence of low back pain in females by 2.1 times (Zaina, Donzelli, Lusini, Minnella, & Negrini, 2015).

Martial art techniques. Recent researches show that deformities of skeletal system could be associated with "syndrome of seven contractures", described by Mau (1982) as "Siebener Kontrakturen Syndrom". This syndrome was also described by Green and

Griffin (1982). According to them, the asymmetry in hips and pelvis region is induced by abduction contracture of the left hip and/or the right hip (shortening of the muscles, tendons, fasciae). For children with the "syndrome of contractures" it is recommended to conduct early prophylaxis programme for scoliosis in accordance with the type of deformity. The abduction contracture of the right hip has significant implications on the spinal column in the period when a child starts standing and walking. It is stated that in sports activities the best exercises are stretching like "warm-up" in martial art techniques: kung fu, karate, taekwondo, tai chi, aikido, yoga, etc. in treatment of postural disorders and IS (Karski et al., 2007).

In our research conducted on a sample of 66 school-age children of the average age of 11.1 years, we assessed the presence of postural disorders and spinal deformities in a group of children composed of those who practise karate and those who do not. The results of our research showed that the children who practise karate have by 46.7% lower percentage of scoliotic posture and scoliosis, but they have a higher percentage of kyphotic posture and kyphosis (33.3%) and lordosis (10%) in comparison with the children who do not practise karate. This also indicates the importance of activation of particular muscle groups during practice (Jandrić, Janković, & Vranić, 2009).

Dance and ballet. There are few reports in the literature on the association between scoliosis and the process of growth, between scoliosis and intensive exercises, between scoliosis and morphological characteristics, as well as between scoliosis and injuries in young dancers. A recent study, conducted on a sample of 1.288 non-professional dancers in the 8-16 age range, researched the experience, body structure, anatomical anomalies and injuries which could be associated with scoliosis, and identified the variables that can be used to determine the difference between the dancers with scoliosis and without scoliosis at the time of the screening. Scoliosis was diagnosed in 23.8% of the dancers. The dancing experience and body structure were similar in the dancers with and without scoliosis. The dancers with scoliosis had significantly higher presence of genu varum and hallux valgus. Back pain caused by injuries was more common in the dancers with scoliosis in comparison with the dancers who did not have scoliosis (Steinberg et al., 2013).

In order to determine the difference in prevalence of AIS in 30 ballerinas in the 9-16 age range, the girls were compared to their peers who are not ballerinas. The research addressed the association between the presence of scoliosis and generalised joint hypermobility, menarche, BMI and the number of hours of practice per week. Scoliosis was diagnosed in 30% of the ballerinas in comparison with 3% of those in the control group. The results showed that ballerinas have 12.4 times higher probability of occurrence of scoliosis than girls of the same age who do not practice ballet. In the group of ballerinas, a higher degree of hypermobility was present (70%) in comparison with those who do not practice dancing (3%), but no statistically significant association was found between scoliosis and hypermobility, menarche, BMI or the number of hours of dancing per week. Considering a higher risk of occurrence of scoliosis, the authors emphasise the need for vigilant screening and improvement of education of dance teachers and parents, which may be of great benefit in early detection and reduction of risk of possible surgical intervention (Longworth, Fary, & Hopper, 2014).

Yoga and Pilates. Elements of these exercises may be incorporated in various therapy programmes for treatment of spinal deformities.

A radiological study of thoracolumbar spine was conducted on a sample of 143 athletes (wrestlers, gymnasts, footballers and tennis players) in the 14-25 age range and 30 males in the 19-25 age range who do not practice any sports. There are various types of radiological abnormalities both in the athletes and in those who do not practice any sports, but they were more common in the athletes, particularly in the male gymnasts and wrestlers. Abnormalities of vertebral ring apophysis occur exclusively in athletes. A combination of various types of abnormalities was most common in male gymnasts and wrestlers (Hellström, Jacobsson, Swärd, & Peterson, 1990).

Parsch, Gärtner, Brocai, Carstens, and Schmitt (2002) report that, in the long term, the patients with IS have functional impairments in comparison with their peers in the control group, and the main cause is functional deficit and frequency of low back pain syndrome.

Fusco et al. (2011) do not advise participation in competitive sports which require increased spinal range of motion, particularly in maximum thoracic spine extension and/or lumbar spine flexion, but they recommend to patients with scoliosis every type of sports activity at the recreational level. Such activities of limited intensity and duration cannot cause structural changes, but they provide significant benefit in the physical and psychological aspect.

In order to identify recommendations related to return to sports and athletic activities after surgical

treatment of AIS, a research was conducted at the level of the Spinal Deformity Study Group members. The research was completed by twenty-three surgeons. It was concluded that modern posterior instrumentation allows surgeons to recommend early return to sports activities after fusion for AIS. Most of them allow running 3 months after, non-contact sports and contact sports 6 months after, and collision sports 12 months after surgical treatment of scoliosis (Lehman, Kang, Lenke, Sucato, & Bevevino, 2013).

The International Scientific Society on Scoliosis Orthopaedic and Rehabilitation Treatment [SOSORT] guidelines for sports activities of children with scoliosis. This association does not recommend sport for treatment of idiopathic scoliosis. Within the guidelines, sports activities are recommended due to their specific useful effects in the psychological, neuromuscular and general aspect of health in patients with scoliosis, even in patients during the treatment with spinal orthoses, with the aim of increasing aerobic capacity and producing psychological effects. They are recommended in the course of all phases of treatment, within the classes of physical education. Limits for specific types of sports activities are determined by a medical specialist, taking into consideration the degree of deformity and other circumstances. During the treatment with spinal orthoses, SOSORT recommends caution in contact and highly dynamic sports activities. It also recommends for patients with a high risk of scoliosis progression to avoid competitive activities with a higher degree of mobility of the spinal column (Negrini, Aulisa, & Zaina, 2012; Jandric, 2012b).

CONCLUSION

In young people, exercises and athletic competitions are socially important. Sport is not recommended for treatment of idiopathic scoliosis, but sports activities are recommended for their specific useful effects in the psychological, neuromuscular and general aspect of health. Young athletes may have scoliosis which can be present per se and unrelated to any sports activity, or it may be potentially associated with the sport they practise. Due to enormous one-sided loading lasting several years, sport may also have negative implications on the movement system, but potential association between AIS and sports is still insufficiently researched, and requires further studies. Athletic activities and participation in sports are usually allowed to patients with scoliosis who use conservative methods of treatment, but caution is recommended in contact and highly dynamic sports activities. Return to sport after surgical treatment is variable, and it is based on a decision of the operating surgeon on the basis of the degree of fusion and the sports activity.

REFERENCES

Bielec, G., Peczak-Graczyk, A., & Waade, B. (2013). Do swimming exercises induce anthropometric changes in adolescents? *Issues Compr Pediatr Nurs*, *36*(1-2), 37–47. doi: 10.3109/01460862.2013.777818; PMid: 23597276

Burton, M. S. (2013). Diagnosis and treatment of adolescent idiopathic scoliosis. *Pediatr Ann*, *42*(11), 224–228. doi: 10.3928/00904481-20131022-09; PMid: 24168116

Damsgaard, R., Bencke, J., Matthiesen, G., Petersen, J. H., & Müller, J. (2001). Body proportions, body composition and pubertal development of children in competitive sports. *Scand J Med Sci Sports*, *11*(1), 54–60. doi: 10.1034/j.1600-0838.2001.011001054.x; PMid: 11169236

d'Hemecourt, P. A., & Hresko, M. T. (2012). Spinal deformity in young athletes. *Clin Sports Med*, *31*(3), 441–451. doi: 10.1016/j.csm.2012.03.013; PMid: 22657994

Fusco, C., Zaina, F., Atanasio, S., Romano, M., Negrini, A., & Negrini, S. (2011). Physical exercises in the treatment of adolescent idiopathic scoliosis: An updated systematic review. *Physiotherapy Theory and Practice*, *27*(1), 80–114. doi: 10.3109/09593985.2010.533342; PMid: 21198407

Górecki, A., Kiwerski, J., Kowalski, I. M., Marczyński, W., Nowotny, J., Rybicka, M. ... Szlachowska-Kluza, W. (2009). Bad posture prevention in children and youth in education and upbringing– experts recommendations. *Pol Ann Med*, *16*(1), 168–177.

Green, N. E., & Griffin, P. P. (1982). Hip dysplasia associated with abduction contracture of the contralateral hip. *JBJS*, 63-A, 1273–1281.

Green, B. N., Johnson, C., & Moreau, W. (2009). Is physical activity contraindicated for individuals with scoliosis? A systematic literature review. *J Chiropr Med*, *8*(1), 25–37. doi: 10.1016/j.jcm.2008.11.001, PMid: 19646383; PMCid:PMC2697577

Hellström, M., Jacobsson, B., Swärd, L., & Peterson, L. (1990). Radiologic abnormalities of the thoraco-lumbar spine in athletes. *Acta Radiol*, *1*(2), 127–132. doi: 10.1177/028418519003100202; doi: 10.3109/02841859009177473

Jandrić, S. (2010). Differences between boys and girls in terms of physical activity. *Facta Universitatis*, *8*(1), 1–7.

Jandric, S. (2012a). Idiopatske skolioze [Idiopathic scoliosis]. *Med Pregl*, *65*(1-2), 35–40. doi: 10.2298/MPNS1202035J; PMid: 22452237

Jandric, S. (2012b). *Skolioze, kifoze i lordoze* [Scoliosis, kyphosis and lordosis]. Laktaši, Bosnia and Herzegovina: Grafomark.

Jandrić, S, & Antić, B. (2006). Low back pain and degenerative disc disease. *Med Pregl.*, *59*(9-10), 456–461. doi: 10.2298/MPNS0610456J

Jandrić, S., Janković, Z., & Vranić, J. (2009). Efekat karate treninga na pojavu posturalnih poremećaja i deformiteta kod djece školskog uzrasta [The effect of karate training on the incidence of postural disorders and deformities in children of school age]. In G. Bošnjak (Ed.), *Prvi međunarodni naučni kongres „Antropološki aspekti sporta, fizičkog vaspitanja i rekreacije"* (pp. 275–279). Banjaluka, Bosna and Herzegovina: Fakultet fizičkog vaspitanja i sporta Univerziteta Banja Luka.

Jovović, V. (2008). *Korektivna gimnastika sa kineziterapijom* [Corrective gymnastics with kinesitherapy]. 2nd ed. Nikšić, Montenegro: Filozofski fakultet, Nikšić.

Karski, T., Kalakucki, J., & Karski, J. (2007). Relationship of "syndrome of contractures" in newborns with the development of the so-called idiopathic scoliosis. *World J Pediatr*, *3*(4), 254–259.

Kenanidis, E. I., Potoupnis, M. E., Papavasiliou, K. A., Sayegh, F. E., & Kapetanos, G. A. (2008). AIS and exercising: is there truly a liaison? *Spine*, *33*(20), 2160–2165. doi: 10.1097/BRS.0b013e31817d6db3; PMid: 18794756

Kenanidis, E. I., Potoupnis, M. E., Papavasiliou, K. A., Sayegh, F. E., & Kapetanos, G. A. (2010). Adolescent idiopathic scoliosis in athletes: is there a connection? *Phys Sportsmed*, *38*(2), 165–170. doi: 10.3810/psm.2010.06.1795; PMid: 20631476

Kratenová, J., Zejglicová, K., Malý, M., & Filipová V. (2007). Prevalence and risk factors of poor posture in school children in the Czech Republic. *J Sch Health*, *77*(3), 131–137. doi: 10.1111/j.1746-1561.2007.00182.x; PMid: 17302855

Łabaziewicz, L. (2008). Faulty postures. In W. Marciniak and A. Szulc (Eds.), *Orthopaedics and Rehabilitation of Wiktor Dega* (Vol. 2; pp. 63–77). Warsaw, Poland: PZWL.

Lehman, R. A. Jr., Kang, D. G., Lenke, L. G., Sucato, D. J., & Bevevino, A. J. (2015). Spinal Deformity Study Group. Return to sports after surgery to correct adolescent idiopathic scoliosis:a survey of the Spinal Deformity Study Group. *Spine J*, *15*(5), 951–958. doi: 10.1016/j.spinee.2013.06.035; PMid: 24099682

Longworth, B., Fary, R., & Hopper, D. (2014). Prevalence and predictors of adolescent idiopathic scoliosis in adolescent ballet dancers. *Arch Phys Med Rehabil*, *95*(9), 1725–1730. doi: 10.1016/j.apmr.2014.02.027; PMid: 24662812

Mau, H. (1982). Atiopatogenese der Skoliose [Etiopathogenesis of scoliosis]. In *Bücherei des Orthopäden* (pp. 1–110). Stuttgart, Germany: Enke Verlag.

Meyer, C., Cammarata, E., Haumont, T., Deviterne, D., Gauchard, G. C., & Leheup, B. (2006). Why do idiopathic scoliosis patients participate more in gymnastics? *Scand J Med Sci Sports*, *16*(4), 231–236. doi: 10.1111/j.1600-0838.2005.00482.x; PMid: 16895527

Meyer, C., Haumont, T., Gauchard, G. C., Leheup, B., Lascombes, P., & Perrin, P. (2008).The practice of physical and sporting activity in teenagers with idiopathic scoliosis is related to the curve type. *Scand J Med Sci Sports*, *18*(6), 751–755. 10.1111/j.1600-0838.2007.00750.x; PMid: 18248544

Mroczkowski, A., & Jaskólski, E. (2006). Effects of aikido exercises on lateral spine curvatures in children. *Archives of Budo*, *2*(4), 31–34

Negrini, S., Aulisa, A. G., & Zaina, F. (2012). 2011 SOSORT guidelines: Orthopaedic and Rehabilitation treatment of idiopathic scoliosis during growth. *Scoliosis*, *7*(1), 3. doi: 10.1186/1748-7161-7-3; PMid: 22264320; PMCid: PMC3292965

Parsch, D., Gärtner, V., Brocai, D. R., Carstens, C., & Schmitt, H. (2002). Sports activity of patients with idiopathic scoliosis at long-term follow-up. *Clin J Sport Med*, *12*(2), 95–98. doi: 10.1097/00042752-200203000-00005; PMid: 11953555

Pećina, M. (1982). Nauka o mišićima [Science of muscle]. In N. J.. Krmpotić (Ed.), *Anatomija čovjeka* (pp. 235–252). Zagreb, Croatia: Jumena.

Radisavljević, M. (2001). *Korektivna gimnastika sa osnovama kineziterapije* [Corrective gymnastics with the basics of kinesitherapy]. Belgrade, Serbia: Viša škola za sportske trenere, Beograd.

Rogala, E. J., Drummond, D. S., & Gurr, J. (1978). Scoliosis: incidence and natural history. A

prospective epidemiological study. *J Bone Joint Surg Am*, *60*(2), 173–176.

Sedrez, J. A., Da Rosa, M. I., Noll, M., Medeiros, F. D., & Candotti, C. T. (2015). Risk factors associated with structural postural alterations on the spine of children and adolescents. *Revista Paulista de Pediatria*, *33*(1), 72–81. doi: 10.1016/j.rpped.2014.11.012; PMid: 25623725; PMCid: PMC4436959

Steinberg, N., Hershkovitz, I., Peleg, S., Dar, G., Masharawi, Y., Zeev, A., & Siev-Ner, I. (2013). Morphological characteristics of the young scoliotic dancer. *Phys Ther Sport*, *14*(4), 213–220. doi: 10.1016/j.ptsp.2012.07.003; PMid: 23146194

Stirling, A. J, Howel, D., Millner, P. A., Sadiq, S., Sharples, D., & Dickson, R. A. (1996). Late-onset idiopathic scoliosis in children six to fourteen years old: A cross-sectional prevalence study. *J Bone Joint Surg Am*, *78*(9), 1330–1336.

Swärd, L. (1992). The thoracolumbar spine in young elite athletes. Current concepts on the effects of physical training. *Sports Med*, *13*(5), 357–364. doi: 10.2165/00007256-199213050-00005

Taft, E., & Francis, R. (2003). Evaluation and Management of Scoliosis. *J Pediatr Health Care*, *17*(1), 42–44. doi: 10.1016/S0891-5245(02)88307-9; doi: 10.1067/mph.2003.7; PMid: 12533733

Tanchev, P. I., Dzherov, A. D., Parushev, A. D., Dikov, D. M., & Todorov, M. B. (2000). Scoliosis in rhythmic gymnasts. *Spine*, *25*(11), 1367–1372. doi: 10.1097/00007632-200006010-00008; PMid: 10828918

Wood, K. B. (2002). Spinal deformity in the adolescent athlete. *Clin Sports Med*, *21*(1), 77–92. doi: 10.1016/S0278-5919(03)00058-9

Zaina, F., Donzelli, S., Lusini, M., Minnella, S., & Negrini, S. (2015). Swimming and spinal deformities: a cross-sectional study. *J Pediatr*, *166*(1), 163–167. doi: 10.1016/j.jpeds.2014.09.024; PMid: 25444007

Received: Febreuary 5, 2015
Revision received: May 15, 2015
Accepted: May 15, 2015

Correspondence to:
Slavica Jandrić, PhD
School of Medicine
Save Mrkalja 14
78000 Banja Luka
Bosnia and Herzegovina
Phone: 00387 65 61 80 92
Fax: 00387 51 23 41 01
E-mail: slavajandric@yahoo.com

SportLogia
2015, 11(1), 11–17
e-ISSN 1986-6119

www.SportLogia.com

DIFFERENCES IN QUALITY OF LIFE ACCORDING TO THE LEVEL OF OHYSICAL ACTIVITY BETWEEN TWO GROUPS OF BASKETBALL PLAYERS IN THE WHEELCHAIRS

Evangelos Chatzilelecas[1], Branimir Filipović[2], and Lidija Petrinović[3]

[1]Elpida, Rodos, Greece
[2]Croatian waters, Zagreb, Croatia
[3]Faculty of Kineziology, Univerzity of Zagreb, Croatia

ORIGINAL SCIENTIFIC ARTICLE
doi: 10.5550/sgia.151101.en.008C
UDC: 796.323.2.034-056.24

SUMMARY

The aim of the study was evaluation of quality of life according to the level of physical activity between two groups of wheelchair basketball players. We included 34 individuals divided into the two groups according to the level of physical activity during the week. Individuals in the first group had trainings two times per week (16 individuals) and in the second group had trainings three to six times per week (18 individuals). Differences between these two groups were measured in quality of life and level of physical activity. Results of discriminative analysis have shown that there is statistically significant difference in quality of life, and results of Student t-test have shown that there is also statistically significant difference in level of physical activity as well as total quality of life. Individuals, who were active three to six times per week according to the schedule, had better results in all variables of the quality of life.

Key Words: individuals with disability, motoric skills, regular training, sport activities.

INTRODUCTION

For long periods of time, disabled persons were marginalized and they were recognized only due to their disability. Other characteristics such as emotional, social or spiritual life as well as any kind of creativity were under recognized. They were considered physically and socially non functional. In last decades, there were a lot of studies evaluating different kind of disability and different kind of exercises.

Hensle (1982) has shown that disabled persons after proper medical treatment and rehabilitation should be considered as healthy persons with different kind of physical disability which is treated as condition, not as disease.

Group of authors (Brasile, Kleiber, & Harmisch, 1991; Cox & Davis, 1992; Martin, Eklund, & Mushett, 1997; Martin & Mushett, 1996) were in their studies evaluating not only sport results, but also social and physical aspects of life of disabled persons. They were evaluating functioning in private life, society, stress control, mood, general physical and psychical functioning as well as cognitive functioning.

Kinesiological activities can help to disabled persons to change their attitude and to improve their way of seeing themselves from "I am disabled person" to "I have some level of disability" (Poretta, 2004).

Regular sport activities in disabled persons, improve their quality of life as well as social status, independence, better organization of free time activities, improves self respect, enables faster and easier achieving of personal goals and high level of reintegration into the society (Campbell & Jones, 2002; Petrinović-Zekan, 2009; Williams & Kolkka, 1998). These results in better organization of free time, as well as establishing new contacts and friendships resulting in higher levels of self-respect, self-confidence, stress control, anxiety and depression as well as improvement in cognitive functioning (Campbell & Jones, 1994; Sherrill, Hinson, Gench, Kennedy, & Low, 1990).

Schonherr, Groothoff, Mulder, and Eisma (2005) Tasiemski, Kennedy, Gardner, and Taylor (2005), and

Wu and Wiliams (2001) have shown similar results when evaluating impact of different levels of sport activities on everyday functioning in persons with spine injuries.

There is no uniform definition for quality of life. Most of the authors are of the attitude that the quality of life is multidimensional and very complex term, it is s emotionally colored and therefore has strong subjective component (Manns, 1999).

Post and Noreau (2005) was using very often in his works term Quality of life - QOL, but still without unique definition. Stevens, Caputo, Fuller, and Morgan (2008) were evaluating impact of different levels of physical activity on quality of life in persons with spine injury (SCI). Quality of life was measured as well with the QWB questionnaire (Quality of Well-Being Scale), while the level of physical activity in persons with spine injury was measured with PASIPD scale (Physical Activity Scale for Individuals with Physical Disabilities). Results of these studies have shown high correlation between levels of physical activity and quality of life.

Ravenek, Ravenek, Hitzig, and Wolfe (2012) were evaluating estimated quality of life (QQL) in persons with spine injury according to the level of physical activity (PA) and showed strong correlation.

World Health Organization [WHO] (1993) defines Quality of Life as individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment.

Some authors concern happiness and satisfaction as main parameters for quality of life, therefore they have special place in evaluation of individuals. Other authors think that quality of life is more complex including beside these two elements also general physical and psychical health, cognitive functions private and social life functioning.

Wheelchair basketball is for a long time one of the most attractive sport games for disabled persons no matter the cause of disability is. These days there is a variety of competition in wheelchair basketball all around the world. Rules are the same as in standard basketball with modification for wheelchair usage. One of the limiting factors in this sport is level of the spinal injury because it affects the level of motoric skills as well as affection of lower extremities, trunk, upper extremities and respiratory functions. Also, cognitive abilities and motivation are very important for achieving good results (Bohm, 1982).

Main goal of this study is to evaluate differences in quality of life in wheelchair basketball players according to the level of physical activity.

METHODS

We were evaluating quality of life according to different levels of physical activity in disabled persons playing wheelchair basketball.

Disability is the consequence of an impairment that may be physical, cognitive, mental, sensory, emotional, developmental, or some combination of these. A disability may be present from birth, or occur during a person's lifetime. Disability can also varies- progressive or regressive dynamics as well as reversible or irreversible despite treatment and rehabilitation. Disability is an umbrella term, covering impairments, activity limitations, and participation restrictions. Impairment is a problem in body function or structure; inactivity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in involvement in life situations. Thus, disability is a complex phenomenon, reflecting an interaction between features of a person's body and features of the society in which he or she lives.

We included in our study disabled persons from Greece using wheelchairs in their everyday's life. There were 34 males ages 18 to 47 years ($M = 28.3$), playing wheelchair basketball at least for a 6 months. These individuals are active players from wheelchair basketball clubs also playing for national cup. In the first group were 16 included persons who train 2 times per week and in the second group were included 18 persons training 3-6 times per week.

Causes of the disability were classified as follows:

- Injury 75 %, ($n = 24$) in 65% ($n = 21$) the cause was traffic accident, in 10% ($n = 3$) consequence of fall down.
- Present from birth, 10%, ($n = 3$)
- Residual disability after malignant or infective central nervous system diseases - 15%, ($n = 4$).

Study was performed for 5 months - started at the beginning of October 2012, and ended in February 2013.

We collected data in interview with wheelchair basketball players by means of standardized questionnaires. Questionnaire had 3 main parts. In first part we evaluated demographic data, personal data, disability data, professional data, education data and habits. According to Washburn, Zhu, McAuley,

Frogley, and Figoni (2002) we included in second part of the questionnaire data about the type and level of physical activity for each individual. According to Cummins (2005) we included into the third part of the questionnaire data about the quality of life.

All persons were informed about the study before entering and volunteered.

We evaluated two main values as a result of summing different parameters. First value was total physical activity [TPA]. This value was subdivided into: stationary activity, activity in movement, light physical activity, moderate physical activity and vigorous physical activity. All individuals were assessing their physical activity daily and weekly according to the method of Washburn et al. (2002). as well as by Van der Ploeg, Streppel, van der Beek, van der Woude, Vollenbroek-Hutten, and van Mechelen (2007). Second value was total quality of life [TQL]; evaluation was performed according to Cummins (2005). Values were standardized for general population (McCabe & Cummins, 1998), and for disabled persons (Cummins, 2001; Verri et al., 1999).

Statistical evaluation was performed by means of STATISTICA 7.0 package. Data were analyzed by means of descriptive statistics including main quantitative parameters. Normal distribution was tested by means of Kolmogorov-Smirnov test. Student's *t*-test was used for evaluation of differences in quality of life. For evaluation of differences between the groups for each variable, we used canonic discriminante analysis. Difference was presented as coefficient of canonic discrimination; statistical significance was tested by means of Bartllet's chi-square test. Impact of individual variables between the groups was calculated by correlation of individual variables with discriminate factor.

RESULTS

Analyses of the descriptive parameters coefficients for TPA as well as the TQL have shown high variety between minimal and maximal values (wide range) for both variables (Table 1).

TABLE 1

Analysis of the descripitve parameters - TPA and TQL.

n	*M*	*SD*	*Mdn*	*Mo*	*Min*	*Max*	*Ra*	*v*	Skew.	Kurt.
34	19.17	11.02	16.57	8.00	6.33	54.50	48.17	121.40	1.46	2.32
34	50.91	9.63	52.50	59.00	30.00	67.00	37.00	92.81	-.41	-.47

Legend: **n** - number of inhabitants; **M** - mean; **SD** - standard deviaton; **Mdn** - Medina; **Mo** - Mode; **Min** - mnimum; **Max** - maxmum; **Ra** - Range; **v** - varianca; **Skew.** - Skewness; **Kurt.** - Kurtosis.

Results of Kolmogorov-Smirnov test have shown asymmetry in distribution for the total physical activity variable (*K-S* = .18) which depends on subvariable "sport activities" as the main characteristic of the two different evaluated groups. One reason for the asymmetry can also be wide range of results comparing to relatively small number of individuals (Figure 1).

Results of Kolmogorov-Smirnov test for total quality of life have shown also asymmetry, negative trend and platykurtic curve, but without statistically

FIGURE 1

Kolmogorov-Smirnov distibution for TPA.

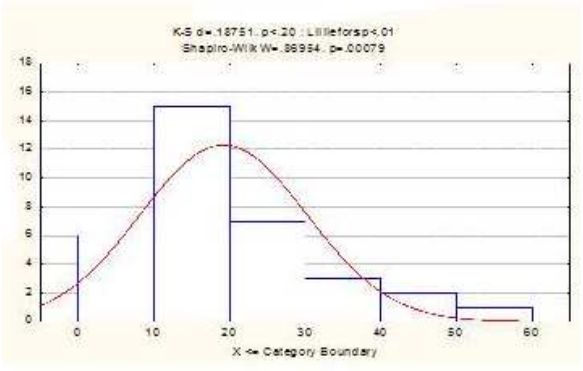
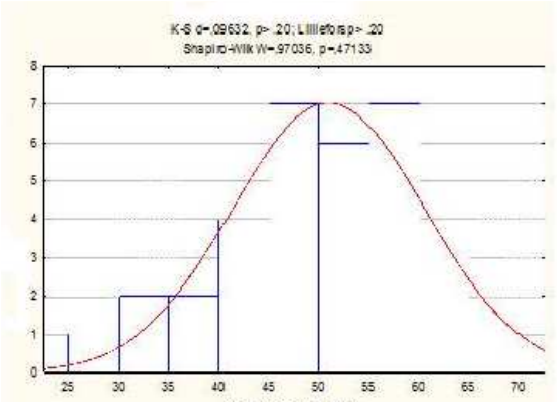


FIGURE 2

Kolmogorov-Smirnov test TQL.



significant differences from normal distribution (*K-S* = .096), standard error 20% ($p > .20$) (Figure 2).

Results of the Student-*t* test have shown statistically significant difference between 2 groups ($p < .01$). Group 2 has statistically significant higher total physical activity level (3-6 times per week) than group 1 (< 2). Group 2 has better results; wheelchair basketball players who have higher level of physical activity (3-6 times per week) have better quality of life (Table 2).

TABLE 2

Student's t-test was used for evaluation of differences in quality of life - TPA and TQL.

	n_1	M_1	SD_1	n_2	M_2	SD_2	t	df	p	F	p
TPA	16	13.00	6.51	18	24.65	11.44	-3.59	32	**.00**	3.09	**.03**
TQL	16	45.81	10.50	18	55.44	6.06	-3.32	32	**.00**	3.00	**.03**

Legend: **n** - number of inhabitants; **M** - mean; **SD** - standard deviaton; **t** - Student-*t* test; **df** - Degrees of freedom; **F** - Fisher′s *F* ratio; **p** - probability.

Canonic discriminant function analysis was used for evaluation of different subdomeins of the quality of life. Canonic correlation coefficient ($R = .63$) reflects differences between the groups. Chi-Square coefficient ($\chi^2 = 14.23$) was tested by means of Bartllet test and has shown statistically significant difference between the groups with p value < .05 ($p = .04$). Wilk's lambda ($\Lambda = .61$) together with Eigen-value (.65) is showing a relationship between the dependent groups and the independent variables (Table 3).

Relationship of the arithmetic means of each group in correlation to discriminative functions is shown in Table 4. Group 1 is on negative pole of the function (-0,83), while the group 2 is on positive pole .of the function (.74). These results are showing that group 2 with higher level of TPA has higher TQL, while group 1 with lower levels of TPA has lower levels of total quality of life.

In Table 5, we presented different subdomains of the total quality of life domain: TQL -self confidence (.71), TQL - family and interpersonal relations (.55), TQL - emotional well being (.49), TQL - physical health (.48) and TQL -social inclusion (.47), TQL - achievements (.31), while others are not statistically significant. All of the previously mentioned variables are on the positive pole of the distribution.

TABLE 3

Eigen-value, canonic correaltion, coeffitient Wilks Lambda, values of the chi-square test, degrees of freedom and level of statistical significance.

Eigenvalue	R	Λ	χ^2	df	p
.65	.63	.61	14.23	7	**.04**

Legend: **R** - canonic correaltion; **Λ** - Wilks Lambda; **χ²** - Chi-square test; **df** - Degrees of freedom; **p** - probability.

TABLE 4

Arithmetic means for the groups with discriminant factor.

G_1:1	-.83
G_2:2	.74

All these results are showing that higher levels of physical activity have positive impact on total quality of life in all subdomains, with higher values for self confidence and family and interpersonal relationships, but also for the other variables.

DISCUSSION

In our study we have shown that the level of total physical activity has high impact on total quality of life in wheelchair basketball players. These results are in the correlation with the results of the previous studies showing positive impact of regular physical activity in general population, as well as in persons with different level of physical disability (Fiorilli et al., 2013 Hensle 1982; Lastuka & Cottingham, 2015).

Evaluating different subdomains of total quality of life, we have shown that quality of life is multifac-

TABLE 5

Correlation of individual variables with discrirminant factor - TQL.

TQL - standards	.30
TQL - physical health	.48
TQL - achievements	.31
TQL - family and interpersonal relations	.55
TQL - self confidence	.71
TQL - social inclusion	.47
TQL - emotional well being	.49

torial and very complex individual perception. It is a broad ranging concept, depending on person's physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment. These results are in positive correlation with previous studies (Brasile, Kleiber, & Harmisch, 1991; Cox & Davis, 1992; Martin, Eklund, & Mushett, 1997; Martin & Mushett, 1996; Wood 2013).

Level of Physical activity was shown in this study as the most important factor affecting total quality of life. Regular physical activity (wheelchair basketball with high intensity trainings) more than 3 times per week with moderate everyday physical activities is in direct positive correlation with quality of life. On the other hand, low levels of physical activity have negative impact on quality of life. These results are in correlation with previous works (Fiorilli et al., 2015; Ranevek et al., 2012; Stevens et al., 2008). There is of great importance that beside regular sport trainings more than 3 times per week, individual has moderate level of everyday physical activities (Granados et al., 2015; Lastuka & Cottingham, 2015; de Witte, Hoozemans, Berger, van der Woude, and Veeger, 2015).

Previously mentioned physical activity in our study had strong impact on variables of the total quality of life subdomains: total quality of life-self confidence and total quality of life-family and interpersonal relations, with very close positive values, showing their importance and interactions. we found same positive trend for the other total quality of life subdomains-total quality of life-emotional well being, total quality of life-physical health, total quality of life-social inclusion and total quality of life-achievements. In general population regular physical activity is very useful in prevention of chronic diseases (mostly cardiovascular and cerebrovascular), in population with different level of physical disability improves quality of life. One of the proposed underlying mechanism for these findings is secretion of endorphins during physical activity, regulating different neurotransmitter pathways of the emotional control in the central nervous system, as well as stimulating body metabolism resulting in physical well being and emotional well being, better stress control and development of healthy style of life. All these results have shown that regular physical activity results in better self confidence, as well as better functioning in family/personal life and reintegration in the society (Fiorilli et al., 2015; Ranevek et al., 2012; Stevens et al., 2008).

CONCLUSON

This study has shown that level of regular physical activity is very important for improvement of the quality of life in disabled persons. Wheelchair basketball was evaluated as regular sport activity of high intensity. In this special subpopulation of the persons with disability, we have shown that such king of activity 3 or more times per week can improve total quality of life, as well as different, very complex personal, physical, emotional, psychological, social subdomains, these results are in correlation with previous studies (Granados et al., 2015; de Witte et al., 2015).

REFERENCES

Böhm, W. (1982). *Wörterbuch der Pädagogik* [Dictionary of Pedagogy]. Stuttgart, Germany, Kröner.

Brasile, F. M., Kleiber, D. A., & Harmisch, D. (1991). Analysis of participation incentives among athletes with and without disabilities. *Therapeutic Recreation Journal*, *25*(1), 18–33.

Campbell, E., & Jones, G. (1994). Psychological well-being in wheelchair sport participants and non-participants. *Adapted Physical Activity Quarterly*, 11, 404–415.

Campbell, E., & Jones, G. (2002). Cognitive appraisal of sources of stress experienced by elite male wheelchair basketball players. *Adapted Physical Activity Quarterly*, 19, 100–108.

Cox, R. H., & Davis, R. (1992). Psychological skills of elite wheelchair athletes. *Palaestra*, 8, 16–21.

Cummins, R. A. (2001). The subjective well-being of people caring for a family member with a severe disability at home. *Journal of Intellectual & Developmental Disability*, *26*(1), 83–100. doi: 10.1080/13668250020032787

Cummins, R. A. (2005). Moving from the quality of life concept to a theory. *J. Intellect Disabil Res*, *49*(10), 699–706. doi: 10.1111/j.1365-2788.2005.00738.x; PMid:16162114

de Witte, A. M., Hoozemans, M. J., Berger, M. A., van der Woude, L. H., & Veeger, D. H. (2015). Do field position and playing standard influence athlete performance in wheelchair basketball? *J Sports Sci*, 29, 1–10.

Fiorilli, G., Iuliano E, Aquino, G., Battaglia, C., Giombini, A., Calcagno, G., & di Cagno, A. (2013). Mental health and social participation skills of wheelchair basketball players: a controlled study. *Res Dev Disabil*, *34*(11), 3679–3685. doi: 10.1016/j.ridd.2013.08.023; PMid: 24012595

Granados, C., Yanci, J., Badiola, A., Iturricastillo, A., Otero, M., Olasagasti, J., ... Gil, S. M. (2015). Anthropometry and Performance in Wheelchair Basketball. *J Strength Cond Res*, *29*(7), 1812–1820. doi: 10.1519/JSC.0000000000000817; PMid: 25536537

Hensle, U. (1982). Zur Auswirkung institutioneller und ausserinstitutioneller Bedinungen aur die Rehabilitaion [Effect of institutional and non-institutional conditions in the rehabilitation]. In W. R. Minsel (Ed.), *Brennpunkt der klinischen Phychologie* (pp. 54–74). Munchen, Germany: Kosel.

Lastuka, A., & Cottingham, M. (2015). Effect of adaptive sports on employment among people with disabilities. *Disabil Rehabil*, 26, 1–7. doi: 10.3109/09638288.2015.1059497; PMid: 26114627

Manns, P. J., & Chad, K. E. (1999). Determining the relation between quality of life, handicap, fitness and physical activity for persons with spinal cord injury. *Arch Phys Med Rehabill*, *80*(12), 1566–1571.

Martin, J. J., Eklund, R. C., & Mushett, C. A. (1997). Factor structure of the Athletic Identity Measurement Scale with athletes with disabilities. *Adapted Physical Activity Quarterly*, 14, 74–82.

Martin, J. J., & Mushett, C. A. (1996). Social support mechanisms of athletes with disabilities. *Adapted Physical Activity Quarterly*, 13, 74–83.

McCabe, M. P., & Cummins, R. A. (1998). Sexuality and quality of life among young people. *Adolescence*, *33*(132), 761–773.

Petrinović-Zekan, L. (2009). *Povezanost tjelesne aktivnosti s kvalitetom života osoba s invaliditetom* [Connection of physical activity with the quality of life of people with disabilities]. Unpublished doctoral dissertation, University of Zagreb, Faculty of Kinesiology.

Porretta, D. (2004). Beginning a third decade. *Adapted Physical Activity Quarterly*, 21, 1–3.

Post, M., & Noreau, L. (2005). Quality of life after spinal cord injury. *J. Neurol Phys Ther*, *29*(3), 139–146.

Ravenek, K. E., Ravenek, M. J., Hitzig, S. L., & Wolfe, D. L. (2012). Assessing quality of life in relation to physical activity participation in persons with spinal cord injury: a systematic review. *Disabil Health J.*, *5*(4), 213–223. doi: 10.1016/j.dhjo.2012.05.005; PMid: 23021731

Schonherr, M. C., Groothoff, J. W., Mulder, G. A., & Eisma, W. H. (2005). Participation and satisfaction after spinal cord injury: results of a vocational and leisure outcome study. *Spinal Cord*, *43*(4), 241–248. doi: 10.1038/sj.sc.3101683; PMid: 15534622

Sherrill, C., Hinson, M., Gench, B., Kennedy, S. O., & Low, L. (1990). Self-concepts of disabled youth athletes. *Perceptual and Motor Skills*, 70, 1093–1098. doi: 10.2466/PMS.70.3.1093-1098; doi: 10.2466/pms.1990.70.3c.1093; PMid: 2144624

Stevens, S. L., Caputo J. L., Fuller, D. K., & Morgan, D. W. (2008). Physical Activity and Quality of Life in Adults With Spinal Cord Injury. *J Spinal Cord Med.*, *31*(4), 373–378.

Tasiemski, T., Kennedy, P., Gardner, B. P., & Taylor, N. (2005). The association of sports and physical recreation with life satisfaction in a community sample of people with spinal cord injuries. *NeuroRehabilitation*, *20*(4), 253–265.

Van der Ploeg, H. P., Streppel, K. R., van der Beek, A. J., van der Woude, L. H., Vollenbroek-Hutten, M., & van Mechelen, W. (2007). The Physical Activity Scale for Individuals with Physical Disabilities: test-retes reliability and comporasion with an accelerometer. *J. Phys Act Health*, *4*(1), 96–100.

Verri, A., Cummins, R. A., Petito, F., Vallero, E., Montheath, S., Gerosa, E., & Nappi, G. (1999). An Italiain-Australian comparasion of quality of life among people with intellectual disability living in the community. *J Intellect Disabil Res*,

43(6), 513–522. doi: 10.1046/j.1365-2788.1999.00241.x; PMid: 10622368

Washburn, R. A., Zhu, W., McAuley, E., Frogley, M., & Figoni, S. F. (2002). The physical activity scale for individuals with physical disabilities: development and evaluation. *Arch Phys Med Rehabil*, *83*(2), 193–200. doi: 10.1053/apmr.2002.27467; PMid: 11833022

Williams, T. ,& Kolkka, T. (1998). Socialisation into wheelchair basketball in the United Kingdom: a structural functionalist perspective. *Adapted Physical Activity Quarterly*, 15, 357–369.

Wood, A. (2013) Drawing disability in Japanese manga: visual politics, embodied masculinity, and wheelchair basketball in Inoue Takehiko's REAL. *Cult Med Psychiatry*, *37*(4), 638–655. doi: 10.1007/s11013-013-9342-y; PMid: 24213739

World Health Organization. (1993). *Rehabilitation after cardiovascular disease, with special emphasis on developing countries: Report of a WHO expert committee*. WHO Technical Report Series 831. Geneva, Switzerland.

Wu, S. K., & Williams, T. (2001). Factors influencing sport participation among athletes with spinal cord injury. *Medicine&Science in Sport&Exercise*, 33(2), 177–182.

Received: April 13, 2015
Revision received: Jun 11, 2015
Accepted: Jun 25, 2015

Correspondence to:
. Lidija Petrinović, Ph.D.
Kineziološki fakultet Sveučilišta u Zagrebu
Horvaćanski zavoj 15
10000 Zagreb
Croatia
Phone: 00385 98 31 71 70
E-mail: lidija.petrinovic@kif.hr

SportLogia
2015, 11(1), 18–33
e-ISSN 1986-6119

www.SportLogia.com

IMPACT OF VITAMIN D DEFICIENCY ON FLUCTUATION OF CALCIUM AND PARATHYROID HORMONE LEVELS IN POSTMENOPAUSAL OSTEOPOROSIS

Tatjana Milivojac[1], Nela Rašeta[1], Vera Aksentić[2], and Milkica Grabež

[1]School of medicine, University of Banja Luka, Bosnia and Hrezegovina
[2]Institute of Physical Medicine and Rehabilitation "Dr Miroslav Zotović", Banja Luka, Bosnia and Herzegovina

ORIGINAL SCIENTIFIC ARTICLE
doi: 10.5550/sgia.151101.en.002M
UDC: 618.173:577.161.2

SUMMARY

The primary role of vitamin D is regulation of calcium, phosphorus and bone metabolism. Vitamin D status assessment is based on measuring of 25 (OH) D concentrations, and disorders of vitamin D status may be manifested as a vitamin D insufficiency, vitamin D deficiency and vitamin D hypervitaminosis. It is generally accepted that values above 75 nmol / L will suffice to prevent the occurrence of secondary hyperparathyroidism. Although vitamin D deficiency can be found at any age, it is most common in women with postmenopausal osteoporosis, and in older women. The aim of this study was to determine the vitamin D status, parathyroid hormone levels and calcium levels in women with newly diagnosed postmenopausal osteoporosis, and to compare the results with the same parameters observed and measured in women without osteoporosis, and to establish whether there is a connection between vitamin D levels and levels of other parameters. The study involved 85 postmenopausal women, all of which were screened for osteoporosis by measuring bone mineral density in the lumbar spine and hip region using DXA method. Of these, 50 women were found to have osteoporosis while 35 had regular DXA values. Our results showed a high incidence of vitamin D deficiency in postmenopausal women, with significantly higher vitamin D deficiency in women with osteoporosis. The values of parathyroid hormone were higher, and the values of ionized calcium were lower in women with osteoporosis, and there is a negative correlation between 25 (OH) D and parathyroid hormone. The most common risk factors for osteoporotic fracture in postmenopausal women were early menopause and previous fracture in adulthood. Reduced levels of vitamin D in women with postmenopausal osteoporosis leads to changes in calcium and parathyroid hormone metabolism

Key Words: parathyroid hormone, postmenopausal osteoporosis, Vitamin D.

INTRODUCTION

Osteoporosis is the most common metabolic bone disease. The process is continuous and progressive, and it is considered that osteoporosis is a process that begins in youth (failure to achieve maximum density), and manifests itself in the older age (accelerated loss) (Richard et al, 2008). It is believed that 10% of the world population suffers from osteoporosis. According to the World Health Organization [WHO] this disease, as a health issue, falls in the second place, after cardiovascular disease (Panneman, Lips, Sen, & Herings, 2004). Basically, osteoporosis is a disorder of balance between the processes of resorption and new bone formation, in favor of the absorption process, which is more intensive than the process of new bone formation and leads to reduction of bone mineral density [BMD] and bone quality (Shoback, Marcus, Bikle, & Strewler, 2001). Osteoporosis is a "silent" disease. Bone strength, and above all the BMD [bone mineral density] is reduced over the years without any symptoms of the disease which is often manifested in the form of spine, wrist and femoral neck fractures (Feskanich, Willett, & Colditz, 2002), even without any inducing trauma.

The largest number of the available data refers to white women, mostly in North America and Europe

(Framingham, SOF - The study of osteoporotic fractures, which includes 9.704 American women older than 65 years, EPOS - European Prospective Osteoporosis study of 3.173 women with an average age of 62.2 years and EPIDOS study of 6.933 women older than 75 years) (Brixen, Abrahamsen, & Kassem, 2005).

The definition of osteoporosis according to the WHO: "Osteoporosis is a metabolic bone disease, which is characterized by decreased bone strength and increased risk for fractures" (Tuck & Francis, 2002).

Bone strength is a reflection of two main characteristics of the bone: bone quality, which refers to the bone micro architecture, bone remodeling, and microscopic damage to the existing bone tissue; BMD which is expressed in grams per unit area (g/cm^2) and is a clinical, rather than the physical measure which is determined by the maximum bone density in youth-peak bone mass and bone loss with aging (Iqbal, 2000).

WHO in collaboration with the International Osteoporosis Foundation [IOF] defines osteoporosis on the basis of the degree of reduction in BMD (*t* score expressed as *SD*), which is obtained by densitometry (WHO, 1994). The criteria for osteoporosis according to the WHO/IOF are in Table 1:

Looking from overall Health and economic aspect, the importance of osteoporosis lies in its way to have

TABLE 1

Criteria for the diagnosis of osteoporosis according to the WHO/IOF.

Dg	BMD (*t* score)
Normal density	≥ -1.0 SD
Osteopenia	-1.0 do -2.5 SD
Osteoporosis	≤ -2,5 SD

Legend: **Dg** - diagnosis; **BMD** - bone mineral density.

an effect on fractures. The most serious consequence of osteoporosis is hip fracture, which always requires hospitalization, with high mortality during the first year after a hip fracture (National Osteoporosis Foundation, 2003; Siris, 2004).

In everyday practice, the diagnosis of osteoporosis, as recommended by the WHO, is achieved by measuring BMD. In addition to reduced BMD other risk factors are important too, like genetic and acquired factors, and among them, those that can be changed and those that can't be changed (Table 2).

The gold standard test for measuring BMD is based on low energy X radiation (DXA, Dual-emission X-ray Absorptiometry, previously DEXA), where the

TABLE 2

Risk factors for osteoporotic fractures.

Non-variable risk factors	Variable risk factors
• A history of previous fracture in adult life, which is not caused by serious trauma	• Smoking
• A positive family history of fractures of closest relatives	• Low body weight (<57kg) or BMI <19
• The white race	• The lack of estrogen
• Female sex	• Low intake of calcium and vitamin d
• Age	• Alcoholism
• Dementia	• Frequent falls
• Poor general health	• Inadequate physical activity
	• Visually impairment

reading of BMD in expressed in g/cm^2 and the results are compared with the values of the bone density of healthy population aged 20-40 years (*t* score expressed as *SD*). When deciding on treatment, patient-obtained values are compared with the mean values of bone mineral density of people of the same age (*z*-score *SD*). One *SD* indicates 10% of bone mass. BMD measurements by DXA is characterized by minimal radiation, it is comfortable, fast and has a high accuracy (Ettinger, 2003; McCloskey, 2006). Patients diagnosed with osteoporosis and confirmed by DXA, can start their treatment using antiresorptive drugs (bisphosphonates), with the use of calcium and vitamin D. The latest recommendations issued by ESCE 09 is that the treatment should last at least 5 years, after which it can be paused provided patients do not

have serious risk factors and that there has been a significant increase in BMD (Zizic, 2004).

A large number of etiological factors may lead to a decrease in bone density, but the most common form of osteoporosis is postmenopausal osteoporosis (National Osteoporosis Foundation, 2003) in which the estrogen deficiency is a major risk factor in early and the late phase of bone loss in women, since estrogens have a very favorable, antiresorptive and a discreet anabolic effect on bone tissue.

Estrogens act directly on bone cells via estrogen receptors which are present in both osteoblasts and osteoclasts (although the expression of these receptors in bone cells is weak), and indirectly via growth factors. Estrogen is: increasing synthesis of calcitriol, slowing down osteoclasts, reducing the effects of resorptive cytokines, protecting osteoblasts and reducing receptor sensitivity to PTH (Nuti et al., 2009). This form of osteoporosis is characterized by altered bone remodeling, which occurs not only due to the deficit of sex hormones, but also due to physiological reduction of calcium absorption in the intestine and the kidney, due to reduction of the synthesis of D hormone in the kidneys and bone tissue, and due to reduction in physical activity (Greiwe, Cheng, Rubin, Yarasheski, & Semenkovch, 2001).

Vitamin D

Vitamin D is very similar to hormones synthesized in the body from its precursors. Whether it is synthesized in the skin or ingested with the food, vitamin D is biologically inactive. It is subjected to hydroxylation in the liver, in position C-25 under the effect of 25α hydroxylase, and it becomes 25-hydroxyvitamin D (25 (OH) D), which represents most of the vitamin D in the plasma, which is attached to the transport protein by which it is transferred to the kidneys. As the concentration of 25 (OH) D depends solely on the presence of substrate (pro-vitamin intake and sun exposure), it is an appropriate measure of the amount of vitamin D in the body. In the kidney 25 (OH) D is further metabolized by hydroxylation at position C-1 with the help of the enzyme 1α hydroxylase, to form an active form of the vitamin, 1,25-dihydroxyvitamin D (1.25 (OH) 2D, calcitriol or hormone D), through which it exerts most of its effects (Holick, 2007). The active form of vitamin D is released into the bloodstream and bound with the carrier protein transcalciferin, by which it is transported to the target organs, where it binds to specific vitamin D receptors [VDR] with which it exerts its effects. The kidney is the main organ in which it is converted 25 (OH) D into calcitriol, but it is not the only place the synthesis of 1α hydroxylase takes place. Extrarenal synthesis of this enzyme has an important role in the immunoregulatory and autoproliferative effects of vitamin D (bone marrow, immune system, epithelial cells of the skin, breast, prostate, muscle and intestines). Extrarenal production of calcitriol is not sufficiently assessed, but it is believed that under normal conditions it does not significantly increase serum concentrations of D hormone (Bronner, 2001).

The most important stimulators of calcitriol synthesis are hypocalcaemia and hypophosphatemia. Hypocalcaemia does not cause direct stimulation of synthesis of calcitriol, rather this effect is achieved indirectly through PTH. Reduction of calcium concentration in plasma increases PTH secretion, which in turn increases the activity of 1α hydroxylase and synthesis of calcitriol (Bischoff-Ferrari et al., 2004). The estrogen and growth hormone [GH], also stimulate renal 1α hydroxylation. Calcitriol actively stimulates the absorption of calcium in the small intestine and thus indirectly regulates the secretion of PTH. It increases the synthesis of transforming growth factor β (TGF-β), and IGF-1, increases the number of IGF-1 receptors, thereby stimulating osteoblastic proliferation and differentiation, increasing the synthesis of type I collagen and matrix proteins (osteopontin and osteocalcin), all of which are necessary for mineralization, function and metabolism of bone tissue, and thus contribute to the bone strength. It also acts on osteoclasts: indirectly through osteoblasts, and directly, suppressing the differentiation of promyelocytes into monocytes, which are the precursors of osteoclasts (Bischoff-Ferrari et al., 2005; Stevenson & Marsh, 2007).

Vitamin D status is estimated on the basis of the concentration of 25 (OH) D levels. There are many disputes in terms of optimal vitamin D status in serum (Aloia, 2001). According to Peacock-in and collaborators, until recently, the lack of vitamin D was defined as concentration of 25 (OH) D serum in which a secondary hyperparathyroidism occurs, and in which there is a decrease in bone mass without the occurrence of hypocalcaemia or osteomalacia (Peacock, Selby, Francis, Brown, & Hordon, 1985). Since 2005, a normal status of vitamin D is defined as the concentration of 25 (OH) D > 75 nmol/L. Vitamin D insufficiency is defined as concentration of 25 (OH) D < 25 nmol/L, Vitamin D deficiency is defined as concentration of 25 (OH) D 25-75 nmol/L and vitamin D Intoxication is defined as concentration of 25 (OH) D > 250 nmol/L (Aloia, Talwar, Pollack, Feuerman, & Yeh, 2006).

Vitamin D deficiency leads to defective calcium metabolism, defective osteoblastic activity, and defec-

tive matrix mineralization and finally leads to disorders of bone mineral density. Vitamin D deficiency is one of the most common causes of secondary hyperparathyroidism, and it is considered that the value of 25 (OH) D > 75 nmol/L can prevent its development. As defined in 2005, there is a high percentage of women (around 60%) with postmenopausal osteoporosis, and a lack of vitamin D (Sweet, Jeremiah, & Galazka, 2009). Vitamin D deficiency leads to muscle disturbances, where calcitriol, by binding to the VDR of skeletal muscle cells regulates muscle contraction and relaxation, increases protein synthesis and the entry of calcium into the cell. In the situation of vitamin D deficiency there is a loss of muscle fibrils of type II and a decrease in muscle strength and increased risk of falling and fractures (Dawson-Hughes et al., 2005; Vieth & Fraser, 2002). Optimal prevention of bone fractures in women with postmenopausal osteoporosis, in addition to the application of antiresorptive therapy, includes adequate supplementation of vitamin D, whose unique dual effect on bone and muscle tissue increases bone mineral density, but also the prevents falls (Canalis, 2010). Nowadays it is considered that for the optimal anti-fracture value of 25 (OH) D serum concentration of 100-120 nmol/L the required daily intake of vitamin D 3 needs to be 1000 IU, if the value of 25 (OH) D in the serum is 60-75 nmol/L, required daily intake of vitamin D 3 needs to be 2000 IU if the value of 25 (OH) D in the serum is 30-60 nmol/L and required daily intake of vitamin D 3 needs to be 3000 IU if the value of 25 (OH) D in the serum is less than 30 nmol/L (Grand et al., 2005; Jackson et al., 2006). These recommendations are in line with recommendations of American osteoporosis Foundation (Cosman et al., 2014; National Osteoporosis Foundation, 2015). There is evidence that treatment with bisphosphonates should be initiated only after ensuring anti-fracture concentration of 25 (OH) D serum is achieved, because otherwise their efficiency is significantly smaller (Cooper, 2006).

Testing of vitamin D status is not part of the daily routine in the diagnosis and treatment of osteoporosis. It is desirable that all patients with osteoporosis have at least one paired finding of 25 (OH) D in the serum, one at the end of winter and one at the end of summer, when minimum and maximum concentration of 25 (OH) D is expected. Determination of vitamin D status is required in patients with hypercalcaemia, hypocalcaemia, elevated PTH, hypercalciuria, hypocalciuria and in patients with a history of prior fractures (Pilipović, Branković, & Vujasinović, 2005).

Calcium and parathyroid hormone

The human organism contains 1000-1200 grams of calcium, 99% of which is located within the bones. 88% of the total amount of calcium in bone is bound to phosphorus (Ca: Pa = 2: 1); 1% of the total amount of calcium is contained within the body fluids in the intra- and extracellular space. Calcium requirements vary by age, sex and physiological state. The organs involved in its metabolism are bones, intestines and kidneys, all of which happens under the influence of PTH, calcitriol, sex hormones and glucocorticoids. The absorption of calcium through the intestinal epithelium occurs passively (non-saturable) and trancellular (saturable) pathway.

Calcium binding protein calbinidin D plays a key role in the transfer of calcium through the enterocytes and the latest data suggest that estrogen can stimulate this influx through cAMP. Calcium homeostasis through osteocytic membrane occurs in the process of active exchange of calcium between the extracellular fluid and bone, wherein the amount of calcium that enters the bone is equal to the amount that comes out (about 500 mg/day), so that bone mass remains constant. Calcitriol via the VDR receptor stimulates: transcription of calbinidin (which increases calcium entry through the apical channels); Activity of Ca^2 + -ATPase in the basolateral membrane and calcium transport through tubulocytes.

PTH is a hormone essential in the process of bone remodeling in the regulation of calcium levels in the blood. Its effect is exerted by binding to receptors in the membrane of osteoblasts and tubular cells of the kidneys. It stimulates mature osteoblasts, which are unable to proliferate and to produce growth factors such as FGF-2 and IGF-1, which stimulates proliferation osteoprogenitor cells that have the receptor for PTH. FGF (fibroblast growth factor) is the primary mediator of action of PTH on bone. PTH leads to the accumulation of a multilayer of osteoblasts at sites of bone formation. Regulation of syntheses and secretion of PTH with Ca ions includes the negative feedback mechanism: the reduction of calcium levels leading to increased secretion and activity of PTH, which stimulates osteoclasts (indirectly via osteoblasts) to produce cytokines which are stimulating osteoblast and osteoclast precursors (IL-1, PG E2 , TNF, etc.), leading to bone resorption and release of calcium into the blood. PTH increases Ca reabsorption in the kidney, GIT absorption of Ca through stimulation of the synthesis of the D hormones, it increases resorption of phosphate from bones and increases excretion of phosphates. In intermittent secretion;

PTH increases the number preosteoblasts and thus it is the most important factor in the formation of bone, while continuing high value of PTH leads to a predominance of bone resorption. Changes in the concentration of ionized calcium in the serum of 8% may lead to a triple change in PTH concentration (Lips, 2006; Stefanović, Zečević, & Petronijević, 2009).

Aim of the paper is:

- to determine the concentration of 25 (OH) D, ionized and total calcium and parathyroid hormone in the blood of women with postmenopausal osteoporosis and to compare them with the values obtained in postmenopausal women without osteoporosis. To determine the frequency and degree of vitamin D deficiency in women with postmenopausal osteoporosis.
- to explore the association between vitamin D deficiency and the values of ionized serum calcium and parathyroid hormone.
- to analyze the most common risk factors for osteoporotic fractures.

METHODS

The study was conducted as a prospective study from May to December of 2010, in Institute of Physical Medicine and Rehabilitation "Dr. Miroslav Zotovic", Banjaluka.

A stratified sample (*N*) of 85 women was created with an average age of 50-70 years.

Once densitometry was done patients were divided into two groups:

- (*n*) of 50 women with a BMD *t*-test ≤ -2.5 *SD* - women with newly discovered osteoporosis
- (*n*) of 35 women with a BMD *t*-test ≥ -1.0 *SD* - women who do not have osteoporosis.

All respondents surveyed questionnaire, which includes risk factors for osteoporotic fractures.

After the DXA, their fasting venous blood (PTH, 25 (OH) D serum Ca) and capillary blood (Ionized Ca) was drawn.

Total Serum Ca was determined by spectrophotometry using Roche Cobas C 111, and ionized Ca was determined by potentiometric method using Roche Analyzer 9180th.

Reference range of the SCa is 2.15 to 2.55 mmol/L; while reference range of Ca^{++} is 1.05-1.35 mmol/L.

Serum concentrations of PTH and 25 (OH) D were determined using electrochemiluminiscent immunochemical method using Roche Elecsys 2010. Reference range of PTH is 15-65 pg/mL.

The significance of the investigated parameters between groups formed on the basis of the value of BMD, was determined using *t*-test for independent samples and using *U* test for non-parametric comparison. Level of statistical significance was arbitrary chosen as $p < .05$.

The correlation of tested parameters with the levels of 25 (OH) D in the group of women with osteoporosis, was statistically calculated using correlation test and was shown as a correlation coefficient.

TABLE 3

Descriptive analysis of the studied parameters in the group of patients (n) 50 with BMD ≤ -2.5 SD.

(*n*)50 BMD ≤ -2,5 SD	Min	Max	*M*	*SD*	*v*
Age	50.000	70.000	61.540	5.210	27.190
Menopause	1.000	30.000	12.340	5.640	31.820
25(OH)D(nmol/L)	10.000	72.660	26.840	14.690	215.670
PTH(pg/mL)	4.040	97.340	44.340	17.230	296.790
Ca^{++}(mmol/L)	1.100	1.480	1.310	.060	.003
CaS(mmol/L)	2.000	2.710	2.330	.130	.025
BMD L1-L4 g/cm^2	.657	.911	.819	.060	.003
BMD L1-L4 *t*-test	-4.400	-2.000	-3.026	.460	.213
BMD NECK of L FEMUR g/cm^2	.389	.916	.765	.090	.007
BMD NECK of L FEMUR *t*-test	-2.700	-.500	-1.759	.560	.319

Legend: **n** - number of inhabitants; **Min** - mnimum; **Max** - maxmum; **M** - mean; **SD** - standard deviaton, **v** - varianca.

Significance of differences of the most-represented risk factors between the two groups is presented in tabular form. Level of statistical significance was arbitrary chosen as $p < .05$.

RESULTS

Tables 3 and 4 show minimum and maximum values, means, standard deviations and variance for

TABLE 4

Descriptive analysis of the studied parameters in the group of patients (n) 35 with BMD ≥ -1.0 SD.

(*n*)50 BMD ≤ -2,5 SD	Min	Max	*M*	*SD*	*v*
Age	50.000	70.000	59.030	4.790	23.028
Menopause	1.000	28.000	7.970	6.370	40.606
25(OH)D(nmol/L)	19.570	74.920	35.670	10.470	109.580
PTH(pg/mL)	2.230	83.810	35.220	19.730	389.179
Ca^{++}(mmol/L)	1.240	1.560	1.340	.060	.004
CaS(mmol/L)	2.130	2.720	2.290	.110	.012
BMD L1-L4 g/cm^2	1.002	1.970	1.260	.170	.031
BMD L1-L4 *t*-test	-1.000	2.600	.660	.970	.956
BMD NECK of L FEMUR g/cm^2	.889	1.270	1.030	.100	.010
BMD NECK of L FEMUR *t*-test	-.080	2.500	.600	.860	.755

Legend: **n** - number of inhabitants; **Min** - mnimum; **Max** - maxmum; **M** - mean; **SD** - standard deviaton, **v** - varianca.

TABLE 5

Descriptive analysis of the studied parameters in the group of patients (n) 35 with BMD ≥ -1.0 SD.

	F	F_c	*t*	t_c	*p*
Age	1.18	1.72	2.25	1.66	**.013**
Durton of menopause	.78	1.72	3.33	1.66	**.001**
25(OH)D(nmol/L)	1.97	1.72	-3.23	1.66	**.001**
PTH(pg/mL)	.76	1.72	1.78	1.66	**.039**
Ca^{++}(mmol/L)	.87	1.72	-2.42	1.66	**.009**
CaS(mmol/L)	2.09	1.72	1.31	1.66	.097

Legend: **F** - *F* test; $\mathbf{F_c}$ - *F* critical value for the test group; **t** - *t*-test; $\mathbf{t_c}$ - the critical value of *t* test; *p* - probablity; the variance is the same for all the examined parameters, except for 25 (OH) D and serum calcium.

age, duration of menopause, the value of vitamin D, PTH, ionized calcium, total calcium, BMD L1-L4 in g/cm^2 and *t*-score, and the value of the left femoral neck BMD in g/cm^2 and *t*-score for both groups.

Figure 1 presents the both groups of postmenopausal women and the percentage distribution of deficiency or insufficiency of vitamin D in the given group. In the group of women with BMD ≤ -2.5 *SD*, 23 women, or 46%, had the insufficiency of vitamin D, while 27 women or 54% of them, had a deficiency of vitamin D. In women with BMD ≥ -1.0 *SD*, 7 women had vitamin D insufficiency (28.6%), while 28 of them (71.4%) had a deficiency of vitamin D.

Out of 85 women surveyed none have had a value of vitamin D above 75 nmol/L.

The association of vitamin D deficiency with values of ionized serum calcium and parathyroid hormone in women with postmenopausal osteoporosis are showen in Figures 2 and 3.

Figure 4 shows the correlation between the levels of ionized calcium (mmol/L) and the level of 25 (OH) D (nmol/L), measured in a group of patients

FIGURE 1

The frequency and degree of vitamin D deficiency (nmol/L) in both groups.

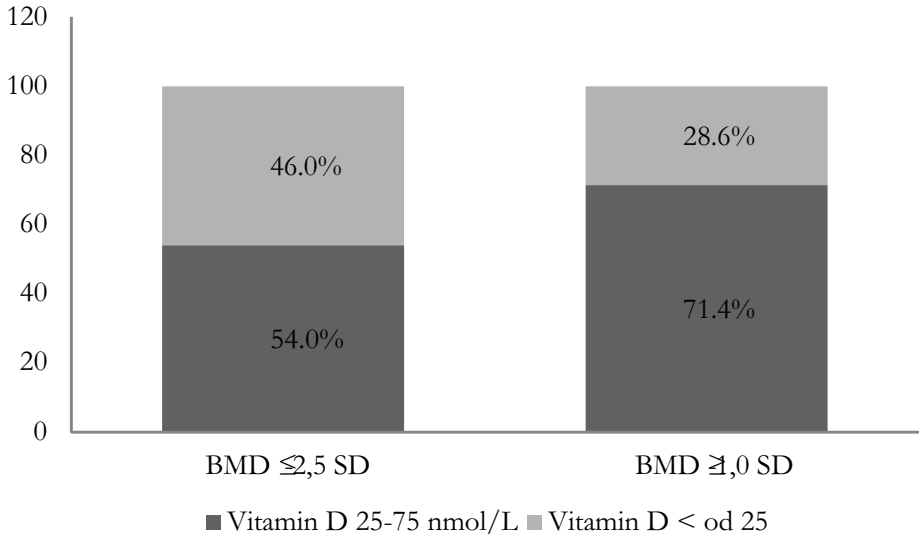


TABLE 6

Calculation of statistical significance of differences value of vitamin D between the two groups.

	(n) 50 BMD ≤ -2.5 SD	*(n) 35 BMD ≥ -1.0 SD*	χ^2	*p*
Vitamin D < 25 nmol/L	23	7	6.09	**.01**
Vitamin D > 25 nmol/L	27	28		

Legend: Fisher exact test for nominal parameters; **χ^2** - the value of Pearson's chi-sq test; **p** - probablity.

FIGURE 2

Scatter diagram of correlation values of PTH (pg / mL), and the value of 25 (OH) D (nmol / L) in the group of patients with BMD ≤ -2.5 SD.

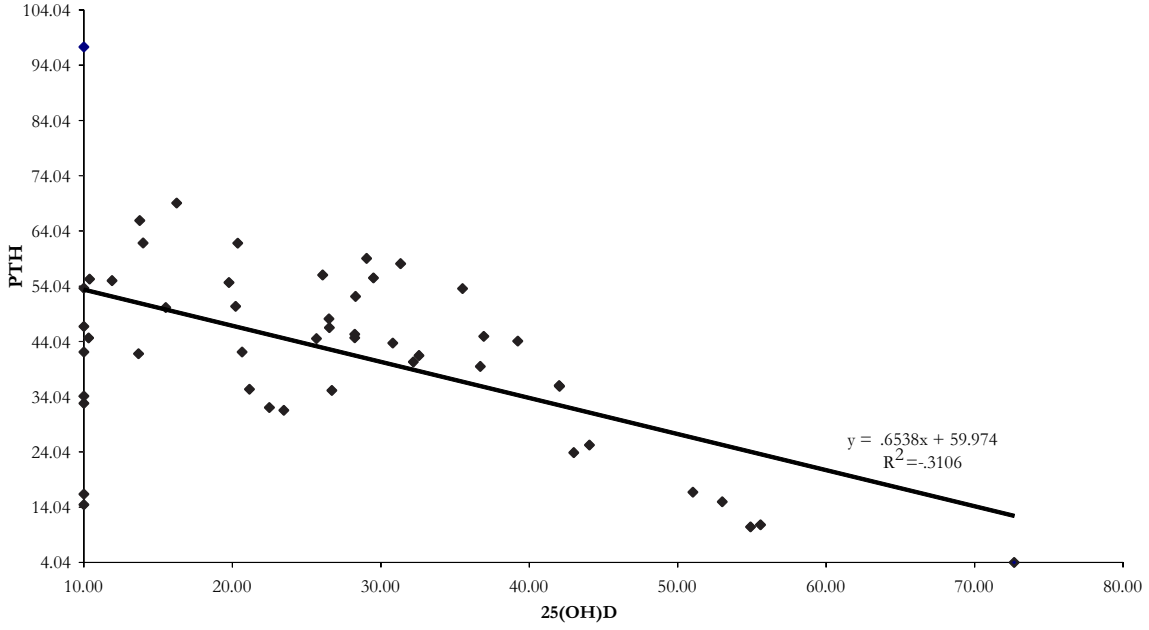


FIGURE 3

Scatter diagram of correlation of values of PTH (pg / mL), and the value of 25 (OH) D (nmol / L) in the group of subjects (n) 35 with BMD ≥ -1.0 SD.

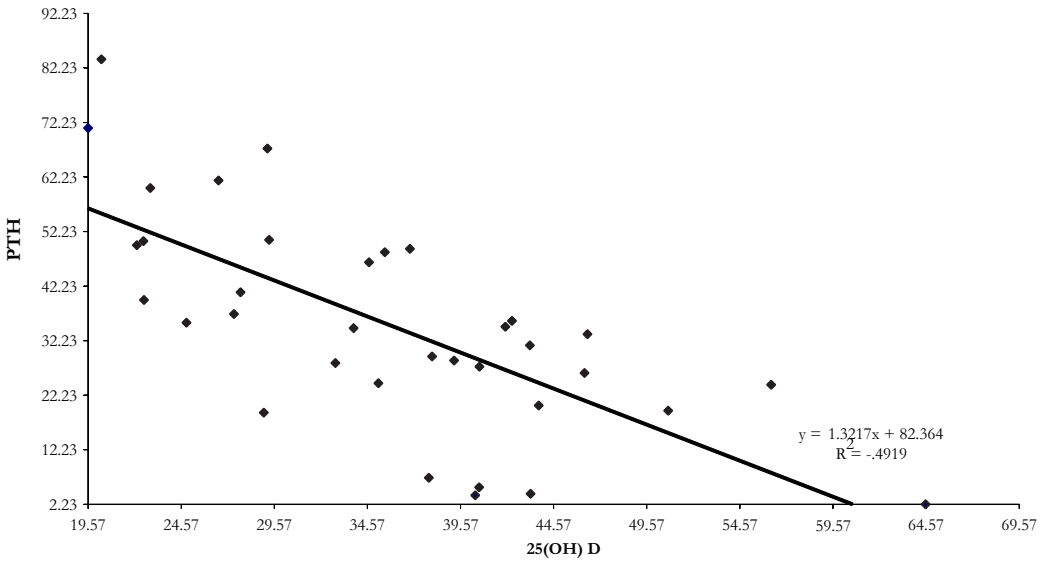
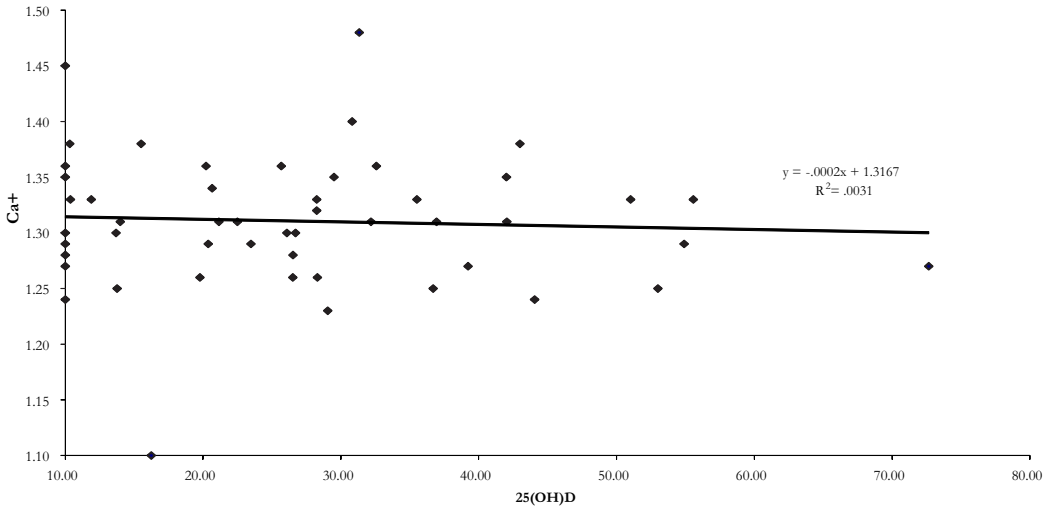


FIGURE 4

Scatter diagram of Correlation of ionized calcium (mmol L) and the value of 25 (OH) D (nmol L).



(*n*) 50 with BMD ≤ -2.5 *SD*. Very low correlation coefficient R^2 of .0031 shows that there is no correlation between the examined parameters in the study group ($p > .05$).

Figure 5 shows the correlation between the serum calcium level (mg/dL) and levels of 25 (OH) D (nmol/L), measured in a group of patients (*n*) 50 with BMD ≤ -2.5 *SD*. Very low correlation coefficient R^2 of .0077 shows that there is no correlation between the examined parameters in the study group ($p > .05$).

The representation of the most common risk factors for osteoporotic fractures are showen in Table 7.

Figure 6 and 7 show the absolute and relative presence of risk factors in a group of patients (*n*) 50 with BMD ≤ -2.5 SD and a group of patients (*n*) 35 with BMD ≥ -1.0 SD.

Table 8 shows that there is no statistically significant difference between the most common risk factors between two group of women ($p > .05$).

FIGURE 5

Scatter diagram of correlation values of serum calcium (mmol/L) and the value of 25 (OH) D (nmol/L).

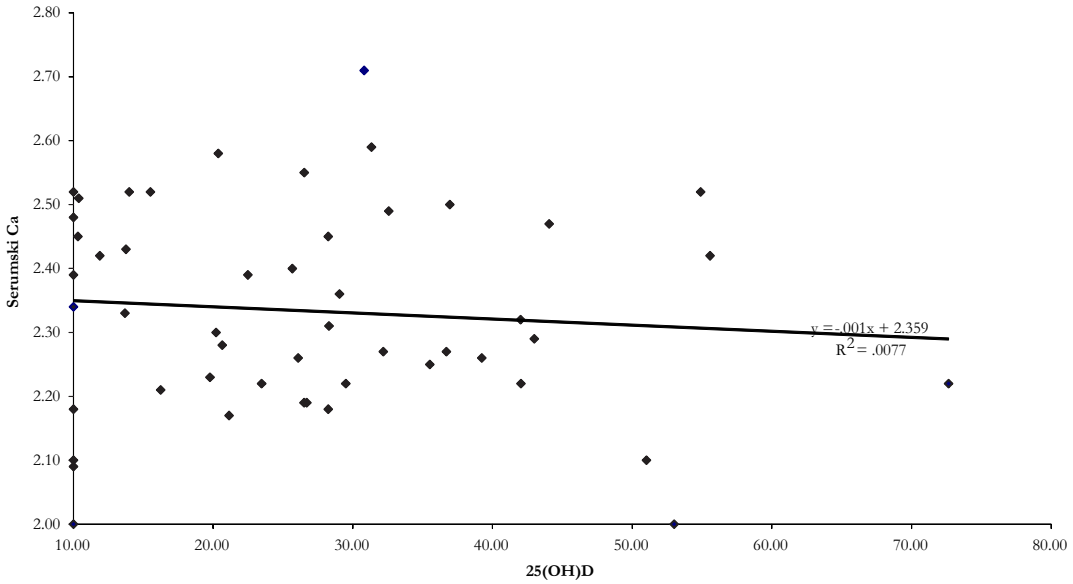


TABLE 7

Risk factors for fracture, and their absolute representation in both populations of women.

Risk factors	*BMD ≤ -2,5 SD*	*BMD ≥ -1,0 SD*
Previous fractures in adulthood	8	2
Fractures in first line relatives	2	1
Very old age	0	0
Prolonged low Ca, vitamin D and protein intake	2	2
Tobacco smoking (over 10 cigarettes)	7	3
BMI (body mass index)<19	1	0
Premature menopause (before age of 45.)	9	3
Visual problems	18	11
Lack of physical activity	3	5
Frequent falls	0	1

FIGURE 6

The presence of risk factors in the group of women with BMD ≤ -2.5 SD presented as absolute (n) and relative (%) values

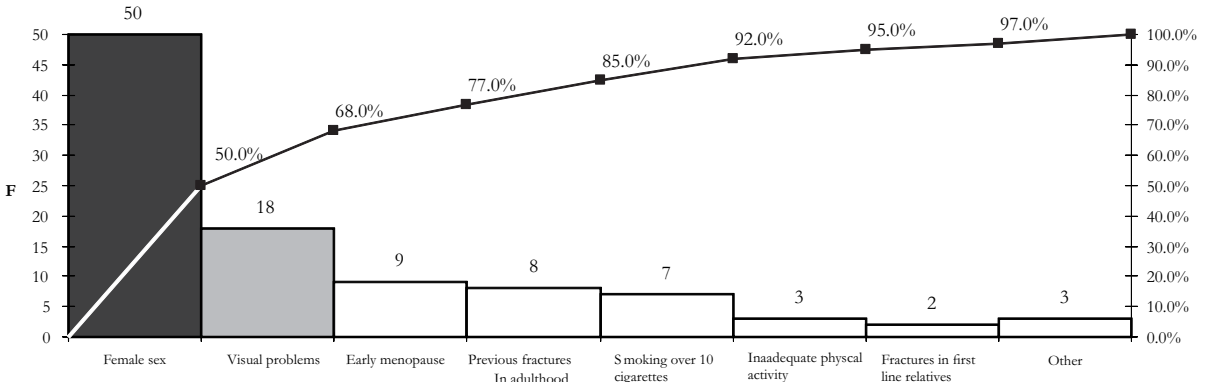


FIGURE 7

The presence of risk factors in the group of women with BMD ≥ -1.0 SD presented absolute (n) and relative (%) values

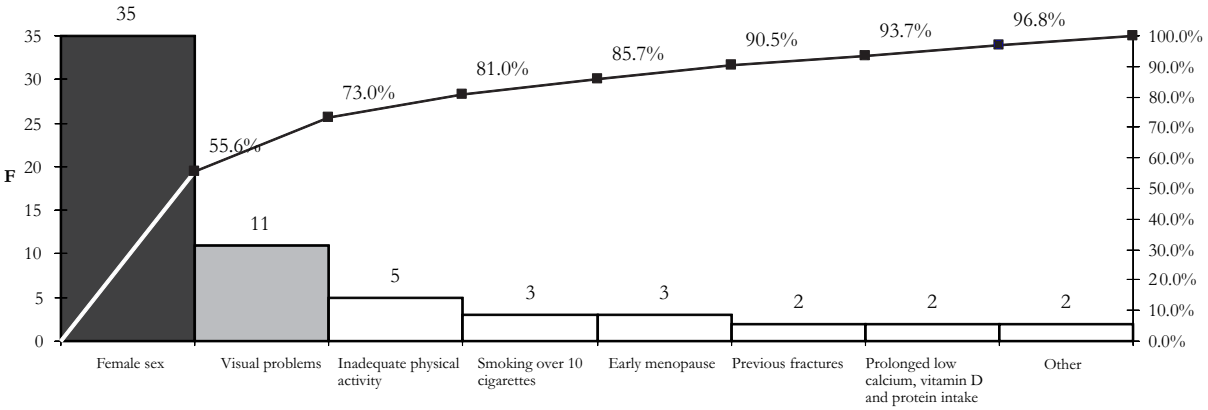


TABLE 8

Calculation of statistical significance of differences of the presence of selected risk factors between the two groups.

Risk factors	Risk factor present	*(n) 50 BMD ≤ -2,5 SD*	*(n) 35 BMD ≥ -1,0 SD*	χ^2	*p*
Previous fractures in adulthood	Yes	8	2	.14	*p*>.05
	No	42	33		
Tobacco use (over 10 cigarettes a day)	Yes	7	3	.44	*p*>.05
	No	43	32		
Early menopause	Yes	9	3	.21	*p*>.05
	No	41	32		
Inadequate physical activity	Yes	3	5	.19	*p*>.05
	No	47	30		

Legend: Fisher exact test for nominal parameters; **χ^2** - the value of Pearson's chi-sq test; **p** - probablity.

DISCUSSION

Loss of bone density begins with irregular menstrual cycles. Postmenopausal women may be classified into two groups according to the rate of bone loss in postmenopausal patients: the "quick" and "normal" loss of bone mass. 1/3 to 1/4 of women in the general population belong into the first group (Morris & Anderson, 2010).

All the subjects covered by our study, were postmenopausal (age 50-70 yr.). The mean age of those in the group with BMD ≤ -2.5 *SD* was 61.54 ± 5.21 years with an average duration of menopause 12.34 ± 5.64 years. In the group of patients with BMD ≥ -1 *SD* mean age was 59.03 ± 4.79 years and the average duration of menopause was 7.97 ± 6.37 years (Table 3 and 4).

In both groups the mean value of 25 (OH) D fell within deficiency range , with a group of BMD ≥ -1 SD having a value of 25 (OH) D higher than in the group of women with osteoporosis (35.67 ± 10, 47 nmol/L vs 26.84 ± 14.69 nmol/L) (Table 3 and 4).

In correlation with the values of 25 (OH) D as was expected the higher values of PTH were obtained with women with osteoporosis (44.34 ± 17.23 pg/mL) compared to women with normal DXA 35.22 ± 19.73 pg/mL), although the value of PTH in both groups were within normal range (Table 3 and 4).

In both groups of subjects values of calcium in the serum, as well as ionized calcium were within normal range, except that the values of the biologically active, ionized calcium in the group of patients with BMD ≤ -2.5 *SD* (1.31 mmol/L)was lower than in the group with BMD ≥ -1 *SD* (1.34 mmol/L) (Table 3 and 4).

By testing the studied parameters within the two groups, we obtained statistical significance for age, duration of menopause, PTH and ionized calcium ($p < .05$), while for 25 (OH) D we obtained strong statistical significance ($p < .01$).

For serum calcium we did not ind statistically significance (Table 5).

The frequency and level of vitamin D deficiency in postmenopausal women

Since 2005, a normal status of vitamin D is defined as the concentration of 25 (OH) D > 75 nmol/L. Insufficiency of vitamin D is defined as the concentration of 25 (OH) D < 25 nmol/L, vitamin D deficiency is defined as concentration of 25 (OH) D 25-75 nmol/L and the concentration of vitamin D marked as intoxication appears when level of 25 (OH) D > 250 nmol/L (Aloia et al., 2006). A numerous studies have demonstrated a high prevalence of vitamin D deficiency in women in postmenopausal period, with the "cut of" 25 (OH) D of 75 nmol/L. Ofelya study, which included 669 postmenopausal women, with mean age of 62.2 years, showed that 73% of subjects had concentrations of 25 (OH) D below 75 nmol/L (Sornay-Rendy, Munoz, Garnero, & Delmas, 2005). Kuchuk, van Schoor, Pluim, Chines, and Lips (2009) published the results of the study, which was conducted in 29 countries and which included 7.441 postmenopausal women. Results of the study showed that the average concentration of 25 (OH) D in the serum of subjects was 61.2 nmol/L. Lips P. et al. (2006) in the study, which included 2.589 women with postmenopausal osteoporosis from 18 countries, showed that the prevalence of vitamin D insufficiency varied by region from 53.4% to 81.8%. Preliminary results of a pilot study of 4 centers in Serbia have shown the insufficiency of vitamin D in 95% of women with postmenopausal osteoporosis (Anđelković, 2009).

From 2012. onward, the following values of vitamin D concentrations were recommended as a mean of classifying vitamin D status: level of 25 (OH) D > 75 nmol/L was recommended as a normal level, level of 25 (OH) D 50-75 nmol/L was considered as insufficiency, while level of 25 (OH) D 25-50 nmol/L was considered as deficiency. Concentration of 25 (OH) D < 25 nmol/L was considered as severe deficiency (Jovičić, Ignatović, Beletić, Mirković, & Majkić-Singh, 2012; Sempos, Vesper, Phinney Thienpont, & Coates, 2012).

European multinational study included 8531 women receiving treatment for osteoporosis and showed that 80% of women had a value of 25 (OH) D less than 80 nmol/L, and about 30% of women had less than 50 nmol/L (Kanis et al., 2009; Lanyon, & Skerry, 2001). Based on recent tests in Serbia, it was found that out of 92 postmenopausal women with osteoporosis, vitamin D deficiency was present in 49% (cut-off value of 25 (OH) D of 50 nmol/L or less), and even 67% of respondents had lack/shortage of vitamin D, if 75 nmol/L 25 (OH) D was taken as a normal value (Ćirković, Petronijević, Ristić, Glišić, & Stefanović, 2010).

Our study found a high incidence of vitamin D deficiency in both group of postmenopausal women, which is consistent with the results of numerous studies. In the group of patients with BMD ≤ -2.5 *SD*, 54% of respondents (n = 27) had a vitamin D deficiency, and 46% (n = 23) lack of vitamin D. In the group of patients with BMD ≥ -1 *SD*, 71, 4% of the patients (n = 28) had lack of vitamin D, and 28.6% (n = 7) had vitamin D deficiency (Figure 1). It is interesting that none of the respondents from both groups had normal vitamin D status, if the "cut of" 25 (OH) D was 75 nmol/L.

By testing the significance of differences, we confirmed a statistically significant difference between the correspondent classes of vitamin D (25 (OH) D < 25 nmol/L and 25 (OH) D 25 to 75 nmol/L) between the groups (p < .01) (Table 6).

One of the most important factors which lead to significant bone loss in postmenopausal women is the decline in vitamin D status (Outila, Kärkkäinen, & Lamberg-Allardt, 2001). By acting on the osteocytes, metabolites of vitamin D enhance the quality (strength and elasticity) of the bone, thus stimulating enchondral growth, thereby reducing the incidence of fractures (Roodman, 1999; Winsloe, Earl, Dennison, Cooper, & Harvey, 2009). It appears that vitamin D increases bone formation and mineralization not only through its stimulating effect on the intestinal absorption of calcium and phosphate, but also by its effect on the differentiation of osteoblasts. Owen and colleagues have shown that vitamin D coordinates the sequence of the development of osteoblast-specific effects on the temporal gene expression and protein synthesis of a number of osteoblasts. It's calcemic effect 1.25 (OH) 2D owes to the activation of osteoclastic bone resorption, which is a secondary effect of the intermediate vitamin D receptor to RANKL-expressing osteoblasts (Owen, Aronow, Barone, Stein, & Lian, 1991). Typical changes within the bones in vitamin D deficiency patients are: increased resorption, decreased formation, decreased production of bone matrix and reduced mineralization, leading to disorders of architecture and mechanical stability of the bone. Also, vitamin D exerts a significant effect on muscle tissue by regulating calcium metabolism within the muscle cells, which is important for the process of contraction and relaxation of muscle fibers (Cumming & Nevitt, 1997).

Parathyroid hormone - In the last decade, numerous studies have consistently shown that for many people there is a vitamin D insufficiency, which is

sufficient to cause an increase in serum PTH values (Aloia, Feuerman, & Yeh, 2006). Souberbielle and associates have suggested reducing the reference values of PTH from the current 65 pg/ml to 46 pg/mL (Souberbielle et al., 2001). They found that the exclusion of people with low values of vitamin D had a significant influence in determining the value of the upper reference range of PTH, and have concluded that when determining the reference values of PTH, both people with low vitamin D, and those whose values of vitamin D were above 25 nmol/L should be taken into account (Souberbielle et al., 2003).

Our results showed that the mean value of PTH in both groups were within normal range (Table 3 and 4), so that in this case one could speak of relative secondary hyperparathyroidism. The highest value obtained in the PTH group of patients with BMD ≤ -2.5 *SD* was 97.34 pg/mL (Table 3).

Correlation analysis showed a statistically significant ($p < .01$) negative correlation between 25 (OH) D and PTH values in both groups (Figure 2 and 3).

Ionized serum calcium - an adequate intake of calcium and vitamin D is the first step in the prevention and treatment of osteoporosis. PTH and the active form of vitamin D (calcitriol) and to a lesser extent, sex hormones and glucocorticoids are crucial in maintaining the balance of calcium.

The analysis of our data found that the mean values and ionized serum calcium, in both groups, were within the normal range (Table 3 and 4).

Correlation analysis values of 25 (OH) D and ionized calcium has shown that there is no correlation between the examined parameters in the group of women with BMD ≤ -2.5 SD, which also applies to serum calcium (Figure 4 and 5).

There is evidence from clinical studies that when administered daily to women who are post-menopausal and osteoporotic, vitamin D not only increases bone mineral density but also reduces the risk of vertebral and non-vertebral fractures. This anti-fracture effect of vitamin D not only has a direct effect on bone, but also an indirect one, by increasing the muscle strength and thereby reducing the tendency to fall and the occurrence of fractures (Recker et al., 2004; Trivedi, Doll, & Khaw, 2003).

Table 8 shows the presence of risk factors in both groups. We analyzed the most common risk factors that were present in all subjects, and then they were graphically represented and grouped as follows: previous fractures in adulthood, early menopause (before 45 years), cigarette smoking (more than 10 cigarettes a day) and insufficient physical activity (Figure 6 and 7).

Previous fractures in adulthood - in the group of patients with BMD ≤ -2.5 SD, eight subjects had this risk factor. Out of these eight, seven had a value of 25 (OH) D below 25 nmol/L, which confirms very important role of initial serum concentration of 25 (OH) D for anti-fracture effectiveness of vitamin D. In the group of women with normal BMD, two women have presented with this risk factor.

Early menopause - in the group of patients with BMD ≤ -2.5 *SD*, nine subjects had this risk factor, which was also the most common risk factor in this study group. In the group of women with normal BMD, early menopause as a risk factor was present in three respondents.

Lack of physical activity - construction and remodeling of bone tissue, and suppression of osteoclasts work, imply that physical activity is a must in the prevention and treatment of osteoporosis. In order to raise these effects, physical activity must be a regular, appropriately intense and that of appropriate sort. This has the effect not only on bone density, but also on trabecular arrangement (Peluso & Guerra de Andrade, 2005). Exercises strengthen the muscles and improve the stability in movement, thus significantly reduce the risk of falls, particularly in the elderly, where the fall is the major risk for bone fractures. National Osteopoross Foundation sought update its consensus statement on peak bone mass. The working group has been formed and scientific literature searches from January 2000 through December 2014 were conducted with with reference to the way that lifestyle can affect the achievement of maximum bone density . The writing group concluded that there was strong evidence for the benefits of physical activity and calcium intake , moderately strong evidence for the benefits of vitamin D , and weaker evidence for the impact of other factors of lifestyle to achieve maximum bone density (Avenell, Mak, & Connell, 2014; Weaver, 2015;).

In the group with BMD ≤ -2.5 *SD*, insufficient physical activity was represented in three respondents, and in the group with normal BMD, this risk factor was most frequent (five subjects).

Smoking of cigarettes - in the course of our research, excess nicotine use is considered smoking more than 10 cigarettes per day, given that many studies have shown that "small amounts" of nicotine have no effect on BMD (Daniel, 1972). The effect of nicotine on bone mineral density reduction is achieved through increased levels of estrogen metabolism in the liver, impaired circulation, reduced resorption of calcium and vitamin D, and a direct action on bone cells (Deng et al., 2000). In our study, this risk factor

was present in seven subjects in the group with BMD ≤ -2.5 SD and in three women with normal BMD.

By testing the significance of differences of most commonly represented risk factors in both groups, we have not found statistical significance ($p > .05$) (Table 8).

CONCLUSON

1. Large percentage of post-menopausal women had vitamin D deficiency
2. Women with postmenopausal osteoporosis had significantly higher vitamin D deficiency in relation to postmenopausal women without osteoporosis.
3. In women with postmenopausal osteoporosis vitamin D deficiency leads to increased levels of parathyroid hormone.
4. Level of ionized calcium was significantly lower in women with postmenopausal osteoporosis.
5. Insufficient vitamin D in postmenopausal women is an important factor contributing to the reduction of bone mineral density.
6. The high prevalence of vitamin D deficiency in women with postmenopausal osteoporosis supports routine determination of the value of 25 (OH) D in order to select the appropriate treatment protocol.
7. Early menopause and previous fracture in adult life are the most common risk factors for osteoporotic fractures.
8. Decreased levels of vitamin D in women with postmenopausal osteoporosis leads to changes in the metabolism of calcium and parathyroid hormone.

REFERENCES

Aloia, J. F. (2001). Optimal vitamin D status and serum parathyroid hormone. *Br J Nutr*, *86*(1), 97–103.

Aloia, J. F., Feuerman, M., & Yeh, J. K. (2006). Reference Range for serum Parathyroid Hormone. Endocrine Practice Journal-American Association of Clinical *Endocrinologists*, *12*(2), 137–144. doi: 10.4158/EP.12.2.137; PMid: 16690460; PMCid: PMC1482827

Aloia, J. F., Talwar, S. A., Pollack, S., Feuerman, M., & Yeh, J. K. Optemal vitamin D status and serumparathyroid hormone concentrations in African American women. *Am J Clin Nutr*, *84*(3), 602–609.

Anđelković, Z. (2009). Značaj određivanja statusa vitamina D u posmenopauzalnoj osteoporozi [The significance of the status of vitamin D in postmenopause osteoporosis]. *Balneoclimatologija*, 33(4), 3–9.

Avenell, A., Mak, J. C., & O'Connell, D. (2014). Vitamin D and Vitamin D analogues for preventing fractures in post-menopausal women and older men. *Cochrane Database Syst Rev*., 4: CD000227. doi: 10.1002/14651858.cd000227.pub4

Bischoff-Ferrari, H. A., Dawson Hughes, B., Willet, W. C., Staehelin, H. B., Bazemore, M. G., Zee, R. Y., & Wong, J. B. (2004). Effect of vitamin D on falls. *JAMA*, *291*(16), 1999–2006. doi: 10.1001/jama.291.16.1999; PMid: 15113819

Bischoff-Ferrari, H. A., Willett, W. C., Wong, J. B., Giovannucci, E., Dietrich, T., & Dawson-Hughes, T. (2005). Fracture prevention with vitamin D supplementation: a metaanalysis of randomized clinical trials. *JAMA*, *293*(18), 2257–2264. doi: 10.1001/jama.293.18.2257; PMid: 15886381

Bronner, F. (2001). Extracellular and intracellular regulation of calcium homeostasis. *Sci World J*, 1, 919–925. doi: 10.1100/tsw.2001.489; PMid: 12805727

Brixen, K., Abrahamsen, B., & Kassem, M. (2005). Prevention and treatment of osteoporosis in women. *Current Obstetrics & Gynaecology*, 15, 251–258. doi: 10.1016/j.curobgyn.2005.05.003

Canalis, E. (2010). Update in new anabolic therapies for osteoporosis. *J Clin Endocrinol Metab*, *95*(4), 1496–1504. doi: 10.1210/jc.2009-2677; PMid: 20375217; PMCid: PMC2853988

Cooper, A. L. (2006). Improved patient persistence on once-monthly dosing regime plus patient support compared with a weekly dosing regime Abstract P798MO. In *IOF World Congress on Osteoporosis*. Toronto, Canada.

Cosman, F., deBeur, S. J., LeBoff, M. S.. Lewiecki, E. M., Tanner, B., Randall, S., & Lindsay, R. (2014). Clinical GUide to Prevention and Treatment of Osteoporosis. *Osteoporosis Int*, 25, 2359–2381. doi: 10.1007/s00198-014-2794-2; PMid: 25182228 ;PMCid: PMC4176573

Cumming, R. G., & Nevitt, M. C. (1997). Calcium for prevention of osteoporotic fractures in postmenopausal women. *J Bone Miner Res*, 13, 1530–1538. doi: 10.1359/jbmr.1997.12.9.1321

Ćirković, M., Petronijević, M., Ristić, G., Glišić, B., & Stefanović, D. (2010). Značaj određivanja koncentracije vitamina D u prevenciji preloma kod postmenopauzalnih žena [The significance

of determining the concentration of vitamin D in the prevention of fractures in postmenopausal women]. *Acta Rheumatologica Belgradensia*, *40*(2), 124

Daniel, H. W. (1972). Osteoporosis and smoking. *JAMA*, 221-240. doi: 10.1001/jama.1972.03200180051022; doi: 10.1001/jama.221.5.509b

Dawson-Hughes, B., Heaney, R. P., Holick, M. F., Lips, P., Meunier, P. J., & Vieth, R. (2005). Estimates of optimal vitamin D status. *Osteoporosis Int*, *16*(7), 713–716. doi: 10.1007/s00198-005-1867-7; PMid: 15776217

Deng, H., Chen, W., Conway, T., Zhou, Y., Daves, K. M., Stegman, M. R., ... Recker, R. R. (2000). Determination of bone mineral density of the hip and spine in human pedigrees by genetic and life-style factors. *Genetic Epidemiology*, 19, 160–167. doi: 10.1002/1098-2272(200009)19:2<160::AID-GEPI4>3.0.CO;2-H

Ettinger, P. M. (2003). Aging bone and osteoporosis. *Archives of Internal Medicine*, *163*(18), 2237–2246. doi: 10.1001/archinte.163.18.2237; PMid: 14557222

Feskanich, D., Willett, W., & Colditz, G. (2002). Walking and leisure-time activity and risk of hip fracture in postmenopausal women. *JAMA*, *288*(18), 2300-2306. doi: 10.1001/jama.288.18.2300; PMid: 12425707

Grand, A. M., Avenell, A., Campbell, M. K., McDonald, A. M., MacLennan, G. S., McPherson, G. C., ... Wallace, W. A. (2005). Oral vitamin D3 and calcium for secondary prevention of low trauma fractures in elderly people (Randomised Evaluation of Calcium or Vitamin D, RECORD): A randomised placebo-controlled trial. *Lancet*, *365*(9471), 1621–1628. doi: 10.1016/S0140-6736(05)63013-9

Greiwe, J. S., Cheng, B., Rubin, D. C., Yarasheski, K. E., & Semenkovch, C. F. (2001). Resistance exercise decreases skeletal muscle tumor necrosis factor in frail elderly humans. *FASEB J*, *15*(2), 475–482. doi: 10.1096/fj.00-0274com; PMid: 11156963

Holick, M. F. (2007). Vitamin D deficiency. *N Engl J Med*, 357(3), 266–281. doi: 10.1056/NEJMra070553; PMid: 17634462

Iqbal, M. M. (2000). Osteoporosis: epidemiology, diagnosis and treatment. *South Med J*, 93, 2–18. doi: 10.1097/00007611-200001000-00001; doi: 10.1097/00007611-200093010-00002; PMid: 10653058

Jackson, R. D., LaCroix, A. Z., Gass, M. Wallace, R. B., Robbins, J., Lewis, C. E., ... Barad, D. (2006). Calcium plus vitamin D supplementation and risk of fractures. *N Engl J Med*, 354, 669–683. doi: 10.1056/NEJMoa055218; PMid: 16481635

Jovičić, S., Ignatović, S., Beletić, A., Mirković, D., & Majkić-Singh, N. (2012). Poređenje tri različite metode za određivanje 25(OH)D i statusa vitamina D u opštoj populaciji [Comparison of three different methods for the determination of 25 (OH) D and vitamin D status in the general population]. *Journal of Medical Bichemistry*; 31(4), 347–357.

Kanis, J. A., Olden, A., Johansson, H., Borgstrom, F., Storm, O., & McCloskey, E. (2009). FRAX its applications to clinical practice. *Bone*, *44*(5), 734–743. doi: 10.1016/j.bone.2009.01.373; PMid: 19195497

Kuchuk, N. O., van Schoor, N. M., Pluim, S. M., Chines, A., & Lips, P. (2009). Vitamin D status, parathyroid function, bone turnover, and BMD in postmenopausal women with osteoporosis: global perspective. *J Bone Mener res*, 24(4), 693–701. doi: 10.1359/jbmr.081209; PMid: 19049341

Lanyon, L., & Skerry, T. (2001). Postmenopausal osteoporosis as a failure of bone's adaptation to functional loading: a hypothesis. J *Bone Miner Res.*, *16*(11), 1937–1947. doi: 10.1359/jbmr.2001.16.11.1937; PMid: 11697789

Lips, P. (2006). Vitamin D physiology. *Prog Biophys Mol Biol*, 92(1), 4–8. doi: 10.1016/j.pbiomolbio.2006.02.016; PMid: 16563471

Lips, P., Hosking, D., Lippuner, K., Norquist, J. M., Wehren, L., Maalouf, G., ... Chandler, J. (2006). The prevalence of vitamin D inadequacy amongst women with osteoporosis: an international epidemiological investigation. *J Intern Med*, 260, 245–254. doi: 10.1111/j.1365-2796.2006.01685.x; PMid: 16918822

McCloskey, E. (2006). Using risk factors for diagnosis ond treatment of osteoporosis. *Osteoporosis Int*, *17*(12), 112–115.

Morris, H. A., & Anderson, P. H. (2010). Autocrine and paracrine action of Vitamin D. *Clin Biochem Rev*, 31(4), 129–138. PMid: 21170259; PMCid: PMC2998276

National Osteoporosis Foundation. (2003). *Physicians guide to prevention and treatment of osteoporosis*. Washington, DC: National Osteoporosis Foundation (NOF).

National Osteoporosis Foundation. (2015). *Interdisciplinary symposium on osteoporosis*. Washington, DC: National Osteoporosis Foundation (NOF).

Nuti, R., Bianchi, G., Brandi, M. L., Caudarella, R., Derasmo, E., Fiore, C., ... Ortolani, S. (2009). Superiority of alfacalcidol compared to vitamin D plus calcium in lumbal bone mineral density in postmenopausal osteoporosis. *Rheumatol Int*, *26*(5), 445–453. doi: 10.1007/s00296-005-0073-4; PMid: 16283320

Outila, T. A., Kärkkäinen, M. U., & Lamberg-Allardt, C. J. (2001). Vitamin D status affects serum concentrations during winter in female adolescents: associations with forearm BMD. *Am J Clin Nutr*, *74*(2), 206–210. PMid: 11470722

Owen, T. A., Aronow, M. S., Barone, L. M., Stein, G. S., & Lian, J. B. (1991). Pleiotropic effects of vitamin D on osteoblast gene expression are related to proliferative and differentiated state of the bone cell phenotype: dependency upon basal levels of gene expression, duration of exposure, and bone matrix competency in normal rat osteoblast cultures. *Endocrinology*, 128, 1496–1504. doi: 10.1210/endo-128-3-1496; PMid: 1999168

Richard, J. B, Rivadeneira, F., Inouye, M., Pastinen, T. M., Soranzo, N., Wilson, S. G. ... Hart, P. (2008). Bone mineral density, osteoporosis and osteoporotic fractures: a genome wide association study. *Lancet*; *371*(9623), 1505–1512. doi: 10.1016/S0140-6736(08)60599-1

Panneman, M. J., Lips, P., Sen, S. S., & Herings R. M. (2004). Undertreatment with anti osteoporotic drugs after hospitalsation for fracture. *Osteoporosis Int*, *15*(2), 120–124. doi: 10.1007/s00198-003-1544-7; PMid: 14618302

Peacock, M., Selby, P. L., Francis, R. M., Brown, W. B., & Hordon, L. (1985). Vitamin D deficiency, insufficiency, sufficiency and intoxication. What do they mean?. In A.W. Norman, K. Schaefer, H. G. Grigoleit, & D. V. Herrath (Eds.), *Vitamin D: Chemical, biochemical and clinical update* (pp. 569–570). Berlin, Germany: Walter de Gruyter.

Peluso, M. A., & Guerra de Andrade, L. H. S. (2005). Physical activity ond mental haelth: the assotiation betveen exercise and mood. *Clinics.*, *60*(1), 61–70. doi: 10.1590/S1807-59322005000100012; PMid: 15838583

Pilipović, N., Branković, S., & Vujasinović, N. (2005). Koštana masa i prelomi kostiju kod stanovnika Beograda [Bone mass and bone fractures in the population of Belgrade]. *Acta Rheum Belgr*, *35*(1), 35–39.

Recker, R. R., Stakkestad, J. A., Chesnut, C. H., Christiansen, C., Skag, A., Hoiseth, A., ... Delmas, P. D. (2004). Insufficiently dose intravenous ibandronate injections are associated with suboptimal antifracture efficacy in postmenopausal osteoporosis. *Bone*, *34*(5), 890–899. doi: 10.1016/j.bone.2004.01.008; PMid: 15121021

Roodman, G. D. (1999). Cell biology of the osteoclast. *Exp Hemat*, *27*(8), 1229–1231. doi: 10.1016/S0301-472X(99)00061-2

Sempos, C. T., Vesper, H. W., Phinney Thienpont, L. M., & Coates, P. M. (2012). Vitamin D status as an international issue: National surveysand the problem standardization. *Scand J Clin Lab Invest*, 243, 32–40.

Shoback, D., Marcus, R., Bikle, D., & Strewler, G. J. (2001). Mineral metabolism and metabolic bone disease. In F. S. Greenspan & D. G. Gardner (Eds.), *Basic and Clinical Endocrinology* (pp 485–493). New York, NY: McGraw–Hill.

Siris, S. E. (2004). Bone health menopause: Assessing who is at risk of developing osteoporosis. In *Satellite Symposium at IOF World Congress on Osteoporosis* (pp. 7–8). Rio De Janeiro, Brazil: International Osteoporosis Foundation.

Sornay-Rendy, E., Munoz, F., Garnero, P., & Delmas, P. D. (2005). Identification of osteopenic women at high risk of fracture: The OFELY study. *J Bone Mener Res*, *20*(10), 1813–1819. doi: 10.1359/JBMR.050609; PMid: 16160738

Souberbielle, J. C., Cormier, C., Kindermans, C, Gao, P., Cantor, T., Forette, T., & Baulieu, E. E. (2001). Vitamin D status and redefining serum parathyroid hormone reference range in the elderly. *J Clin Endocrinol Metab.*, *86*(7), 3086–3090. doi: 10.1210/jcem.86.7.7689; doi: 10.1210/jc.86.7.3086; PMid: 11443171

Souberbielle, J. C., Lawson-Body, E., Hammadi, B., Sarfati, E., Kahan, A., & Cormier, C. (2003). The use in clinical practice of parathyroid hormone normative values established in vitamin D-sufficient subjects. *J Clin Endocrinol Metab.*, *88*(8), 3501–3504. doi: 10.1210/jc.2003-030097; PMid: 12915625

Stefanović, D., Zečević, R., & Petronijević, M. (2009). *Vitamin D i analozi za zdrave kosti, za zdrav život* [Vitamin D and analogues for healthy bones, for healthy life]. Belgrade, Serbia: Actavis trading.

Stevenson, J. C., & Marsh, M. S. (2007). *An atlas of osteoporosis*. 3rd edition. London, Unred Kngdom: Informa UK Ltd. doi: 10.3109/9780203090848

Sweet, M. G., Jeremiah, M. P., & Galazka, S. S. (2009).Diagnosis and treatment of osteoporosis. *Am Fam Physician*, *79*(3), 193–200. PMid: 19202966

Trivedi, D., Doll, R., & Khaw, E. (2003). Effects of fourly oral vitamin D supplementation on fractures ond mortality in men and women living in the community: randomised double blind controlled trial. *BMJ*, *326*(7387), 469–475. doi: 10.1136/bmj.326.7387.469; PMid: 12609940; PMCid: PMC150177

Tuck, S. P., & Francis, R. M. (2002). Osteoporosis. *Postgrad Med J*, *78*(923), 526–532. doi: 10.1136/pmj.78.923.526; PMid: 12357012; PMCid: PMC1742482

Vieth, R, & Fraser, D. (2002). Vitamin D insufficiency: No RDA exists for this nutrient. *Can Med Assoc J*, *166*(12), 1541–1542.

WHO. (1994). *Study Group on assessment of fracture risk and application to screening for postmenopausal osteoporosis*. Report of WHO study group. Geneva, Switzerland: WHO Technical Report Series, 1-129.

Weaver, C. M. (2015). Parellels between nutrition and physical activity: research questions in development of peak bone mass. *Res Q Exerc Sport*, *86*(2), 103–106. doi: 10.1080/02701367.2015.1030810; PMid: 25965111

Winsloe, C., Earl, S., Dennison, E. M., Cooper, C., & Harvey, N. C. (2009). Early life factors in the pathogenesis of osteoporosis. *Curr Osteoporos Rep.*, *7*(4), 140–144. doi: 10.1007/s11914-009-0024-1; PMid: 19968918

Zizic T. (2004). Pharmacologic prevention of osteoporotic fractures. *Am Fam Physician*, *70*(7), 1293–3000. PMid: 15508540

Received: Febreuary 19, 2015
Revision received: May 28, 2015
Accepted: Jun 25, 2015

Correspondence to:
Tatjana Milivojac, MSc
School of Medicine
Save Mrkalja 14
78000 Banja Luka
Bosnia and Herzegovina
Phone: 00387 65 82 30 84
E-mail: tatjanamilivojac@yahoo.com

SportLogia
2015, 11(1), 34–42
e-ISSN 1986-6119

www.SportLogia.com

MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES OF PHYSICALLY ACTIVE AND INACTIVE FEMALE HIGH-SCHOOL STUDENTS

Marijana Simić[1], Jovan Vuković[1], Saša Marković[2], and Mila Vukadinović[1]

[1]Faculty of Sport and Physical Education, University of Novi Sad, Serbia
[2]Faculty of Physical Education and Sport, University of Banja Luka, Bosnia and Herzegovina

ORIGINAL SCIENTIFIC ARTICLE
doi: 10.5550/sgia.151101.en.003M
UDC: 796.012.1-057.874

SUMMARY

On a sample of 72 girls from high school „Svetozar Miletic“ from Novi Sad, age 18 ± 6 months divided into two groups: physically active (at least 30 minutes of daily physical activities of moderate intensity) and insufficiently physically active (below average) was performed a research of transversal character with intent to determine whether there are statistically significant differences in morphological characteristics and motor abilities. The study applied 13 variables, five morphological (body height, body weight, body mass index, body fat percentage, m muscle mass percentage) and 8 motorically (flamingo balance test, hand tapping, sit and reach, standing broad jump, from lying to sitting position for 30 seconds, bent arm hang, shuttle run 10x5 m and endurance shuttle run). Obtained results of multivariate analysis (MANOVA) indicate that there are statistically significant differences between the variables in morphological characteristics at level of $p = .02$ and motoric abilities at the level of $p = .00$, while univariate analysis (ANOVA) indicates, that in morphological characteristics there are only differences in the percentage of muscle mass, at the level of $p = .006$, while in motor abilities difference was determined in all variables.

Key Words: active, inactive, morphological characteristics, motor abilities.

INTRODUCTION

Physical activity is one of the criteria for assessing the health, while physical inactivity has been identified as the fourth leading risk factor for overall mortality which globally contributes to 3.2 million deaths per year (WHO, 2012).

Physical activity is associated with numerous health benefits (Bouchard, Blair, & Haskell, 2012), and studies have shown that even small and moderate activity can contribute to the improvement of health status (Blair, 2005), both for adults and for children and adolescents (Camero, Hobbs, Stringer, Brancum, & Taylor, 2012). Physical activity is particularly important for children and youth because it promotes healthy growing up and affects social (Malina, Bouchard, & Baror, 2004) and cognitive development (Biddle & Asare, 2011). In most countries, children and adolescents are not active enough (Guthold, Cowan, Autenrieth, Kann, & Riley, 2010; Hellal et al., 2012; Troiano et al., 2008).

Although positive effect of physical exercise on physical and mental health is scientifically proven (Byrne & Byrne, 2003; Heyward, 1991; Plonczynski, 2000; Weinberg & Gould, 2007), and indirectly on the overall quality of life, statistics show that most people are not sufficiently physically active. Physical inactivity among young people has increased dramatically during the last few decades (Brodersen, Steptoe, Boniface, & Wardle, 2007) and represents a clear threat to health both in developed and developing countries. In the research on physical fitness and sports lifestyle conducted and published by the International Council of Sport Science and Physical Education (Telama, Naul, Nupponen, Rychtecký, & Vuolle, 2002), with the participation of over 60,000 respondents aged 12 to 15 years from six European countries, participating in sports as a form of recre-

ation was ranked 6th, while the same study ranked participation in organized competitive sports as 9th on the list of leisure activities.

Regular physical activity is a key determinant for energy consumption and is of fundamental importance for the energy balance and body weight control. It also reduces the risk of cardiovascular and cerebrovascular diseases, diabetes, breast cancer and colon cancer, depression... Therefore, the World Health Organization recommends 30 minutes of physical activity of moderate intensity (National Health Survey Serbia, 2014).

A study conducted in the US (Bammel & Burrus-Bammel, 1992) showed that young people spend up to six hours a day in front of TV and sleeping is the only activity that young Americans practiced more than watching TV, and research from Poland (Drygas, Kwasniewski, Kaleta; & Ruszkowski-Majzel, 2008) has shown that over 50% of young people between 15 and 19 years of age do not participate in any sports or recreational activity but spend 15 hours a week in activities that do not demand any physical activity. According to the research performed by the Institute for Public Health "Dr Milan Jovanovic Batut" in 2006, almost one-fifth of children and adolescents aged 7-19 in Serbia (18%) were moderately obese and obese, which is an increase compared to 2000. The increase in the number of moderately obese and obese children in Serbia is the result of bad eating habits and lack of physical activity. The incidence of obesity, according to UNICEF data from 2007 in children under five years of age in Serbia, is 15% (Đokić, Međedović, & Smiljanić, 2011).

Positive aspects of regular physical activity can be seen on physical and mental health, and psychosocial development. It's never too early to start adopting healthy habits and education about the importance of physical activity: studies show that the majority of children engaged in sports and physically active in childhood, also keep these habits later when they grow up. Sport has a positive effect on development of personality – children engaged in some sporting activity during the early age develop good work habits and self-discipline early in their life. Sport on the other hand has a positive role in the emotional development of children since it facilitates the process of their socialization. There are many reasons in favor of sports. Sport and physical activity may prevent the excessive obesity in childhood and of course in adulthood. Sport and physical activity help in developing self-awareness and reduce anxiety and stress. Sport teaches a child both how to surpass and to accept defeat and it teaches it fair play in the game and in life, and leads to developing friendships.

Regarding young people, sports programs lead to the development of skills, teamwork, self-discipline, better socialization in the society. The world is facing new challenges to maintain and improve the health of people. The way of life has changed in the developed world. A better standard of living has not been used for the advancement and improvement of health and therefore we are exposed to threats of new pandemics of non-communicable diseases such as obesity, heart disease and vascular disease, diabetes, cancer, osteoporosis.

On the basis of this conclusion we come to the basic problem of this research and these are the morphological characteristics and motor abilities of physically active and inactive female high-school students. Starting from the basic problem, the subject of this paper is the difference in morphological characteristics and motor abilities of physically active and inactive female high-school students. The purpose of our study was to analyze morphological and motor variables in physically active and inactive female high-school students with the aim to determine whether there are statistically significant differences between the two groups.

This work provides answers for the two following questions: there are statistically significant differences in morphological characteristics of physically active and inactive female students, and there are statistically significant differences in motor skills of physically active and inactive female students.

METHODS

Sample of respodents

Sample of respondents

The total sample in this study consists of 72 female students from high school "Svetozar Miletic" from Novi Sad, aged 18 ± 6 months, who were divided into two groups: the first group consists of 36 female students who are considered to be physically active (minimum 30 minutes a day of practicing physical activity of moderate intensity) and the second group consists of 36 female students who are considered to be insufficiently physically active (under 30 minutes).

Sample of variables

In order to determine the morphological status and level of motor abilities of female students, with the aim of monitoring and comparing the results, four morphological characteristics were measured for all students in the sample: body height (anthropometer by Martin), body weight, body fat percentage,

muscle mass percentage (body composition determining system, Omron BF511). Body mass index BMI is calculated using a simple mathematical formula that shows the relationship between weight and height:

BMI = body weight (kg) / body height^2 (m)

The motor skills were evaluated using the Eurofit battery (Nićin, 2000) composed of eight tests: flamingo balance test, hand taping, sit-and-reach, standing broad jump, trunk lifting, bent arm hang, 10x5 m shuttle run, 20 m endurance shuttle run.

Description of the measurement procedure

All tests were performed in the morning during physical education class in the gym on working days. Testing was conducted by five examiners, professors of physical education. Anthropometric measurements were performed immediately before checking physical abilities. In the first half of the testing period (the first class) anthropometric measurements and tests of balance, flexibility and strength were conducted, while during the second class tests of speed and endurance were performed.

Data processing methods

This study had a transversal character. The data obtained in the survey were analyzed using descriptive and comparative statistics. Regarding the domain of descriptive statistics the mean value, minimum, maximum, and standard deviation were shown. The Kolmogorov-Smirnov test was used to determine the normality of distribution, while, regarding the domain of comparative statistics, multivariate analysis of variance (MANOVA) and univariate analysis of variance (ANOVA) were used to determine the significance of differences between arithmetic means of the respondents.

RESULTS AND DISCUSSON

In accordance with previously established research objective, the thematic unit of morphological characteristics of girls in relation to the level of physical activity will be analyzed in Table 1. The analysis will be conducted on the following morphological characteristics: body height, body weight, body mass index, % of body fat, % of muscle mass. The descriptive parameters of morphological variables in physically active and inactive female students indicate that there are no statistically significant deviations from the normal distribution in all variables, which was suggested by the results of Kolmogorov-Smirnov (KS) test.

By examining the mean values of the results it was observed that the results regarding growth and development are within expected limits of the reasonably possible values for the studied age as indicated by Rakić (2009, 2010) and Pavlica (2012). The average height of physically active girls is 156 cm, while the average height of physically inactive girls is 166.4 cm which, compared with research results from Rakić

TABLE 1

Descriptive statistics of morphological variables for physically active (1) and physical inactive (2) female students.

Varables	Group	M	Min	Max	SD	K-S
BH	1	156.00	155.40	181.30	59.31	.94
	2	166.40	155.40	179.00	63.71	.65
BW	1	45.20	48.10	76.90	75.17	.97
	2	59.10	48.10	71.70	71.31	.63
BMI	1	17.50	21.80	27.70	2.29	.88
	2	21.30	17.30	26.70	2.22	.98
BFP	1	17.40	28.40	40.50	5.76	.70
	2	29.60	7.30	42.80	6.43	.95
BMMP	1	25.90	30.70	40.90	3.36	.57
	2	28.50	15.40	33.40	3.31	.53

Legend: **M** - Mena; **Min** - Minimum; **Max** - Maximum; **SD** - Standard deviation; **K-S** - Statistcal signficance by Kolmogorov-Smirnov test; **BH** - Body height; **BW** - Body weight; **BMI** - Body mass index; **BFP** - Body fat percentage; **BMMP** - Body muscle mass percentage.

(2009) in which it was found that the average height in the 17th year was 167.2 cm and in the 18th 167.4 cm, is similar to results of this research. The average value of body weight in physically active girls is 45.1 kg while the average weight in physically inactive girls is 59.1 kg. In Rakić (2009) average weight for age of 17 years was 60.58 kg and for age of 18, 62.16 kg. Similar values regarding the average results were obtained in studies by Pavlica (2012) and Rakić (2010). The analysis of the minimum and maximum results of all the variables do not show some significant individual differences in the variables for the assessment of the morphological status of the students.

Further analysis of differences between minimum and maximum values between groups reveals that the group 1 – physically active female students have higher values than the group 2 –physically inactive female students in almost all variables, except for the variable (BMI) Body mass index for which second group has higher results for minimum and maximum values. The percentage of body fat is higher (BFP), i.e. the results are also higher for second group: 42.8, but it represents the worst result since this is an inverse variable (the higher percentage – the worse result).

Table 2 shows the results of motor tests for both groups of respondents in the area of basic motor skills. The descriptive parameters of morphological variables for physically active and inactive female students indicate that there are no statistically significant deviations from the normal distribution in all variables, which is also shown by the results of KS test. Examining the mean values of the results reveals that the results are in realistic boundaries. The analysis of the minimum and maximum results for some variables (flamingo test – FLAM, bent arm hang – BAH, shuttle run – SHR, endurance shuttle run – ESHR) shows a greater range of values for variables used for assessing the motor status of female students

Further analysis of minimum and maximum values among groups reveals that the group 1 – physically active female students, have higher values than the group 2 – physically inactive female students regarding most of the variables, except for the variables: flamingo test FLAM, hand tapping HTAP and shuttle run SHR, with higher values for the second group, which was the worse result since this is an inverse variable (the higher value – the worse result). Greater value is achieved by group 2 only for a

TABLE 2

Descriptive statistics of motor variables for physically active (1) and physically inactive (2) female students.

Varables	Group	M	Min	Max	SD	K-S
FLAM	1	9.74	1.00	21.00	4.69	.70
	2	15.26	4.00	30.00	7.75	.04
HTAP	1	130.62	108.00	167.00	15.60	.96
	2	142.24	114.00	183.00	16.43	.77
SAR	1	609.12	430.00	770.00	91.00	.76
	2	545.79	320.00	710.00	85.57	.66
SBJ	1	171.74	149.00	200.00	14.24	.31
	2	150.63	74.00	202.00	27.44	.99
TRL	1	24.03	19.00	32.00	3.43	.67
	2	19.13	14.00	29.00	3.06	.72
BAH	1	307.71	81.00	754.00	186.11	.40
	2	114.24	10.00	411.00	91.21	.16
SHR	1	197.35	170.00	219.00	13.01	.83
	2	215.79	185.00	239.00	12.48	.87
ESHR	1	665.29	320.00	1300.00	211.33	.23
	2	362.11	100.00	680.00	125.18	.79

Legend: **M** - Mena; **Min** - Minimum; **Max** - Maximum; **SD** - Standard deviation; **K-S** - Statistcal signficance by Kolmogorov-Smirnov test; **FLAM** - Flamingo balance test; **HTAP** - Hand taping; **SAR** - Sit-and-reach; **SBJ** - Standing broad jump; **TRL** - Trunk lifting; **BAH** - Bent arm hang; **SHR** - 10x5 meter shuttle run; **ESHR** - 20 meters endurance shuttle run.

maximum result for variable standing broad jump SBJ (202).

By analyzing the differences between the morphological characteristics of the system variables from the two groups, based on the results of multivariate analysis of variance, significance level of $p = .02$, one can conclude that there is a statistically significant difference between these groups regarding the total system of variables, Table 3. Based on the values obtained by the univariate analysis of variance and values of F relation of univariate test, it can be concluded that between physically active and physically inactive girls regarding the morphological status, there are statistically significant differences only regarding one variable: the percentage of muscle mass (BMMP), at the level of $p = .01$, while no statistically significant differences ($p > .05$) were found for other variables.

The results of multivariate analysis of variance for eight of the observed characteristics of the motor space, with a significance level of $p = .00$, indicate that there are statistically significant differences in the level of motor skills among physically active and physically inactive female students. The analysis of individual variables from univariate analysis of variance for eight of the observed characteristics of the motor space, found that there are statistically significant differences in the level of motor skills between physically active and physically inactive female high-school student for all variables at the level of $p < .05$.

Physical fitness has proved to be an important factor when it comes to public health both in grown-ups (Mette, Talbot, Schrager, & Conwit, 2002; Venn et al, 2007) and in children and adolescents (Ortega et al., 2008; Ortega, Ruiz, Castillo, & Sjostrom, 2008;

TABLE 3

Differences in individual variables regarding the morphological status of physically active (1) and physically inactive (2) female students (ANOVA).

Varables	M_{SV1}	M_{SV2}	*F*	*p*
BH	156.00	166.00	.18	.67
BW	45.20	59.10	.31	.58
BMI	17.50	21.30	.83	.37
BFP	17.40	29.60	.73	.40
BMMP	25.90	28.50	8.07	**.01**

Legend: $\mathbf{M_{SV1}}$ - Mena group 1; $\mathbf{M_{SV2}}$ - Mena group 2; **F** - Tabular value of Fischer distribution; **p** - Probibility; **BH** - Body height; **BW** - Body weight; **BMI** - Body mass index; **BFP** - Body fat percentage; **BMMP** - Body muscle mass percentage; $F = 2.70$; $p = .02$.

De Bourdeaudhui, 1998; Sallis, 1994; Sallis et al, 1992). All studies have shown that the time spent in physical activity among adolescents is reduced, and that the time spent in sedentary lifestyle increases (Nader, Bradley, Houts, McRitchie, & O'Brien, 2008), and both trends are more pronounced in girls (Brettschneider et al., 2010; Silva et al., 2010; Troiano et al., 2008), followed by the deterioration of their physical condition, especially endurance and strength (Beunen et al., 1992; Froberg & Andersen, 2010; Tomkinson & Olds, 2007; Westerståhl, Barnekow-Bergkvist, & Jansson, 2005) and in activities that require running capacity (Froberg & Andersen, 2010; Tomkinson & Olds, 2007; Wedderkopp, Froberg, Hansen, & Andersen, 2004).

The analysis of mean values shows us that the group 1 – physically active female students showed significantly better results in all respects of motor space compared to group 2 – physically inactive female students.

In accordance with the recommendations of the "President's Council on Physical Fitness and Sports" (Department of Health and Human Services, 2008) children and teenagers need 60 minutes of physical activity of moderate intensity daily in order to reach the consequent beneficial effects on their health. A similar recommendation was given by the World Health Organization: (a) children and young people aged 5 to 17 years should have at least 60 minutes of moderate to intense physical activity daily; (b) more than 60 minutes of physical activity provides the added benefit for the health of young people; (c) the greater part of the daily physical activities should be of aerobic character while more intensive activities, including those that develop strength and strengthen bones, should be included at least three times a week (Global Recommendations on Physical Activity for Health, 2011). Population studies show that many young people do not meet this requirement. Although

TABLE 4

Descriptive statistics of motor variables for physically active (1) and physically inactive (2) female students.

Varables	M_{SV1}	M_{SV2}	*F*	*p*
FLAM	9.74	15.26	13.03	**.00**
HTAP	130.62	142.24	9.42	**.00**
SAR	609.12	545.79	9.26	**.00**
SBJ	171.74	150.63	16.19	**.00**
TRL	24.03	19.13	40.98	**.00**
BAH	307.71	114.24	32.41	**.00**
SHR	197.35	215.79	37.65	**.00**
ESHR	665.29	362.11	56.22	**.00**

Legend: **M_{SV1}** - Mena group 1; **M_{SV2}** - Mena group 2; **F** - Tabular value of Fischer distribution; **p** - Probibility; **FLAM** - Flamingo balance test; **HTAP** - Hand taping; **SAR** - Sit-and-reach; **SBJ** - Standing broad jump; **TRL** - Trunk lifting; **BAH** - Bent arm hang; **SHR** - 10x5 meter shuttle run; **ESHR** - 20 meters endurance shuttle run.

80% of adolescents are physically active 30 minutes a day, less than half of them are active 60 minutes (Pate, Longi, & Heath, 1994).

Children spend more time than ever in institutions such as schools (Rønning, 2001) which itself results in less physical activity. School requirements also get bigger, often at the expense of physical education classes, although all studies suggest that physical activity is associated with better success in school (Brettschneider et al., 2004). In addition, in many European countries, young people walk or ride a bicycle to school lesser and lesser, and this is particularly evident in large cities (European Common Indicators, 2003).

Organized classes of physical education are one of the strategies to increase the level of recommended physical activity for children and adolescents (McKenzie et al., 2004; Task Force on Community Preventive Services, 2002).

CONCLUSON

In accordance with the objectives of the research we tested the differences between groups of female students who are engaged in any mode of physical activity of moderate intensity (sports games, recreation programs, skating, aerobics programs, etc.) and who are considered to be physically active (minimum 30 minutes of practice a day) and insufficiently physically active female students (below average).

Based on the results of the morphological status research, differences have been found between the groups at the level of $p = .02$. By analyzing some individual variables it can be concluded that in only one variable, there is a statistically significant difference: the percentage of body muscle mass (BMMP), at the level of $p = .00$, which is in some way a logical conclusion, because the muscle growth requires some stimulus, such as a physical exercise. Physical exercise increases the strength and endurance of muscles and therefore muscle mass is increased. In addition to physical activity, increasing of the muscle mass is largely affected by food, i.e. adequate intake of calories, carbohydrates and proteins. No statistically significant differences at $p < .05$ were observed regarding other variables. From the table of descriptive characteristics it can be observed that the Body Mass Index (BMI) and body fat percentage (BFP) are moving in a slightly larger borders and that both groups belong to the pre-obese and obese categories, i.e. they have excess body fat. The causes of obesity are complex and numerous, but one of the strongest predictors of obesity is genetic predisposition so excess body fat in these groups can be attributed to this factor and also the fact that many changes occur during puberty, both in mental and physical development.

Multivariate analysis of the system of motor skills among the groups found statistically significant differences at the level of $p = .00$, while the analysis of individual variables shows us that there are statistically significant differences among the groups for all the individual variables, as can be seen in Table 4. There are many reasons that support engagement in physical activities. These differences indicate how much physical activity and sport play an important role in the development of motor skills in adolescents as well as all other aspects that emerge from it (enhanced cardio-respiratory function, disease prevention, emotional stability, social and mental welfare, etc.).

REFERENCES

Bammel, G., & Burrus-Bammel, L. L. (1992). *Leisure and human behavior*. Dubuque, IA: Wm.C.Brown Publishers.

Beunen, G., Lefevre, J., Claessens, A., Lysens, R., Maes, H., Renson, R., (1992). Age-specific correlations analyses of longitudinal physical fitness in men. *European Journal of Applied Physiology and Occupational Physiology*, 64, 538–545. doi: 10.1997/BF00843765

Brettschneider, W., Neal, R., Armstrong, N., Diniz, J., Froberg, K., & Laakso, L. (2004). *Study on young people's lifestyle and sedentariness and the role of sport in the context of education and as a means of restoring the balance*. Paderborn, Germany: EC, Directorate-General for Education and Culture, Unit Sport.

Biddle, S. J., & Asare, M. (2011). Physical activity and mental health in children and adolescents: A review of reviews. *Br J Sports Med*, *45*(11), 886–895. doi: 10.1136/bjsports-2011-090185.

Blair S. (2005). Physical inactivity: The major public helth problem in 21st century. In: D. Milanović and F. Prot (Eds.), *Proceedings of 4th International Scientific Conference of Science and profession: Challenge of future* (p. 22). *Opatija*. Croatia. Zagreb: Fakulty of Kinesiology, University of Zagreb. PMid: 1560126

Bouchard, C., Blair, S. N., & Haskel, W. L. (2012). *Physical activity and health*. 2nd ed. Champaign, IL: Human Kinetics.

Brodersen, N. H., Steptoe, A., Boniface, D. R., & Wardle, J. (2007). Trends in physical activity and sedentary behaviour in adolescence: Ethnic and socioeconomic differences. *Br J Sports Med.*, 41, 140–144. doi: 10.1136/bjsm.2006.031138

Byrne, A, & Byrne, D. G. (1993). The effect of exercise on depression, anxiety, and other mood states: A review. *J Psychosom Res.*, 37, 565–574. doi: 10.1016/0022-3999(93)90050-P

Camero, M., Hobbs, C., Stringer, M., Branscum, P., & Taylor, L. (2012). A review of physical activity interventions on determinants of mental health in children and alolescentes. *International Journal of Mental Health Promotion*, 14, 196–206. doi: 10.1080/14623730.2012.752901

De Bourdeaudhui I. (1998). Behavioural factors associated with physical activity in young people. In: S. Biddle, J. Sallis, and N. Cavill (Eds.), *Young and active? Young people and health-enhancing physical activity: Evidence and implications*. London, Unted Kingdom: Health Education Authority.

Department of Health and Human Services: The President's Council on Physical Fitness and Sport. (2008). *Physical activity facts*. Rockville, MD: The President's Council on Physical Fitness and Sport; 2008. Retrived from http://www. fitness. gov/resources_factsheet.htm.

Drygas, W,. Kwaśniewska, M., Kaleta, D., & Ruszkowska-Majzel, J. (2008). *Increasing creational and leisure time physical activity in Poland – how to overcome barriers of inactivity. Journal of Public Health*, 16(1), 31–36. doi: 10.1007/s10389-007-0151-z

Đokić, Z., Međedović, B., & Smiljanić, J. (2011). Stanje uhranjenosti, posturalni status i kvalitet sprovođenja nastave fizičkog vaspitanja u osnovnim školama. *TIMS Acta*, 5, 10–19

European common indicators: Towards a local sustainability profile (Indicator 6 – Children's journeys to and from school). (2003). Milan, Italy: Ambiente Italia Research Institut.

Froberg, K., & Andersen, L. B. (2010). The importance of physical activity for childhood health. In: M. Kovač, and G. Jurak (Eds.), *Proceedings of the Fifth International Congress Youth Sport*. Ljubljana, Slovenia: Faculty of Sport, University of Ljubljana. PMCid: PMC3048259

Global recommendations on physical activity for health: 5–17 years old. (2011). Geneva: World Health Organization; Retrived from http://www.who.int/dietphysicalactivity/physical-activity-recommendations-17years.pdf?ua=1

Guthold, R., Cowan, M. J., Autenrieth, C. S., Kann, L., Riley, L. M. (2010). Phyisical activity and sedentary behavior among schoolchildren: A 34 – country comparison. *J Pedatr*, *157*(1), 43–49. doi: 10.1016/j.jpeds.2010.01.019

Hallai, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., & Ekelund, U. (2012). Global physical activity levels Surveillance progress, pitfalls, and prospects. *Lancet*, *380*(9838), 247–257. doi: 10.1016/S01406736(12)60646-1

Heyward, V. H. (1991). *Advanced fitness aassessment andexercise prescription*. 2nd ed. Champaign, IL: Human Kinetics.

Malina, R., Bouchard, C., & Baror, O. (2004). *Growth, maturation, and physical activity*. 2nd ed. Champaign, IL: Human Kinetics.

Mckenzie, T. L., Sallis, J. F., Prochaska, J. J., Conway, T. L., Marshall, S. J., & Rosengard, P. (2004). Evaluation of a two-year middle-school physical education intervention: M-SPAN. *Med Sci Sports Exerc*, 36, 1382–1388. doi: 10.1249/01.MSS.0000135792.20358.4D

Metter, E. J., Talbot, L. A., Schrager, M., & Conwit, R. (2002). Skeletal muscle strength as a predictor of all-cause mortality in healthy men. *J Gerontol A Biol Sci Med Sci.*, *7*(10), B359–B365. doi: 10.1093/gerona/57.10.B359

Nader, P. R., Bradley, R. H., Houts, R. M., McRitchie, S. L., & O'Brien, M. (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA*, *300*(3), 295–305. doi: 10.1001/jama.300.3.295

National Healt Survey Serbia. (2014). Republic of Serbia: Ministry of health. Retrived from http://www.batut.org.rs/download/publikacije/IstrazivanjeZdravljaStanovnistvaRS2013.pdf

Nićin, Đ., (2000). *Antropomotorika*. Novi Sad, Serbia: Fakultet fizičke kulture.

Ortega, F. B, Artero, E. G., Ruiz, J. R., Vicente-Rodriguez, G., Bergman, P., & Hagstromer, M. (2008). Reliability of health-related physical fitness tests in European adolescents. *Int J Obes.*, *32*(Suppl. 5), S49–S57. doi: 10.1038/ijo.2008.183

Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjostrom, M. Physical fitness in childhood and adolescence: A powerful marker of health. *Int J Obes.*, 32(1), 1–11. doi: 10.1038/sj.ijo.0803774

Pate, R. R., Long, B. J., & Heath, G. (1994). Descriptive epidemiology of physical activity in adolescents. *Pediatr. Exerc. Sci.*, 6, 434–447.

Pavlica, T., Rakić, R., Djuričanin, A., Korovljev, D., & Srdić, B. (2012). Growth and Nutritional Status of Childred and Adolescents from 7 to 19 Years of Age in the Town of Jagodina (Central Serbia). *HealthMED*, *6*(1), 284–292.

Plonczynski, D. J. (2000). Measurement of motivation for exercise. *Health Educ Res.*, 15, 695–705. doi: 10.1093/her/15.6.695

Rakić, R. (2009). *Značaj nekih faktora sredine na rast i razvoj dece i adolescenata u Vojvodini* [The importance of some environmental factors on the growth and development of children and adolescents in Vojvodina]. Unpublish doctoral dssertation, University of Novi Sad, Prirodno-matematički fakultet, Departman za biologiju i ekologiju.

Rakić, R., Božić-Krstić, V., & Pavlica, T. (2010). Age changes in height, weight and nutritional condition in adolescents from Novi Sad. *Acta morphologica et antropologica*, 15, 217–219.

Rønning, E. (2001). *Living conditions of children before and now*. Oslo, Swiden: Statistisk Sentralbyŕ. Retrived from http://www.ssb.no/vis/samfunnsspeilet/utg/200104/01/art-2001-09-20-01.html.

Sallis, J. F. (1994). Determinants of physical activity behavior in children. In: R. R. Pate, and R. C. Hohn (Eds.), *Health and Fitness through Physical Education*. Champaign, IL: Human Kinetics.

Sallis, J. F., Simons-Morton, G., Stone, E. J., Corbin, C. B., Epstein, L. H., Faucette, N. (1992). Determinants of physical activity and interventions in youth. *Med. Sci.Sports Exerc.*, 24, S248 –S257. doi: 10.1249/00005768-199206001-00007

Silva, P., Sousa, M., Aires, L., Seabra, A., Ribeiro, J., Welk, G. (2010). Physical activity patterns in Portuguese adolescents: The contribution of exra-curricular sports. *European Physical Education Review*, *16*(2), 171–181. doi: 10.1177/1356336X10381305

Task Force on Community Preventive Services. (2002). Recommendations to increase physical activity in communities. *Am J Prev Med*, 22, 67–72. doi: 10.1016/S0749-3797(02)00433-6

Telama, R., Naul, R., Nupponen, H., Rychtecký, A., & Vuolle, P. (2002). *Physical fitness, sporting lifestyles, and Olympic ideals: cross-cultural studies on youth sport in Europe*. Schorndorf, Germany: Karl Hofmann.

Tomkinson, G. R., & Olds, T. S. (2007). Secular changes in pediatric aerobic fitness test performance: *The global picture. Med Sport Sci.*, 50, 46–66. doi: 10.1159/000101075

Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*, *40*(1), 181–188. doi:10.1249/mss.0b013e31815a51b3

Venn, A. J., Thomson, R. J., Schmidt, M. D., Cleland, V. J., Curry, B. A., & Gennat, H. C. (2007). Overweight and obesity from childhood to adulthood: a follow-up of participants in the 1985 *Australian Schools Health and Fitness Survey. Med J Aust.*, *186*(9), 458–460. PMid: 17484707

Weinberg, R. S., & Gould, D. (2007). *Foundations of sport and exercise psychology*. 4th ed. Champaign, IL: Human Kinetics.

Westerståhl, M., Barnekow-Bergkvist, M. M., & Jansson, E. (2005). Low physical activity among adolescents in practical education. *Scandinavian Journal of Medicine & Science in Sports*, *15*(5), 287–297. doi: 10.1111/j.1600-0838.2004.00420.

WHO. (2012). Ageing and Life Course, Geneva. Retrived from http://www.who.int/ageing/about/facts/en/.

Wedderkopp, N., Froberg, K., Hansen, H. S., & Andersen, L. B. (2004). Secular trends in

physical fitness and obesity in Danish 9-year-old girls and boys: Odense school child study and Danish substudy of the European youth heart study. *Scand J Med Sci Sports.*, *14*(3), 150–155. doi: 10.1111/j.1600-0838.2004.00365.x

Received: December 30, 2014
Revision received: May 25, 2015
Accepted: Jun 15, 2015

Correspondence to:
Marijana Simić, MSC
Faculty of Sport and Physcal Educaton
Lovćenska 16,
21000 Novi Sad
Serbia
Phone: 00381 64 36 56 295
E-mail: marijanas15@gmail.com

SportLogia
2015, 11(1), 43–48
e-ISSN 1986-6119

www.SportLogia.com

INTERCONNECTION OF WOMEN EPEE FENCERS OF DIFFERENT QUALIFICATION INDICATORS

Briskin Yuriy[1], Pityn Maryan[1], Semeryak Zoryana[1], and Vaulin Oleksandr[1]

[1]Department of olympic, professional and adaptive sport, Lviv State University of Physical Culture, Ukrane

SHORT SCIENTIFIC ARTICLE
doi: 10.5550/sgia.151101.en.004Y
UDC: 796.015.1-055.2

SUMMARY

It is set that discrepancy in the structure and content of correlational connections between indicators of technical and tactical kinds of training of women epee fencers of different qualification can allow to confirm about the need of educational and training correction with use of accents on the improvement of hits accuracy without attention decrease on other kinds of training of qualified sportsmen on the stage of specialized basic development and their training level approach to model indicators of high qualified women epee fencers..

Key Words: interconnection, qualification, technical training, women epee fencers.

INTRODUCTION

Rivalry level in main fencing competitions of Ukraine between women epee fencers in quite low. In the training system it can be related to low quality of training at previous stages of long-term improvement. (Келлер, 1983; Шевчук 2007; Триперина 2004; Тышлер & Рыжкова, 2010).

Ability to correct the orientation of accentuated increases of specialized load amount that happens at the stage of specialized basic development is determined by indicators interconnection of different parts of sportsmen training with consideration of factors that provide sport result.

So, solving prerequisites of actual scientific and practical task of technical and tactical sportsmen improvement on the stage of specialized basic development should be seen in setting the interconnections between indicators of technical training and other parts of women epee fencers of different qualification training and their characteristics.

Fencing refers to a group of combat arts with variant conditions of competitive activity that sets the priority in the structure of sportsmen training and abilities for effective realization of all technical and tactical actions (Келлер, 1983; Семеряк & Смирновський, 2013; Турецкий, 1991). Main attention of specialists in fencing in set on the questions that are related to the structure and content of competitive activity in different kinds of weapons, improvement of different kinds of fencers training and their control that basically solve the question of sportsmen training and only partly solve the question of theoretical and methodological aspects of fencing training (Келлер, 1983; Семеряк & Смирновський, 2013; Шилова, 1992; Тышлер & Мовшович, 1993; Тышлер & Рыжкова, 2010).

This research is performed in according to topic 2.8 "Improvement of sportsmen training in groups of sports" of Consolidates plan of scientific research work in field of physical culture and sport on 2011-2015 years.

Aim of the research is to determine interconnections between indicators of technical training and other parts of women epee fencers of different qualification training

METHODS

Theoretical analysis and generalization, pedagogical observation, methods of mathematical statistics.

Into the research were involved 13 high qualified women epee fencers from national fencing team of

TABLE 1

Indicators interconnection of technical training with other parts of high qualified women epee fencers training (n = 13).

	1	2	3	4	5	6	7	8	9	10	11
12	**.63**	**.58**	.36	.46	.05	-.24	-.20	.45	.26	-.27	.22
13	-.01	-.33	.24	.29	-.02	**.59**	.36	.51	.14	-.36	**.56**
14	-.25	**-.60**	.20	.18	.06	-.17	.22	.14	.04	.20	.25
15	.11	**.59**	.11	.21	**.60**	-.40	-.03	.35	.23	.02	.32
16	.08	.26	**-.57**	.32	**-.70**	.05	.03	-.51	.40	.08	.00
17	-.44	-.06	.03	.53	**-.59**	-.10	.12	-.35	-.05	.09	-.14
18	-.45	**-.59**	.26	.32	-.04	-.12	-.06	.20	-.15	-.44	-.17
19	-.42	**-.68**	.09	.19	-.12	-.22	**.56**	-.23	-.10	-.17	-.05
20	-.13	.23	**-.62**	**-.62**	**-.75**	-.37	.01	-.24	-.45	**-.61**	-.48
21	-.26	-.49	-.44	.07	**-.63**	.39	-.35	.01	**-.56**	.04	-.42
22	-.28	.36	-.29	-.51	.23	.34	.19	**.64**	.01	-.33	.30
23	-.06	.00	.09	-.30	**-.57**	**-.58**	.06	-.01	.26	.17	.23
24	.01	-.11	-.03	**-.60**	**-.62**	**-.56**	.08	-.07	.03	.00	.01
25	.05	-.11	.10	-.21	**-.69**	**-.64**	-.04	-.02	.05	.00	.00
26	-.02	.12	.12	.13	.01	-.42	.42	.08	.16	**.58**	-50
27	-.37	-.43	.21	.28	-.06	.13	-.03	-.20	-.18	-.30	-.33
28	-.15	.33	.45	.20	.35	.07	.25	-.10	.16	.41	.28
29	.03	-.41	-.07	.14	-.26	.05	-.14	-.35	-.50	**-.55**	**-.73**
30	-.40	.26	.28	-.05	.43	-.02	.31	.27	.24	.34	.52
31	.27	-.05	-.02	-.01	-.01	.24	-.52	-.17	-.04	**-.62**	-.53
32	**.65**	.16	-.11	-.53	.49	-.24	.13	.49	.10	-.06	.39
33	.53	.40	.05	-.29	.42	-.28	.00	**.69**	.10	.03	.44
34	-.30	-.14	.10	.26	-.17	.48	-.18	**.61**	.05	-.33	-.48
35	-.02	-.32	-.20	-.12	-.11	-.47	.27	.30	-.16	.46	.34
36	.30	.20	-.18	.02	-.26	.32	-.06	**.72**	.06	-.52	.20
37	.35	.19	-.11	-.02	-.12	.29	-.32	**.60**	.12	-.34	.15

Legend: $p \leq .05$ with $r_{cr} = .55$; $p \leq .01$ with $r_{cr} = .68$; indicators of control exercises;

Horizontal: **1.** – "Lounge from sitting with target hit" (10 times), st. un.; **2.** – "Jump, lounge with target hit" (10 times), st. un.; **3.** – "Lounge, second lounge in two targets", 10 times, st. un.; **4.** – Effectiveness of first lounge; **5.** – Effectiveness of second lounge; **6.** – "Hits frequency at place, 10 sec" (amount); **7.** – Sector 1 (amount) ; **8.** – Sector 2 (amount); **9.** – Sector 3 (amount); **10.** – Sector 4 (amount); **11.** – "Hits frequency by trunk sectors, 40 sec" (amount).

Vertically: **12.** – jump into length from a place (cm); **13.** – ball (2kg) throw (cm); **14.** – cross twine, distance to the floor (cm); **15.** – fencing lounge (cm); **16.** – reproduction of fencing lounge at 75% (cm); **17.** – reproduction of fencing lounge at 50% (cm); **18.** – shuttle run 4x14м (forward – face looks forward, return with back forward), s; **19.** – running 14 m, (s); **20.** – fencing piste passing with closed eyes 14x1m, (s); **21.** – exit from corridors (amount); **22.** – coordination by profile, (s); **23.** – amount of touches by coordination by profile (amount); **24.** – "big lap" (15 sec), touches (amount); **25.** – "small lap", (15 s), touches (amount); **26.** – simple visual-motor reaction (ms); **27.** – mistakes during simple visual-motor reaction (amount); **28.** – choosing reaction (ms); **29.** – mistakes during choosing reaction (amount); **30.** – distinction reaction (ms); **31.** – mistakes during distinction reaction (amount); **32.** – reaction on a moving object (ms); **33.** – amount of accurate reproduction of reaction on a moving object (amount); **34.** – amount of advances during reaction on a moving object (amount); **35.** – amount of delays during reaction on a moving object (amount); **36.** – amount of touches during tapping test (times); **37.** – average frequency by tapping test (Hz).

Ukraine and 32 qualified fencers from sport schools of Lviv, Ternopil and Uzhgorod. Correlational interconnections were based on the analysis of eleven indicators pf technical training and twenty six indicators of other parts of training that included specialized physical training and psychophysical training. Pedagogical observations by the parts of training of women epee fencers were made during January 2013.

RESULTS AND DISCUSSION

Near the study of qualification and determined features of different parts of women epee fencers training was set a need to study structure and content of interconnections between technical training and other parts of training of different qualification sportsmen (Table 1).

Correlation analysis showed that despite the exclusiveness of the sample of high qualified women epee fencers there are reliable correlational interconnection (totally 35 positions) between indicators of different parts of training.

Results of a control exercise "lounge from sitting with target hit" of high qualified women epee fencers had only two interconnections with results of " jump into length from a place" (r = .63) and reaction on a moving object (r = .65). So, in the first case we can see a positive dynamic of indicators showing that high qualified sportsmen can demonstrate bigger displays of explosive power and can provide more qualified performance of a fencing lounge that is included into the content of control exercise. Negative interconnection with indicators of reaction on a moving object on our opinion is related with to the problem of lounge performance. Lounge from sitting with target hit is related to relatively simple exercises for high qualified women epee fencers and doesn't need the displays of this kind of complex reaction.

Note, that in results of a control exercise "jump, lounge with a target hit" are recorded five reliable ($p \leq .05$-.01) positive interconnection of medium density with results of control exercises that are used for identification of specialized physical training: "jump into length from a place" (r = .58); "cross twine" (r = -.60), fencing lounge (r = .59); shuttle run 4x14 m (r = -.59) and "running 14 m" (r = -.68). Received data is quite predictable that is related to the same internal and external sportsmen muscle structure during this exercise. For qualified analysis and effective performance of "jump, lounge with a target hit" exercise sportsmen must have enough level of explosive strength that is shown in control exercise (long jump from a place). Besides the distance for a fencing hit is determined by the level of hips joint mobility (control exercises "cross twine" and "fencing lounge"). The interconnection justification of "shuttle running 4x14 m" and "running 14 m" also is determined by dominated displays of lower extremities explosive strength in these exercises, especially in situation of start and change of the direction of motion (Шилова, 1992; Тышлер & Мовшович, 1993; Тышлер & Рыжкова, 2010).

For the results of a control exercise "lounge, second lounge in two targets" were observed two interconnections – with "reproduction of 75% fencing lounge" and "fencing piste passing with closed eyes 14x1 m" (r = from -.57 till -.62 with $p \leq .05$). The existence of such interconnections allows to affirm that for the contingent of high quailed women epee fencers the performance of control exercise "lounge, second lounge in two targets" is characterized by the displays of coordination abilities of dynamic character and the rating and regulation of muscle efforts that complements scientific data that was received by specialists before (Келлер, 1983; Тышлер & Мовшович, 1993; Триперина, 2004).

The same amount of reliable interconnections was set between the results of first lunge in control exercise "lounge, second lounge in two targets" and "fencing piste passing with closed eyes 14x1m" (time of performance) – r = -.62 ($p \leq .05$) and contact tremography ("big circle") – r = -.60 ($p \leq .05$). Received coefficients meaning show that high qualified sportsmen that better perform first hit in control exercise "lounge, second lounge in two targets" quicker overcome with closed eyes a fencing piste and more qualified withstand static load. It can be confirmed that qualified level of sportsmen training is displayed on their confident organization of movement activity in heavy coordinated exercises that transferred on the conditions of competitive activity can give benefits in attack and counterattack actions.

With it, the results of the second lounge in exercise "lounge, second lounge in two targets" was fixed by us the biggest between other indicators correlation of reliable interconnections (eight). They exist with the indicators of control exercises that are related to specialized physical training ("fencing lounge", "reproduction of 75% fencing lounge", "reproduction of 50% fencing lounge", "fencing piste passing with closed eyes" and "exit from corridors" – r = from .59 till .70 with $p \leq .05$-.01; and psychophysical qualities ("profile", "big circle", "small circle"). All they have a positive focus. This means that in conditions of a control exercise "lounge, second lounge in two targets" and the second hit for high qualified women epee

TABLE 2

Indicators interconnection of technical training with other parts of qualified women epee fencers training (n = 32)

	1	2	3	4	5	6	7	8	9	10	11
12	-.03	.06	**.40**	**.38**	.08	.09	.19	-.14	.17	.28	.24
13	.02	**.38**	.07	-.05	.15	.10	-.13	**.35**	.15	-.04	.10
14	.05	-.30	**-.35**	-.10	**-.46**	.04	.14	-.16	-.16	-.18	-.14
15	-.17	.18	.26	.12	**.37**	-.14	-.18	.23	.11	.05	.06
16	-.10	.03	.10	.14	.02	-.09	-.12	.26	-.02	.11	.08
17	-.10	-.22	.13	.22	.02	-.19	-.02	-.03	-.01	-.06	-.05
18	.14	.11	.19	.18	.01	-.08	-.02	.01	**.43**	.17	.22
19	-.01	-.29	**-.49**	-.28	**-.49**	-.09	.00	-.10	.09	**.38**	.18
20	-.08	.05	**-.52**	**-.44**	-.33	.10	-.03	-.29	.11	.10	-.03
21	-.07	-.11	-.14	-.22	.06	.04	.01	-.09	-.06	.07	-.01
22	.01	.04	.02	.07	.01	-.31	**-.43**	.14	-.09	-.03	-.19
23	.28	.05	-.03	-.08	.11	.11	.04	.20	.10	.01	.13
24	.02	.12	.16	.14	-.02	-.01	.20	-.30	.07	.16	.09
25	-.23	.00	-.21	-.17	-.06	-.29	-.09	**-.55**	**-.36**	-.28	**-.49**
26	.06	-.30	-.09	-.08	-.04	.15	.15	.34	.08	.16	.29
27	.09	-.09	.11	.00	.04	-.05	.09	-.32	-.11	.04	-.09
28	.02	-.33	-.32	-.18	-.21	.08	.08	.05	.00	.13	.12
29	.12	**.38**	.22	.11	.17	.00	.05	-.33	-.08	-.23	-.23
30	-.21	-.30	-.16	-.14	-.02	-.17	-.07	.03	-.15	-.03	-.09
31	.21	**.49**	.32	.22	.18	.01	.05	-.15	-.02	-.27	-.17
32	-.02	-.33	-.28	-.19	-.26	.04	.25	-.06	.17	.24	.27
33	.31	.03	.23	.30	-.07	-.07	.13	-.11	.07	-.03	.03
34	-.16	.05	-.02	-.10	.13	.00	-.10	-.23	**-.38**	-.14	-.32
35	-.12	-.08	-.20	-.17	-.07	.06	-.02	.32	.31	.17	.29
36	-.04	-.27	-.13	-.17	-.08	.01	.06	.03	.03	.01	.05
37	-.08	-.29	-.10	-.18	.05	.12	.24	-.11	-.08	.13	.11

Legend: $p \leq .05$ with $r_{cr} = .35$; $p \leq .01$ with $r_{cr} = .45$; indicators of control exercises;

Horizontal: **1.** – "Lounge from sitting with target hit" (10 times), st. un.; **2.** – "Jump, lounge with target hit" (10 times), st. un.; **3.** – "Lounge, second lounge in two targets", 10 times, st. un.; **4.** – Effectiveness of first lounge; **5.** − Effectiveness of second lounge; **6.** – "Hits frequency at place, 10 sec" (amount); **7.** − Sector 1 (amount) ; **8.** − Sector 2 (amount); **9.** − Sector 3 (amount); **10.** − Sector 4 (amount); **11.** – "Hits frequency by trunk sectors, 40 sec" (amount).

Vertically: **12.** – jump into length from a place (cm); **13.** – ball (2kg) throw (cm); **14.** – cross twine, distance to the floor (cm); **15.** – fencing lounge (cm); **16.** – reproduction of fencing lounge at 75% (cm); **17.** − reproduction of fencing lounge at 50% (cm); **18.** – shuttle run 4x14м (forward – face looks forward, return with back forward), s; **19.** − running 14 m, (s); **20.** – fencing piste passing with closed eyes 14x1m, (s); **21.** – exit from corridors (amount); **22.** – coordination by profile, (s); **23.** – amount of touches by coordination by profile (amount); **24.** – "big lap" (15 sec), touches (amount); **25.** – "small lap", (15 s), touches (amount); **26.** – simple visual-motor reaction (ms); **27.** – mistakes during simple visual-motor reaction (amount); **28.** – choosing reaction (ms); **29.** – mistakes during choosing reaction (amount); **30.** – distinction reaction (ms); **31.** – mistakes during distinction reaction (amount); **32.** – reaction on a moving object (ms); **33.** – amount of accurate reproduction of reaction on a moving object (amount); **34.** – amount of advances during reaction on a moving object (amount); **35.** – amount of delays during reaction on a moving object (amount); **36.** – amount of touches during tapping test (times); **37.** – average frequency by tapping test (Hz).

fencers is characterized a displays of complex qualities that are based on the displays of several coordination qualities and their long ensuring.

For group of technical training control indicators that are connected with hits frequency were observed isolated and scattered interconnections indicators of control exercises from specialized physical training and psychophysical qualities, such as: positive – ball (2 kg) throw (cm) that can be related to the use of big muscles of upper ling during performance (r = from .56 till .59 with $p \leq .05$) and other indicators: "fencing piste passing with closed eyes", "exit from corridors", mistakes amount during options "profile", "big lap", "small lap", mistakes during choosing reaction, mistakes during distinction reaction, amount of accurate reproduction of reaction on a moving object (r = from .56 till .69 with $p \leq .05$-.01). It shows on an absence of clear factors that provide the results of this control exercises from technical training of women epee fencers from the side of specialized physical training and psychophysical qualities.

Along the same was fixed some negative interconnections with results of control exercises "running 14 m", time for coordination by profile and simple visual-motor reaction (r = from .56 till .64 with $p \leq .05$). It can be related with the frequency of moves in this exercises that doesn't have a determining value for the control exercise result formation.

At the same time, structure and content of correlational interconnections of technical and other parts of qualified women epee fencers training on the stage of specialized basic development showed on the presence of significant differences (Table 2). In total are fixed less amount of reliable interconnections of different level of density (20 positions). Note that between this indicators of technical training as the result of control exercises "lounge from sitting with target hit" and "hits frequency at place for 10 seconds" with indicators of other parts of training didn't show any reliable correlational interconnections (r = from .00 till .31 with $p > .05$).

Along the same for the result of control exercise "jump, lounge with a target hit" are fixed three reliable ($p \leq .05$-.01) interconnections of low and medium level of density. With indicators of control exercise "ball (2 kg) throw" (r = .38); mistakes during choosing reaction (r = .38), mistakes during distinction reaction (r = .49). Herewith, if in first case it can be related to new trends. Meaning that sportsmen with higher results at the "jump, lounge with a target hit" also demonstrate higher indicator in the exercise "ball (2 kg) throw. In second and third case is observed a negative trend. It means that qualified sportsmen spend more functional efforts during performance of said exercise ("jump, lounge with a target hit") demonstrate positive transfer on "ball (2 kg) throw" and this ruins the accuracy of rating and regulation of muscle efforts that is confirmed by higher amount of mistakes in choosing and distinction reactions.

With the results of control exercise "lounge, second lounge in two targets" are registered four reliable positive correlational interconnections in indicators of specialized physical training (results of long jump from a place, cross twine, running 14 m, fencing piste passing with closed eyes – r = from .35 till .52 with $p \leq .05$-.01). This on our opinion is logical because specificity of physical qualities display and structure and content of control exercise from determination of technical training are similar. In fact it is formed from components that are provided by displays of specialize physical qualities.

A minor amount of interconnections are fixed for such indicators as first and second lounge in exercise "lounge, second lounge in two targets" (two and three respectively). In first case this are two positive interconnections with the result of long jump from a place and fencing piste passing with closed eyes (r = from .38 till .44 with $p \leq .05$). In second case – results of a control exercise "cross twine", "fencing lounge" and "running 14 m" (r = from .37 till .49 with $p \leq .05$-.01). It shows that for qualified women epee fencers on the stage of specialized basic development are characterized is the domination in the structure of training properly the specialized physical qualities, and not the technical skills. Besides, we should note that the providing factors during the performance of first and second hits that they are performed with the expense of different structure of physical qualities. This places demands for concentrated influence on specialized training of qualified sportsmen that is related with the use of targeted and successful technical and tactical actions and the consideration of the need of its repeated character.

As in the case with high qualified women epee fencers for the group of indicators that control technical training with the hits frequency were observed isolated and scattered interconnections between indicators of control exercises with specialized physical training and psychophysical qualities. Between them we should select coordinamometry ("small circle") with the results that set positive interconnections of total result in exercise "hits frequency by trunk sectors, 40 sec" and separate sectors – sector 2 and sector 3 (r = from -.36 till -.55 with $p \leq .01$). This confirms that achieving of the result by thus group of control

exercises provides the existence of strong nervous system in qualified sportsmen.

Along the same for frequency indicators of exercises are found separate reverse (negative interconnections. Is found that the higher amount (frequency) of hits by separate sectors is negatively connected with results of shuttle run 4x14 m (r = .43 with $p \leq$ .01); running 14 m (r = .38 with $p \leq$ .05) and amount of advances during reaction on a moving object (r = -.38 with $p \leq$ .05), that need further study.

CONCLUSION

Are set inconsistencies in the structure and content of correlational interconnections between indicators of technical and other parts of women epee fencers training of different qualification.

There is a need for correction of educational and training process with accentuated improvement of hits accuracy of qualified sportsmen on the stage of specialized basic development and their training level approach to model indicators of women epee fencers of high qualification.

Prospects of further research provide the building of a technical and tactical training program for qualified women epee fencers.

REFERENCES

Келлер, В. С. (1983). Теоретические основы спортивной тактики [Theoretical basis of sport tactic]. In *Fencing articles collection*, 37−39.

Семеряк, З. С., & Смирновський С. Б. (2013). Техніко-тактична підготовка фехтувальників на шпагах: стан та перспективи досліджень [Technical and tactical training of epee fencers: conditions and prospects of research]. *Young Sport Science of Ukraine: col. of scientific works in ph. cul,* 17(1), 239−244.

Триперина, Т. (2004) Индивидуализация технико-тактического совершенствования квалифицированных фехтовальщиков на рапирах 17-19 лет [Individualization of technical and tactical improvement of foil fencers 17-19 y.o.]. Retrved from http://www.disszakaz.com/catalog/262492.html

Турецкий, Б. В. (1991). Стили боевой деятельности фехтовальщиков [Competitive activity styles in fencing]. In *Researches of system individualization*, 120 − 121.

Тышлер, Д. А., & Мовшович, А. Д. (1993). Методы технико-тактического совершенствования в фехтовании [Methods of technical and tactical improvement in fencing] *Theory and practice of physical culture*, 4, 27−28.

Тышлер, Д. А., Мовшович, А. Д., & Бочарникова, Л. Г. (1985) Критерии оценки технико-тактического мастерства [Criteria's of technical and tactical skills]. In Fencing articles collection, 34-36.

Тышлер, Д. А., & Рыжкова, Л. Г. (2010). Фехтование. Технико-тактическая и функциональная тренировка. [Fencing. Technical, tactical and functional training]. Academic project.

Шевчук, Е. Н. (2007) Состояние проблемы технико-тактической подготовки квалифицированных фехтовальщиков [The technical and tactical training problem of qualified fencers]. XI Inter. sci. congress Modern Olympic sport for all (pp. 56–59) Minsk, Belarus.

Шилова, И. М. (1992) Модельные характеристики личности квалифицированных фехтовальщиц [Model characteristics of qualified fencers]. In Materials of scientific conference for 1990-91(pp. 73−74). Omsk, Russia.

Received: February 23, 2015
Revision received: Jun 1, 2015
Accepted: Jun 27, 2015

Correspondence to:
Maryan Pityni
Lviv State University of Physical Culture,
Kostyushka str. 11
Ukraine, Lviv, zip code 79000
Phone:
E-mail: pityn7@gmail.com

SportLogia
2015, 11(1), 49–56
e-ISSN 1986-6119

www.SportLogia.com

USE OF DIETARY SUPPLEMENTS AMONG ELITE ATHLETES

Elma Omeragić[1], Jasmina Đeđibegović[1], Miroslav Sober[1], Aleksandra Marjanović[1], Mirza Dedić[1], Haris Niksić[1], and Mahir Fidahić[2]

[1]Faculty of Pharmacy, University of Sarajevo, Bosnia and Hrezegovina
[2]Medical Faculty, University of Tuzla, Bosnia and Hrezegovina

SHORT SCENTIFIC ARTICLE
doi: 10.5550/sgia.151101.en.005O
UDC: 613.2:796.4

SUMMARY

Many athletes use supplements in their diet as part of regular training or competition, thus enabling more intense training by encouraging faster recovery between workouts, minimizing interference caused by disease or injury and increasing competitive performance. These supplements, unlike medications, are not subject to rigorous efficiency and safety checks and tests. There is a risk with regard to those supplements which include positive doping test result as a consequence of presence of the prohibited substances not listed in the declaration of the preparation.

The aim of this study was to examine the use of supplements among elite athletes by analyzing the forms for doping control, issued by the Agency for Anti-doping control of Bosnia and Herzegovina, performed in the period from 2010 to 2012. The study includes supplements whose use was reported by athletes in the period of the last 7 days (prior testing).

The study results indicate the frequency of dietary supplements use of 34.5%. The most dominant group among users of dietary supplements were men aged between 18 and 29 years. From 152 users of dietary supplements 62.3% of them have used more than one product. The number of used supplements was an average of 2.9±2.8 products. Amino acids and proteins are the most commonly used dietary supplements.

This study confirmed excessive use of dietary supplements among elite athletes and pointed to the need of necessary education and ensuring the availability of scientific and unbiased information, about the benefits and risks of dietary supplements use, to athletes..

Key Words: athletes, dietary supplements, sport.

INTRODUCTION

The U.S. Food and Drug Administration [FDA] defines the term "dietary supplement" to mean: "a product (other than tobacco) intended to supplement the diet that bears or contains one or more of the following dietary ingredients: a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by man to supplement the diet by increasing the total dietary intake, or a concentrate, metabolite, constituent, extract, or combination of any of the aforementioned ingredients" (Dietary Supplement Health and Education Act of 1994, 2013).

There are a large number of published studies on the frequency of use of dietary supplements among athletes. Meta-analysis of 51 such study indicates that use of dietary supplements is present among 46% of athletes, while this frequency of use among elite athletes is even higher, at around 59%, depending on the type of sport, athletes' age, gender and level of competition (Maughan, 2004).

The benefit of supplementation in sports is still controversial. A well-designed diet that ensures optimal intake of energy, building and protective substances is the basis of a well-planned training and sports results. However, there is not enough evidence to prove that dietary interventions which imply potentiation of dietary supplements could improve the efficiency of training and sports results (Molinero & Marquez, 2009). On the other hand, inadequate and

excessive use of dietary supplements can lead to significant side effects and interactions and distortion of the health status of athletes (Maughan, Doug & Trevor, 2004).

Since these products are not subject to strict production standards and labeling and that there is no harmonized legislation by which their distribution would be controlled, there are no guarantees that supplements do not contain prohibited substances that can harm the health of consumers and lead to a positive drug test result. Numerous studies demonstrated persistence of counterfeit dietary supplements on the free market that contained banned substances whose presence is not indicated on the product declaration (Maughan, 2004).

Although many authors have considered excessive intake of supplements, there is little data on the frequency, type, quantity and age and gender distribution of dietary supplements among elite athletes from Bosnia and Herzegovina.

The aim of our study was to quantitatively and qualitatively analyze the intake of dietary supplements by elite athletes.

METHODS

We analyzed a total of 442 forms for doping control done on national and international competitions and out of competition during the period from 2010 to 2012. The study included supplements whose use was reported by athletes in the last 7 days prior testing.

Statistical analysis was performed using the software Minitab 13.0 (Minitab Inc., USA). Data are presented as frequencies. The significance of the proportion differences between appropriate age-gender groups in the total sample and the users of dietary supplements was tested by chi-square test (χ^2). Difference between the mean values of continuous variables was tested by Student's *t*-test. Probabilities of $p < .05$ were considered statistically significant.

RESULTS

Data were provided by the Agency for Antidoping control of Bosnia and Herzegovina [BiH]. In the period between 2010 and 2012 data were collected from a total of 441 athletes with a mean age of 23.7±5.8 years (range 13-45 years), of whom 352 (79.8%) were citizens of BiH. Most athletes were aged between 18 and 23 years (both genders), while a significant percentage of women was noted among athletes younger than 18 years of age (Figure 1).

In the total sample, the most common sports were athletics (10.4%) and basketball (10.2%), followed by handball (8.8%), volleyball (8.2%) and soccer (7.3%), while the remaining 55.1% was consisted of 28 different sports with a single representation of <5.5%. Descriptive statistics of the sample is shown in Table 1.

FIGURE 1

Distribution of athletes of both genders by age groups.

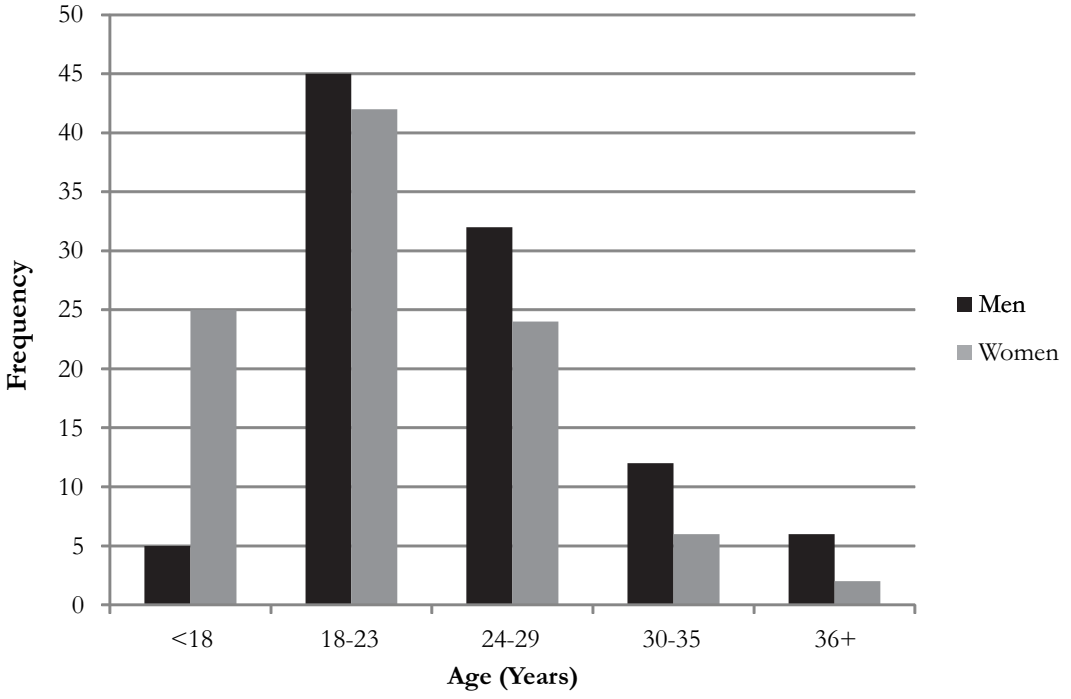


TABLE 1

Descriptive statistics of the sample.

Vriables	Category	*n*	%
Gender	Men	283	64.2
	Women	158	35.8
Athletes wth coach	Yes	407	92.3
	No	31	7.0
	Unknown*	3	.7
Athletes with a doctor/physician	Yes	184	41.7
	No	254	57.6
	Unknown*	3	.7
In competition	Yes	250	56.7
	No	188	42.6
	Unknown*	3	.7

* Data is not entered in the doping control form

A total of 152 (34.5%) athletes have reported a consumption of dietary supplements [DS]. Men aged between 18 and 29 years (Figure 2) dominate among the DS users. Distribution by gender-age groups in the total sample did not differ significantly with respect to users of dietary supplements. However, the representation of two gender-age groups differed significantly in the total sample and among the DS users (Figure 2).

Female athletes under the age of 18 years were significantly (p = .04) underrepresented among DS users (4.8%), than in the total sample (9.5%). Representation of athletes aged ≥ 36 years was also significantly (p = .01) lower among the DS users (1.4%), than in the total sample (4.0%). The established differences suggest that the characteristics of the groups (defined by combination of gender and age) are associated with the use of the DS in the tested athletes. When it comes to female athletes, the results show a trend of slight increase in the use of the DS after 24 years, while in men the DS consumption was most intensive between the age of 18 and 29 years, after which it declines.

The largest number of athletes (92.3%) had their own coach. Therefore, the distribution of gender-age groups among athletes having a coach (Figure 3)

FIGURE 2

Representation (%) of age-gender groups of athletes in the total sample and among users.

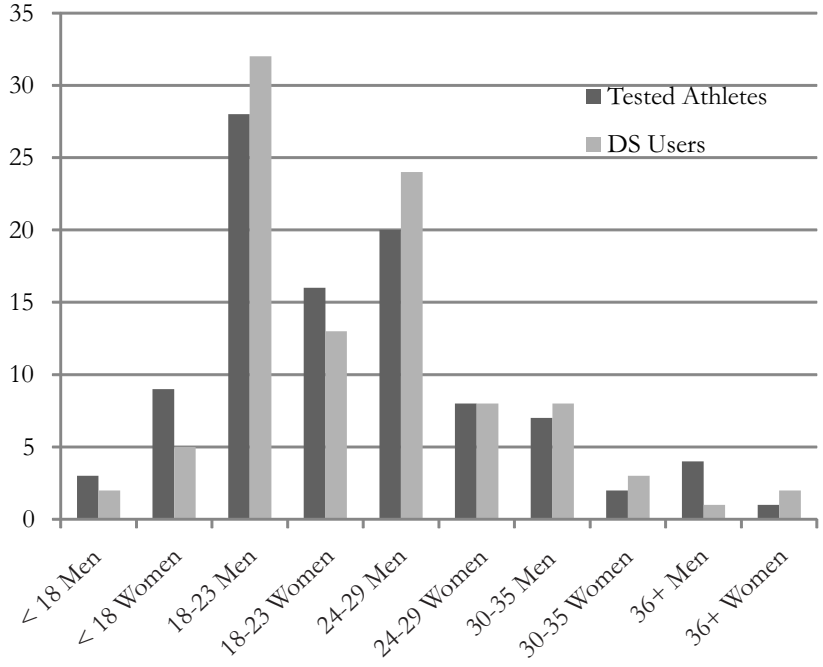
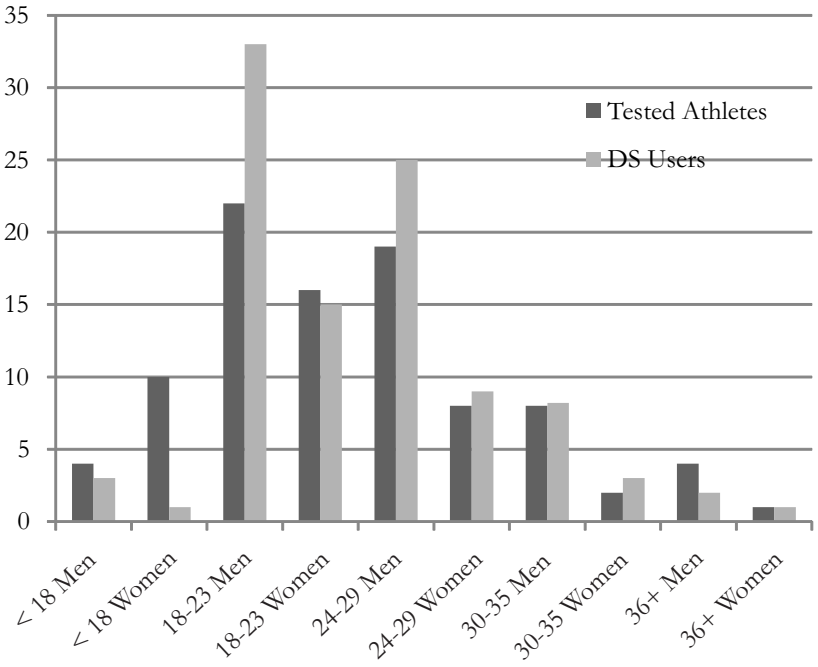


FIGURE 3

Representation (%) of age-gender groups of athletes in the total number of athletes with a coach and among DS users with a coach.

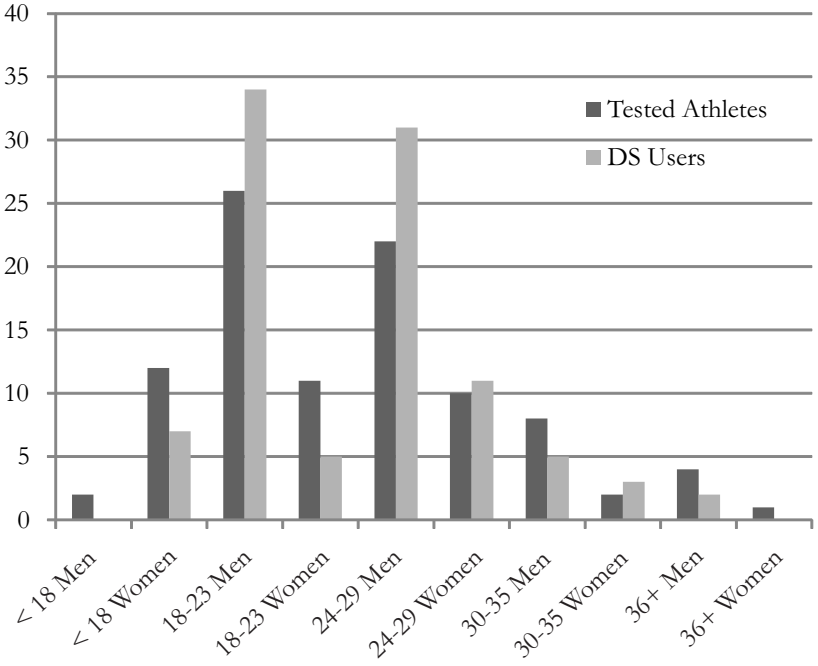


expectedly follows the distribution found in the total sample (Figure 2).

There was no significant difference in the distribution in the total number of athletes with a coach and among DS users with a coach (p = .36), suggesting that coaches do not play a significant role in advising on the DS consumption among athletes. Similarly, it was not established a significant influence of doctors/physicians (p = .25) on the DS consumption among athletes (Figure 4).

FIGURE 4

Representation (%) of age-gender groups in the total number of athletes with a doctor/ physician and among DS users with a doctor/physician.



Participation in the competition also does not affect significantly (p = .73) on the DS consumption among athletes (Figure 5).

Among DS users (n = 152), the number of used supplements varied in the range of 1 to 21 (a mean of 2.9±2.8) in the week before the test. Concomitant consumption of two or more of the supplements was noted/recorded in 96 (63.2%) DS users (Table 2).

The three most commonly used supplements were amino acids and proteins, preparations classified in the group of others (different preparations intended for strengthening the immune system), and vitamin C (22.37; 15.79 and 15.73%, respectively) among athletes who were analyzed in the course of the competition (Figure 6), or amino acids and proteins, sports meals and vitamin C (21.71; 13.81 and 6.58%, respectively) among athletes analyzed out of competition (Figure 7).

FIGURE 5

Representation (%) of age-gender groups in the total number of competitors and among DS users on competition

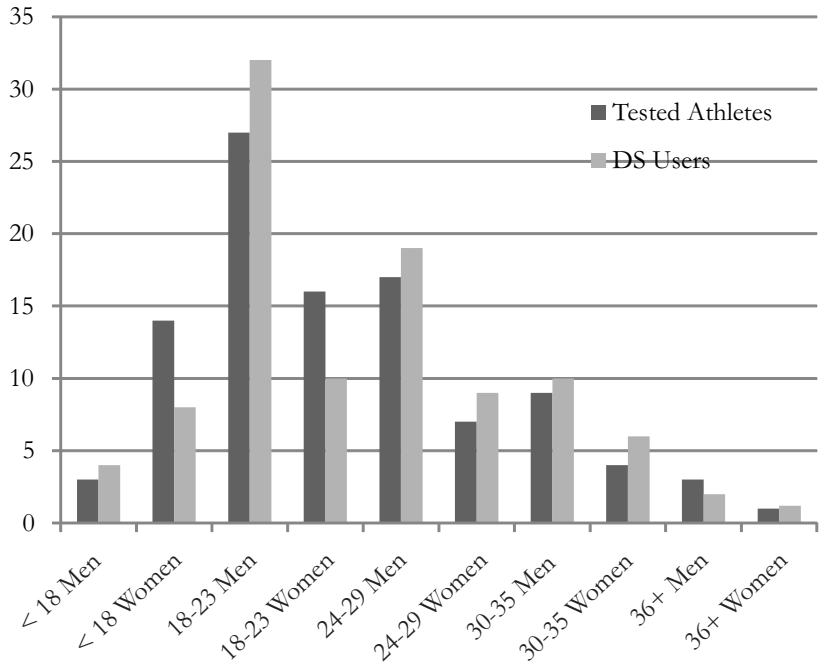


TABLE 2

Distribution (%) according to the number of used supplements in the total sample and among DS users.

Number of DS	Total sample (n = 441)			DS Users (n = 152)		
	Men	Women	Total	Men	Women	Total
1	9.50	3.20	12.70	27.60	9.20	36.80
2	5.70	3.20	8.80	16.40	9.20	25.70
3	3.60	.70	4.30	10.50	2.00	12.50
4	1.40	.90	2.30	3.90	2.60	6.60
5	1.60	.50	2.00	4.60	1.30	5.90
6	.50	.50	.90	1.30	1.30	2.60
7	.50	.70	1.10	1.30	2.00	3.30
8	.90	.50	1.40	2.60	1.30	3.90
11	.20	.00	.20	.70	.00	.70
13	.00	.20	.20	.00	.70	.70
16	.00	.20	.20	.00	.70	.70
21	.00	.20	.20	.00	.70	.70
Total	23.80	10.70	34.50	69.10	30.90	100.00

FIGURE 6

A list of supplements used by athletes analyzed in the course of the competition.

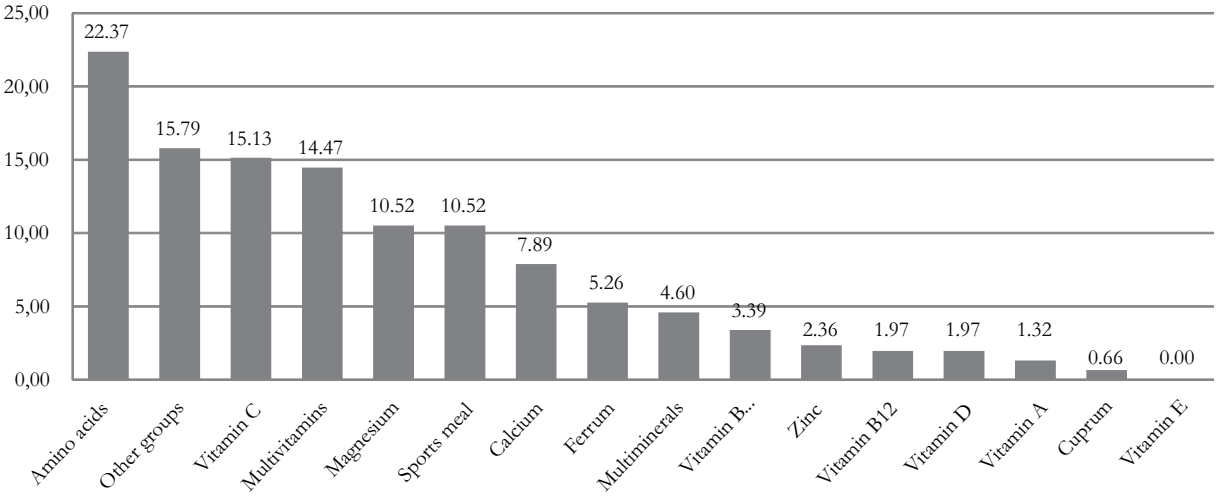
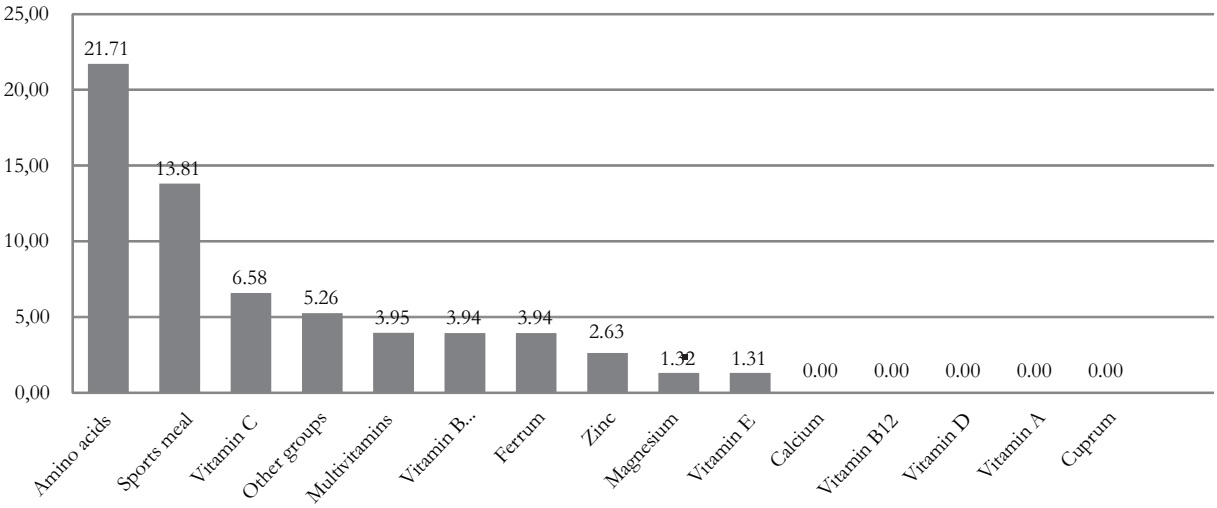


FIGURE 7

A list of supplements used by athletes analyzed out of competition



DISCUSSON

Our study showed that 34.5% of athletes used dietary supplements. The total percentage of athletes who have used supplements was lower than in previous studies. Thus, the study conducted by the Anti-Doping Agency of Republic of Serbia, which monitored the frequency and quantity of consumption of dietary supplements and medications among athletes analyzed on the consumption of doping substances at national and international competitions from 2005 to 2008, stated that a total of 62.2% of athletes took supplements (Dikić, Suzić, & Radivojević, 2010). Furthermore, a study examining the consumption of dietary supplements among university athletes in Singapore stated that 76.8% of the analyzed athletes were taking dietary supplements (Tian, Ong, & Tan, 2009), while a study examining the age-gender distribution of elite athletes who use dietary supplements in Great Britain found that 59.5% of tested athletes took supplements (Nieper, 2005). Other studies results are similar, which reported the total percentage of users of dietary supplements in a range of 46 to 100%. Such large variations can be partly explained by the different methodology used in the collection of data such as the definition of dietary supplements, the time period in which their consumption was examined

among athletes, the way the survey was done and so on.

In our study, the data were used concerning the use of supplements among athletes reported by them during the doping control, so the low percentage of athletes who use dietary supplements can be explained by a possible insincerity of athletes due to fear of sanctions which would be implied based on a positive doping control results. In addition to this, only supplements and medications used by athlete during the period of seven days prior to analysis were recorded in doping forms. Only study conducted by the Anti-doping Agency of Republic of Serbia examined the use of supplements for the period of last seven days prior to the moment of analysis, and all others during longer periods of time (6-12 months).

The most dominant group among DS users were men aged in range 18-29 years, while a trend was noted of slight increase of DS consumption among the female athletes only after 24 years of age. This agrees with the results of other studies that also state that the dominant gender-age group of athletes who use dietary supplements were men aged between 24 and 34 years and women aged between 24 and 29 years (Nieper, 2005).

Our study did not establish any significant advisory role of doctors/physicians and coaches/trainers to the use of the DS among athletes. This finding indicates the fact that decision of athlete, on the use of a dietary supplement, probably is not rational. By browsing through the available sources we did not find studies that examined the representation of athletes who have had their coach or doctor/physician, within the total number of athletes who use dietary supplements.

This study noted that the number of used supplements among DS users was a mean of 2.9 ± 2.8. Co-administration of two or more DSs was observed among 63.2% of DS users. And other studies have also noted concomitant consumption of dietary supplements among athletes DS users. Thus, the study, which examined the age-gender distribution of elite athletes who use dietary supplements in Great Britain, found that 82.6% of athletes were taking two or more supplements at the same time, while a mean number of used supplements among athletes DS users was 3.22 to 4.03 (Nieper, 2005). A study conducted by the Anti-doping Agency of Republic of Serbia has come up with the data a mean number of dietary supplements among athletes DS users from 1.55 ± 0.9 to 5.29 ± 2.9 per athlete (Dikić, Suzić, & Radivojević, 2010). Such irrational use of supplements has no founded scientific justification and it can lead to serious health disorders due to interaction, boosting the effects and overdosing.

Our study has shown that the most commonly used dietary supplements are amino acids and proteins, taken, in the group of athletes who use dietary supplements analyzed in the course of the competition, by 22.37% and 21.71% of athletes analyzed out of competition. This agrees with the results of other studies according to which proteins are one of the most popular dietary supplement among athletes and physically active individuals. However, most of the relevant organizations dealing with estimates of reference values for nutrients intake, state that, due to the lack of adequate evidence to the contrary, healthy adults engaged in sports (power and endurance events), have no need for higher doses of protein than the recommended daily dose (Eng. Recommended Dietary Allowance, RDA) (Maughan, Doug & Trevor, 2004). As for the amino acid supplementation, there are some clinical trials involving individuals who have experienced trauma (post-operative trauma, burns) which show that intake of amino acids may reduce the degree of loss of muscle mass, but the catabolic state is irrelevant for healthy athletes who by intake of amino acids are trying to increase muscle mass. There is a theory that amino acids increase physical performance, by increasing the secretion of anabolic hormones, changing the way of energy utilization, preventing the adverse effects of intensive training and preventing the mental fatigue. There is little evidence to support the benefit of amino acid supplements to the normal diet of athletes (Melvin, 2005).

CONCLUSION

Our study confirmed excessive use of dietary supplements among athletes regardless of age and gender category. Given the established mean number of used supplements among athletes who use dietary supplements, as well as the total percentage of athletes DS users with simultaneous consumption of two or more supplements the irrational use of supplements was demonstrated/proved. Since the study has not demonstrated/proved significant impact of coaches and doctors/physicians on the DS consumption among athletes, it was assumed that the decision of athlete as a person without any health education on the selection of individual supplement is probably scientifically unfounded. Because of all of this, it is necessary to have education and prevention strategy that will be geared toward athletes, doctors/physicians, coaches and others working with athletes.

REFERENCES

Dietary Supplement Health and Education Act of 1994. (2013). Washington, DC: U.S. Food and Drug Administration. Retrived from: http://www.fda.gov/RegulatoryInformation/Legislation/FederalFoodDrugandCosmeticActFDCAct/SignificantAmendmentstotheFDCAc/ucm148003.htm

Dikić, N., Suzić, J., & Radivojević, N. (2010). Upotreba suplemenata i lijekova u sportu: Šta sportisti zaista koriste? [The use of supplements and drugs in sport: What athletes actually use?]. *Sportska medicina*, 8, 1–9.

Maughan, R. J. (2005). Contamination of dietary supplements and positive drug tests in sport. *Journal of Sports Sciences*, *23*(9), 883–889. doi: 10.1080/02640410400023258; PMid: 16195040

Maughan, R. J., Doug, S. K, & Trevor, L. (2004). Dietary supplements. *Journal of Sport Science*, 22, 95–113. doi: 10.1080/0264041031000140581; PMid: 14971436

Melvin, H. W. (2005). Dietary Supplements and Sports Performance: Amino Acids. *Journal of the International Society of Sports Nutrition*, *2*(2), 63–67.

Molinero, O., & Marquez, S. (2009). Use of nutritional supplements in sport: risks, knowledge and behavioural-related factors. *Natur Hosp*, *24*(2), 128–134. doi: 10.1186/1550-2783-2-2-63; PMid: 18500957; PMCid: PMC2129148

Nieper, A. (2005). Nutritional supplement practices in UK junior national track and field athletes. *Br J Sports Med*, 39, 645–649. doi: 10.1136/bjsm.2004.015842; PMid: 16118303; PMCid: PMC1725305

Tian, H. H., Ong, W. S., & Tan, C. L. (2009). Nutritional supplement use amoung university athletes in Singapore. *Singapore Emd J*, 50, 165–172.

Received: March 5, 2015
Revision received: Jun 10, 2015
Accepted: Jun 10, 2015

Correspondence to:
Elma Omeragić, PhD
Faculty of Pharmacy
Zmaja od Bosne 8
71000 Sarajevo
Bosnia and Herzegovina
Phone: 00387 61 98 92 67
E-mail: elma.omeragic1465@gmail.com

SportLogia
2015, 11(1), 57–62
e-ISSN 1986-6119

www.SportLogia.com

FEET STATUS IN FOOTBALL PLAYERS OF DIFFERENT COMPETITION CATEGORIE

Dejan Ilić[1], Stefan Stojaković[1], Nikola Fišeković[1], and Saša Đurić[1]

[1]Faculty of Sport and Physical Education, University of Belgrade, Serbia

SHORT SCIENTIFIC ARTICLE
doi: 10.5550/sgia.151101.en.006I
UDC: 611.986:796.332

SUMMARY

Medical check-up shave determined an increasing number of children with body defects as well as functional disabilities of locomotors system. Therefore it is essential to involve children in various forms of physical activities. In that sense, one of the most successful measures to implement in order to act preventively, and consequently correctively, are the sports games. Modern way of life leads to many postural disorders and deformities and one of the most presenting schoolchildren is flatfeet. The aim of the paper is detections well as presentation of feet postural status of football players of different competition categories in Valjevo football clubs. This search included 114 children playing for football clubs of Valjevo, and indicated the fact of lower percentage of children with flatfeet (40.35%), than the children with no deformities (59.65%). Additionally, the data showed that tighter percentage of children with regular feet belongs to senior categories, which are, on one side, alarm in data since they indicate that younger children have higher percentage of deformities and weaker posture, but on the other hand this fact is encouraging because such deformities are eliminated with more success at young age. It is necessary to promptly implement prophylaxis, especially in critical periods for flatfeet occurring. Thus, the deformities can be duly treated. Initially, the exercises performed at football training are not aimed at correction of a deformity, but as means of football game. But, when analyzed in details we can see that they have significant preventive action for certain body parts..

Key Words: competition categories, correction, feet status, football, prevention.

INTRODUCTION

Today, modern men live in predominantly urbanized and technologically developed society. Having in mind our biological background that adapted us to more active life style (hunting, food search and other needs) we should, for our own good, influence our modern lifestyle (Ilić, 2006).

Medical check-ups indicate that, besides bad posture, an increasing number of children suffer from body deformities as well as functional disabilities of locomotors system based on certain diseases (Radisavljević, 2001).

Understanding this, it is clear that physical exercises, when adequately implemented, together with all precautions, can be one of the most efficient and most useful measures to correct such states. Thus, physical exercises should be understood as basic means of kinesitherapy and therefore, of corrective gymnastics as its integral part (Koturović & Jeričević, 1996).

Sports games are one of more successful methods of corrective gymnastics. They are applied in order to undertake precautions to improve physical and functional abilities as well as to undertake measures for complete rehabilitation, i.e. re-socialization of those who have already developed disease, defect or deformity (Radisavljević, 2001).

Statistical analyses indicate that most frequent disorders and deformities of locomotor system in schoolchildren refer to different forms and stadiums of fallen arches (Kosinac, 2008). Incidence of this deformity is caused, or at least contributed by modern way of life. Using transportation means leads to less activities of feet musculature which in children is in development. Therefore, movement is particularly

important because it causes progress of muscular quality decrease (Koturović & Jerinčević, 1996).

METHODS

Simple of subject

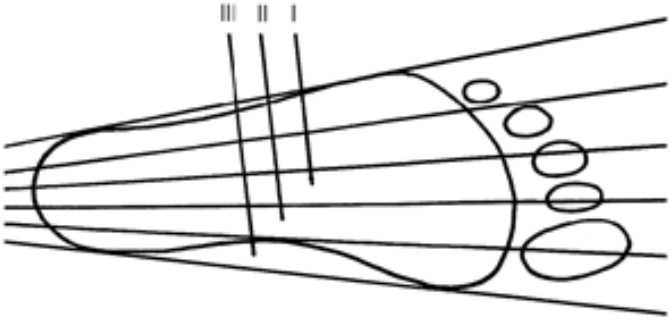
The research included 114 children playing for football clubs of Valjevo. They were classified according to training categories and include children aged 10 - 18yrs.

The research was done in March 2013, and statistical and descriptive methods were used for paper

Simple of variables

The research involved the feet status variable, determined by plantography method. Plantograms were interpreted and data were obtained by the method of Russian authors (Figure 1). According to this method, the plantogram in the front part of foot, at the level of the first and fifth metatarsal bone and at the level of the fifth is divided into five equal sections. If the footprint, seen from the lateral towards medial part, does not exceed 2/5 of the plantogram i.e. two of the five drawn sections, that is considered good feet status. Should the footprint cover 3/5 of the platnogram, that indicates the first degree, 4/5 is the second degree while 5/5 signifies the third degree of fallen side arches (Ilić, 2012).

FIGURE 1
Plantogram interpretation by the method of Russian authors.



Legend: **I** – 1st degreeof fallen arches; **II** – 2nd degreefallen arches; **III** – 3rd degreefallen arches.

RESULTS AND DISCUSSON

Upon statistical elaboration, the data were shown in tables and graphs, with conclusion.

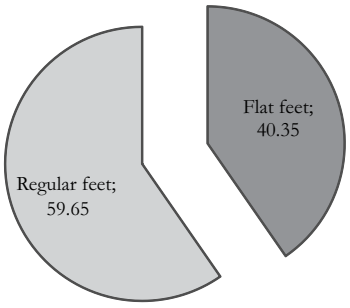
TABLE 1
Number and percentage of participants with flat feet.

Sample	n	%
Overall	114	100.00
Regular feet	68	59.65
Falt feet	46	40.35

Legend: **n** - Number of participants; **%** - Percentage.

Based on the results displayed in Table 1 and Figure 2 we can conclude that regular feet status occurred in 68 participants i.e., 59.65 %, while physiologically fallen arches occurred in 46 participants i.e. 40.35%of the overall number of examined football players.

FIGURE 2
Number and percentage of participants with flat feet.



The data were further analyzed in Table 2 and presented by Figure 3 and indicate that regular left foot status occurred in 71 participant (i.e. 62.28%), that 1st degree occurred in 32 (i.e. 28.07%), 2nd degree in 11 (i.e. 9.65%), while the 3rd degree of fallen arch was not detected in any of the participants.

TABLE 2

Number of participants with regard to degree of left foot fallen arches.

	Regular left feet status	1st degree of fallen arches	2nd degree fallen arches	3rd degree fallen arches
Number of participants	71	32	11	0

FIGURE 3

Percentage of participants with regard to degree of left foot fallen arches.

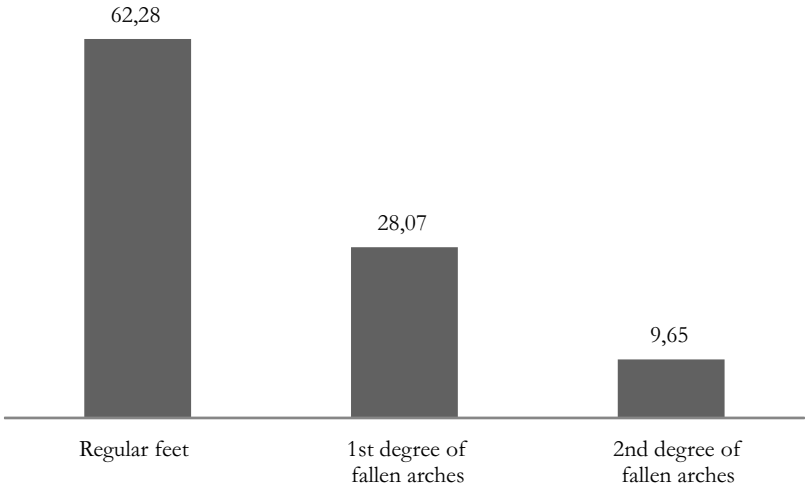


Table 3 as well as Figure 4 display the level of right foot fallen arches. The data indicated that regular right foot occurred in 77 participants (rj. 67.55%), that first degree occurred in 26 (i.e. 22.80%), second degree in 11 (i.e. 9.65%), while the 3rd degree of fallen arch was not detected in any of the participants.

TABLE 3

Number of participants with regard to degree of right foot fallen arches.

	Regular left feet status	1st degree of fallen arches	2nd degree fallen arches	3rd degree fallen arches
Number of participants	77	26	11	0

FIGURE 4

Percentage of participants with regard to degree of right foot fallen arches.

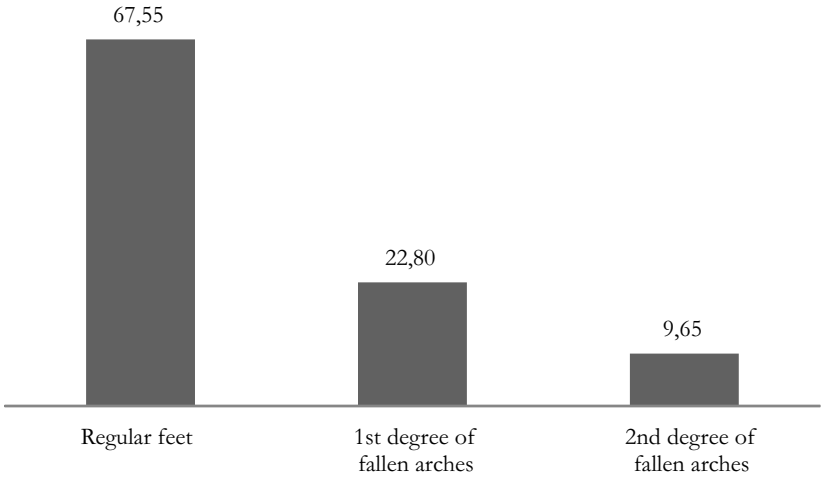


Table 4, as well as Figure 5 present the number and percentage of participants with flat feet according to the competition categories. It was established that the 1st degree of fallen arches occurred most with children aged 7-10, 53.33%, and the 2nd degree of fallen arches occurred most in children aged 11-12, 14.82%. The highest percentage or regular feet occurred in cadets (70.59%), and the lowest in players aged 7 to 10 (40.00%).

TABLE 4

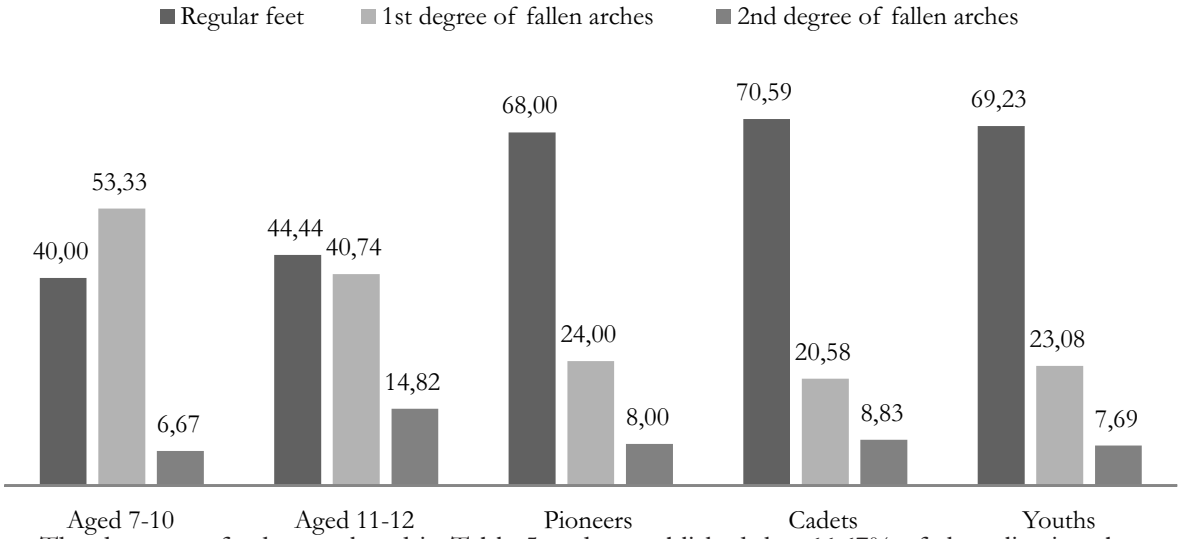
Number of participants with regard to feet status according to competition categories.

Feet status	n	RF	I	II	III
Aged 7-11	15	6	8	1	0
Aged 11-12	27	12	11	4	0
Pioneers	25	17	6	2	0
Cadets	34	24	7	3	0
Youths	13	9	3	1	0
Overall	114	68	35	11	0

Legend: **n** - Number of participants; **RF** – Regular foot; **I** – 1st degreeof fallen arches; **II** – 2nd degreefallen arches; **III** – 3rd degreefallen arches.

FIGURE 5

Percentage of participants with regard to feet status according to competition categories.



The data were further analyzed in Table 5 and graphically in Figure 6, showing the number of participants with regard to place of residence. It was established that 66.67% of them live in urban environments and only 33.33% of them are from rural environments.

TABLE 5

Number and percentage of participants with regard to residence.

Residence	n	%
Urban environment	76	66.67
Rural environment	38	33.33

Legend: **n** - Number of participants; **%** - Percentage.

FIGURE 6

Percentage of participants with regard to residence.

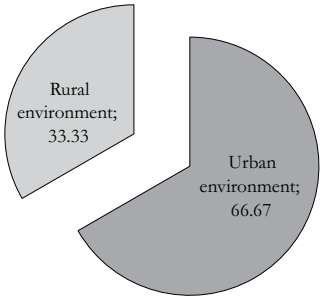


Table 6 and Figure 7 display the degree of fallen arches with regard to children's residence (urban vs. rural environment). The data show that greater percentage of participants with regular feet status live in rural environment 68.42%. The first degree of fallen arches was more represented in participants from urban environment (35.52%), while the 2nd degree of flat feed occurred more in participants from rural environment(10.53%).

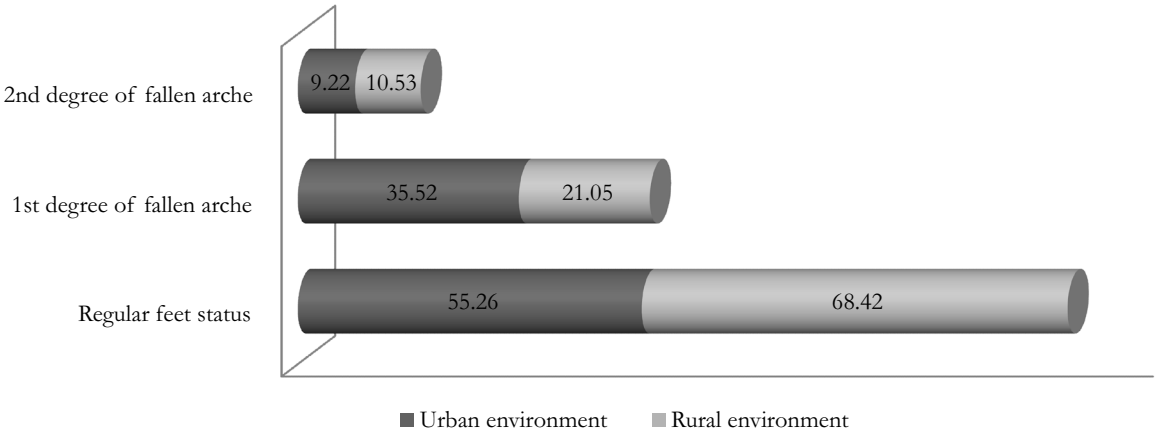
TABLE 6

Number of participants with flat feet regard to residence.

	Number of participants	Regular feet status	1st degree of fallen arches	2nd degree fallen arches	3rd degree fallen arches
Urban environment	76	42	27	7	0
Rural environment	38	26	8	4	0

FIGURE 7

Percentage of participants with flat feet with regard to residence.



CONCLUSON

The results of the research indicate that 59,65% participants have regular physiological feet status, without signs of a possible deformity occurrence.

Flat feet most occur at the age of 10-12 years (first two categories), followed by pioneers 13-14 years, 18-year old youth, while it occurred most rarely in cadets aged 15-17 years.

Feet deformities such as flat feet occurred more in children from urban environment 66.67%, then in those who grew up in rural environment 33.33%.

We can conclude that the percentage of participants with 1st degree of fallen arches in urban environment was 35.52%, while in rural environment that percentage was much lower 21.05%. The 2nd degree of fallen arches occurred in urban environment in 9.22%, while in rural environment that percentage was slightly higher and amounts to 10.53%.

The obtained results indicate that it is necessary to implement all possible prevention measures in order to prevent further progression of feet status deterioration and football is surely sports game, which according to its features, is very appropriate for application of therapeutic influence. Children can be motivated through different elementary games, and additionally by placing specific tasks, it can result in elimination of certain deformities. The application of different skips (frontal, side), starting from ladders, rolling, ball carrying represents exercises that contribute to adequate formation of bone and muscle- ligament foot structure. It is necessary to focus on regular position in of feet, to teach children about regular body posture while taking certain positions in order to distribute evenly load sand not to overload some foot bone and muscle structures. Surely, it is good that children walk bare foot for some part of training, if the reare adequate conditions that would not damage children's health.

It is of utmost importance to implement feet controls and consequently implement corrective treat-

ments. Such treatments imply applications of movements for preventive and corrective purposes.

REFERENCES

Ilić, D. (2012). *Korektivna gimnastika* [Corrective gymnastics]. Belgrade, Serbia: Faculty of Sport and Physical Education.

Ilić, N. (2006). *Fiziologija sporta* [Physiology of Sport]. Belgrade; Serbia: SIA.

Kosinac, Z. (2008). *Kineziterapija sustava za kretanje* [Kinesitherapy of the locomotor system]. Zagreb, Croatia: Gopal.

Koturović, LJ., & Jeričević, D. (1996). Korektivna gimnastika [Corrective gymnastics]. Belgrade; Serbia: IGP „MIS SPORT".

Radisavljević, M. (2001). *Korektivna gimnastika sa osnovama kineziterapije* [Corrective gymnastics and elements of kinesitherapy]. Belgrade, Serbia: Advanced school for sports coaches.

Received: October 4, 2014
Revision received: Jun 21, 2015
Accepted: Jun 21, 2015

Correspondence to:
Dejan Ilić, PhD
Faculty of Sport and Physical Educaton
Blagoja Parovića 56
11000 Belgrade
Serbia
Phone: 00387 64 24 47 720
E-mail: dejan.ilic@fsfv.bg.ac.rs

SportLogia
2015, 11(1), 61–70
e-ISSN 1986-6119

www.SportLogia.com

ADMINISTRATION DEVELOPMENT OF OMAN ATHLETICS ASSOCIATION

Majid AL-Busafi[1]

[1]Physical Education Department, Sultan Qaboos University, Sultanate of Oman

EXPERT ARTICLE
doi: 10.5550/sgia.151101.en.007B
UDC: 796.4.011.3(535)

SUMMARY

The objective of the study understands and highlights the primary administrative issues and barriers occur in the administrative system of Oman Athletics Association. In order to collect the sample, interviews were conducted with the people working in this association. The interviews were conducted with the directors, coaches and employees. The questions asked were related to the problems they faced and what kind of resources is required. The possible solutions according to them were also asked. The participants were divided into three groups, group A consist of employees, group B consist of directors and group C consist of coaches. The questions were asked according to their field. The results of the study depicted that obstacles faced by the association has the negative impact on the workflow and progress of the organization. There is the need of effective programs in the organization.

Key Words: acreditation, administrative, competencies, complex and structure.

INTRODUCTION

Administration is an important field in the management of different types of organizations. It is a fundamental department as it facilitates workflow and focuses on achieving goals and objectives of an organization. Any flow in this department may cause failure to the whole system. It is essential to keep continuously developing this department to ensure higher performance levels. However, defects and weaknesses, in real life situations, are expected to occur in any unit of any organization.

The purpose of this study is to identify and understand main administrative issues and obstacles in the administration system of Oman Athletics Association, try to reach possible solutions to overcome these obstacles, and create methods to prevent their recurrence in the future. This ensures the organizations' stability and continues success.

Realizing the obstacles is the first step towards correction. Ignorance and avoidance will not solve the issue. Contrarily, ignorance leads to accumulation of the issues, which most probably will further complicate the problem. When the issue is addressed, it becomes easier and more realistic to search for solutions. Sometimes one solution might not be sufficient to solve the problem. That is why a number of possible solutions need to be considered before a final applicable solution is reached. This process is preferably to be done in coordination with a skilled and experienced person in that particular area. That is not the end of the process. A solved issue must be considered as a life lesson. As a result, special techniques must be created in order to ensure that it does not happen again in the future ("Sultan Qaboos", 2007).

The Sultanate of Oman is the second biggest country in the Arab peninsula. Its geographical area is 309.500 square kilometers, and the length of its coastline is approximately 2.092 km. The coastline borders the Indian Ocean and the Arabian Gulf, the Gulf of Oman and the Arabian Sea. The geography of the country provides opportunities for practicing different kinds of sports activities. It has a varied geography and landscape, consisting of sand dunes (82%), mountains (15%) and plains (3%). The weather near the coast is hot and humid in summer, and it is hot and dry in the inland regions, with temperatures reaching an average of 45°C in summer. In winter, the weather usually turns to average 25°C in most regions ("Oman", 2014).

The geography of the country has shaped people's activities. The geographical diversity in the Sultanate with its long coasts, valleys, desert and mountains requires different physical attributes and adaptations for each environment. For instance, those who live on the coast understandably focus their activities on the sea and fishing. In addition, those who live in the interior areas, where mountains, desert and valleys dominate, are mainly involved in activities relating to farming and shepherding. Accordingly, populations adapt and achieve the necessary fitness according to each environment (AL-Shamli, 2008). In addition, because of the weather, people in Oman can only start practicing outdoor sport at about the approach of sunset or after that, when the temperature becomes cooler. However, Oman, like other countries in the world, has been affected by technological advances, mechanization and automation, which have radically reduced human physical activity (Ibid). The coastline, which is almost 1.700 km long, gives opportunities for Omani people to practice beach sports. As a result, it is suggested to give such sports more attention in term of facilities. Hosting the second Asian Beach Games in Muscat ("Muscat", 2014) could be a significant opportunity to build the culture of beach sports among Omani people. It is clearly evident that geographical diversity can affect the lifestyle and economic actions of the inhabitants, and so it is assumed that it may have the same effect on sports activities too (AL-Shamli, 2008).

This increased wealth has led to significant changes since the 1980s for sport in Oman, predominantly for men. The government of Oman has built and developed sports facilities and established organizations for some major Olympic sport. It has fostered interest in sport among regulations to improve conditions for youth, stimulating youth involvement in national, regional and international competitions (AL-Zedjali, 2005). However, it is worth noting that these facilities are only available in some major cities in Oman such as Muscat (the capital) and Salalah city (in the south).

Most of the national organizations for major Olympic sports were established between 1973 and 1988. The national Omani Olympic Committee [OOC] was created in 1982 and joined the International Olympic Committee [IOC] in the same year. Oman first participated in the Olympic Games in 1984 (Ahmed, 1996; AL-Tauqi", 1998; Ministry of Sports Affairs, 2010).

The last transfer of the sports sector was by Royal Decree 120 in 2004, which created the Ministry of Sports Affairs (Ministry of Legal Affairs, 2010; Ministry of Sports Affairs, 2010). It was set up to work with other relevant bodies; in helping, the Sultanate's youth develop their sporting talents and potential.

All sports federations are voluntary organizations. While many of these federations have a professional salaried staff to manage affairs on a day-to-day basis. Some of the major sports (such as football) have many administrators, those who decide policy are unpaid volunteers elected by members. The methods of election are based on a democratic constitution, which may only be changed by the members of the sport itself (Beashel and Taylor, 1996; Ministry of Sports Affairs, 2010).

The vision and mission of OAA is to achieve sports excellence and honorable representation of the Sultanate of the sports in regional and international events, and to popularize athletics.

Oman Athletics Association [OAA], established in 1982, member of the IAAF since 1982, member of GCC Athletics Organizing Committee since 1986 and member of the Asian Athletics Association [AAA] and the Arab Athletics Association since 1987. In 2010, Oman Athletics the youth, provided trainers and coaches from the external market. They have proposed laws and training center gained the IAAF accreditation as an IAAF ATC Accredited Training Center, which allowed the opportunity for a plenty of international athletes to have their training camps in Muscat.

The General Assembly consists of all affiliated clubs. It meets at least once a year to review activities and events at congress to elect the OAA board of directors once every four years. The current board was elected on November 11, 2012. It consists of nine board members, including Chairman, Sheikh Saif Bin Hilal Al Hosni and General Secretary, Mr. Said Bin Saif Al Qasmi.

OAA plays a significant role in the development of athletic sports in the Sultanate of Oman by preparing qualified coaches and referees and selecting athletes according to a set criterion. It also supervises different local competitions in cooperation with official and civil society institutions. It takes it to its mission to support athletes on the technical, medical and social aspects in order to achieve sports excellence. Further, it works to qualify national technological and managerial cadres to align with international systems and standards. It also works to develop the events and activities of the sport of athletics in Oman.

Since established, OAA has participated in various GCC, Arab, Asian and international competitions. It has participated, as of today, in seven Olympic Games, starting in the 23rd Olympic Games in Los Angeles

1984, and continued to the 30th Olympic Games in London 2012.

On the other hand, there are numerous Omani youth who work in military sectors who are willing to engage in the game, the prevalent age group in the Sultanate is the youth, increased government funding, in addition to willingness of the privet sector to support and market athletics in Oman. All these factors are promising for a brighter future for the athletics sport in Oman.

Finance: OAA receives its budget (O.R. 600.000 per annum) from Ministry of Sports. It is distributed to cover salaries and wages (O.R. 191.700), variable / administrative (O.R. 40.300) and activity expenses (O.R. 368.000). In addition to that, it has a one-year contract with Muscat Pharmacy, where the latter provides minerals and vitamins to the national team worth (O.R. 10.000).

TABLE 1

Human Resources.

Occupations	Numbers
1. Board members	9
2. Staff	8
3. Local coaches	7
4. International coaches	5
5. Physiotherapist	2
6. Registered referees	140
7. Active referees	60

The Table 1 depicts the current HR structure. Work values and principles of Oman Athletics Association consist of the following:

- Transition from management to strategic planning
- Respond to demands of beneficiaries and contributors
- Team work
- Transparency and responsibility
- Diversification in evaluation management
- Respect and protection of human rights
- Maintain Islamic identity

Activities: Every year, OAA organizes / takes place in a number of activates. Local competitions; where clubs compete against each other within their region and only those who are qualified can compete to win OAA cup. Cross-country, school competitions, kid's athletics, road races, social and specialized competitions for women are the primary activities organized by OAA as part of its role and responsibility to activate the sport in the Sultanate. In addition to local activities, OAA takes part in several competitions abroad; GCC, Arab, West Asian, Asian and World Championship.

Table 2 displays the partnership of OAA with other organizations. OAA strategic plan focuses on a number of areas as follows, noting that in this research my focus is on administrative/ managerial area:

- Sport management and supervision.
- Elite sport; supporting athletes, development of training facilities and training camps.
- Events and activities.

TABLE 2

Partnership with Other Organizations.

Organizations	Organizations
1. Ministry of Sports	8. Ministry of Municipality
2. Oman Olympic Committee	9. Civil Society institutions
3. Sports club	10. GCC Athletic Association
4. Military sectors	11. Arab Athletic Association
5. Educational Sectors	12. Asian Athletic Association
6. Private Sectors	13. IAAF
7. Media	

TABLE 3
Sport Management and Supervision.

Goals	Evaluation Criteria
Distribution of administrative task, job descriptions and defining staff duties and responsibilities.	• Integration of administrative structure. • Existence of job classification and evaluation method.
Application of e-management principles	• Increase of e-mail communication between board members. • Development of website and provide some administrative services (registration forms, reports etc).
Increase cooperation, communication and trust with local partners.	• Cooperation in terms of timing local events and avoid duplication. • Simplification of administrative procedures to execute events.
Increase abilities to self-financing and create investment and marketing committee.	• Increase of marketing opportunities (facilities, athletes, services and events). • Seasonal marketing contracts.
Develop the culture of teamwork in event management.	• Activation of sub-committees and attraction of professional personals. • Establishing work teams for executive projects.
Modify some of the existing internal regulations.	• Modification of rewards and allowances system for administrative and technical staff.

- Development of athletics; developing technical and administrative staff, athletics for all, kid's athletics, athletics for women and awareness.

Table 3 presents the goals of OAA and its evaluation criteria.

METHODS

The field study of this research involved interviews across the Association, through which realities, problems, needs, possible solutions and ideas were discussed with those currently working in the athletics field in Oman. Interviews were conducted with (7) persons of OAA Employees, (7) Directors and (10) Coaches from Oman Athletics Association. The interviews were conducted during May 2013 in Muscat.

The aim of this study is to identify and understand main administrative issues and obstacles in Oman Athletics Association, and to reach for possible solutions to overcome the obstacles, as well as to eliminate possible future occurrence of these obstacles. The questions asked of the participants varied between issues concerning planning, organizing, coordinating, and leadership.

The questionnaires mainly contained three types of questions, for three different groups in the Association. The first group consisted of the employees of the Association (those with permanent contracts). The second group included directors while the third group consisted of coaches.

Participants in Group A (Employees) were given a number of questions to measure their satisfaction, understanding of their role, having a clear understanding of the Association objectives and level of coordination in the system of the Association. They were asked to rate these aspects in terms of good, acceptable or poor.

Group B (Directors) were given a number of general administrative obstacles and were asked to give their opinion whether those obstacles do exist, somewhat or do not exist.

In Group B (Coaches), considered as beneficiaries, were requested to rate the services provided by coaches and their athletes, whether they were good, acceptable or poor.

RESULTS

Results of the field study will be discussed in detail concerning the administrative obstacles facing OAA, obstacles that have negative influences on the progress of the workflow and may disturb competencies and effectiveness in the administration system.

The results show that most of the respondents (employees, management and coaches) agreed that administration issues and obstacles do exist in the administrative system of the Association.

Group A

Most employees of Oman Athletics Association agreed that the procedures to carry out works in the Association are easy. Contrarily they think that the availability of an atmosphere that encourages creativity and innovation is poor. The majority of the employees believe that these aspects are acceptable; participation of staff in decision-making, existence of a clear hierarchal system, cooperation and friendly relations between employees. In regards to the availability of information and easy access to them should be given whenever needed, suitability of financial resources in order to improve workflow and all of them agreed that financial rewards in comparison to work responsibilities are acceptable.

Table 4 shows the outcome of the questionnaires with the staff of OAA.

The majority of the employees find it difficult to perform their jobs due to:

- Job role and responsibilities are not clear.
- The way work is distributed.

The employees believe that the following are urgent issues that need to be solved in the Association:

- Slow in workflow due to delays in decision-making
- Distribution of work
- Cooperation at work

Group B

The majority of OAA directors agreed that these obstacles do exist in the Association. Improvisation in conducting work, weakness in evaluation process, weakness in planning, confused hierarchal system and lack of coordination between employees and supervisors are major issues. Most respondents implied that these obstacles somewhat existed in the Association; unclear objectives, weakness in human resources, lack of horizontal and vertical coordination, workflow is slow and procedures are complicated. The lack of innovation and creativity, lack of unity in the way works are conducted, coordination is not sufficient to prevent inconsistency and redundancy, and administrative procedures are bureaucratic.

A good number of respondents believe that centralization of authority and autocratic procedures do not exist in the Association.

Table 5 shows detailed findings resulted from interviews with directors at OAA.

Group C

As it is shown in the table below, most coaches agreed that speed of work performance, speed of

TABLE 4

The questionnaires with the staff of OAA.

	Question Addressed	Ratings (No. out of 7)		
		Good	Aceptable	Poor
1.	Participation of staff decision	1	4	2
2.	Clear hierarchal system	0	4	3
3.	Division of work	2	2	3
4.	How serious and honest is the relationship of the employees and the management	2	3	2
5.	Cooperation and friendly relation of the employees with each other	3	4	0
6.	Cooperation and friendly relation of the employees with each other	3	2	2
7.	Clarity of role and responsibilities of employees	2	2	3
8.	Easy procedures to conduct work	5	2	0
9.	Availability of information and easy access when in need	0	4	3
10.	Availability of an atmosphere that encourages creativity and innovation	0	3	4
11.	Availability of suitable work requirements to improve work conditions	2	5	0
12.	Suitability of financial resources in order to improve workflow	0	6	1
13.	Financial reward is appropriate in relation to your work responsibility and hours of work.	0	7	0

fulfilling needs of coaches, flexibility in responding to needs, ability to accomplish work, suitability of services provided and the ability to provide services in a sufficient way are acceptable, however can be improved in the future. Six out of ten coaches think that OAA is poor in taking care of beneficiaries, delegation and transparency with coaches. Five coaches believe that speed of decision making by the management of OAA is poor, equally five coaches believe the same aspect is acceptable.

Table 6 shows results found in interviews with OAA coaches:

RESULTS

General findings confirmed that there are obstacles in the administration system of the Association. The existence of obstacles is normal in any organization. However, solutions and ways to overcome these obstacles are necessary in order for the organization to continue providing its services efficiently.

The results of the study show that one major issue behind the occurrence of those obstacles in the Association is lack of planning. Planning is an essential element in the management of organizations. Planning focuses attention on objectives and results, and so it gives necessary direction to the future activities. It reduces mistakes and unnecessary pressures and ensures greater productivity. Good planning provides guidance to decision-making. Lack of planning is one of the reasons behind issues like lack of communication, lack of coordination. Planning facilitates communication and coordination between different departments in an organization. Lack of planning leads, as well, to delays in decision-making at the Association.

The suggested IAAF coach education model is split into five levels of accreditation, framing progressive responsibilities, competencies and capabilities from foundation to level five. The 5-level structure addresses the weakness of the old 3-level structures that are criticized for minimizing the opportunities for providing qualified coaches at different levels of

TABLE 5

Results from interviews with directors at OAA.

Question Addressed	Ratings (No. out of 7)		
	Exist	Somew-hat	Do not exist
1. Objectives are not clear	3	4	0
2. Lack of criteria to determine priorities	3	2	2
3. Improvisation in work conduct	4	1	2
4. Weakness in human resources	1	5	1
5. Lack of horizontal and vertical coordination	2	4	1
6. Weakness in monitoring and evaluation process	6	0	1
7. Weakness in planning	5	2	0
8. Lack of qualifications for those in the position of planning	3	3	1
9. Centralization of authority	2	1	4
10. Slow workflow and complicated procedures	3	4	0
11. Lack of creativity and innovation	3	4	0
12. Autocratic procedures	1	2	4
13. Responsibility is not distribute among the leaders	1	3	3
14. There is no unity in the way work is conducted	2	5	0
15. Hierarchy system is not clear	5	1	1
16. Job description is not clear	2	3	2
17. Shortage in human and material resources	3	3	1
18. Lack of coordination between employees and supervisor	4	2	1
19. Coordination does not prevent inconsistencies and redundancies	1	5	1
20. Administrative procedures and bureaucratic	3	4	0

TABLE 6
Interviews with OAA coaches.

Question Addressed	Ratings (No. out of 7)		
	Good	Aceptable	Poor
1. Speed of work performance	1	6	3
2. Speed of fulfilling needs	1	6	3
3. Flexibility in responding to needs and development	2	8	0
4. Ability to accomplish the world	2	7	1
5. Suitability of services provided to beneficiaries needs	1	7	2
6. Provide services in sufficient way	1	6	3
7. Taking care of beneficiaries	1	3	6
8. Transparency	2	2	6
9. Speed of decision making	0	5	5
10. Delegation	1	2	7

sports program. The matrix is completed with four 'sites' at which coaches could be involved in participation, performance or competitive sport: local, regional, national or international. One of the great advantages of this new structure is that, in addition to provision for elite coach development for international competition, it provides the opportunity for coaches to qualify at level five. It will remain working at grass roots level whilst gaining higher-level qualifications, allowing them to use their increasingly complex skills and knowledge at a local level. The matrix structure addresses criticisms of the pyramid style models that are viewed as elitist and lacking in vision regarding the need for sophisticated skill sets to work in community/participation sites. This structure is one of the most valuable outcomes of the current study and addresses the first principle, to commit to the provision of high quality active, trained and accredited coaches to ensure that participants, performers, and competitors involved in sport have access to the best coaching at each stage of their development.

DISCUSSION

General findings confirmed that there are obstacles in the administration system of the Association. The existence of obstacles is normal in any organization. However, solutions and ways to overcome these obstacles are necessary in order for the organization to continue providing its services efficiently.

The results of the study show that one major issue behind the occurrence of those obstacles in the Association is lack of planning. Planning is an essential element in the management of organizations. Planning focuses attention on objectives and results, and so it gives necessary direction to the future activities. It reduces mistakes and unnecessary pressures and ensures greater productivity. Good planning provides guidance to decision-making. Lack of planning is one of the reasons behind issues like lack of communication, lack of coordination. Planning facilitates communication and coordination between different departments in an organization. Lack of planning leads, as well, to delays in decision-making at the Association.

The suggested IAAF coach education model is split into five levels of accreditation, framing progressive responsibilities, competencies and capabilities from foundation to level five. The 5-level structure addresses the weakness of the old 3-level structures that are criticized for minimizing the opportunities for providing qualified coaches at different levels of sports program. The matrix is completed with four 'sites' at which coaches could be involved in participation, performance or competitive sport: local, regional, national or international. One of the great advantages of this new structure is that, in addition to provision for elite coach development for international competition, it provides the opportunity for coaches to qualify at level five. It will remain working at grass roots level whilst gaining higher-level qualifications, allowing them to use their increasingly complex skills and knowledge at a local level. The matrix structure addresses criticisms of the pyramid style models that are viewed as elitist and lacking in vision regarding the need for sophisticated skill sets to work in community/participation sites. This structure is one of the most valuable outcomes of the current study and addresses the first principle, to commit to the provision of high quality active, trained and accredited coaches to ensure that participants, performers, and competitors involved in sport have

access to the best coaching at each stage of their development.

CONCLUSON

As the aim of this study was to identify the obstacles that affect the workflow at Oman Athletics Association, explore ways to overcome the obstacles and find techniques to avoid recurrence in the future. Following are some recommendations for a successful administration system. The recommendations are divided into two parts; general recommendations and specialized recommendations in the area of human development.

Currently, sport and all its activities in Oman are under the supervision of the Ministry of Sport Affairs, to which the sports federations report. From an organizational, administrational and functional point of view, these sports federations control and supervise all sports clubs in Oman with financial support from the Ministry of Sports Affairs. The sports federations are the supreme bodies that govern sports clubs, and their main task is to develop and promote the sport they represent.

General Recommenadaton

Vision, mission and objectives of the Association must be clear to all the stakeholders, especially employees, to enable their efforts to achieve the objectives through the process of management. Regular meetings between management and the employees, management and the coaches are necessary. In these meetings, needs, plans, progress reports and achievements should be discussed. This will facilitate communication and leads to mutual understanding between different parties/departments in the Association.

Simplify procedures and avoid bureaucracy as much as possible. The process of decision-making needs to be improved and it should be more flexible to enable quick response to the needs of coaches and athletes. Activating electronic communication between board members, staff and member of the committees is highly important to make decisions faster, since board members and most members of different committees are volunteers who are committed to full time jobs.

Delegation of authority is a very important tool to make workflow easier and faster.

Work division among employees must be on an equal and fair basis.There should be transparency in the relations between the management and employees, the management and coaches as well as the employees and coaches. This can increase trust between the different parties. Promote teamwork, by creating an environment where everybody works collaboratively and in coordination to achieve the objectives through the process of management. Unity of command, as discussed earlier, in accordance with Fayol's theory of management principles, each individual must have only one direct supervisor or manager, from whom directions are taken. Use of expertise houses in the field of administration, and establishing exchange programs with local and regional sports associations.

Future Research

With the aim of this study to explore administrative issues, other topics come up to be studied in the future. It is important to study performance development plan. Any type of organization, especially sports organizations, need a risk management plan. In the future researches, developing a human resources strategy and action plan will be beneficial.

REFERENCES

Ahmed, B. (1996). *Oman sport and Olympiad*. Muscat, Alwatan: Omani Olympic Committee.

AL-Shamli, A. (2008). T*he effectiveness of after-school physical activities on the physiological fitness components of 10th grade male students in Al-Dhahirah Region, Sultanate of Oman*.Unpublished doctoral thesis, University of Malaya.

AL-Tauqi, M. (1998). *Organizational effectiveness: Oman Football Association*. Ottawa, Canada: University of Ottawa.

AL-Zedjali, Y. (2005). *Omani sport. From the beginning to universal*. Muscat, Oman: Ministry of Sport Affairs.

Beashel, P., & Taylor, J. (1996). *Advanced studies in physical education and sport*. London, Unted Kngdom: Nelson.

Ministry of Legal Affairs. (2010). T*he Royal Decree No. 112/2004: Establishing the Ministry of Sports Affairs*. Muscat, Oman: Ministry of Legal Affairs.

Ministry of Sports Affairs (2010). *Omani sports history*. Muscat. Oman: Ministry of Sport Affairs.

Muscat. (2014). *The second Asian Beach Games*. Retrieved from http://www.muscat2010.org . om/ar/Pages/ default.aspx.

OMAN. (2014). Muscat: Ministry of Information, Oman establishment for Press, Publication & Advertising.

Sultan Qaboos University. (2007). S*elf Study Report. College of Education Physical Education Department*. Retreived from http://www.squ.edu.om/portals/43/selfstudyphysical.pdf

Received: February 11, 2015
Revision received: May 29, 2015
Accepted: May 29, 2015

Correspondence to:
Majid AL-Busafi
Physical Education Department,
Sultan Qaboos University
Muscat, Oman-32AL-Khod-123
Phone: 0096899444661
E-mail: majed_busafi@yahoo.com