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The Technology to Train Techniques in Sports

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Abstract

The training session of technical techniques is proposed to conduct on the playing ground where computer-controlled light emitters create allowed and unallowed light dynamic zones. Each athlete is to be placed in one of the allowed zones and to execute with an implement some techniques directed with his breast on the light guide mark created outside the allowed zone. The athlete holding an implement is not allowed to go out of the permitted area. In the course of the training session unpredictably for an athlete the position, the shape and the area of the permitted and unallowed zones is changed. The athlete's going into the unallowed zone or performing techniques in the position not-oriented on the guide mark is considered to be an error. If the errors are none, the allowed zone area is reduced and the intensity of the session is increased until the athlete commits an error. By the minimum square of the allowed zone, the maximum speed of its movement that the athlete performing the exercise does not commit any errors, they evaluate the athlete's technical skill.

The proposed technology facilitates in faster mastering the play technique, unlocking the individual technical features and enhancing them at any stage of the professional career. The technology can be used for the technical training of athletes of different professional profiles specializing in football, hockey, handball, basketball and other sports that require implement handling.

Keywords: sports, movements technique, techniques, training, methodology of training, informationt.

1. Introduction

Sport technique is considered to be a set of techniques and actions executed to obtain the most effective solution of motor problems due to the specifics of a particular kind of sport (Krivoshchekov, 2007). As early as at the stage of basic training (in the first year) one of the main tasks in sports education is training the fundamental sport techniques such as motor skills (Sofronov et all., 2012).

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The conventional methods of technique training have been used for more than 40 years already, so the problem of the technical skill growth is highly dependent upon the established system to train the basics of the sport drills through mainly such methods as a description, an explanation, and a demonstration.

According to M. Vershinin et al. (Vershinin et all., 2013), at the present time, a systematic approach to the development and improvement of sport technique training methods involving the search and development of novel technologies is absolutely required. As the technical skills improve, the opportunities for making the selective impact on certain aspects of the motor function increases. To provide for many-sided training more coaching tools ought to be applied (Abramov, 2012). For this purpose seeking innovative, more efficient means to build up movement techniques using information technologies is important. This will allow us to (Ermakov, 2001; Petushinskii, 2006; Luk'yanov et all., 2007):

- master quicker the rational and efficient technology and know how to apply it;
- find an individual technique style;
- modify the technical training at any stage of the athlete's training starting from the beginner and to Merited Master of Sports level;
- bring the quality of training in team sports to a higher level;
- facilitate the coach's work aimed at achieving better results in sports.

The use of information technologies for technical and tactical training in team sports have been earlier examined by the authors and the method of technical (Afon'shin et all., 2014; Polevshchikov et all., 2014), tactical actions training by means of simulation play situations in virtual reality (Rozhentsov and Afon'shin, 2013) and technical and tactical training in team sports has been proposed (Rozhentsov and Afon'shin, 2014).

The purpose of the work is to develop the techniques training technologies in sports using information technologies.

The Technology of Techniques Training in Sports

The session to train techniques takes place on the playing ground, where by means of computer-controlled light emitters, allowed and unallowed light-dynamic zones are created. Each athlete is to keep staying in one of the allowed zones, execute certain drills with an implement, focusing with his breast on a light guide mark created outside the permitted zone. The athlete holding his implement is not allowed to leave the permitted area. In the course of the training session unpredictably for an athlete the position, the shape and the area of the allowed and unallowed zones is changed.

Depending on the athlete's proficiency level the speed of transformation and movement of zones on the playing field is set. For beginners the minimum speed is set and higher qualified athletes are subjected to more difficult tasks simulating the play with an experienced opposing player. The error is considered to be committed when the athlete enters the unallowed zone or performs the technique in the non-oriented to the guide mark position.

If the errors are not committed the area of the allowed zone area is reduced, and the intensity of the training session is to be increased until the athlete fails to perform the drill correctly. The minimum area of the allowed zone, the maximum movement speed that the athlete is performing his drill not making any errors help to evaluate the athlete's technical proficiency (Patent..., 2015).

2. Discussion

According to V.I. Prokopenko and V.P. Metyolkin (Prokopenko and Metelkin, 2011), the researchers studying the problem of children's physical activity proved that 5-7 year old children were able to master the sport movements being complex types of motor skills. Therefore, much attention in the domestic and foreign sports science and practical experience is paid to the researches related to not only children's involvement in sports but also to the development of the scientifically substantiated training methods. In this respect, a special emphasis in training team sports should be allocated to learning the technical elements (technique) of sport as one of the main factors of consistency and productivity of the athlete taking part in competitions.

The initial stage of young athletes training in team sports is characterised by a large number of single-purpose drills performed in standard conditions e.g. on the playing ground or at a low

speed, without any time constraints, etc. (Lobachev et all., 2011). Then, the techniques are trained in more complex conditions and finally, in complicated ones close to the real play (Dulibskii, 2010).

At the same time, one of the factors restraining young athletes' training in team sports according to A. Dulibsky (Dulibskii, 2010) is the technological infrastructure. This gap in the play technique is already seen at the early training stages. The methods that have been defectively applied in infancy continue to be a stumbling block at the time of maturity in sports as well (Lobachev et all., 2011).

While training young athletes, improved efficiency of play technique and skills mastering in variative conditions, close to the play ones is required. The process of young athletes' training ought to be based on learning and mastering techniques not in isolation from each other, but in certain combinations, which are most often found in game situations (Lobachev et all., 2011).

It is necessary to modify the structure of motor actions, their dynamics, kinematics and rhythm to improve the technical qualification. To do this the 'set' of movements in the situations close to the conditions of a competition is to be extended. An important role in solving those problems belongs to various training devices, facilitating in evaluation and development of both physical and technical qualifications (Ermakov, 2001). However, both abroad and in Russia those devices are generally highly specialised and have low functionality. For example, to monitor and analyse the athlete's movements they film the movements under study with the video camera, then the video clips are transmitted to the computer, set the reference points on the athlete's body or on the implement in the first frame, track their positions in all the subsequent frames, calculate the trajectory of reference points movement and analyse them. Such a system facilitates in examining the athlete's movements in a confined space, but not in evaluating the speed and intensity of motor and technical actions in team sports directly on the playing ground (Patent..., 2004).

According to D.A. Leleko (Leleko, 2011), application of the latest technical devices and information technologies for training sessions helps to develop efficiently the motor abilities, improve technical skills, and receive immediate and reliable information on the quantitative and qualitative characteristics of the movements, of the level of the athlete's technical proficiency and ensure rapid improvement of the motor skill. Owing to this, it is possible to diversify the training process and enhance athletes' excitement.

3. Conclusion

The proposed technology facilitates in quick mastering the rational play technique, unlocking the player's individual technical features and improving them at any stage of the professional career. The technology can be used to quantify the athlete's proficiency in a wide range of cognitive and motor tests, which will be the basis for analysing the player's capabilities and adjusting his/her training tasks.

The technology can be used for technical training of athletes of different proficiency profiles who specialise in football, hockey, handball, basketball and other sports played with the implements.

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Технология тренировки технических приемов в спортивных играх

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Аннотация. Тренировку технических приемов предлагается проводить на игровом поле, на котором световыми излучателями, управляемыми компьютером, формируются разрешенные и запрещенные светодинамические зоны. Каждый спортсмен должен находиться в одной из разрешенных зон, выполнять заданные технические приемы со спортивным снарядом, ориентируясь грудью на световую метку, создаваемую вне разрешенной зоны, не выходить из разрешенной зоны и удерживать в ней спортивный снаряд. В процессе тренировки непредсказуемо для спортсмена меняют положение, форму и площадь разрешенных и запрещенных зон. Ошибкой считается попадание спортсмена в запрещенную зону или выполнение технических приемов в положении не ориентированным на метку. При отсутствии ошибок площадь разрешенной зоны уменьшают, а интенсивность тренировки увеличивают до тех пор, пока спортсмен не сможет безошибочно выполнять данное упражнение. По минимальному размеру разрешенной зоны, максимальной скорости ее перемещения, при которой спортсмен, выполняя данное упражнение, не допускает ошибок, судят о технической подготовленности спортсмена.

Предложенная технология позволяет быстрее овладеть рациональной игровой техникой, раскрыть индивидуальные технические особенности игрока и совершенствовать их на любом этапе профессиональной карьеры. Она может использоваться при технической подготовке спортсменов разной квалификации, специализирующихся в футболе, хоккее, ручном мяче, баскетболе и в других видах спорта, где необходима работа со спортивным снарядом.

Ключевые слова: спортивные игры, техника движений, технические приемы, обучение, методика тренировки, информационные технологии.

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The Functional State of the Cardiovascular System of Students with Different Levels of Physical Fitness

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Abstract

In this article the current functional state of the cardiovascular system of the body of students that regularly go in for sport and those that are not involved in sports is studied. The cardiovascular system was eestimated by recording the heart rate variability, and bydefining a work capacity of a man by Rufe method. A complex estimation of heart rate variability by index of activity of the regulatory systems of the body was carried out. It was found that students involved in sports had a moderate and expressed stress on regulatory systems observed in 55 % of cases that composed more than half of the surveyed students. It may be due to inadequate physical load placed on the current functional state of the body.

Keywords: adaptation, cardiovascular system, nervous system, students, cardiac rhythm, regulator system, health, operability.

1. Introduction

In the life of a certain part of the students sport, which to some extent is an anti-stress factor, takes an important place. Physical activity plays an important role in the formation of body's functional reserves. At the same time in Universities training and competitive activity alongside withthe academic load places high demands on the functionality of the body, which is especially typical for sport games. Any discrepancy between the volume as well as intensity of physical activity and adaptive capabilities of the organism can cause a number of changes in functional systems on homeostatic level, change the regulatory-adaptive status of the body, predetermining the further course of adaptation (Bersenev, 2008).

Body's resistance to the sports' training and competition loads, sports results, maintenance of the favorable dynamics of health state are determineddepending on the nature of the mechanisms of regulation, the level of physiological reserves and physiological price of adaptation of the basic adaptive systems of the body. The complex of functional systems, providing final sports' results, first of all include the cardiovascular system (CVS), which is the most mobile system in the process of urgent and long-term adaptation to the muscular load of varying intensity and duration, and according to the concept of Baevsky R.M. (2005), is an indicator of adaptive reactions of the whole body (Makarenko et all., 2001: 52-57; Sostojanie..., 1978: 105).

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Sports training loads, in their turn, have a significant impact on the morphofunctional development of the circulatory apparatus and, in particular, of the heart, as well as the usefulness of the mechanisms of its regulation (Tihvinskij, 1991). However, the specialized literature does not cover issues concerning the dependence of the level of physical fitness on the autonomic regulation of the heart rate, sports qualification and specialization of athletes, and doesn't identify informative criteria for estimation of the functional state of the cardiovascular system. The lack of data on this issue made it possible to determine the priority areas for further research. The development of criteria for estimation of the functional state of the cardiovascular system will improve the efficiency of the training process at stages of long-term improvement, the system of selection of athletes to the national team to participate in the main events of the season.

Inconsistency level of athletes load requests leads to the development surge cardiovascular system, the emergence of pre- and pathological changes in organs and systems (Il'in and Krivoruchenko, 2006). Therefore, the purpose of our research is to study the dynamics of functional state of the mechanisms of regulation of cardiac activity, level of work capacity of students with different levels of physical fitness.

2. Research materials and methods

The study involved two groups of 1st year students, male, without bad habits, aged 19-21 years old. The first group consisted of students studying at the Faculty of Physical Education and Sports, the second – a control group consisted of students from the Faculty of Biology and Geography, who are not involved in sports. Current functional state was estimated according to the heart rate variability. Heart rate variability was examined using a computerized complex «Varikard» (Russia). Estimation of heart rate variability was made using method of mathematical statistics of Baevsky R.M. (1997). Recording Mode - a short-term, in the supine position (5-minute recording). The article contains the most informative parameters of heart rate variability (HRV): total power spectrum (TP), the balance of departments of the autonomic nervous system (ANS) (LF / HF), the index of regulatory systems tension (SI), the index of centralization (VLF + LF) / HF (IC) and the structure of the spectral power (HF, LF, VLF). Statistic data processing was performed on a PC using Excel program.

3. Results and discussion

Specialists in the field of sports physiology and medicine proved that the cardiovascular system (CVS) limits the development of adaptive reactions of the organism, and that the performance of the muscular system depends on its state. Specification of Quetelet index revealed drop of indicators below normal in 10 % of cases, 90 % of surveyed students had normal indices (Figure 1). However, the students from the control group had normal Quetelet index in 59 % cases, below the normal – 29% and 12 % of students had indicators above normal. Students that do not go in for sports, had downward and upward deviations in fatness. Only 59 % of students in the control group had normal indicators, while the majority of students regularly involved in sports, had a normal index of fatness.

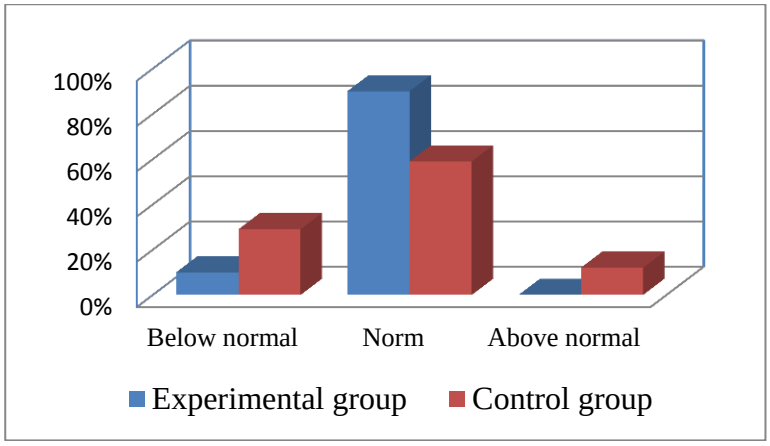

Figure 1. Quetelet index in the experimental and control groups of students

Study of indicators of work capacity revealed that the group 12 %of students who regularly go in for sport had a good work capacity, and 88 % – average work capacity (Figure 2). In the control group indicators of work capacity by Ruffier test were as following: good work capacity was observed at 20 % of students, the average work capacity is not found, satisfactory work capacity – at 10 % and poor work capacity was observed at 70 % of the surveyed students.

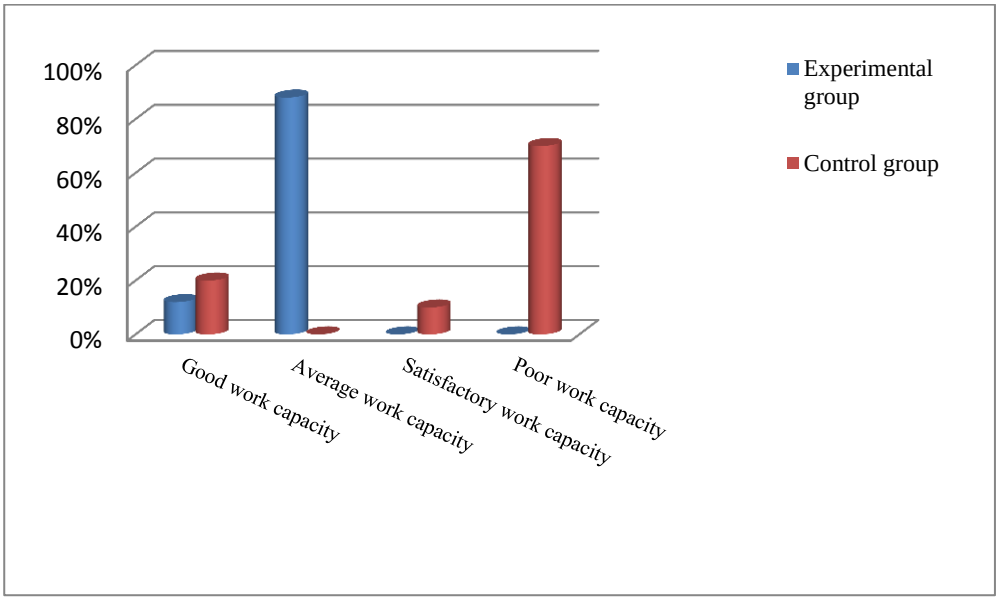

Figure 2. Indicators of Ruffier test

Thus, students that are not involved in sports, according to the results of our research, had deviations in the degree of fatness in 41 % of cases, which correlated with a decrease in work capacity (in 70 % of cases) of surveyed students. Alongside with this, the students that regularly go in for sports tended to have a normal fatness (in 90 % of cases), which was accompanied by a good and normal work capacity.

These results indicate that adaptation to physical activity is a dynamic process, which is based on the formation of a new program of physical development and health. This ability to adapt to the conditions of a regular training activity depends not only on the existing constitutional reserves, but also on the volume of training loads of students involved in cyclic sports, the adequacy, efficiency and stress of regulation mechanisms of the body of students.

Improving the efficiency of the training process of athletes is impossible without improving the system of estimation of the functional state of the cardiovascular system of students [5]. To estimate the cardiovascular system a number of parameters is used: frequency of heart contraction (FHC), heart rate, quantity of a minute and pulsatile blood volume, blood pressure, phase analysis of systole. Of all these indicators the most widely used in the sports practice is the analysis of FHC and heart rate. Mathematical and statistical characteristics of heart rate have individual specificity that allows early diagnosis of fatigue and monitor of the adaptation process of each athlete, to predict sport results, hold the sport selection, as well as use in the management of the training process in order to optimize the mode of training sessions. Therefore, we examined the heart rate variability (HRV) of students in the two groups.

In the experimental group average frequency of heart contraction (FHC) of students at rest was 57 ± 4,1 cont./min., it was significantly ($p < 0.05$) lower than the average FHC in the control group (77 ± 7,8 cont./min.).

The total power spectrum (TP) in the experimental group of athletes was high and amounted to 5328,3 ± 2813,1 ms^2/Hz. In the control group TP was equal to 7208.1 ± 2813.1 ms^2/Hz. Characteristic features of the cardiac rhythm during a 5 min. record was following (Table 1).

Table 1. Values of structure of the total power spectrum of HRV of students- athletes.

	TP, ms²/Hz		HF,%		LF,%		VLF, %		LF/HF	
	Experimental group	Control group	Experimental group	Control group	Experimental group	Control group	Experimental group	Control group	Experimental group	Control group
Median	6792,8	3067,8	34,3	36,3	53,3	41,2	25,5	24,5	2,29	1,79
25 percentile	1901,5	1266,0	12,7	16,2	22,3	22,4	5,1	16,4	0,29	0,53
75 percentile	9487,5	25669,5	76,9	42,4	86,4	56,7	48,2	58,7	6,81	3,02

In estimation of indicators we usedthe median and interquartile range. The latter is pointed in 25 % and 75 % percentile. Average value of TR indicators, reflecting the current functional status of the body was substantially above normal value in both the experimental and the control groups.

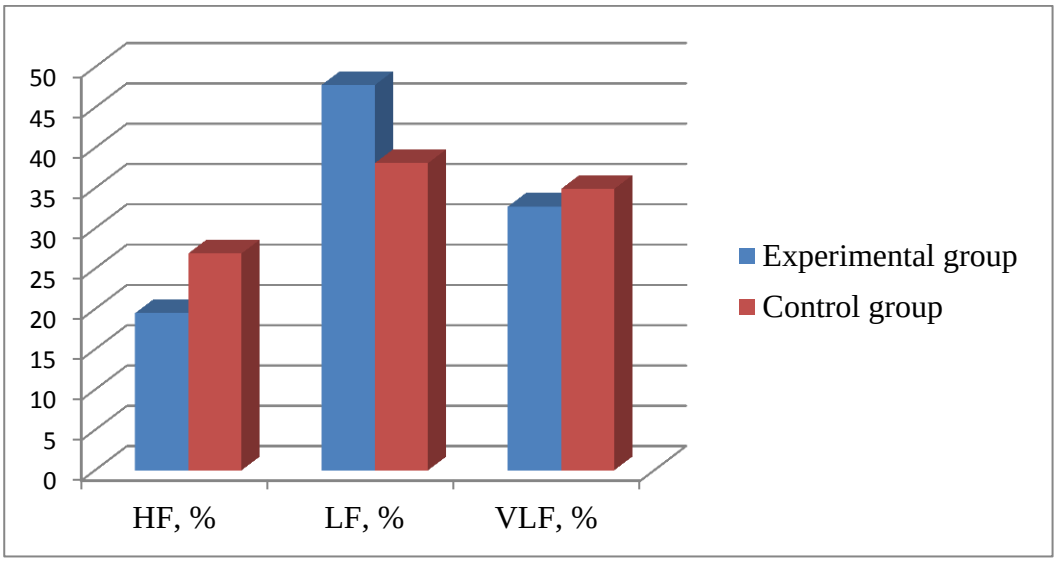

Figure 3. Indicators of the heart rate variability oftrained and not trained students

The structure of the spectral power of HRV during registration of students at rest was distributed as follows: the most lowered component at athletes is high-frequency component (HF-component), reflecting modulating influence of the parasympathetic department of the ANS on heart rhythm. The predominance of LF and VLF-component in the structure HRV at athletes indicates the influence of long physical activity, aimed to form stamina, as well as the diminution of physical fitness. In the control group there is a higher total power spectrum and increase the share of VLF-component, reflecting the transition from the vegetative level of regulation to a slower humoral-metabolic one. LF/HF index, which characterizes the balance of the ANS departments, indicates the predominance of the activity of the sympathetic-adrenal system at athletes (2.29) as compared with the control group (1.6) (Figure 3).

Complex assessment of heart rate variability can be done according to the index of activity of regulatory systems (IARS). Analysis of the functional state of regulatory systems revealed that state the optimal stress of regulatory systems (physiological norm) was observed at 50 % of students in the experimental group and at 25 % of students in the control group (Figure 4).

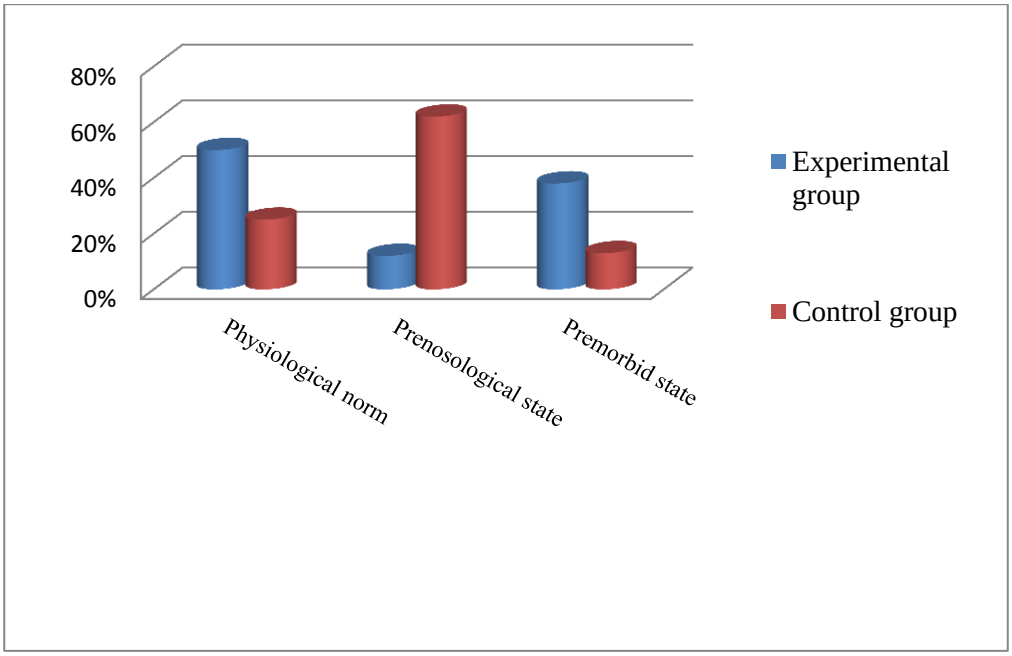

Figure 4. Complex assessment of heart rate variability by IARS

State of a moderate stress of regulatory systems (prenosological state), when in order to adapt to environmental conditions a body requires additional functional reserves, in the process of adaptation to work, under emotional stress or under influence of un favorable environmental factors, was observed at 12 % of the students in the experimental group and at 62 % of students in the control group. State of expressed stress of regulatory systems (premorbid state) that is associated with the active mobilization of protective mechanisms, including increased activity of the sympathetic-adrenal system and pituitary-adrenal gland system was found at 38 % of the students in the experimental group and at 13 % of the surveyed students in the control.

The gathered data attest that moderate and expressed stress of regulatory systems in the experimental group was observed in 55 % of cases, that is more than half. It can be explained by the inadequacy of the current physical load placed on the functional state of the body. In this case, as a rule, the main burden falls on the regulatory mechanisms, on account of stressing themadaptation of physiological responses and CVS metabolism to increasing physical activity is fulfilled. Studies have demonstrated the need for regular monitoring of the process of physical exercise with a purpose of its optimization. The survey of students in the control group who are not involved in sports, revealed changes in the degree of fatness, the low level of work capacity, expressed level of stress of regulatory systems (75 % of students), indicating diminution of reserve capacity of the body.

In addition, studies have shown that in the experimental group with higher adaptive capacity of CVS all indicators of physical development and health were higher. Further stress of regulatory adaptive mechanisms of CVS of students in the control group and some students of the experimental group may lead to the development of disadaptation processes of the body. Thus, despite the fact that the major physiological systems providing working in athletic activities are oxygen transport system, the central nervous system plays an important pole too.

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УДК 612

Функциональное состояние сердечно-сосудистой системы у студентов с различным уровнем тренированности

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Аннотация. Изучено текущее функциональное состояние сердечно-сосудистой системы организма у студентов регулярно занимающихся спортом и не занимающихся спортом. Состояние сердечно-сосудистой системы оценивалось с помощью регистрации вариабельности сердечного ритма, определения работоспособности по Руфье. Была проведена комплексная оценка вариабельности сердечного ритма по показателю

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активности регуляторных систем организма. Выявлено, что у студентов, занимающихся спортом умеренное и выраженное напряжение регуляторных систем наблюдалосьв 55 % случаев, что составило более половины обследованных, это может быть обусловлено неадекватностью предъявляемых физических нагрузок текущему функциональному состоянию организма.

Ключевые слова: адаптация, сердечно-сосудистая система, студенты, сердечный ритм, регуляторная система, здоровье, работоспособность.

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Static Balance Ability in Children with Developmental Coordination Disorder

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Abstract

The aim of the current study was the examination of disorders in motor coordination of 8/9-year-old school aged children and the detection of possible differences in balance performance between those children assessed with Developmental Coordination Disorder (DCD) and matched peers. It was found that 20 children out of the total number of 200 participating in this study, exhibited definite motor difficulties indicating a DCD disorder.The 20 students diagnosed with DCD were matched one by one with typically developing children participated in a detailed study of balance control. The main finding of the present study was the ability to control balance in both Anterior Posterior (A/P) and Medio Lateral (M/L) directions was inferior in students with DCD than in typically developing children. The findings reinforce the need for the evaluation of balance performance in school-aged children, in order specific individual motor profiles to be established for optimizing and adapting appropriate intervention programs.

Keywords: posture, motor performance, motor difficulties, stability, DCD.

1. Introduction

A minimal level of competence in motor skills, ranging from fine coordination to gross motor coordination and balance skills, is necessary to participate in daily physical activities typical of young children. However, while some children execute a whole range of motor tasks easily, others experience considerable difficulties coordinating and controlling their body movements. The latter children are often diagnosed with Developmental Coordination Disorder (DCD) which has been described as one of the six most commonly occurring developmental disorders (Kwan, Cairney, Hay & Faught, 2013).

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DCD refers to a chronic neuro-developmental condition and is characterized by a marked impairment in the performance of motor skills, with a significant negative impact on the performance of activities of daily living (APA, 2013). The estimated prevalence ranges from 1.8 % to 20 % (Lingam, Hunt, Golding, Jongmans, and Emond, 2009) with the most frequently percentage quoted in literature being 5 % to 6 % (Gaines, Missiuna, Egan & McLean, 2008) for the school aged population.

The core aspects of the disorder include difficulties in learning new motor skills and sensorimotor coordination deficits (Geuze, 2005). Among the many sensorimotor problems found in children with DCD, poor postural control is the most common, demonstrated in 73–87 % of the DCD-affected population (Macnab, Miller, & Polatajko, 2001). Static balance refers to the ability to maintain an upright posture and to keep the centre of gravity within the limits of support (Nashner, Shupert, Horak & Black, 1989).

Children without static balance control lack the stabilizing framework that is necessary to develop normal functional activities. Since the development of the balance control is the base for development of all other skills, the ability to maintain postural stability in children with DCD is an important area that needs to be addressed. The problem requires special attention because any impairment in balance ability may increase the risk of falls, limit activity participation, and affect motor skill development (Fong, Lee & Pang, 2011; Grove & Lazarus, 2007).

However, there is increasing evidence that children with DCD often withdraw from physical activity opportunities as a consequence of their movement incompetence (Bouffard, Watkinson, Thompson, Dunn, and Romanow, 1996) and they are significantly less likely than their peers to participate in organized and free play activities (Cairney et al., 2005, Cairney, Hay, Veldhuizen, Missiuna & Faught, 2010). At early ages, skill deficits may be less noticeable as the movement demands of play are low. However, skill demands increase with age and children with motor difficulties fall further behind (Wall, 2004). The result is that low participation delays skill development which in turn increases withdrawal from active play (Cairney et al., 2010). Thus, early identification of poor activity and participation is essential to promote successful transition and integration into the elementary school setting (Wong, 2002).

The attainment of motor skills is a continuous challenge for children (Geuze, 2007), particularly for those whose coordination is not developing in a typical form. A basic motor action might represent a troublesome task rather than play and fun for these children, who gradually tend to withdraw from tasks that include motor coordination demands. Since the effects of DCD appear to be so far reaching and the early years of life are such an important period of growth opportunity (Anderson, Shinn, Fullilove et al., 2003), it is important to emphasize early identification and intervention of young children suspected as, or at risk of, having DCD.

Children with probable DCD have an increased risk of wide-ranging difficulties outside the motor domain (Lingam et al., 2010). Thus, early identification can lead to education, guidance and encouragement of children to engage in typical childhood activities and hence decrease the risk of reduced self-esteem, self-efficacy and social participation (Missiuna, Rivard, and Bartlett, 2003). Therefore, because motor development of children with DCD is generally slower than that of typically developing children and presumably this is also true for balance skills, it was considered crucial for a better understanding of their motor characteristics to examine the possible difference in static balance between children with and without DCD.

2. Methods

2.1. Participants

The children who participated in this study were sampled from various elementary schools in Thessaloniki, a big town of Northern Greece. There were 200 children (104 boys and 96 girls) 8-9 years old (mean age 8.43±1.85 months). All children were tested using the tasks from the quantitative test of neuromuscular coordination of the whole body (Body Coordination Test for Children BCTC; Körperkoordinationstest für Kinder, KTK) (Kiphard and Schilling, 2007, 1974). It was found that 20 children (13 boys and 7 girls) out of the total number of 200 children participating in this study exhibited definite motor difficulties indicating a DCD disorder. The 20 students diagnosed with DCD were matched one by one with typically developing children according to gender, age, school placement and socioeconomic characteristics, minimizing in this way the risk of different environmental and educational influences.

All children had normal-range IQs and no evidence of physical or neurological disorder. Children with a history of prenatal problems, neurological diseases, sensory disturbances, premature children and children with epilepsy or other chronic diseases were excluded from the study. Additionally, information such as motor skill delays and poor coordination interfere with the performance of self-care activities and academic achievement beyond what would be anticipated, given their age and intellectual ability was derived from children's school records and parent's reports according to APA's (2000) recommendations.

All parents or legal guardians provided written informed consent prior to participation approved by an Institutional Review Board for use of Human subjects, allowing children's involvement in the program and access to relevant information.

Testing procedures and instrumentation

Body Coordination Test for Children (BCTC; Körperkoordinationstest für Kinder, KTK, Kiphard & Schilling, 1974).

Actual motor competence of the 200 students from the initial sample was measured by the Body Coordination Test for Children (BCTC; Körperkoordinationstest für Kinder, KTK, Kiphard & Schilling, 1974), which is designed to evaluate the overall body co-ordination and control of children from 5 to 14.11 years old. It is appropriate for children with typical development, as well as for children with developmental disabilities. This test measures the overall body coordination and control of children, through the measurement of four tasks: balance during walking backwards, obstacle jump on one foot, sideways movements with initial position and side jumps right-left of two trials, during which the children had to jump from side to side over a little beam with both feet together, as often as possible within a period of 15 seconds. The instructions provided at each participant were the same for everyone in order to avoid influence from internal or external motivation.

For each of the four items, a raw score (RW) and a scaled score (Motor Quotient score) are recorded. A total Motor Quotient (MQ=100±15) percentiles, and motor age can be estimated per item as well as for the global test. A score less than 85 in MQ indicates a serious co-ordination disturbance (Schilling & Kiphard, 1974). Internal consistency reliability based on test-retest reliability coefficients, for each item, ranges from .80 to .96. Data collection took approximately 20 minutes to complete for each child.

Balance testing

All balance tests were performed on an EPS pressure platform (Loran Engineering S.r.I., Bologna – Italy). The system uses 2304 force sensing resistors in an active area of 70x50 cm to record plantar pressure at 25Hz. All the participants performed one-leg stance (OLS) with opened eyes and double-leg stance (DLS) with opened and closed eyes. During the DLS, the children were instructed to stand erect, as motionless as possible, on a normal comfortable posture, with opened eyes looking straight ahead at a cross marked at approximately eye level on a black board three meters away and barefoot with feet shoulder width apart on the platform with the arms by their sides. Each child was requested to keep a quiet stance posture for 30 seconds. The assessment included three measurements, and a five-minute rest was provided between successive trials. The best trial was further analyzed (Ageberg, Roberts, Holmström, and Fridén, 2003). The participants performed the same task with closed eyes. During OLS, the participants were instructed to stand on their dominant foot, which was placed pointing straight forward in relation to reference lines in the frontal and sagittal planes. The dominant leg was defined by asking the children to kick a ball five times (Hopper, Allison, Fernandes, O'Sullivan & Wharton, 1998).

The swinging leg was flexed 90° at the hip and knee joints with both arms hanging relaxed at the sides (Ageberg et al., 2003). The subjects were instructed to stand as still as possible, looking straight ahead at a point on the wall 65 cm away. The test order between legs was randomized. Data recording started once the subject was stable in the required posture. Ample time was provided for familiarization. If OLS balance was not maintained for ten seconds, the trial was not recorded and the measurement was repeated. A computer program (Footchecker 3.2, Engineering S.r.I., Bologna-Italy) was used to compute peak-to-peak amplitude (CoPmax) and standard deviation of the COP from the mean value of COP in antero-posterior (SDy) and mediolateral (SDx) axis in mm, often defined as sway amplitude. Students executed the test by standing on the platform in a normal position with the hands next to the thighs and the feet slightly apart. The first

test included the Normal Quite Stance for 30 seconds and the second test the OLS for 10 seconds. The COP sway area used in the data analysis was the average from three successful trials for each participant in each test condition. The larger the COP sway area was, the more the body swayed and the worse the standing balance was.

Statistical Analysis

For the statistical data analysis the statistical package SPSS 20 was used. All data are presented as means ± SD. The performance on balance tasks (DLS with open and closed eyes, and OLS) was examined using Independent sample t-tests. The level of significance was set at $p<0.05$.

3. Results

The independent sample t-test revealed that in M/L direction, CoPmax (t=5.32, p=.000) and CoPsd (t=3.65, p=.001) in double leg stance (DLS) with eyes open were significantly greater in children with DCD comparing to children with typical development. In the same task with the eyes closed, there was also statistically significant difference in both CoPmax (t=3.91, p=.001) and CoPsd (t=2.58, p=.016). Additionally, statistically significant difference in A/P direction was also noticed between the 2 groups in DLS with eyes open [(t=2.85, p=.007), (t=3.24, p=.002)] and eyes closed [(t=4.94, p=.000), (t=3.24, p=.004)] in CoPmax and CoPsd, respectively.

As regards to one leg stance (OLS) task on dominant foot, the Independent sample t-test revealed a statistically significant difference between the groups in CoPmax (t=4.14, p=.000) and CoPsd (t=8.11, p=.000) in M/L direction as well as in CoPmax (t=3.27, p=.003) and CoPsd in A/P direction. The means and SD values of balance tasks, Peak-to-peak amplitude of the center of pressure (CoP) displacement (CoPmax) and standard deviation of the CoP (CoPsd) in the Anterior Posterior (A/P) and in Mediolateral (M/L) direction in 3 balance tasks for the children with DCD and typically developing children are represented in table 1.

Table 1. Peak-to-peak amplitude of the center of pressure (CoP) displacement (CoPmax) and standard deviation of the CoP (CoPsd) in the Anterior Posterior (A/P) and in Mediolateral (M/L) direction in 3 balance tasks for the 2 groups

	Students with DCD (n=20)	Typically Developing (n=20)
Double Leg Stance with opened eyes (mm)		
CoPmax -M/L	24.59 ±10.82	11.34 ±2.61*
CoPsd -M/L	5.60 ±2.06	3.78 ± .84*
CoPmax-A/P	18.02 ±6.88	13.36 ±2.42*
CoPsd-A/P	5.03 ±3.09	2.59 ±1.12*
Double Leg Stance with closed eyes (mm)		
CoPmax -M/L	22.49 ±10.99	12.51 ±3.09*
CoPsd -M/L	5.29 ±1.52	4.34 ± .64*
CoPmax-A/P	18.20 ±4.40	12.66 ±2.39*
CoPsd-A/P	4.24 ±2.72	2.21 ± .63*
One Leg Stance (mm)		
CoPmax -M/L	30.67 ±7.80	22.77 ±2.52*
CoPsd -M/L	11.98 ±2.92	6.11 ±1.39*
CoPmax-A/P	38.92 ±7.24	23.29 ±4.17*
CoPsd-A/P	8.18 ±1.93	6.52 ±1.19*

* p<.*05* pre to post

4. Discussion

The present study aimed to examine movement difficulties among typically developing elementary students in Greece and to examine the static balance ability between those children assessed with Developmental Coordination Disorder (DCD) and matched peers. The Body Coordination Test for Children (BCTC; Körperkoordinationstest für Kinder, KTK, Kiphard and Schilling, 1974) was chosen for the purposes of this study since it was considered an adequate test for the assessment of children's coordinative performance (Graf, Koch, Dordel *et al.,* 2004; Graf, Koch, Kretschmann-Kandel *et al.,* 2004). The results showed that 10 % of the children participating in this study exhibited motor difficulties indicating the existence of DCD disorder, a percentage that is similar to previous findings (dos Santos & Vieira, 2013; Tsiotra, Flouris, Koutedakis et al., 2006).

Fundamental motor skills are still improving in developing children. To avoid the variability of postural control and balance in younger children, the age band selected for this study was between 8 and 9 years of age, when static balance control reaches adult levels for open-eye conditions (Taguchi and Tada, 1988) and becomes steadier (Wolff, Rose, Jones, Bloch, Oehlert & Gamble, 1998). The main finding of the present study was that the ability to control balance in both Anterior Posterior (A/P) and Medio Lateral (M/L) directions, so far static balance is described by the CoP excursions, was inferior in students with DCD.

The reduction of children's with DCD ability to maintain balance has been well documented. In agreement with previous studies (Cherng, Hsu, Chen & Chen, 2007; Inder and Sullivan, 2005; Tsai, Wu & Huang, 2008), the results of the present study demonstrated that participants with DCD display greater CoP displacement than their typically developing counterparts (Table 1). This result reflects less efficient control of balance in all 3 conditions with increasing difficulty that were examined.

An absence of differences between children with and without DCD on sway measures when standing with two legs, either with eyes open or closed, was found in recent studies (Geuze, 2003; Przysucha & Taylor, 2004). However, in the present study, students with DCD demonstrated significantly larger sways similarly with recent reports (Inder & Sullivan, 2005; Tsai et al., 2008). Remarkably, although participants with DCD had significantly larger sway compared to typically developing counterparts in both two leg stance conditions, there was not larger CoP displacements in both groups when performed the DLS task blindfolded (Table 1). These observation maybe explained by the fact that the momentary absence of vision, in both students with and without DCD, resulted in greater reliance on proprioceptors, rather than on visual afferent inputs in maintaining balance control.

Poor balance control may indicate a cerebellar impairment. The cerebellum is essential for the fine motor control of movement and posture and its dysfunction may dislocate balance control. Balance is supposed to be one of the most autonomously controlled tasks in the motor domain. It has been suggested that the picture emerges is that non-optimal cerebellar function affects the development of autonomous control of balance and contributes to the problems that children with DCD have (Geuze, 2003).

An interesting review by Wilson & McKenzie (1998) using meta-analysis noted that children with DCD were inferior on most measures of information processing, including visual-spatial processing, kinaesthetic perception, and cross-modal sensory integration which integrates two or three different sensory inputs. This finding suggests that the poor motor performance of children with DCD could result from both a deficit in the individual sensory systems as well as a deficit in sensory organization. Although the studies under review focused on fine motor performance, the implication of the finding could potentially generalize to standing balance. However, since one of the diagnostic criteria for DCD is that no known medical problems can explain the motor coordination disorder, it is unlikely that the balance difficulty in the children with DCD was due to a deficit in the individual sensory system.

No matter what is the proper explanation for balance difficulties in children with DCD, the fact is that they have reduced performance in all balance tasks that were examined. Since DCD is known to have immediate adverse effects on children's day-to-day functioning (both academic and daily living skills) and significantly impacts on academic, psycho-social and vocational outcomes (American Psychiatric Association, 2000), studying balance abilities of young children as they develop throughout their school years emerges as a very important issue.

Children with DCD judge themselves to be less competent than their peers, both physically, psychologically and socially (Cairney et al., 2005), and are likely to avoid participating in physical activities in order to avoid experiencing failure and sustaining injuries due to their difficulty in balance control. Thus, early identification and treatment of children with balance control difficulties like those in DCD children may help lighten such restrictions. More studies using larger samples and conducted in different school education regions are needed to ascertain motor profiles and balance performance of Greek elementary school children before appropriate intervention programs are applied to deal with DCD occurrence and its negative consequences.

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The Effect of the Contrastive Training Using Weights and Plyometrics on the Development of the Vertical Jump Ability to Improve the Performance of the Smash for Volleyball Players

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Abstract

Considering training as a purposeful educational process that implies scientific planning for the sake of preparing the players, with their different physical, psychological and skill levels, to achieve the highest possible levels, it acquired a special character and was implemented into different important domains to achieve athletic goals at various levels for the development of motor performance. Many methods are used commonly by most of the trainers, and this led us, as researchers, to suggest a training programme that is based on the use of a contrastive training method using weights and plyometrics to achieve the highest degrees of efficiency, through using strength in different and opposite ways within the training unit or within a set of exercises, while trying to contribute to the clarification of this way for all types, in general, and applying it with the volleyball students as a sample representing the research community.

The research process is meant to be conducted through pre and post tests on two groups; one as the control group and the other pilot. The first sample group underwent a programme established under the supervion of the professor of the subject, while the second underwent the suggested programme.

Ultimately we found out through the statistical analysis of the results the existence of significant statistical differences between the pre and post tests in favour of the pilot group on the account of the control one. Researchers attribute these results to the impact of the suggested contrastive training using weights and plyometrics, which leads to the improvement of the ability to jump through bridging the gap between strength training and speed, using the so-called reactive prolongation which facilitates and adapts the additional kinetic units in the muscles during the performance, and gains muscle elasticity, and thus the development of vertical jumping ability, which contributes to the improvement of the smash skill in Volleyball.

Keywords: contrastive training, vertical jump, smash skill, volleyball.

1. Introduction and problematic of the research

Planning for training in different sport activities became a crucial means for the improvement of the training state of players, as the great scientific development in the training methods and preparation of players, having implemented the scientific truths presented by the

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different other sciences including biology, psychology, sociology or technology, led to the improvement of the training process.

Sport training has crossed huge distances in the way of science, as it moved to the implementation of different sciences to build its processes and plans. It relies on different training methods and means, while every method targets specific goals. Mohamed Hassen Allawi (1992) points out to the training methods as being the different means through which we can develop the training state of the sport individual to the maximum possible degree.

Volleyball, as one of those mass games that were developed, was also touched by development through targeting the improvement of its skills which are considered as its characterising aspects. These skills seem for us characterized by dynamism and excitement, mainly during the defence and attack phases. It is one of those rich games in terms of technical skills, as we find that they include scrolling and transmission skills, beating, blocking and reception of the transmission and reception of balls, and in all of these the movements of the feet play an important role.

The blyometric tarining is known as a training system designed to dveleop the elastic strength of the muscles, as the muscular sets start to lengthen first under the impact of a given weight before it starts then to contract to the maximum possible degree. Training with wieghts has an important role in the developement of the muscular strength of the palyer, as the nature of the skill performance in this sport requires strength characterized by speed, thence training with weights is essential among the contents of the training (Hamdi Abdel Munim, Muhamed Sobhi Hassaneen, 1997).

Essaid Abdelmaksood (1997) mentions that in the contrastive training, there is an attempt of reaching the maximum degree of efficiency through the use of force in contrastive or sense opposing ways with the same training unit or a set of exercises, and it is possible to reach the contrast through the change of weights in an explosive way , or through the change at the level of the weight or the type of contraction and muscle tension, or from weight to plyometrics (Zaki Muhamed Hosseen, 2004).

Kheyria Essokri and Myhamed Breeaka (2009) mention that the creative trainer designs trainings that have a positive effect on the development of his/her players abilities using various sets of activities within the training unit, and changes in training ways based on individual differences among the sportsmen, and that the adequate planning for the increase of the weight leads to reaching the top of the high levels (breekaa, 2009, 10-19).

Through dealing with the previous studies, researchers found out that the use of the plyometrics and weight training has a great importance in the development of physical aspects. The previous researchers agreed on the importance of using these two methods to enhance the muscular ability, mainly the lower limbs of the body and the vertical jumping operation.

Many researchers consider the plyometric training as one of the most frequently used methods for the dvelepment of strength which is characterized by speed for many sport activities that require the integration of the maximum force with the maximum speed, as this method helps in overcoming the problems confronted in the development of strength that is characterized by the speed, and this is what Hamid Sofiane (2011) mentions copying from Malisux (2006), as he states that the plyometric training contributes in the improvement of the performance, mainly in activities that use explosive muscle contractions. As for Rahman, he mentioned that plyometic training at short term is effecient for for the dvelopment of the musle strength and high vertical jumping and anerobic abilities, as he adds that on the other hand, that associating plyometrics with trainings using weights is of a considerable effeciency for volleyball players (Sofiane Hamid, 2011, 01-05).

The problem of research is due to field follow-up in the domain of teaching of volleyball players in the Physical Education and Sports Institutes, as a lack in the variation and mixture in modern methods of training was remarked, and mainly for the developùent of special body characterestics, as though the inclusion of weight training in programmes for some and the appearance of plyometrics for others, we did not remark any coordination of these different methods. And on the basis of the scientific observation of researchers, it was found out that trainers use plyometrics and weightlifting in an absolutely separate way. For this reason this research comes to try the use of plyometrics and weightlifting in a contrastive way and to show its impact on the development of the vertical jumping ability in order to perform the smash skill for the students of volleyball specialty.

Research procedures:

Research Methodology:

The researcher used the experimental method using two groups, one as experimental and the other as control.

The research sample:

The research sample included 30 students chosen in an intentional way among third-year LMD students at the Institute of Physical Education and sports at the University of Oran. (Exploratory sample (06 students), the control sample group (12 students), the experimental sample group (12 students).

Tools and methods of the research:

-Arabic and foreign sources and references.

-Physical and skill tests.

-The suggested training programme (contrastive training)

-Statistical instruents.

Statistical instruments:

Pearson correlation R was used as the research' statistical instrument to study the scientific basis for the tests used in the research, while the T Student was used to compare the results of the pre and post tests used for the experimenatl and control groups.The statistical methods are based on the arithmetic average standard deviation, in addition to the equation of the progress ratio to know the output throughout the basic experiment in the research.

Used tests:

Test (1): vertical jump to the top from stability "Sargent"

Test (2): vertical jump to the top from movement, "Sargent"

Test (3): Smash test

The main experiment:

The sessions were conducted in the afternoon parts of days, which is the usual time of training for the samples of this research. Also a training programme was established including a set of plyometric and weight-lifting trainings through the contrastive method for the development of vertical jumping for the smash skill for volleyball players, using necessary instruments and means.

The main experiment was applied in the same field and with the same variables apart from the use of the weight lifting and plyometric trainings in the contrastive way (the independent variable) which was included in the training unit for the experimental group under the supervision of the professor, through suggesting 14 training units in addition to the pre and post tests. Every unit has its own main objective which is the same objective planned by the teacher.

The first phase included 3 weeks and the period of trainings took 16 minutes and the lifting tension was about 40 % to 60 %, as the number of repetitions for the same exercise varied from 6 to 10 in 3 to 4 sets with a rest of 60 to 90 seconds.

As for the second phase, it took 4 weeks, and the period of the suggested trainings 18 minutes, as for the lifting tension it varied from 50 % to 70 %, as for the number of repetitions for each exercise, it ranged from 8 to 12 in 4 to 5 sets with a rest of 60 to 90 seconds.

Comparison of the pre-test sample research results

The Student t-test was used to determine the homogeneity of the two sample groups: experimental and control, in these tests.

Table 1. Homogeneity of the sample control and experimental results in the tribal test

Statistical measurements / tests	Experimental sample		Control sample		Calculated T	Tabular T	Signifi-cance level	Difference significance
	$\bar{X}_1$	Y_1	$\bar{X}_2$	Y_2				
Sargent test (stability), "m"	0.35	0.04	0.28	0.05	0.001	2.201	0.05	No significance
Sargent test (of the movement), "m"	0.42	0.06	0.35	0.05	0.003			No significance
Smash test	12.41	2.42	7.33	2.42	1.92			No significance

The sample size 24, degree of freedom (2 n-2) = 22

From Table 1, we find that the calculated value of (T) ranged between 0.001 and 1.92, and all of them are smaller than the tabular T that is estimated 2.201 at the degree of freedom 22 and the level of significance 0.05. This means that the difference between the averages is statistically insignificant, i.e. that members of the two samples are homogenous and that the random differences that have emerged are only individual differences among them.

Presentation, analysis and discussion of the pre and post tests

Presentation, analysis and discussion of the "Sargent" test (vertical jump from stability):

Table 2. comparison of the pre and post tests for the experimental and control samples

The sample	Pre test		Post test		Calculated T	Tabular T	Level of Significance	Degree of freedom	Statistical significance	Collection rate
	$\bar{X}_1$	Y1	$\bar{X}_2$	Y2						
experimental	0.35	0.04	0.48	0.05	3.26	2.201	0.05	11	Statisticcally significancant	%37.14
Control	0.28	0.05	0.34	0.06	2.82				Statisticcally significancant	%21.42

It is remarkable from Table 2 that there are significant differences between the arithmetic averages for the pre and post tests for the experimental sample group which undertook a set of plyometric exercises, as calculated (T) was estimated at 3.26 . While for the control sample group it was estimated at 2.82. These values are bigger than tabular (T) which reached 2.201 at the degree of freedom 11 and the significance level 0.05. This means that there are significant differences between the arithmetic averages for the two tests in favor of the post test for both samples, as the experimental one realized superiority in the arithmetic average of the post test as compared to the control sample group.

Presentation, analysis and discussion of the Sergent test (Vertical jump from movement)

Table 3. Comparison between the results of the pre and post tests for the control and experimental research sample groups

The sample	**Pre test**		**Post test**		**Calculated T**	**Tabular T**	**Level of Significance**	**Degree of freedom**	**Statistical significance**	**Collection rate**
	$\bar{X}_1$	Y1	$\bar{X}_2$	Y2						
experimental	0.42	0.06	0.57	0.04	4.74	2.201	0.05	11	Statisticcally significancant	35.71%
Control	0.35	0.05	0.42	0.06	3.53				Statisticcally significancant	20%

It is remarkable from Table 3 that there are statistical significances between the arithmetic averages of the pre and post tests for the experimental sample group, which means that there are significant differences between the tests in favor of the post test for both sample groups, as the experimental group outperformed the control one in the arithmetic average of the post test.

Presentation, analysis and discussion of the smash test

Table 4. Comparison of the results of the pre and post tests for the experimental and control sample groups

The sample	Pre test		Post test		Calculated T	Tabular T	Level of Significance	Degree of freedom	Statistical significance	Collection rate
	$\bar{X}_1$	Y1	$\bar{X}_2$	Y2						
Experimental	13.18	2.78	19.7	2.74	5.71	2.201	0.05	11	Statisticcally significancant	48.82%
Control	10.75	3.45	12.73	2.67	3.72				Statisticcally significancant	22.36%

It is remarkable from Table 4 that the value of calculated (T) is 5.71 for the experimental sample group, while it is 3.72 for the control one, and they are bigger than tabular (T) 2.201 at the degree of freedom 11 and significance level 0.05. This means that there is a statistical significance between the arithmetic averages for the pre and post tests, i.e. there are significant differences in favour of the post test for both sample groups.

Comparison of the results of the post test

In order to know the differences in tests between the two samples; experimental and control, the Student (T) was used.

Table 5. Differences between the experimental and control groups in the post test

Statistical measurements / Tests	Experimental sample		Control sample		Calculated T	Tabular T	Significance level	Difference significance
	$\bar{X}_1$	Y1	$\bar{X}_2$	Y2				
Sargent test (from stability), "m"	0.48	0.05	0.34	0.06	3.95	2.201	0.05	significance
Sargent test (from the movement), "m"	0.57	0.04	0.42	0.06	4.63			significance
Smash test	18.5	2.43	9.08	2.67	3.82			significance

Table 5 shows the values of calculated (T) which ranged between 3.82 and 4.63 and all of them are bigger than tabular (T) which estimated at 2.201 at the degree of freedom 22 and the level of significance 0.05. This means that the obtained results are statistically significant, i.e. the individual differences between the members of the two samples become significant.

2. Discussion of the results

Researchers attributed the results of the test of vertical jump from stability to the effect of the suggested contrastive training using weights and plyometrics, as it led to the improvement of the ability of jumping through bridging the gap between strength exercises and speed ones, using the so-called “reaction prolongation” which facilitates and adapts additional movement and muscular units in the muscles during performance. Moreover, it offers the muscle elasticity. Thus, the performed sequenced models of exercises in a medium tension confirmed the positive output and the efficient effect on the muscular system through the development of the relation between the maximum strength and the explosive one of the lower limbs. Thence, the development of the ability of vertical jumping improves the smash skill in volleyball, and this matches the study of Ibrahim Adel (1993) which confirms the importance of the use of muscle strengthening exercises in addition to the plyometric training for the development of a better muscular strength.

The outperformance of the experimental group over the control one which is confirmed by the progress ratios in the Sergent test from movement, as it reached 35.71 % for the experimental group and 20 % for the control one, is attributed by the researcher to the effect of the optimal choice of the suggested exercises to the experimental group in order to develop their ability of vertical jumping. These exercises are a set of different jumps in a medium tension, and that proved their positive effect on the muscular system while developing the explosive strength of the lower

limbs for the sake of developing the ability of vertical jumping in order to improve the smash skill in volleyball.

According to the obtained results we see that the trainings used led to the development of the muscular ability of the legs, and this is what Hamed Sofiane (2011) mentioned reporting from Rahmane (2005), as he mentioned that the plyometric training at short term is efficient for the development of the muscular strength and the vertical jumping and the anaerobic abilities. As he ads, on the other hand, that when the plyometric training is linked to weight lifting trainings, it proves efficiency for volleyball players.

Said Abelmaksood (1997) points out to the fact that contrastive training using weights and plyometrics increases the speed of movement performance through the increase of muscles ability to contract in a faster and more explosive average throughout the movement' term within the articulation and in the fullest movement' speed. In addition to that, the high tension use in these exercises leads to the improvement of the agreement within the muscle and among the sets of muscles and that leads to the improvement of the level of strength without increasing the weight of the muscle.

The percentages of the outperformance in the test of the smash reached 49.07 % for the experimental group, while for the control one it reached 23.87 %. This means that the members of the experimental group realized the best results in the post test as compared to the members of the control group, this is due to the inclusion of exercises targeting the development of the explosive strength of the lower limbs for the experimental group, and thus the development of the jumping ability and the improvement of the smash skill in volleyball. The sequenced samples of the plyometric exercises performed in medium tension, in the form of a set of different plyometric jumping exercises, confirmed the positive output and the efficient effect on the muscular system through the development of the maximal strength and the explosive one of the lower limbs, and thence the development of the vertical jumping ability which contributes to the development of the smash skill in volleyball.

And this goes with the study of Atef Rashad (1995) which insists on the appropriate application of the physical exercises (repetition, density, adequacy and tension). Hamed sofiane (2011) also pointed to the same idea reporting from Malisoux (2006), stating that plyometric training contributes to the improvement of performance mainly in activities that use explosive muscular contractions. Rahman (2005) pointed to the idea that short term plyometric training is efficient for the development of the muscular strength and vertical jumping and the anaerobic strength.

Researchers consider vertical jumping as crucial in volleyball, and this is obvious throughout the results obtained from the smash test which reflects the interrelation between vertical jumping and performance. Thence, the betterment that took place resulted from the respect of the training scientific basics in dealing with students of the specialty through the adequate increase of the training weights, the period of permanence and continuity of the training and its repetition and period (number of weeks).

3. Conclusion

In the light of the experimental sample group and the instruments and means that were used, in addition to the results that we obtained, we can state the following conclusions:

- The suggested contrastive training programme has a positive effect on the variables that are under research.
- The existence of statistically significant differences between the pre and post measurements of the experimental sample group in favour of the post measurement.
- The existence of statistically significant differences between the experimental and control samples in the post measurement in favour of the experimental one.
- The contrastive training method using weights and plyometrics is one of those efficient methods for the development of the muscular ability and vertical jumping for volleyball players.
- The contrastive training method using weights and plyometrics has an efficient effect and a positive output on the development of the vertical jumping and the smash skill in volleyball.

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