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PHYSIOLOGICAL RESPONSE TO NON-TRADITIONAL HIGH-INTENSITY INTERVAL TRAINING

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Summary: High intensity interval training (HIIT) is an exercise program not only for professional athletes, but also for the general population. Usually, one-dimensional modalities such as running or a cycling simulator are used. There also exist protocols that use the HIIT principles but apply full-body exercises (HWT). The purpose of the study was to verify the response to unconventional loads based on HIIT and HWT protocols using the near infrared spectroscopy (NIRS) and spiroergometry: wall ball (WB); SKI ergometer, toes to bar (TTB) and assault air bike (AB) in a selected proband. Working interval was 60 s resp. 30 s, the rest between sites was progressively reduced from 60 s to 30 s. The proband completed a total of 3 laps. The results showed that the load applied had been similar to that of HWT or HIIT, where the effect on cardiorespiratory and metabolic functions was confirmed. Acute changes in the observed parameters of SmO2 in *m. vastus lateralis* indicate a possible effect on the development of strength capabilities. It has also been confirmed that the application of variable types of load can be applied simultaneously with the adjustment of rest time and thus using conditions that can reflect current options (material, environment, time) and specific goals. The measured values of muscle tissue oxidation, carbon dioxide output, heart rate confirm that a similar type of load can be a suitable means of affecting cardiovascular and metabolic functions.

Key words: high intensity interval training; whole-body training; near infrared spectroscopy; spiroergometry

Introduction

High intensity interval training (HIIT) is a training program that is characterized by a relatively low workload and high intensity (Batacan et al. 2016). It is an intermittent method where a large short load alternates with passive rest or a very light load (20 – 40 % VO2

max) (Norton & Sadgrove 2010). The intensity is determined by various parameters such as RPE, V02max, heart rate. The common denominator is the movement of the athlete in submaximal to maximum values (ACSM 2009).

HIIT differs from classic interval training by load and rest length. The working interval is in the range of 6 s – 4 min, the rest period is 10 s – 5 min and the total time is 4 - 30 min (Sloth et al. 2013). Among the practitioners, the popular protocol is the so-called Tabata training, where 20 s work and 10 s rest alternate (Tabata 2019). The means for HIIT are usually one-dimensional modalities such as running, cycling, rowing. They are not combined with each other nor are they varied (Batacan et al. 2016). HIIT has proven to be a suitable and safe means of developing cardio-metabolic health in patients as well as in diabetic patients (Cassidy et al. 2017). Compared to continuous medium intensity training, HIIT appears to be a more appropriate means of weight reduction and has a positive effect on fat reduction (Keating et al. 2017). HIIT seems to be a very good and effective exercise tool that has the potential to comprehensively influence physiological, anatomical, and performance parameters at optimal settings.

In practice, in addition to the above mentioned HIIT, similar forms are used, which need to be terminologically defined. For example, Circular Training (CT). Exercise usually includes 6 – 12 low resistance exercises (40 – 60 % 1 RM) with higher repeats (12 – 20). Rest between series is often set at 1: 1 to load time, i.e. 30 – 60 s (Muños-Martínéz et al. 2017). Machado et al. (2017) uses the High-intensity interval training using whole body exercise (HWT). The concept is very similar to the classic HIIT, but the means are complex exercises (burpee, Jumping jack, or jump squat), which are performed at maximum effort for 30 s with equally long rest and a total duration of 20 – 30 minutes (Machado et al. 2018). However, there may be a different timing (Ho et al., 2012). The development of aerobic and strength skills by HWT is also demonstrated by Myers et al. (2015), where it was compared with CT. The HWT application has the advantage over HIIT in the complex connection of the upper body and the application of power exercises. This benefit is demonstrated by the development of strength endurance with simultaneous action on cardiovascular fitness or maintenance of training levels (Gist et al. 2015; McRae et al. 2012; Schaun et al. 2018). These studies involved the use of exercises with their own body that were not combined with other endurance or power modalities (exercises with external load or exercise on machines). For similar combinations, Feito et al. (2018) uses the term High-intensity functional training (HIFT). It should be an umbrella term for different combinations of exercises, load/ rest size

and total exercise time. He places here all CrossFit exercises; this is not an intermittent load, but a variable continuous high-intensity training (Murawska-Cialowicz et al. 2015).

Near infrared spectroscopy (NIRS) is a non-invasive imaging technique that monitors the oxidation and hemodynamics in the muscle using infrared radiation. It has been used for sports sciences since the 1990. Since then, it has been applied to groups of runners, cyclists, rugby players, or swimmers, as well as various muscle groups. NIRS was used at different loads including HIIT. Brocherie et al. (2015) followed the oxygen saturation of the lower limb in the 6 x 35 m sprint with 10 s active rest. The load caused a rapid decrease in the level of oxidation, especially in *m. vastus lateralis*. During this period, the ability to re-oxidize, influence on repeated performance and saturation index progression has also been shown. The interval protocol (10 s work, 20 s rest) on the Ski Erg (SKI) double poling ergometer was applied by Frais et al. (2015) to cross-country skiers. Testing was performed under simulated hypoxic conditions in the experimental group and showed differences in total hemoglobin (THb). Short interval load similar to HIIT is also used as a test criterion in combination with NIRS (Jones et al. 2015). We are not aware of any study that would monitor NIRS in combined load endurance activities, exercises with one's own body, or external-load exercises.

The research used Moxy oxygen monitor, which measures, among other things, local oxygen saturation (Sm02) and total hemoglobin (THb), whose value corresponds to the current blood flow through the muscle. Proven to be a valid and reliable tool (Crum 2017). Spiroergometry (SP) is used for the qualitative and quantitative assessment of acute cardiovascular, pulmonary, and metabolic load responses. It brings important information from the point of view of diagnostics and forecasting for various scientific fields. Significant monitored variables are carbon dioxide production, minute ventilation, oxygen consumption and heart rate. The most important parameter in SP is the maximum oxygen demand (VO2max). It defines the capacity of the cardiopulmonary system and provides an objective estimate of physical fitness. Minute ventilation (VE) consists of respiratory rate and tidal volume (Vt). In addition, the ventilation threshold and the "respiratory compensation point" can be determined as submaximal fitness parameters. The principle of SP examination is to analyze the composition of inhaled and exhaled air and serves to determine the functional response of the organism to the load. The quality and optimal respiratory rate that may represent performance limitations is also important for diagnosis (Jernej 2013). SP is used to

detect an acute response to exercise and is also a very good control tool for monitoring the body's adaptation to recurrent workload (Guio de Prada et al. 2019).

Research has not been focused on combining cyclic endurance activities yet, exercises with one's own body, and external workloads within HIIT or HWT (Gibala & Jones 2013). The question is what kind of physiological response this kind of burden has and how it can help in the development of health or selected motoric skills.

Methods

Participant

The present study is in the form of a case study: the proband was a 35-year-old athlete, 179 cm, 85 kg with experience in HIIT, HWT and given exercises. He was an athlete with very good level of fitness (CrossFit competitor). Two tested Moxy sensors (*m. vastus lateralis and m. deltoideus*), a heart rate sensor (HR) and a Cortex MetaMax 3BR2 portable spiroergometry system were placed on the body. The Borg scale (1 – 20) was used to determine subjectively perceived intensity. The following parameters were monitored:

1. Breathing - MV (minute ventilation - L/min)
2. Cardiovascular system - HR, VO2 / HR (pulse oxygen)
3. Metabolism - guideline value of aerobic/anerobic metabolism rate by Respiratory Equivalent Ratio (RER = VCO2 / VO2); carbon dioxide dispensing (VCO2)
4. Muscle tissue - SmO2, THb.

In connection with the description of the development of quantities, it should be noted that the monitored person knew in advance the protocol and counted on the total time and nature of the load. Therefore, the measurement is influenced by a certain tactic whereby the proband tried to complete the whole protocol at high / maximum intensity, but did not try to "all out" (instantaneous maximum performance regardless of later progress) from the beginning. The purpose was to approach the conditions during the real training process.

Procedure

The load protocol contained 4 sites, the working interval was 30 s – 90 s, the rest between the sites progressively reduced from 60 s to 30 s. He completed a total of 3 rounds, including a 60 s pause (Fig. 1). Four exercises were selected:

1. wall ball (WB) (squat with medicine ball 9kg and throw on the wall)
2. SKI (double poling ergometer)

3. toes to bar (TTB)
4. assault air bike (AB).

The aim of the test was to select exercises that affect the upper and lower half of the body under uneven conditions with changing rest periods; two exercises represent endurance cycling movements, one exercise with one's own body, one complex exercise for the whole body with a light load. The medicine ball throw is a slight 1 RM load. Therefore, it does not meet the requirements for a typical CT and can be used in a similar way as the HSW exercises. Exercises and their order were chosen so that they burden the organism differently, even from the point of view of the involved muscle groups. For the WB and TTB exercises the requirement was not to interrupt the movement during the full interval, for SKI and AB to maintain a high speed that would not decrease significantly.

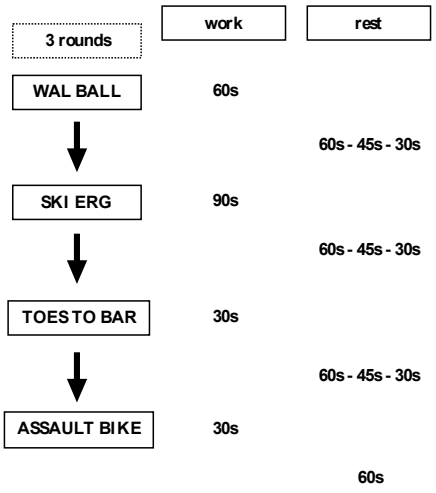


Figure 1
Test flow chart with time intervals of work and rest

Data processing

Moxy monitor (Moxy, Fortiori Design, LCC, Minnesota, USA) uses 630 – 850 nm wavelength, records the amount of returned scattered light at two detectors positioned 12,5 and 25 mm form the light source. The NIRS data transfer was computerized via Bluetooth. Subsequently, all data was evaluated using Moxy5 software. Spiroergometry was performed using the Cortex MetaMax-3B telemetry system, which is used for field testing and also exports selected parameters to graphs

Results

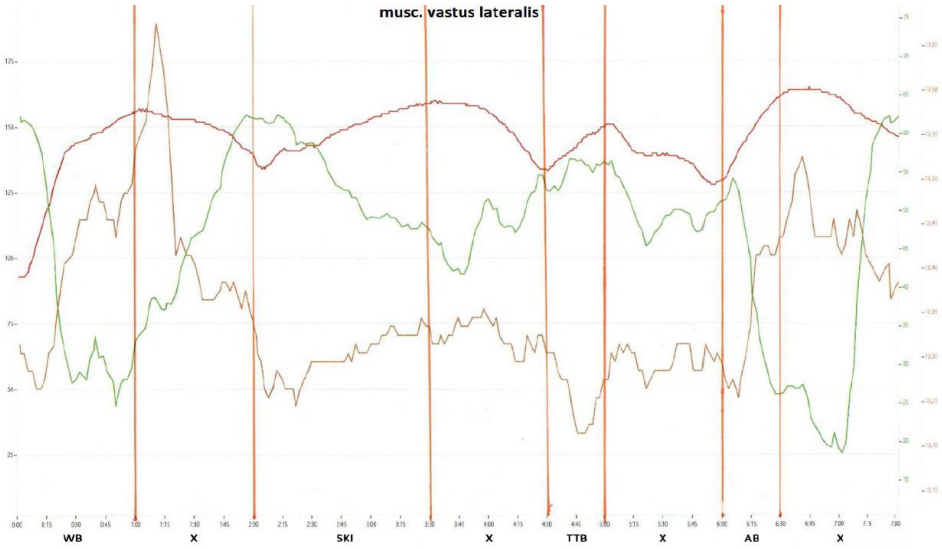
Fig. 2 and Fig. 3 show a record of two Moxy sensors, which monitored the physiological response to the load in the form of muscle oxygenation. Due to similar values, the record of the first round was chosen for the explanation.

In *m. deltoideus*, it is apparent that the first exercise (WB) was subject to large THb fluctuations. This was due to the nature of the exercise that disrupted the reading of the given values in all rounds. In other exercises, the response was no problem despite the swings in the TTB or SKI. Even so, thanks to SmO2 and the subsequent development of the THb curve, the active (power) wiring of the m. deltoideus can be observed.

It is evident that the flow rate in the monitored muscles decreases at working intervals. With *m. deltoideus*, we find more fluctuations, but also faster resaturation. WB dropped to 25 %, returning above 70 % during the rest. For instance, at TTB, when the muscle is isometrically working, shows a very low percentage of SmO2 (10 %), but in subsequent rest, it returns rapidly to its original values.

Moxy record values clearly show different effects of individual exercises on both Sm02 and THb. Both TTB and SKI involve mainly the upper half of the body, which has been demonstrated in the course of *m. vastus lateralis* curves. Since the proband was an athlete with good fitness abilities, there is a rapid return to baseline. Despite this, there was a high breath and RPE increase, which was subjectively perceived at 18 – 19 (20 was maximum). The aforementioned return was also not identical for all exercises. A marked difference was observed after riding an AB, especially after the end of the interval due to the delayed response of the organism.

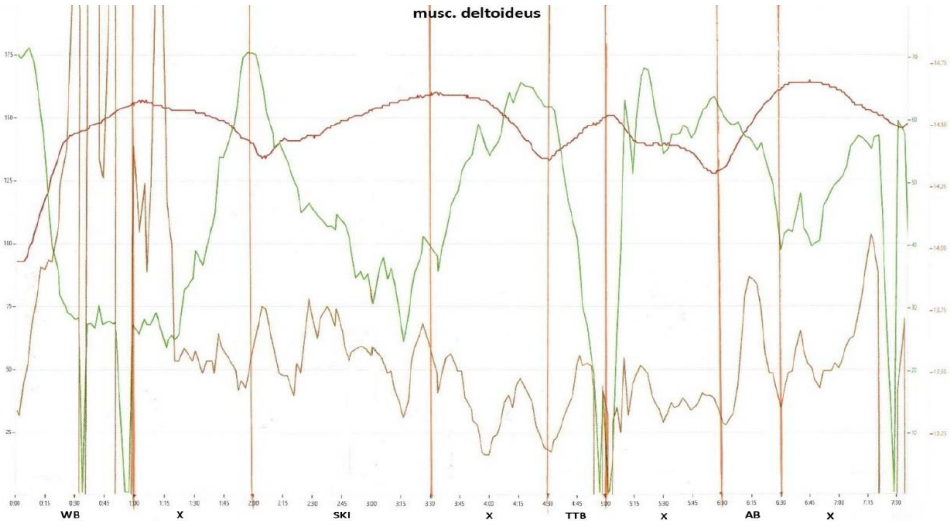
The highest NIRS load was for WB and AB, which are dominant in the involvement of lower limb muscles and at the same time require considerable work on arm and torso muscles. For these exercises, there is a noticeable power load related to the Sm02 fluctuation, including subsequent development after the end of the interval. The dynamics of muscle resaturation changed over time and showed a logically worse trend. Due to the fact that the athlete was working at a high intensity from the beginning, he exhausted the gradually related compensation mechanisms (respiratory, muscular, circulatory), which affected work in the next rounds and increased the perceived RPE. This is also confirmed by the heart rate, which was higher than the first interval.



Notes: red - heart rate [beats/min], green - smO2 [%], brown THb[g/dl], WB- wall ball, X – rest, SKI- Ski Erg, TTB – toes to bar, AB – assault bike

Figure 2

Moxy record of load progress (m. vastus lateralis)



Notes: red - heart rate [beats/min], green - smO2 [%], brown THb[g/dl], WB- wall ball, X – rest, SKI- Ski Erg, TTB – toes to bar, AB – assault bike

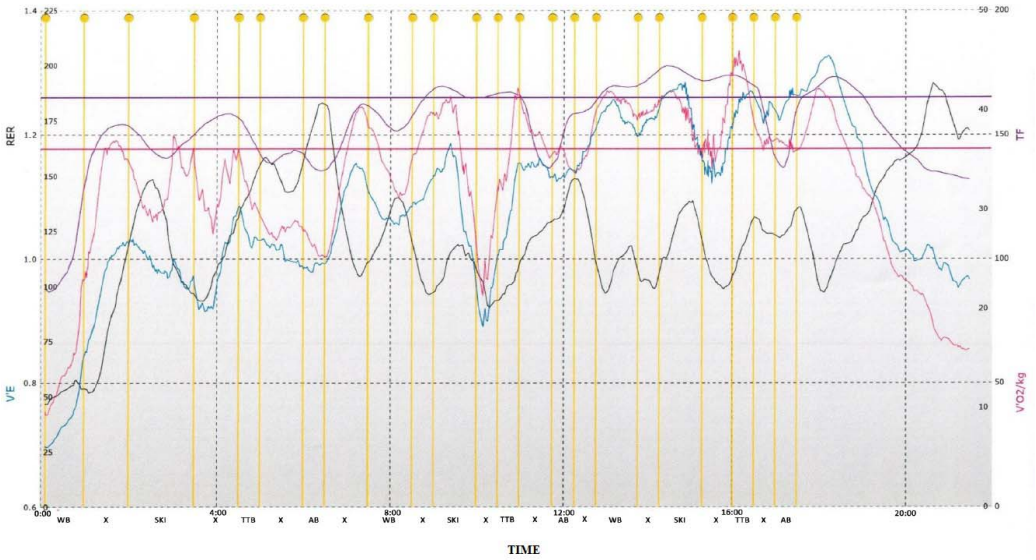
Figure 3

Moxy record of load progress (m. deltoideus)

The following Fig. 4 shows the course of the individual respiratory parameters and HR. Again, different responses to specific exercises can be seen. When comparing SKI and AB as representatives of cyclic endurance activities, it is evident that there is a significantly different response of the organism. V'E value decreased during and after SKI (by 30 – 50 L/min), on the contrary it increased after AB (by 10 – 30 L/min). The SKI in this case was a

exercise that did not increase the overall load intensity. Even though SKI was the simplest exercise in terms of load, it did not affect the overall intensity (influence on the course of the heart rate curve, V'E).

The reaction with the TTB exercise, during which V'E decreased, is interesting. TTB is not a typical static exercise (athlete performs kipping, at the same time raises his legs up, which is by nature closer to the isotonic load). This is probably due to the nature of the exercise, where the breath pattern changes when hanging and simultaneously compressing the torso, which affects the depth and quality of breathing. AB showed the potential to be very heavily loaded during the interval training. Especially after the last interval when the participant was motivated for high performance. Here, the highest values of V'E and RER were achieved. Due to the expected delay in the recording of respiratory parameters, monitoring was continued for several minutes after the end of the protocol.



Notes: V'O2 - oxygen consumption [L/min.kg], RER - Respiratory Equivalent Ratio, V'E - minute ventilation [L/min], TF - heart rate [beats/min]

Figure 4

Recording of respiratory parameters

Discussion

During the testing, there was a different load, which was reflected in the Sm02 or VCO2 values. The deflections of these variables correspond to HIIT and indicate intense muscular work associated with high effort (Brocherie et al. 2015). Muscle oxidation (mainly *m. vastus lateralis*) was then directly related to the respiratory functions, which reflected the

work of large muscle groups. Large changes in oxygen saturation were evident mainly after the wall ball and assault bike sites. As these were not all-out intervals and as it was also a short overall load time, such reactions as in Jones et al. (2015) cannot be stated. Different fluctuations as well as the rate of return to resting values in the monitored muscles were more evident in *m. deltoideus* due to the muscle size and intermittent (in WB) and lighter isometric (at TTB) loads.

On the basis of the records, it can be concluded that the total intensity (in the form of RPE, HR) was dependent on the involvement of the lower limbs. Although all exercises were compound, but for example, exercise on bar was connected with the strength endurance of the center of the body, which does not require oxygen saturation. Thus, the monitoring of *m. vastus lateralis* seems to be a suitable means of monitoring the overall intensity (Grassi & Quaresima 2016). Faiss et al. (2015) has shown that even with SKI, high metabolic values can be achieved. Similar conclusions have been reached in our case study (e.g. V'O2 value), although such a high load was not achieved. Cross-country skiing (double poling) is a comprehensive exercise that dominates the upper half of the body. The monitoring of *m. deltoideus* has not proven to be ideal for monitoring this type of load. In Faiss et al. (2015), a sensor was placed on the *m. triceps brachialis*, which better reflects this movement. To record the effects of various compound exercises, *m. deltoideus* seems to be a more appropriate means because it is a larger muscle group that is more involved in the whole body exercises. Monitoring of large muscle groups seems to be more suitable for overall load analysis (Re et al. 2018). In WB, deltoids are strongly involved in muscle work, similarly in AB, a pressure movement is performed. The measured values do not correlate with difficulty in terms of respiratory parameters (eg V'O2, V'E). Monitoring of lower limb load appears to be decisive.

In a set of the selected exercises, SKI was the least difficult exercise in the records, but this does not mean that it was not a suitable means for this type of load. In cycling simulators, the intensity measure can always be easily influenced, but in this measurement we did not intentionally do that. The aim was to maintain a high non-decreasing speed at all intervals. Both HIIT and HWT change spiroergometric parameters by varying the load and rest intervals. For exercises, the proband sets a certain respiratory rate, which changes based on the protocol. In this test, the depth of inhalation/exhalation and frequency varied based on the nature of the exercises. Each exercise naturally forces a certain pattern of breath, which is related to the power load, body position or frequency of movement (Jernej 2013).

Significant differences can be found, for example, in TTB, where there was a lower frequency of movements and at the same time light compression of the body, which also affects the quality of breathing. Even this fact contributes to the higher demands of the chosen protocol. HIIT is characterized by the rapid rise of HR and its subsequent ripple (Keating et al. 2017), which was confirmed in this case as well. Although the HR is not a fully reliable indicator (does not accurately reflect the level of the aerobic and anaerobic systems, does not take into account the lactate metabolism, etc.), it helps to evaluate the intensity and partly training effect. In addition to HRmax, an average HR of 151 is important factor of aerobic system development effect. The total protocol time was 18 min, which is shorter than in Machado et al. (2018), but, for example, Tabata (2019) or Engel et al. (2018) confirm the effectiveness of much shorter loads for improving endurance and anaerobic performance. Unlike other studies (Cassidy et al. 2017; Machado et al. 2017; McRae et al. 2012), the pause between the rounds has been progressively reduced to increase the demands of the protocol (due to procedure). This was confirmed, although it was not so distinctive in the upper body exercises (see Fig 4). The pause between the intervals/exercises and its nature is an important factor for the overall training effect and involvement of individual energy systems (Gibala & Jones 2013). Shortened rest was far from sufficient regeneration and an increase in RER was reported, suggesting an increased involvement of anaerobic metabolism.

Although the various parts of the body and the way of their load were involved, this led to the maintenance of the required intensity, resp. to increase in sense of HR, RPE etc. (RPE value was 18-19 at the end). As in the studies by Machado et al. (2018) and Schaun et al. (2018), variable interval training seems to be an effective means for significant physiological responses to the body (cardiorespiratory adaptation, lactate metabolism etc.). Given the originality and nature of testing, it is not clear whether it would be more effective in comparison with HWT or HIIT (Machado et al. 2017; Sabag et al. 2018), but the potential in developing endurance and aerobic fitness of such a protocol has been shown.

Conclusion

The acute physiological response to non-traditional HIIT was verified from the point of view of oxidation of the selected muscles and spiroergometric parameters. The results show that there is a similar load to HWT or HIIT, which affects cardiorespiratory and metabolic functions. Acute changes in the observed parameters (SmO2 in *m. vastus lateralis*)

also indicate a possible impact on the development of strength endurance. Furthermore, it has been confirmed that variable load types can be applied at the same time as rest time adjustments, thus using conditions that can reflect current options (material, environment, time) and specific goals in the form of fitness development. It is necessary to take into account the limitations of the field testing where there is a risk of worsening or distortion of records due to non-standard measurements. Based on the results, similar protocols can be recommended to develop fitness or as a part of specific sport training. This was a case study and therefore it is necessary to confirm the results on a larger sample and especially from the point of view of long-term adaptation, resp. influence on the development of selected performance parameters.

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THE EFFECT OF MOVEMENT INTERVENTION ON MUSCULOSKELETAL SYSTEM IN UNDERGRADUATES

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Summary: The aim of the research was to diagnose manifestations of functional and structural disorders and consider the effect of intervention on the musculoskeletal system of students of teacher's program of physical education. A total of 40 students of Faculty of Sports Prešov University in Prešov participated in the research. As part of the experiment we designed a targeted movement program as an intervention and applied it to an experimental group of students. After 5 months of the intervention, the measurements were repeated. In experimental group we noticed that 30 % of men and 20 % of women improved from III. to II. qualitative degree of shortened muscles. The statistically significant difference ($p < .05$) was confirmed in group of men. From the perspective of intersexual differences, we observed a statistically significant difference among the shortened muscles in the experimental group ($p \leq .05$). Changes in structural disorders of the spine after the intervention were statistically insignificant. In regards to good spinal health and muscle balance, we assume that targeted movement program can have preventive effect against functional and structural disorders.

Key words: hypokinesis, spine mobility, shortened muscles, fascial training program.

Introduction

Knowledge of the current lifestyle of the population shows a decreasing interest in regular physical activity in all age categories and the associated appearance of civilization diseases. Approximately one in two students at Slovak universities do not spend their free time regularly doing physical activity, resp. do sports only occasionally. Students report workload and stress factors as the most common reason for hypokinesis but are unaware of the need for recovery, which is only achieved by compensating lack of exercise (Véle 2006).

These negative factors are also reflected in the musculoskeletal system of the current young generation. Static-dynamic function of the musculoskeletal system is disrupted leading to clinical syndromes and generally reducing the tolerance threshold for physical load (Dostálová & Sigmund 2017).

Functional disorders of the musculoskeletal system refer to all disorders of joint, muscle, nerve and organ function where the primary cause of the disharmony is not a structural cause. Malfunction is a manifestation of a malfunctioning control function, whether it's a limitation of joint mobility, increased resp. decreased muscle tension or impaired movement stereotype (Véle 2006; Beránková, Grmela, Kopřivová & Sebera 2012). There are three main levels of the musculoskeletal system where function disorders occur: central nervous movements regulation, muscle and joints (Lenková & Boržíková 2018). These levels can not be separated from each other, they're interrelated and they interact. However, scientific knowledge of recent years shows that muscle factor plays a crucial role in most functional disorders of the musculoskeletal system (Bendíková 2010; Kanásová 2017). Important is the functional relationship between the muscles, speaking of muscle balance (Dostálová & Sigmund 2017), which arises from a violation of functional relationships between the postural and phasic muscular system. It is often the result of insufficient, excessive but also one-sided movement overload (Bendíková 2016; Lenková, Mikuľáková, Labunová & Urbanová 2018).

Postural muscles perform a predominantly static function, keeping the body upright. Their primary functional feature is that they have a strong tendency for shortening that occurs throughout life as an adaptive response to inappropriate functional loads (Norris 1995; Čermák, Chválová, Botlíková & Dvořáková 2008; Bursová 2005; Dostálová & Sigmund 2017). According to Kolář et al. (2009) muscle shortening is a condition where, for a various reasons, resting shortening occurs. The shortened muscle loses the ability to fully relax and reach its original length. By passive stretching, the full range of motion can not be achieved. Muscles with tendency to shorten tend to be hyperactive, so compared to other muscle groups they are more often activated in situations where they should not be activated and take over the function of phasic muscles.

Muscle imbalance negatively affects body posture, movement stereotypes, muscle coordination, increases the risk of injury and, in addition, limits joint movement and mobility (Kopřivová & Beránková 2002; Bendíková 2016). If the muscles can not resist the overload,

the ligaments and joints take responsibility for the shape of the spine, very often leading to degenerative changes that are accompanied by pain (Dylevský 2009; Górnicka 2014).

The physiological curvature of the spine within the sagittal plane is shaped in the process of posturogenesis and is characterized by high plasticity and the level of curvature of the spine in the sagittal plane depends on many factors such as somatotype, lifestyle of physical activity. Excessive overloading of the spine in the form of a long-term sitting position, inactivity without compensation or asymmetric stress can lead to pathological curvature of the spine and decreased quality of life (Lichota & Plandowska 2011; Mikuľáková, Urbanová, Lenková & Boržíková 2017; American Heart Association 2015).

Within the sagittal plane we mention cervical and lumbar lordosis, thoracic and sacral kyphosis. Lordic-kyphotic curvature of the spine helps to absorb and ease shock impacts. Due to various factors, there are significant curvature of the given spinal segments, which is perceived as a manifestation of deformity. The upper sacral syndrome typically has a accompanying phenomenom in the form of thoracic hyperkyphosis, while the lower sacral syndrome manifests itself as hyperlordosis in the lumbar segment. The reduced curvature of the spine in terms of hypokyphosis and hypolordosis in all its segments is known as the „flat back“ which is also considered to be the non-optimal condition of the spine. Within the deviation of the curvature of the spine in the frontal plane, we are talking about scoliosis, resp. scoliotic curvature of the spine. Progressive decline of spinal mobility is generally accepted as one of the main causes of spinal deformity (Aebi 2005).

The aim of our research was to diagnose structural abnormalities and functional disorders of the musculoskeletal system of students of teacher’s program of physical education and to intentionally correct them by means of an interventional movement program. Regard to the sedentary lifestyle of university students, who analyze researches Šimončičová & Kanásová (2014), Levitová & Hošková (2015), Chen, Yarnal, Hustad & Sims (2016), we anticipated changes in the curvature and mobility of the spine and 75 % incidence of functional disorders in shortened muscle dimension. By the intervention of the targeted movement program, we expected changes in the level of musculoskeletal system disorders of the experimental group compared to the control group without intervention.

Methods

The object of our research was a group of 40 students from the 1st year of the bachelor’s degree study program Physical Education Teaching at the Faculty of Sports of the

University of Prešov in academic year 2018/2019. The experimental group (EG) consisted of 20 students (10 men and 10 women). The average age of the experimental group men was 20.2 ± 0.65 years. They had an average body height 179.5 ± 6.15 cm, an average body weight 75.96 ± 8.23 kg and an average BMI 23.57 ± 2.45. The average age of EG women was 19.1 ± 0.53 years, the average body height was 167.9 ± 5.25 cm, the average body weight was 57.4 ± 6.85 kg and the BMI was 20.3 ± 1.78. The control group (CG) consisted of 20 students (11 men and 9 women). The average age of men and women was 19.55 ± 0.68 years. The average body height of men was 182.3 ± 5.25 cm and body weight was 73.2 ± 8.42 kg. The average body height of CG women was 164.98 ± 4.85 cm, body weight on average 60.6 ± 3.65 kg. Given the average body height and weight, the BMI index for men was 22.1 ± 1.93 and for women was 22.8 ± 2.24.

Muscles that tend to shorten were diagnosed by 11 testS according to Janda (1982), modified by Thurzová (1992) for physical educational practise. Diagnoses of curvature and mobility of the spine was performed by using SpinalMouse® diagnostic technology, which records spinal movements during tests in the sagittal and frontal planes. Spinal mobility tests were performed from baseline and the extent of movement in torso flexion and extension within the sagittal plane, lateroflexions within the frontal plane as well as from baseline was measured. The data obtained during the diagnostics were recorded by the SpinalMouse® software, which graphically presented the curvature of the spine in individual sections. The software visualized problem spine areas as well as any deviations from the reference values (Mikuľáková, Urbanová, Lenková & Boržíková 2017). The results show an excellent match when compared to X-ray documentation (Ripani et al. 2008; Dohi 2013).

The research was conducted as a parallel experiment. The experimental factor in the project was an interventional movement program, which was aimed at reducing muscle tension, stimulating and improving the flexibility of the fascia, increasing the mobility of individual spine sectors using blackrollers and various balancing instruments. Intervention lasted 5 months, EG students exercised 2 times a week for 45 minutes. In the course of the research investigation, both EG and CG ensembles were engaged in physical activities within the study program of physical education teachers – swimming, sports games, athletics, gymnastics in the extent of 5 hours per week. At the end of the experiment we performed a retest of the studied indicators.

The changes in the observed musculoskeletal system parameters of the students were calculated by chi-square χ^2 at the significance level of 5 %. Using the same method we

compared quantitative indicators. We used Mann-Whitney U Test for independent data to compare EG and CG and to determine intersexual differences in individual files. We compared the input and output measurements of the experimental set with Wilcoxon's paired test by percentage analysis. We considered the changes that occurred between the input and output measurements at the 5 % significance level ($p \leq .05$).

Results

Functional disorders of the musculoskeletal system can be caused by incorrect movement habits or lack of movement. They are manifested by hypertonus of hypotonus in muscles, disturbance of static position of the spine, muscle imbalance, overload of muscles and ligaments at work and sports, pain in muscle and joints, joint blockage and impaired movement stereotypes (Levitová & Hošková 2015). If the muscles can not resist the overload, the ligaments and joints take responsibility for the shape of the spine leading to degenerative changes that are accompanied by pain.

Curvature and mobility of the spine

SpinalMouse® spine curvature and mobility measurements within sagittal plane of future teachers of physical education and sports education are graphically designed in baseline, flexion and extension (Figure 1).

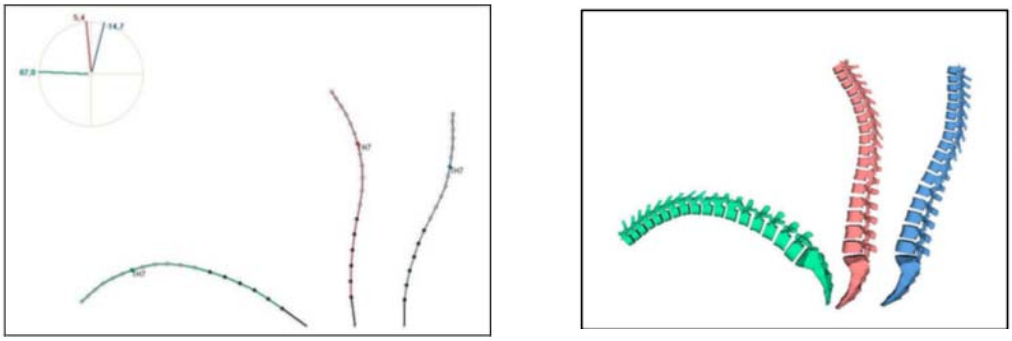

Figure 1
Visualisation of measurements within the sagittal plane (Source: SpinalMouse® software)

After diagnosing the backbone mobility of the students with the SpinalMouse® at baseline we found significant intersexual differences in the individual spine segments. In the thoracic segment, 67 % of men had decreased curvature, 50 % of women had increased curvature. In the lumbar segment were no significant differences in the shape of the spine between the sexes. In the sacral segment there was evident 50 % hyperlordotic curvature of

the spine in men 28.5 % of tested women had increased curvature. Correct curvature was diagnosed in 50 % of men and 71.5 % of women (Table 1).

Table 1

The curvature of the spine in baseline within the sagittal plane

The curvature of the spine in baseline within the sagittal plane				
Segments of the spine	**Sex**	**Decreased curvature (%)**	**Correct curvature (%)**	**Increased curvature (%)**
Thoracic	M	67.0	33.0	0
	W	0	50.0	50.0
Lumbar	M	50.0	33.0	17.0
	W	35.8	42.8	21.4
Sacral	M	0	50.0	50.0
	W	28.5	71.5	0

(Source: author)

In flexion in the sagittal plane a hyperkyphotic curvature of the spine was found in the thoracic sector of men up to 92 %, 17 % in the lumbar sector, indicating limited mobility of the spinal sacral sector, an obvious sign of the occurence of muscular imbalance – lower sacral syndrome. Similar results were detectable in the group of women, the hyperkyphotic curvature of the spine in the thoracic sector was in 50 % of tested women, the hypokyphotic curvature in the lumbar sector was in 35.7 % (Table 2).

Table 1

Mobility of the spine – flexion within sagittal plane

Mobility of the spine – flexion within sagittal plane				
Sectors of the spine	**Sex**	**Decreased curvature (%)**	**Correct curvature (%)**	**Increased curvature (%)**
Thoracic	M	0	8.0	92.0
	W	7.1	42.8	50.0
Lumbar	M	33.0	50.0	17.0
	W	35.7	64.2	0
Sacral	M	75.0	25.0	0
	W	50.0	50.0	0

(Source: author)

The results of standing and flexion measurements within the sagittal plane were confirmed in the extension of the trunk. In the group of males, 65.3 % of probands had reduced mobility in the thoracic sector, the trunk extension was performed mainly in the lumbar sector of the spine, where 53.8 % of the men experienced increased curvature, 42.8 % of women had hyperkyphotic curvature in the thoracic sector. Reduced curvature in the lumbar sector was measured in 35.7 % of women, in 92.8 % of women we observed a reduced spine curvature in the sacral spinal sector. In the extension of the trunk, women mostly engage the thoracic and lumbar spinal sectors (Table 3).

Table 3

Mobility of the spine – extension within sagittal plane

Mobility of the spine – extension within sagittal plane				
Sectors of the spine	**Sex**	**Decreased curvature (%)**	**Correct curvature (%)**	**Increased curvature (%)**
Thoracic	M	65.3	34.7	0
	W	42.8	54.2	3.0
Lumbar	M	2.7	43.5	53.8
	W	35.7	54.5	9.8
Sacral	M	7.3	69.2	23.5
	W	92.8	7.2	0

(Source: author)

The results of the examination of the quality of spinal curvature in the frontal plane at baseline and lateroflexions to the right and to the left in individual spinal sectors in the study group are presented in Figure 2.

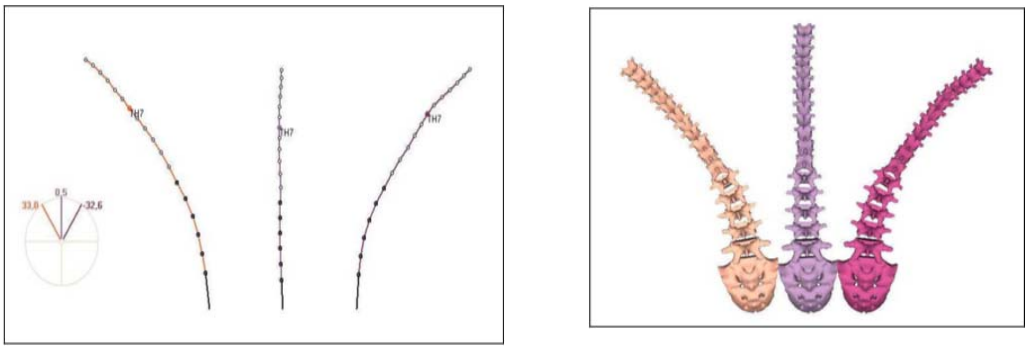

Figure 2

Visualisation of measurements in frontal (Source: SpinalMouse® software)

Within the frontal plane in the standing position, in lateroflexion on the right and left side, we found in the group of men the occurence of scoliotic curvature of the spine in all spinal sectors. The greatest deviation was noted in lateroflexion on the left in the sacral sector in up to 54.5 % of probands and 38.2 % in the lumbar sector. A similar finding was also found in lateroflexion on the right. In the group of women in the standing position we found that in the thoracic and sacral sector of the spine, all probands have the correct curvature. The most pronounced scoliotic curvature in lateroflexion in both directions was observed in the spinal sacral sector (Table 4).

Table 4

Curvature and mobility of the spine – lateroflexion within frontal plane

Occurance of the scoliotic curvature				
Sectors of the spine	**Sex**	**Baseline position (%)**	**Lateroflexion to the left (%)**	**Lateroflexion to the right (%)**
Thoracic	M	2.3	19.4	21.4
	W	0	15.1	15.2
Lumbar	M	12.4	38.2	32.5
	W	8.3	29.4	21.8
Sacral	M	3.4	54.5	52.7
	W	0	49.8	50.0

Individual postural parameters represent similar values in input and output diagnostics. There were no statistically significant differences in the assessment of spinal mobility in individual sectors after the intervention. The result may be associated with similar characteristics of somatic properties in the study group. We note that a longer interval of targeted action of the experimental indicator is needed to achieve positive changes, given that the initial level of spinal mobility was insufficient by physiological recommendations (Kociová & Mikuľáková 2011). The limited mobility of the spine in the sagittal and frontal planes clearly points to significantly shortened postural muscles of EG students (Table 5).

Table 5

Average values (±SD) of postural parameters in the sagittal and frontal planes of ES, statistical significance evaluated by t-test

Postural parameters	Input (°)	Output (°)	T	p
SR U sacral sector	2.83 ±5.67	1.30 ±7.13	.589	.562
SR U thoracic sector	35.58 ±11.85	34.38 ±14.68	.223	.825
SR U lumbar sector	-16.75 ±7.20	-14.53 ±9.67	-.644	.526
SR F sacral sector	71.00 ± 15.66	61.00 ± 12.74	1.757	.092
SR F thoracic sector	16.50 ± 13.70	17.23 ± 14.81	-.128	.900
SR F lumbar sector	43.08 ± 8.50	42.92 ± 9.36	0.045	.965
SR E sacral sector	-27.50 ± 8.36	-26.84 ± 12.35	-.154	.879
SR E thoracic sector	-9.25 ± 15.63	-6.53 ± 16.06	-.427	.673
SR E lumbar sector	-10.66 ± 8.13	-14.07 ± 8.63	1.014	.321
FR U sacral sector	2.42 ±4.25	2.36 ±8.59	.498	.483
FR U thoracic sector	23.48 ±10.87	35.74 ±13.86	.348	.832
FR U lumbar sector	2.17 ±3.54	1.96 ±6.35	.276	.493
FR LL sacral sector	46.00 ± 12.63	53.21 ± 9.32	1.653	.078
FR LL thoracic sector	9.56 ± 11.94	11.84 ± 12.58	.082	.864
FR LL lumbar sector	39.71 ± 9.50	39.57 ± 8.64	0.134	.798
FR LP sacral sector	-13.50 ± 6.32	-19.57 ± 19.48	-.183	.628
FR LP thoracic sector	-7.85 ± 14.56	-4.36 ± 9.47	-.539	.716
FR LP lumbar sector	-9.33 ± 8.94	-11.97 ± 5.62	.019	.284

Legend: SR – sagittal plane, FR – frontal plane, U – baseline, F – flexion, E – extension, LL – lateroflexion left, PL – lateroflexion right *(Source: author)*

Dimension of shortened muscles

In the diagnosis of shortened muscles, we consider the level of shortening in four qualitative degrees. I. degree is characterized by sufficient muscle elasticity, II. degree is characterized by moderate level of shortening, III. degree is characterized by medium level of shortening and IV. degree is characterized by significant muscle shortening. At the beginning of the experiment, the students were in II. and III. qualitative degrees (Figure 3). In the experimental group, 60 % of men were in III. degree and 70 % of women in II. degree of shortened muscle dimension (SS). In input measurement total percentage of the experimental

group was 55 % in II. degree and 45 % in III. degree. The level of muscle imbalance of our experimental group was in a better condition compared to the students of the UKF in Nitra, who were mostly in III. (66.7 %) and IV. (33.3 %) qualitative degrees (Šimončičová & Kanásová 2014).

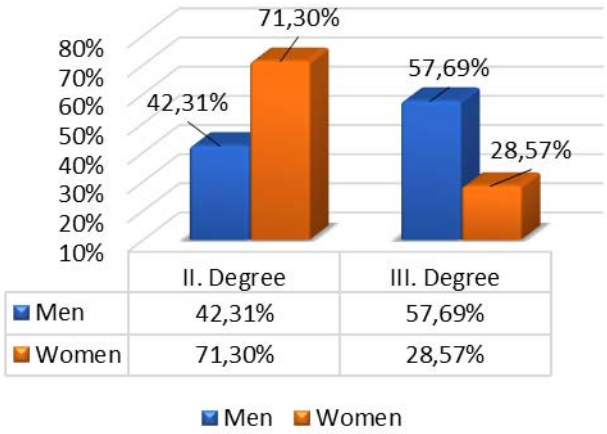

Figure 3
Percentage of students in shortened muscles dimension in initial measurement (Source: author)

Shortening of muscles occurred mainly in men than women in both measurements. In the initial measurement the main shortened muscles in men were *m. tensor fasciae latae* (80 %), *m. triceps surae* (80 %), *m. quadratus lumborum* (70 %), *m. pectoralis major* and *m. rectus femoris* (60 %). On the contrary, the main shortened muscles in women were *m. tensor fasciae* and *m. erector spinae* (60 %) (Figure 4).

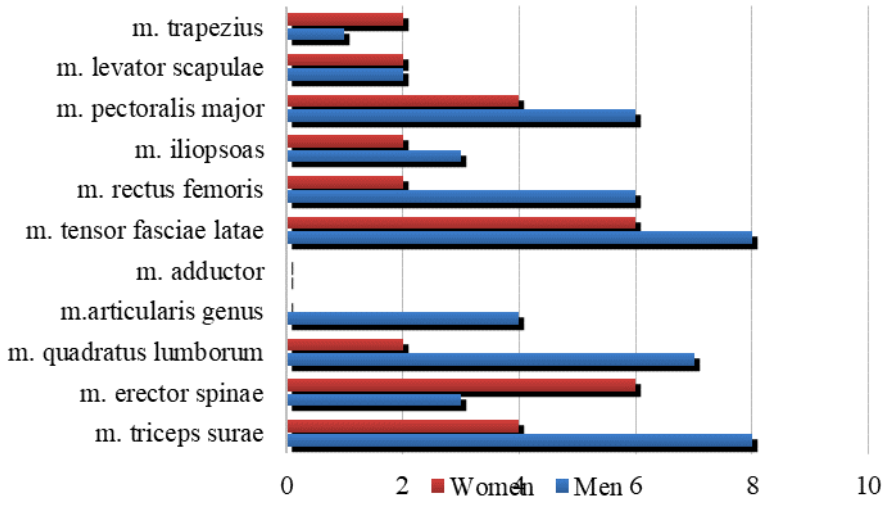

Figure 4
Number of students in shortened muscles dimension of the experimental group in initial measurement (Source: author)

In repeated measurement, the main shortened muscles in men were *m. rectus femoris* and *m. tensor fasciae latae* (80 %). Other shortened muscles were *m. levator scapolae* and *m. pectoralis major (*60 %). In women the highest frequency of muscular shortening was found in *m. rectus femoris* and *m. tensor fasciae latae* (60 %).

Similar results have been observed in the research of Lopata & Broďáni (2014). The most frequently shortened muscles in men were m. iliopsoas, m. rectus femoris, m. trapezius (64 %) and mm. pectorales (60 %). The results of our research do not correspond to the results of previously reported by Bendíková et al. (2015). They reported that the most frequently shortened muscles in women were m. rectus femoris (78.32 %), m. quadratus lumborum (69 %) and m. pectoralis major (64.5 %).

Table 6

Changes in qualitative degrees of shortened muscles after intervention

Shortened muscles	**II.**		**III.**	
	test	**retest**	**test**	**retest**
Men	4	7	6	3
	40 %	70 %	60 %	30 %
p	**0.028403***			
Women	7	9	3	1
	70 %	90 %	30 %	10 %
p	**0.059337**			
Together	11	16	9	4
	55 %	80 %	45 %	20 %
Chi-Square	**2.85**			
p	**0.091431**			

(Source: author)

After application of the interventional program, we confirmed by Wilcoxon pair test a statistically significant reduction in the incidence of shortened muscles in experimental group of men by comparing the total score obtained for the shortened muscles dimension between input and output measurements ($p = 0.028403$). In the experimental group of women, there was no statistically significant difference ($p = 0.059337$). Despite the improvement in the shortened muscles level of the experimental group, the statistically significant difference was not confirmed ($p = 0.091431$). The total chi-square value was 2.85, which is less than 3.84, which is a value χ^2 at first degree of freedom (df). (Table 4).

According to Mann-Whitney U Test, we confirmed a statistically significant difference ($p < .05$) in the total number of points acquired in the shortened muscle dimension comparing

intersexual difference. We did not confirm statistically significant difference in qualitative degrees of shortened muscle dimension between measurements (Table 7).

Table 7
Shortened muscle scores between men and women of experimental group: Mann-Whitney U Test

	Input measurement		Output measurement	
	Points	**Qualitative degrees**	**Points**	**Qualitative degrees**
U	23	4	17.5	4
Z	2.003212	0.5	2.418973	0.5
p	0.045155	0.617075	0.015565	0.617075

(Source: author)

A statistically significant difference between experimental and control groups was confirmed in the initial measurement based on the number of points achieved in the shortened muscle dimension (p = 0.000006). The final measurement did not confirm a statistically significant difference between experimental and control groups. In both measurements there was a statistically significant difference in the number of points achieved by men of experimental and control groups (Tab 6). On the contrary, women in both groups did not show a statistically significant improvement in the level of shortened muscles.

Table 8
Comparison of gained points of the shortened muscle dimension in experimental and control groups: Mann-Whitney U Test

	Input measurement			Output measurement		
	Together	**Men**	**Women**	**Together**	**Men**	**Women**
U	32.5	74	141	130.5	85.5	177.5
Z	4.517365	3.394786	1.58243	-1.86646	3.08371	0.595102
p	**0.000006**	**0.000687**	0.113552	0.061978	**0.002045**	0.551776

(Source: author)

Discussion

Spine mobility and function of postural muscles are important for movements of body segments. The sports activities contribute to the level of flexibility and functionality of university students, often active athletes. Asymmetric stress, especially during periods of intense growth, can lead to pathological curvature of the spine (López-Minarro et al. 2010; Lichota & Plandowska, 2011). Early sports specialization can cause musculoskeletal injuries, reduce flexibility, cause muscle hypertrophy and muscle imbalance (Grabara 2015).

The results of our research using the SpinalMouse® diagnostic method show that there are variations in the spinal shape in the thoracic sector in women at baseline in the sagittal plane. A half of women had a hyperkyphotic curvature of the thoracic spine. Several studies point to the occurrence of changes in spine curvature in this sector. Physical education students are often active athletes in whom incorrect movement stereotypes are observed as a result of intensive training (Mikuľáková, Urbanová & Lenková 2017). Lichota & Plandowska (2011) recorded increased thoracic kyphosis in volleyball players, handball, athletes - sprinters and taekwondo wrestlers. Several studies justify the increase in thoracic kyphosis in relation to specific training positions, e.g. a markedly reduced thoracic kyphosis was observed in basketball players compared to their non-training peers.

Lopez-Minarro et al. (2010) evaluated spinal curvature in the sagittal plane and pelvic slope in young kayakers. Spinal defects in the thoracic region affect changes in the position of the lumbar spine and pelvic slope (Wilke et al. 2001). In the stem sector, 35.7 % of women had insufficient curvature, but 21.4 % had excessive curvature of the spine, 71.4 % of women in the cross sector had a good curvature. The greatest problems found in the male population of the study group were mainly in the thoracic spine in the baseline position in the sagittal plane.

Measurements showed that up to 50 % had a flat back, 17 % had a hyperkyphotic position of the thoracic spine. In the spine sector of the spine, 50 % of men had hyperlordotic curvature. We did not see a reduced curve in this sector. 67 % of men had pelvic position in retroflection. Within the frontal plane in the standing position, lateroflexia on the right and left we found in the group of men the occurrence of scoliotic curvature of the spine in all sectors of the spine. The largest deviation was observed in lateral reflex in the left part of the cross-section in up to 54.5 % of men.

We believe that the probands bow in isolation, with lateroflexia occurring only in one spine sector, without the cooperation of other sectors, which may cause wear of individual spine movement segments in the future. In the thoracic and sacral sector of the spine, all probands have the correct curvature of the spine. By evaluating with SpinalMouse®, we obtained information about changes in the axial organ in each spine sector. There were no statistically significant differences in the monitored parameters between individual measurements after the intervention. The results of our research correspond to the results of previously reported by Bendíková (2009), which pointed out the affection of students of UMB in Banská Bystrica with structural disorders of the spine, especially scoliosis and occurrence

of osteophytes. Hrčka, Kovářová & Beňačka (2011) report the most common back pain in the area of the spine (33 %), cervical spine (29 %) and thoracic spine (17 %) among students of UCM physiotherapy in Trnava.

Therefore, is necessary to pay attention to the state of the musculoskeletal system of students of physical education and sports teachers, to develop appropriate measures to ensure the correction and compensation of structural and functional disorders. After finishing their studies, they should also be able to work independently as specialists in the field of sport for all, nutrition and health for a wide range of the general population, athletes and disabled individuals. They should have acquired practical skills and be able to classify them and apply their training methodology in practice. Their physical abilities and skills should be developed to the required level so that they can present them in the gym. Managers of presumed health, compensatory movement exercises and activities are a prerequisite for the success of their educational activities.

Conclusion

The results of the research point to the occurrence of negative qualitative changes in the postural system of students of the Faculty of Sports. Other regular activities that do not cause a unilateral burden on the postural system are also an important factor in shaping the correct figure. In a natural experiment following the application of an interventional movement program we aimed at reducing muscle tension, stimulating and improving the flexibility of the fascias, increasing the mobility of individual spine sectors using unconventional equipment. Based on the aim of the current study, we found that:

We recorded no significant changes ($p > .05$) in spine mobility as well as in individual sectors of spine by applying the intervention in experimental group. We assume that a longer interval of targeted action of the experimental indicator is needed to achieve positive changes in the area of the spine curvature. In experimental group we noticed changes in the area of the overall muscular system. 30 % of men and 20 % of women improved from III. to II. qualitative degree of shortened muscles. Despite the improvement in the shortened muscles level of the whole experimental group, the statistically significant difference ($p < .05$) was confirmed only in group of men. In the relatively short time, the positive impact of intervention was recorded in experimental group of students. In regards to good spinal health

and muscle balance, we assume that targeted movement program can have preventive effect against functional and structural disorders.

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EFFECT OF SPRINT TRAINING EXERCISE, SHUTTLE RUN AND PREVENTION ON BASE SOFTBALL RUNNING SPEED AMONG HIGH SCHOOL STUDENTS

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Summary. This study aims to determine the differences and to achieve better effect in the sprint training, shuttle run and agility on base of running speed of athletes softball. This study uses an experimental method with a 2x2 factorial design. Participants in this research were 42 male athletes (mean age = 16.88; SD = 1.31), Indonesian high school students. The instruments of this study were the base running test and reactive agility testing protocols. Analysis of the data is analysis of variance (ANOVA) of two pathways at a significant level $\alpha = 0.05$. The results of the study are as follows: exercise sprint training give better effect to the results of base running extracurricular softball, as evidenced by the value of $p = 0.036 < 0.05$. Participants who have high agility level give a better effect than participants who have low agility level on the results of softball extracurricular base running, as evidenced by the value of $p = 0{,}000 < 0.05$. There is no interaction between the training model and agility on the results of softball extracurricular base running, which is evident from the value of $p = 0.634 > 0.05$. This research contributes to the field of softball sports, especially in creating an appropriate training program to increase the speed of base running in male students by using sprint training so that results are more effective.

Key words: agility, athlete, exercise, run, softball, speed

Introduction

Softball game sport is one of the sports that is included in the physical education curriculum, this game requires technical mastery and a long enough game time, so this game is included in extracurricular activities (Burhaein 2017b; Srinivasan, Pescatello & Bhat 2014). The existence of softball extracurriculars in certain schools, the sports teacher or extracurricular coaches must be able to master softball material, basic techniques and rules of

the game, so that they do not experience difficulties in carrying out these extracurricular activities. Physical conditions are the basic needs of every sport. In achieving an achievement, physical condition is the initial provision and as a basic basis for participating in sports training. In addition, physical conditions are the foundation and barometer of achievement and the ability of biomotor or fitness components required by an athlete (Burhaein 2017b; Srinivasan, Pescatello & Bhat 2014). Exercise to improve physical conditions can develop and improve the physical condition of athletes. Techniques, tactics and psychics can be well developed if they have good quality physical condition. Thus, athletes and sportsmen have to have a physical condition that is good for excellent physical condition to help them reach the achievement of the maximum. The elements of physical condition namely heart and lung endurance, speed, strength, agility, flexibility, explosive power, coordination, balance, accuracy and speed of reaction (Burhaein 2017b; Srinivasan, Pescatello & Bhat 2014). Softball requires an element of physical condition to support the athlete's achievement. If analyzed from the movements of running between bases (base running) in softball sports, movements from the legs, legs, hips and arms are needed as a balance. An athlete's physical condition or initial abilities can be improved through a programmed training process so that the desired achievements can be achieved (Dosil, Cremades & Rivera 2014; Hakim, Ambardini, Nugroho & Burhaein 2018). The physical condition element is very possible to support an athlete's skill level to run to each base in softball games. One of the basic techniques in softball games, which is often overlooked in its functions and basic techniques so that many do not match what is expected is running speed. Training by applying good and appropriate training methods is an effort to increase the ability in running speed base running must be done. To make it easy for players to learn without leaving the basic technique of running, it is necessary to design an exercise method that suits the student's character. We recommend that you first explore the factors that affect the speed of running base running, so that the training methods to be applied can be designed properly. Apart from the main elements or physical components that must be considered in training are the principles of training so that the exercise can be done properly and appropriately.

Agility is a component of motor freshness that is needed in all activities that require speed of changes in body position (Purnomo, Tomoliyus & Burhaein 2019; Young & Willey 2010). Agility is part of movement skills and sports techniques, especially movements that require continued movement coordination. Agility is needed for high adaptability to changes in the situation in the game (Purnomo, Tomoliyus & Burhaein 2019; Young & Willey 2010). Urgently needed agility to change a different position in high speed with good

coordination and balance, means that the agility is quite good. This is very closely related to softball as an infield or outfield player. High agility is a capital in addition to speed because the conditions during the game is very possible once an athlete takes a short decision, it aims to outwit your opponent or get a value.

Sprint training is an exercise that is done with intensity or full speed interspersed with rest periods during each training session and completed in a short time, and done repeatedly to the maximum on a flat surface and resilient like grass, mat or ground (Phytanza, Burhaein, Sukoco & Ghautama 2018; Srinivasan et al. 2014). One form of exercise to improve agility is shuttle run. Shuttle run exercises are done as fast as possible starting from one point to another by covering a certain distance. Motion elements in shuttle run exercises are running by changing the direction and position of the body, speed, balance are components of agile motion so that this exercise can be used to increase agility. The advantage of shuttle run training is that this exercise is oriented on footwork, speed, which gets a lot of portion in this exercise. Agility is the ability for a person to run fast by changing his direction. If a base runner has good speed and agility, it will be easy to get points in softball matches.

Jumping, running, and changing direction speed are specific variables that must be treated separately (Nimphius, McGuigan & Newton 2010). The three forms of exercise are both having a good influence in increasing running speed, so that it will affect the running speed of base running. But on the other hand, base running speed is not only influenced by the form of exercise applied. Individual factors (athletes) are crucial to the mastery of the skills learned. Several studies report that improvement in running skills or agility as a result of increased strength in lower limb muscles (Nimphius, McGuigan & Newton 2010). It needs to be studied and examined more thoroughly both in theory and practice through experimental research, to find out which form of exercise has better impact on sprint training , shuttle run and agility and their influence on the speed of running base running.

Methods

Participants in this research were 42 male athletes (mean age = 16.88; SD = 1.31), Indonesian highschool students. This research is an *experimental research*, using two groups which will receive different treatment (Toomela 2010). The method used in this study is an experimental research method using a 2 x 2 feature design (Toomela 2010). The procedure of conducting research followed the flow of the implementation of experimental research in the form of pretest, treatment, and posttest. Sprint training methods with high intensity and full speed interspersed with breaks during each training session. And the shuttle run training

method runs as fast as possible starting from one point to another over a certain distance by changing the direction and position of the body, speed, balance. Furthermore, the experimental research method using this 2 x 2 factorial design, can be described in tabular form on the next page.

Table 1

Research Design of Experiment

Attributive Variable (B) **Manipulative Variable (A)**	**Method of Exercise**	
	Sprint Training (A1)	Shuttle Run (A2)
High Agility (B1)	A1B1	A2B1
Low Agility (B2)	A1B2	A2B2

Source: Analysis data research (2020)

Information:

A1B1: Group with high agility treated by using a training methods sprint training.

A2B1 : Group with high agility treated by using a training method shuttle run.

A1B2 : Group with low agility treated by using a training methods sprint training.

A2B2: Group with low agility treated by using a training method shuttle run.

The instruments of this study were the base running test and reactive agility testing protocols. The base running test uses instructions from the softball choice sports book Parno's (Parno, 1992) and the journal Sintara's (Sintara & Sonchan 2015). Reactive agility testing protocols. This test is done by giving the opportunity to run according to the instructions of the agility test by running as fast as possible, when turning the stopwatch starts to run until the final turn (Young & Willey 2010).

Data collection techniques, prior to the experiment, first male students participating in softball extracurricular consisting of 42 people were given agility tests Reactive agility testing protocols to measure the level of agility of each student. After the agility data were collected, the first step in the analysis was to identify the upper and lower groups using the overall score. The sample used was 27 % top score and 27 % bottom score. Two steps to analyze included: (1) organizing agility tests in determining high scores and low scores, (2) determining 27 % high scores and 27 % low scores by placing them in the same group. This group is called the upper group and lower group, thus 27 % upper group and 27 % lower group are considered the best for maximizing the differences between the two groups (Toomela 2010). After knowing the level of student agility, then 42 students participating in softball extracurricular activities were ranked first by sorting from the highest level to the lowest level based on the overall student agility results. Furthermore, the sample will consisted of 27 % of students who had high agility and 27 % of students who had low agility. Then each group was divided into 2 groups again so that it consisted of 4 groups. Based on

this, the sample used consisted of 7 people who had high agility and 7 people who had low agility were trained using the sprint training method, 7 people who had high agility and 7 people who had low agility were trained using the shuttle run method. While the rest of students who had middle motivation were not included.

Data analysis technique used for hypothesis testing was the analysis of variance (ANOVA) two paths. Hypothesis testing was done with a significance level $\alpha = 0.05$. Next, to compare the average pair of treatments the Tukey test was used (Sudjana 2002). Considering that the research data analysis was carried out using ANOVA, before testing, it was necessary to conduct a data reliability test and test the analysis requirements which include the normality test and homogeneous variant bag test (Sugiyono 2014).

Results & Discussion

Discussion of the results of this study provides further thought and interpretation regarding the results of data analysis that have been stated previously. Based on hypothesis testing, the following discussion was produced:

1. **There were differences between the softball extracurricular groups that were trained using the sprint training exercise and the groups that were trained using the shuttle run exercises.**

Table 2

Result of ANOVA experiment group are trained using the sprint training exercise and the groups that are trained using the shuttle run exercises

Type III Sum of Squares	***df***	***Mean Square***	***F***	***p***
6.070	1	6.070	5.068	0.036

Source: Analysis data research (2020)

Based on the results of the analysis of research data, it was stated that the first hypothesis was confirmed that there was a difference in the influence of the softball extracurricular groups that were trained using sprint training with the groups trained with shuttle run exercises. This could be seen from the results of signification $p = 0.036 < 0.05$ so this result can be interpreted that the sprint training method can increase the speed of base running. According to Parno (Parno 1992), sprint training is an effective exercise for developing pure speed, reaction speed in sprinter, running skills and coordination of sprinting and developing maximum speed and leg muscle strength. To increase the speed, sprint

training program in research is done at a distance of 30 meters with the intensity of stimulation between sub-maximal and super-maximal, simultaneously stimulated between 5 – 20 seconds so that the total volume was between 5 – 15 times the competition distance. The frequency of stimulation was repeated 5 – 6 times per exercise and 2 – 4 times a week during the competitive phase.

Short sprints often occur during softball games. Running straight is the action most often performed on athletes whose shots are less than the maximum, both for hitter and runner on each base. Straight line running speed (both acceleration and maximum running speed), certain dexterity skills and repetitive running skills are shown to distinguish groups from different levels of performance. Professional players become faster over time, which shows that running speed is becoming increasingly important in softball base running. Some softball-related training has had a positive effect on running ability, leading to the assumption that all types of training can be carried out successfully. The aim is to be included in the softball training program. Although the principle of specificity clearly exists, some questions remain regarding optimal training methods in the larger context of team sports arrangements to consider time efficiency.

Training sprint training was recently conducted on elite softball players have shown a positive effect after the training sprint only once a week (Young & Willey 2010). Exercises that are done repeatedly with an intensity according to the exercise program will have a good effect on both athletes, this will be better if the exercise is done often repeated with repetitions and sets that are increasing. Repeated running is mainly classified as anaerobic exercise, but the contribution of aerobic metabolism increases with repetition. Sets and repetition must be related to distance and intensity when designing a sprint conditioning program. The importance of peak speeds increases when the sprint starts from jogging or is not stationary. It is also important to remember that 80 – 90 % of the maximum sprint speed is reached after 2 – 3 seconds. Sprints on base running are very important because runners who pass will create value for their team. Other studies have shown positive results when training sprint have been done at the beginning of the season or early preseason games. The ability to repeat sprints is the ability to do repeated sprints with short recovery intervals (Young et al. 2015).

Based on expert opinion and the results of the above research obtained in the field, it can be concluded that the sprint training method has a better influence in running base running on softball extracurricular male students. Besides when training has a short recovery, this is also because sprint training provides a more real picture during softball matches, because not all hitters create good shots.

2. There was a difference in the effect of high agility with low agility on the speed of softball extracurricular base running.

Table 3

Result of ANOVA high agility with low agility on the speed of softball extracurricular base running

Type III Sum of Squares	***df***	***Mean Square***	***F***	***p***
23.108	1	23.108	19.294	0.000

Source: Analysis data research (2020)

Based on the ANOVA test results in the above table, it was shown that the significance value of 0.036 ≤ 0.05, then H0 is rejected and Ha is accepted, so it can be said there is a difference between the training methods between sprint training and shuttle run to base running speed on extracurricular participants softball. Thus the first hypothesis stated that the sprint training method is better than the shuttle run method.

Most agility tests in softball are designed to evaluate the physical quality of the players, without cognitive challenges (choice reactions). The softball field in the form of a square crossing with a 90° turn, in a running strategy back and forth, sideways, and back with maximum intensity is the usual exercise used. Several studies have reported that professional players have better dexterity skills compared to players with lower standards (Francova et al. 2013; Pramantik & Burhaein 2019). Means that action and decision making are important elements in developing the ability to express speed and agility in match conditions.

Expert opinion also shows the importance of high agility in sports games. They emphasize the fact that the speed of movement is only one component of complex motor abilities called agility (Francova et al. 2013). Agility often includes running in a straight line or intentional change of direction quickly. The basic definition of agility is too simple, because it is now considered to be far more complex not only involving speed, but also balance, coordination, and the ability to react to changes in the environment, so high agility is needed to meet all of these. High agility as rapid whole body movement with changes in speed or direction in response to stimulus, based on the conception that agility has a relationship with physical and cognitive components (Wallace, Kernozek & Bothwell 2007). Agility context not only consist of changes in the ability of the direction but also the perception and decision-making. In much the same way as expression of speed, agility in the context of team sports is multifactorial. This implies that the development of agility in sports games is very important for optimizing the preparation of sports players.

From some experts it can be concluded that high agility is needed in sports by involving speed, coordination, balance and direction changes quickly. High agility is needed for softball players, especially base runners who have to make decisions quickly to get points. This must be complex for all softball players, ranging from speed to high agility.

3. There was no interaction between the methods of sprint training, shuttle run and agility to the speed of running base running in male students extracurricular softball.

Table 4

Result of ANOVA interaction of training methods and agility towards the results of base running

Type III Sum of Squares	***df***	***Mean Square***	***F***	***p***
0,280	1	0,280	0,233	0.634

Source: Analysis data research (2020)

Based on the ANOVA test analysis results above, it can be seen that the value of p = 0.634 ≥ 0.05, then H0 is accepted and Ha is rejected. So that it can be said that there is no interaction between the two sprint training exercises, shuttle run and agility on the results of the running students' softball extracurricular students. Thus the third hypothesis stated that there is no interaction between the two sprint training exercises, shuttle run and agility on the results of the softball extracurricular base running. The following is a graphic image that shows the absence of interaction between the two sprint training exercises, shuttle run and agility towards the results of the softball extracurricular base running.

Based on the analysis of research data, it was stated that the third hypothesis showed no significant difference between the interactions of the two sprint and shuttle training exercises on running speed based on the extracurricular softball of male students.

The results of the first hypothesis indicate that the sprint training method gives a better effect than the shuttle run training method to give effect to all base run speeds running extracurricular softball. While the second hypothesis shows that students with all the agility of the high category are better than students with the lower category of running speed based on extracurricular softball.

The third hypothesis showed no significant difference between the interaction of practice sprint training, shuttle run and agility on to the velocity base running extracurricular softball. This can be seen in the result p = 0.634 > 0.05 so that from these results it can be stated that there is no interaction between the training method and the agility of the softball extracurricular base running ability. Exercise sprint training aims to improve the

speed of running, exercise programs sprint training in this study conducted with a distance of 30 meters, with the stimulus intensity between the maximum and super maximum sub., simultaneously stimulated between 5 – 20 seconds so that the total volume is between 5 – 15 times the competition distance. The frequency of stimulation is repeated 5 – 6 times per exercise and 2 – 4 times a week during the competitive phase.

The effect of sprint training, on softball players, can benefit more by conducting sprint training that is similar to the developmental model used in strength training and by world-leading athletic practitioners (Dosil et al. 2014). So the sprint training exercises use training programs that each session places an increasing burden with rest periods between reps and sets. The impact of sprint training exercises gives better results because it matches the game strategy. Many extracurricular softball players whose shots have not been maximized, this can be tricked by running with all their strength to immediately reach the base in front of him.

Shuttle run or run back and forth is one way to improve the speed and agility (Wirat Sonchan & Pratoom Moungmee 2017). Through this exercise, anaerobic fitness will be better. The shuttle run training is oriented to footwork speed and is easier to remember so that the athlete can concentrate fully on running speed and if done continuously the athlete will be accustomed to sharp turning angles in 1800 (Deane, Chow, Tillman & Fournier 2005). Thus, through the test shuttle run agility of feet can be measured.

Shuttle run in this study was carried out at a distance of 10-10-10 m. To increase agility, an exercise program is carried out with sub-maximal and super-maximum intensities with stimulation duration between 5 – 20 seconds so that the total volume is between 5 – 15 times the competition distance. The frequency of stimulation is repeated 5 – 6 times per week per exercise, 2 – 4 times per week during the competitive phase. Based on some of the explanations above, it can be concluded that the sprint training and shuttle run methods are different training methods in increasing agility. Therefore, the use of the sprint training method and shuttle run have different effects on increasing agility in softball extracurricular participants.

Conclusion

Based on the results of the research and the results of data analysis that have been carried out, the following conclusions are obtained: 1) There is a difference between the sprint training method and the shuttle run of the base running speed of the softball extracurricular male students; 2) There is a difference between high agility and low agility towards base running speed in softball extracurricular male students; 3) However, there is no interaction

between sprint training, shuttle run and agility on base running speed in softball extracurricular male students. This research contributes in the field of softball sports, especially in creating an appropriate training program to increase the speed of base running in male students by using sprint training so that results are more effective.

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THE LEVEL OF COMMUNITY COHESIVENESS UNDER PSYCHOLOGICAL PRESSURE AND CONTROL CENTER FOR EMERGING FOOTBALL PLAYERS U17

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Summary: The objective of this study is to know the level the group cohesiveness and the type of relationship between it and the psychological pressure and control center for emerging footballers under the 17 years. The descriptive approach of the study was based on a sample of 70 young footballers between the ages of 15 – 17 years of the professional Algerian championship who are still studying. The measurement of cohesiveness of the group, consisting of 34 phrases divided into four dimensions, was used on 5 dimensions, and on the scale of the center control the internal and external consists of 20 phrases. We found an average level of group cohesiveness in all dimensions and in the total score of the group cohesiveness scale with mean and standard deviation estimated at (118.5 ± 13.13), high level of psychological stress and total degree of psychological stress with mean and standard deviation of 163.38 ± 10.67). The average level in the remote control center and high in the external control center, there is a statistically significant correlation between group cohesiveness and psychological stress, and a statistically significant correlation between the cohesiveness of the group and both the internal control center and the external control center. The psychological pressures negatively affect the cohesiveness of the group while the control center with its both sides the internal and external does not affect the cohesiveness of the group.

Key words: sport group cohesiveness, stress, control center, emerging player.

Introduction

One of the reasons behind the success of modern football teams is to provide a cohesive group of players among them in what appears as an integrated unit where the cohesiveness of the group is a dynamic process reflected in the tendency of the group to stick together and remain united in pursuing their goals and satisfying the emotional needs of the member (Carron, Brawley &Widmeyer 1998). The group's cohesiveness includes individuals'

sense of belonging to the group, loyalty to it, discussion of its standards and membership rather than talking about themselves, their work together towards a common goal, and their willingness to take responsibility and defend the group (Ekhlas & Bahi Mustafa 2001).

The process of interaction between individuals engaged in an activity is the basis for achieving the objectives of the exercise of that activity whether during the preparation of competition or during competition directly taking into account the consolidation of good social relations between individuals working in the field of sport (Mustafa Mohammed 1998).

Thus, the cohesiveness of the group within the same group is the result of the outcoming forces that attract the individual to the group (Mohamed Hassan Allawi 1998). The practice of football is a very important issue for those interested in preparing young players to reach the upper levels. The young football player is influenced by the environment of the family, coach, colleagues and school, that surround him. A variety of emotional and psychological situations are often facing these players which are often accompanied by psychological stresses which are a confusion of ideas that enter the mind, often occur when giving the situation more than it deserves, and sometimes followed from external forces (Al Arabi Chamghoun 2012).

Mandler also defines pressure as "the conditions associated with stress and intensity resulting from the requirements or variables that necessitate some kind of re-adjustment of the individual and the resulting physical or psychological effects." (Abdul Aziz Abdul Majeed Mohammed 2000). Psychological pressure in competitive sports is a set of Complex responses to different types of psychological effects on the athlete and cause him a state of psychological stress, which leads to a significant reduction in the level of physical preparation, skill and planning and affect the level of achievement (Ghazi Saleh Mahmoud 2011).

One of the sources of pressure for the emerging player is the start of training and competition at an early age, high training load, excessive attention to results, training, study requirements, and repeated failures (Ossama Kamel Rateb 1997).

The player is always linked to the coach's directions and the results of the competitions which can affect him, and the value of the result achieved is united in the light of two directions either recognition of his own abilities or his awareness of external circumstances. This is called the control center (Musa Jibril 1996). Thus, players with external control rely on luck in performance and attribute failure to it, while the players with internal control are better in performance and level than those with external control (Rifai Hussein Mustafa 2001) and therefore the football player meets the challenges of psychological pressure, To perform well in the presence of these pressures, to achieve the

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goals and objectives of his team through the extent of acceptance of his role, so this research aims to find out the relationship between the cohesiveness of the group and both psychological pressure and control center of players emerging in football.

Methodology

In order to carry out this study, the three criteria used for a sample of young footballers under the age of 17, active in the first national division of 70 players, are estimated to be 23.33 % of the original community of 300 players for the 2016/2017 sports season. The sample was selected according to the following specifications:

- To be regular in participating with his team in the championship for the season 2016/2017.
- The player should be student and most of them were from the secondary school.

The following tools were used to collect the data after the scientific bases were confirmed and they obtained high transactions in both honesty and consistency.

The Community Cohesion Scale: The group's collective cohesiveness scale, which consists of 34 paragraphs, has been used in the following four dimensions:

1. Collective integration dimension with regard to work duties, it consists of 9 paragraphs.
2. The attraction of the individual towards the social aspects of the community consists of 10 paragraphs.
3. Collective integration dimension with respect to social aspects, it consists of 9 paragraphs.
4. The attractiveness of the individual towards the duties of work consists of 6 paragraphs.

It is based on a five-pronged scale as follows: Always (5) degrees, often (4) degrees, sometimes (3) degrees, little (2) degrees, never (1) degree (Bennaaja Mohammed 2016).

Psychological pressure scale: consists of 40 paragraphs distributed over the following five dimensions:

1. Pressure before and during and after the competition consists of 8 paragraphs.
2. Pressure of communication between the coach and the player before and during and after the competition consists of 8 paragraphs.
3. The pressure of overload and the beginning of sports competition at an early age consists of 8 paragraphs.
4. The pressure of attention to gain and family attitudes towards the positions of competition consists of 8 paragraphs.
5. The pressure time organization of the player to participate in the competition consists of 8 paragraphs

It is based on a three-pronged scale: often (3) degrees, sometimes (2) degrees, rarely (1) degrees (Bray a Whaley 2001).

Control Center Scale: consists of 20 paragraphs distributed over two dimensions:

- First dimension: The internal control center consists of 10 paragraphs,
- The second dimension: the external control center consists of 10 paragraphs, and this depends on the balance of the estimate of four: always (4) degrees, medium (3) degrees, sometimes (2) degree, rarely (1).

Table 1

Shows the results of arithmetical mean and standard deviation of variables (Bray & Whaley, 2001)

Group cohesiveness	**Average**	**Standard deviation**	**Level**
collective integration with regard to work duties	29.5	5.64	Average
the individual's attraction towards the social aspects of the community	35.01	8.54	Average
collective integration with regard to social aspects	32.8	5.62	Average
the attraction of the individual towards the duties of work	21.2	4.50	Average
The overall degree of community cohesion	118.51	13.13	Average

Table 1 shows that the collective integration in relation to the work duties has a mean and a standard deviation of (29.5 ± 5.64) and the attraction of the individual towards the social aspects of the group were achieved by mean and standard deviation of (35.01 ± 8.54). The social aspects ended with a mean and a standard deviation of (32.8 ± 5.62). The attractiveness of the individual towards the work duties ended up with a mean and a standard deviation of 21.2 ± 4.50, and the total score of the group cohesion scale with a mean and a standard deviation of (118.5 ± 13.13). The level of all dimensions including the overall score was average.

Table 2

Results of the arithmetic mean and the standard deviation of the variables (Brehm, Kassin & Fein, 2002)

Psychological pressure	**Average**	**Standard Deviation**	**Level**
Pressure before, during and after competition	30.94	5.81	High
Connection pressure between the player and coach before and during competition	33.57	5.46	High
Pressure of participating in sports competitions at younger age	34.78	3.26	High
Pressures of interest in gain and family attitudes towards competitions	34.87	3.99	High
Player's time management pressure to participate in competitions	29.21	5.31	Average
The overall degree of psychological pressure	163.38	10.67	High

The following table shows the mean and standard deviation of the pressure between the coach and the youth before, during, and after the competition of (30.94 ± 5.81), the mean and standard deviation is estimated at (33.57 ± 5.46) concerning the pressure related to the connection between the player and his coach before during and after the competition. The overloaded pressure and early sports competition at an early age with a mean and a standard deviation of (34.78 ± 3.26). And the pressure of attention to the gain and the family's attitudes towards the competition is estimated of a mean and standard deviation at (34.87 ± 3.99). And the stress concerning the player's own time organization to participate in the competition with a mean and a standard deviation estimated at (29.21 ± 5.31) and the total score of the psychological stress index with a mean and a standard deviation estimated at (163.38 ± 10.67). The level of all dimensions, including the total score is high except the fifth dimension concerning the pressure of the time organization to participate in the competition, in which was the level of response of the players emerging on average.

Table 3

Results of arithmetic mean and standard deviation of variables (control center)

Control Center	Average	Standard Deviation	Level
Internal control center	27.38	5.45	average
External control center	32.15	5.79	high

In table 3 we found that the internal control center has an average mean and a standard deviation of (27.38 ± 5.45) at an average level. In the case of the external control center, the mean and standard deviation is estimated at (32.15 ± 5.79) at a high level. The results of their performance depend a lot on external and environmental conditions and luck plays a large role in it.

Table 4

Shows the correlation between the cohesiveness of the group from both the psychological pressure and the dimension of the control center of the emerging players

Variables	Correlation coefficient total degree of coherence	Freedom Degree	T-value of r	Level of significance	Type of relation	Statistical significance
Total degree of psychological pressure	-0.25	69	0.231	0.05	Inverse	Functional
Internal control center dimension	+0.03				Positive	None functional
External control center dimension	+0.14				Positive	None functional

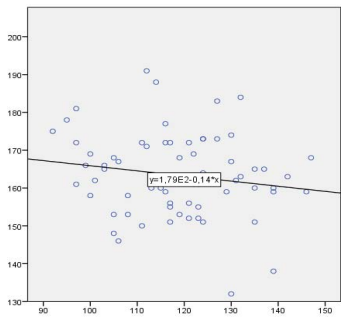

Figure 1

Shows the correlation between group cohesiveness and psychological stress among young players

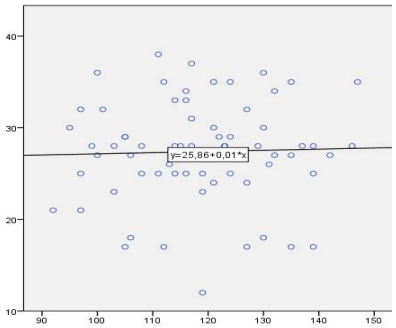

Figure 2

Shows the correlation between the cohesiveness of the group and the internal control center of the emerging players

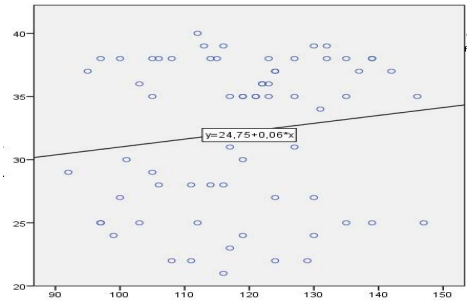

Figure 3

Shows the correlation between group cohesiveness and the external control center of emerging players

Table 4 and Figures 1 and 2 show that there is a statistically significant correlation between the group cohesiveness and the psychological pressure of the emerging players. There is also a statistically significant correlation between the group cohesiveness and the internal control center. There is a significant indirect correlation between the group cohesiveness and the external control center of the emerging players, but it is relatively stronger compared to the group cohesiveness and the internal control center.

Results

The objective of this study was to clarify the type of correlation between the group cohesiveness and the psychological pressure in addition to that the control center of the emerging players. The results obtained in Table 1 - 3 concluded that the emerging players have an average cohesiveness. Among the activities that establish a positive cohesiveness are having clear objectives for the team, clarification of the player's behavior role, building elements of communication between members of the team within specific criteria, building the training plan and matches played by the team, and building a clear vision for the role of the team leader (Benjamine James & David Collins 1997).

Research also showed some of the common characteristics of the cohesive team without a particular arrangement that they are committed to a common goal and accept personal roles and criteria for the sake of the team success and feel personal involvement toward the team, communication and a strong leadership.

The results showed that the emerging players are characterized by high psychological pressure in the competition period where the competition is a sports test or assessment of the capabilities of the player, whether these competitions are friendly or official competitions, are characterized by high intensity, and the players recognizes that his value and appreciation by others is determined by winning and the competition is not always a success that's why a negative source of increased psychological stress emerge within the emerging players (Stutt 1981).

The results in Table 2 show that there is a high level in most dimensions of pressures and the total degree of pressure. This indicates that there are various sources of psychological pressure on the emerging player, the most important are pressures associated with carrying training, pressure related to family and social support, with duties other than training and competition such as study and stress related to the player's relationship with the coach and others.

The results in Table 3 showed that there is an average level in the remote control center and a high level in the remote control center where the control center is an important personal dimension, as players in the internal control position feel that they can control what is happening to them and players with the external control position see themselves under the control of external forces. (Ossama Kamel Rateb 2001).

Players who showed, concerning internal control, they tend to believe that their behavior in competitive situations affects results. Players who appeared to be externally inclined tend to attribute their results to external factors such as referee, opponent, player

tools, chance, luck and the coach. The importance of the role of the player and trainer in determining the player's style is shown to be external or internal control (Djamal Mohamed El Sayed 2005).

The results obtained showed that the emerging players are affected by the external control as they attribute their failure to factors beyond their control such as ability or bad luck, which may lead to a sense of helplessness and low expectation of success and thus represent obstacles to achievement.

In Table 4 there was a statistically significant correlation between the group cohesiveness and the psychological pressure of the emerging players. Here we explain the inverse relationship. The researchers found that the sample obtained high scores in various psychological stresses in Table 2. It is a behavioral manifestation of psychological stress, lack of enthusiasm for the player, high degree of tension, tendency to quarrel. Also, when the pressure rises significantly, performance can suffer from all symptoms of stress, become distracted and become a risk in competition (Wafaa Darwish 2007).

A football competition is not always a success for young players, and winning is dedicated for few of them. It is expected that competition will represent the experience of failure and source of the negative stress of a large number of players, and that attention to the results alone in the evaluation of the emerging young players leads to the lack of self-esteem and may lead to weakness of confidence, increased psychological stress resulting from anxiety and frustration and lack of confidence in success. This is due to the negative perception of the symptoms of stress, lack of self-esteem and ease of anger or aggression, lack of interest and negative communication with the coach, colleagues and others (Hausenblas & Eys 2005).

Therefore, pressure and stress have a negative impact on the cohesiveness of the group in terms of poor communication between the emerging players and the coach. Not pursuing the team’s goal, which is the cause of cohesiveness of the group. Table 4 shows that there is a statistically significant correlation between the group cohesiveness and the internal and external control center of the emerging players. Based on the results in Table 3 we found a high level of external control compared to the distance of the internal control center To the strength of the somewhat correlated relationship with external control, and that the lower the cohesiveness of the group gets, the lower the center of internal and external control is.

The difficulty of winning is due to the lack of a cohesive and unifying team, because the opposite of cohesion is division and disintegration. The feelings of participation, empathy, unity and team spirit are due to the best possible cooperation among the team members, which

is reflected in the form of more effective sports performance for the team compared to the opposing team.

The four main characteristics of the cohesiveness are multidimensional, dynamic, methodic and emotional. Each sports team will be distinguished by the distinction of players who are part of the team (Haidar Karim 2016). Since we have found an average level of internal control; as the players with internal control, guide them to their skills and have a more propensity for motivation to achieve, and be more cooperative in order to achieve the goal of the group and they are better in achieving the results than external players who rely on luck and fear failure, To external factors such as the difficulty of competition, the public, arbitration or luck.

In the opinion of the researchers the players with external control who do not rely on their ability to attribute their results have less performance and therefore less cohesiveness. Finally, we found in this study that football player in the Algerian championship less than 17 years are characterized by an average level of group cohesiveness and a high level of psychological stress and are characterized by an average level of internal control center and high level in the external control center, and that there is a reverse relationship between the function of both the cohesiveness of the group and psychological pressure and stress, and that there is a direct relationship none significant between the group cohesiveness with each of the internal control center and the external control center.

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INTENSITY OF SOCCER PLAYERS´ TRAINING LOAD IN SMALL-SIDED GAMES WITH DIFFERENT NUMBER OF PLAYERS

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Summary. The main aim of this research was to compare differences in heart rate values (HR) of soccer players during small-sided games (SSGs) with different number of players. We assumed that the number of "neutral" player or players in small-sided games will significantly affect the intensity of SSGs and in this case the heart rate values of participating players. The experimental group consisted of older junior players from the FC DAC 1904 Dunajská Streda soccer club (n = 9). The heart rate values were evaluated on the basis of collected data, which we obtained using Polar sport testers and special software Polar Team^2. In order to find out the statistical significance of the difference in heart rate was used the One-Way ANOVA and the Bonferroni post hoc test. The level of statistical significance we set at 5 %. We found out that with increasing number of "neutral" players' the intensity of small-sided games gradually decreased. During SSG1 (3 vs. 3), we recorded the highest achieved average heart rate values of the monitored players, in average 171.33 ± 9.39 beats.min^{-1}. This form of the SSGs was the most intense, but not statistically significant. Our recommendation is to employ SSGs in the systematic training process with different number of players, because we can adequately prepare the players for the match load itself. Attention need to be paid for the playing position requirements.

Key words: soccer, training load intensity, heart rate, small-sided games, number of players.

Introduction

The continual development of soccer in the present is also influenced by the value of the systematic training process. By the increased game demands the level of the training process brings about important questions and tasks for coaching staff including the optimization and intensification of soccer players´ training load intensity. In the purposefully designed training process of soccer players small-sided games have an inevitable role. Through small-sided games, it is possible to raise the level of technical

preparedness, tactical independence, bio-energetic systems and emotional intelligence of players. During small-sided games players need to solve different complex game situations under the time and space deficiency and under active pressure of the opponent players. The conditions within small-sided games are closely related to the real match conditions.

The main aim of a systematic training process is to help increase the adaptation capacity
of player´s organism to the load, with which players are closely confronted in the competitive match itself (Holienka 2004). The meaningful training process needs to focus on the creation of a specific adaptation change in the player´s organism, which is induced by well-thought repeated adaptation stimuli (Holienka 2012). When work and rest ratio is proper, it contributes to the development, progressive increase, stabilization and observation of the training experience state, then we can note about the suitable training load (Kačáni 2005).

Holienka (2012) states that indicators of internal load, including the heart rate values (HR), make it possible to determine the usefulness and effectiveness of training load. Modern measuring devices of heart rate can record HR values with high accuracy and reliability. These devices provide exact feedback on actual reactions of the internal state of players´ organism to the training load. Nowadays HR is a widely accepted and frequently used physiological indicator of the players´ physical activity in the training process (Holienka 2016). During last couple of years monitoring the HR became a necessary part of the training load research
in collective sports and many authors dealt with this issue in their research works (Aktas et al. 2014; Halouani et al. 2014a, 2014b; Randers et al. 2014; Gonzáles-Rodenas et al. 2015; Köklü et al. 2015; Torres-Ronda et al. 2015; Asci 2016; Campos-Vázquez et al. 2016; Clemente & Nikolaidis 2016; Giovannelli 2016; Holienka 2016; Owen 2016; Sannicandro et al. 2016; Brandes et al. 2017; Clemente et al. 2017;González-Villora et al. 2017; Halouani et al. 2017; Proietti et al. 2017;Rojas-Valverde et al. 2017; Sannicandro & Cofano 2017a, 2017b; Sánchez-Sánchez et al. 2017; Babic & Holienka 2018; Babic et al. 2018; Giménez et al. 2018; Lacome et al. 2018; Malone et al. 2018; Nagy & Holienka 2018; Peráček et al. 2018a, 2018b; Nagy & Babic 2019; Nagy et al. 2019; Obetko et al. 2019; Nagy et al. 2020). Sport testers give us immediate feedback on the reaction of player´s organism to the load (Benson a Connolly 2012). Monitoring of HR values is also used in youth soccer to gain valuable information
and understand the physiological parameters of training units and match load (Owen 2016).

Holienka (1998) stated that the principle – all with the ball - which currently is strongly required in training activities of soccer players, fulfils the game training (GT). The dominant position in it have different forms of SSGs, which include a lot of game situations that are similar to the competitive game situations occurring in the match. Training activity of players in collective sports games, like in soccer should take into consideration the specifics technical, tactical, physiological and psychological elements of individual game performance (Christopher et al. 2016; Zapletalová et al. 2017).

Therefore, the SSGs have become an inevitable part of the training units when increasing the level of game preparedness and fitness capacity of players. By applying the principle of "adequate coverage theory", we try to simulate in the training process through small-sided games such game conditions, which are similar to competitive match conditions and prepare players game-ready.

Small-sided games with different number of "neutral" players aim to improve the individual´s game activities and game combinations in the development of youth soccer players. SSGs are widely used also in daily practice in the training units of the older and younger age categories. During SSGs players gain valuable experience in solving unique game situations, which constantly occur during the match. When solving various game situations during SSGs, the participating players are able to improve their skill potential, tactical variability, coordination – condition capabilities and they can increase their mental endurance level as well. Soccer coaches are able to influence the intensity of the training load during small-sided games if they adequately change the variables, which affect the intensity of SSGs. Among these variables we can mention for example: the number of players, playing field dimensions, coaching, game rules, content focus of the game, goal size, number of goals, presence of goalkeepers, work and rest ratio (Aktas et al. 2014; Randers et al. 2014; Young & Rogers 2014; Köklü et al. 2015; Los Arcos et al. 2015; Torres-Ronda et al. 2015; Asci 2016; Holienka 2016; Christopher et al. 2016; Sannicandro et al. 2016; Brandes et al. 2017; Clemente et al. 2017; Eniseler et al. 2017; González-Villora et al. 2017; Halouani et al. 2017; López-Fernandéz et al. 2017; Praça et al. 2017; Rojas-Valverde et al. 2017; Sannicandro & Cofano 2017a, 2017b; Giménez et al. 2018; Lacome et al. 2018; Mikulič et al. 2018; Nagy & Holienka 2018; Sarmento et al. 2018, Sgro et al. 2018; Nagy & Babic 2019; Nagy et al. 2019; Nagy et al. 2020).

Knowing that different number of players could affect the physiological responses and, therefore, the potential beneficial effect for individual and team performance improvement, it has to be noted how "neutral" players affect the intensity of SSGs.

Thus, the main aim of the current study was to compare the effects of 4 forms of SSGs with different number of additional players (1, 2 or 3 floaters). These 4 forms of SSGs are indeed very popular and much used by soccer coaches during training sessions. The findings could potentially provide valuable, reliable and useful information to soccer coaches for the design different forms of SSGs as part of their training process.

Methods

In our research we monitored the internal response of players´ organism expressed by the heart rate (HR) values in different forms of small-sided games (SSGs). The research consisted of monitoring of individually selected physiological load indicators during the training process. In our case, these were the HR values of young soccer players through SSGs with different number of "neutral" players. The dependent variable was the internal response of players´ organism, expressed by the values of HR, and the independent variable was the number of "floaters" during the SSGs.

The research group consisted of players (n = 9) of the soccer club FC DAC 1904 Dunajská Streda (aged 17.8 ± 0.7 years, body mass 68.5 ± 6.1 kg, body height 176.6 ± 5.5 cm, VO_{2max} 61.06 ± 3.24 $ml.min^{-1}.kg^{-1}$, maximum heart rate (HR_{max}) 199.8 ± 7.6 $beats.min^{-1}$). The monitored players were participants at the highest competition of this age category (U19) in Slovak Republic.

The main method used to obtain the research data was the measurement of heart rate values. The maximal heart rate (HR_{max}) values were obtained by using the Hipp´s field test (2007). The measurement of HR_{max} were realized on artificial grass pitch in the MOL Football Academy in Dunajská Streda. After determination of the (HR_{max} values, we created 5 intensity load zones according to the level of difficulty, which were defined by the percentages of the HR_{max} values.

Table 1

Intensity load zones according to the heart rate values (Moravec et al. 2007)

Zone	% HR_{max}	Character
Zone 1	50 – 59	Very low intensity
Zone 2	60 – 69	Low intensity
Zone 3	70 – 79	Medium intensity
Zone 4	80 – 89	Submaximal intensity
Zone 5	90 – 100	Maximal intensity

To measure the HR level we used the sports test device POLAR TEAM. The calculation of the percentage and time spent of HR values in different zones of load intensity and determination of various HR value, % of HR_{max} and time spent above the anaerobic threshold (ANT) was represented by using special software Polar Team.

Players were divided into two teams (3 vs. 3) according to their performance-related level. The players remained in the selected team during all four forms of the SSG. Goalkeepers did not have the sports testers on themselves, since we did not monitor the level of their HR values. The playing field with the size of 450 m^2, (width = 18 m, length = 25 m) was marked out with cones and the portable goal had a standard size. There was a minimum of coaches´ interaction during SSGs with verbal instructions but players could verbally encourage each other with the aim to maintain the intensity level of the SSG.

During the SSGs the minimal, average and maximal values of HR were recorded, abidance of players in individual intensity load zones and time spent above the ANT. We determined the HR values in four SSG variants, in which the size of the playing field, the main focus and the ratio of load interval to rest interval were the same. The load interval lasted 2 minutes, the rest interval was 2 minutes too (the ratio of LI to RI was 1:1). We intentionally change the number of "neutral" players.

SSG1

Players played the SSG 3 against 3 in a defined area with an unlimited number of ball contacts. The conditions in the SSG1 were same for both teams. The main aim of SSG1 was to create goal opportunities and finished the offensive phase of the game by shooting on the goal.

SSG 2

Players played the SSG 3 vs. 3 and with 1 "neutral" player in a defined area with an unlimited number of ball touches. The conditions during the SSG1 were same for both teams. The "floater" was with the team in possession. The main aim of SSG2 was to create goal chances and finish the offensive phase of the game by shooting on the goal.

SSG 3

Players played the SSG 3 vs. 3 in a defined area with an unrestricted number of ball contacts. Next to the side-lines were 2 more "neutral" players, who tried to help the players in possession. The conditions during the SSG3 were the same for both teams.

SSG 4

Players played the SSG 3 vs. 3 and with 1 neutral player in a defined area with an unrestricted number of ball touches. Next to the side-lines were 2 more "neutral" players, who

tried to help the players in possession. The "floater" was with the team in possession. The conditions during the SSG4 were same for both teams. The main aim of SSG4 was adequate situation solving (6 vs. 3) and goal chances creation with finishing the offensive phase of the game by shooting on the opponent's team goal.

Table 2

Different forms of small-sided games

SSG	Players	GK´s	Field dimensions		Size of field	Dosing of load				
	(n = 9)	(n = 2)	width [m]	length [m]	[m^2]	LI [min.]	RI [min.]	NR	NS	Load [min.]
SSG1	3/3	1/1	18	25	450	2	2	4	1	8
SSG2	3/3+1	1/1	20	27	540	2	2	4	1	8
SSG3	3/3+2	1/1	18	25	450	2	2	4	1	8
SSG4	3/3+3	1/1	20	27	540	2	2	4	1	8

To determine the statistical significance of the HR values the One-Way ANOVA method and Bonferroni post hoc test were used. The level of statistical significance was set at 5% level. The results were interpreted, compared and we tried to find connections between them. On the basis of these data, we have formulated conclusions and recommendations for didactic theory and training practice.

Results

The internal load of the soccer players´ organism to the load during the SSG1

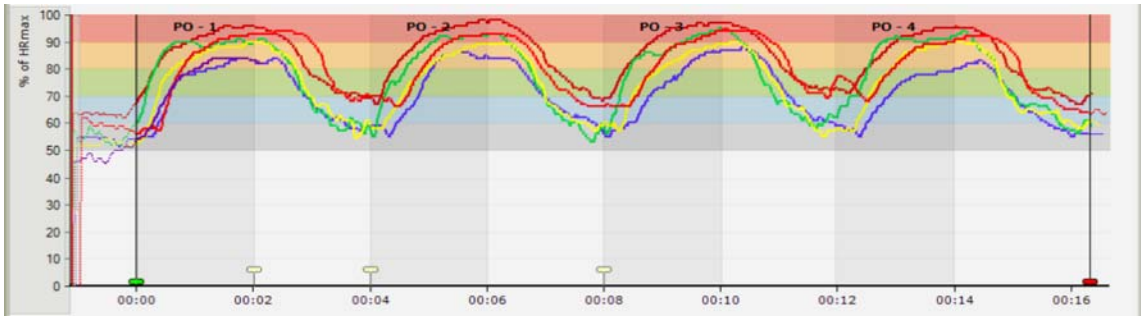

Figure 1

Physiological curves of the monitored soccer players in SSG1

In the above stated Figure 1 are depicted physiological curves of the six monitored soccer players during the SSG1. On this physiological curve, we can see a graphic illustration of the internal response of the soccer players´ organism to the load in SSG1 when the work and rest ratio was on the same level (1:1).

The internal load of the soccer players´ organism to the load during the SSG2

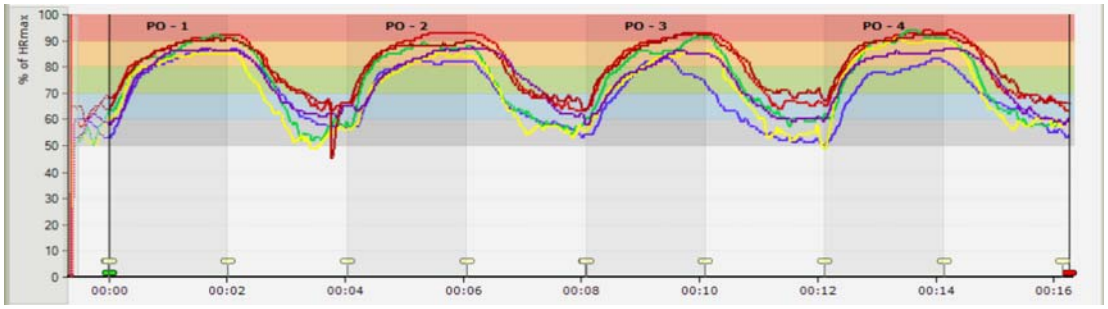

Figure 2

Physiological curves of the monitored soccer players in SSG2

In the above stated Figure 2 are represented physiological curves of the monitored soccer players during the SSG2. On this physiological curve, we can see a graphic illustration of the internal response of the soccer players´ organism to the load in SSG2 with four different vertices representing four repetitions with the same work and rest intervals.

The internal load of the soccer players´ organism to the load during the SSG3

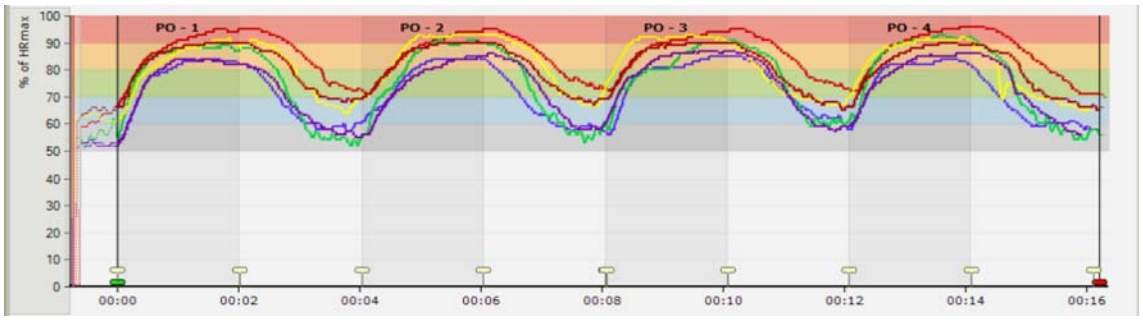

Figure 3

Physiological curves of the monitored soccer players in SSG3

In the above stated Figure 3 physiological curves of the monitored soccer players are represented, which refer to the equality of the work and rest intervals which lasted 2 minutes in four repetitions during the entire SSG3.

The internal load of the soccer players´ organism to the load during the SSG4

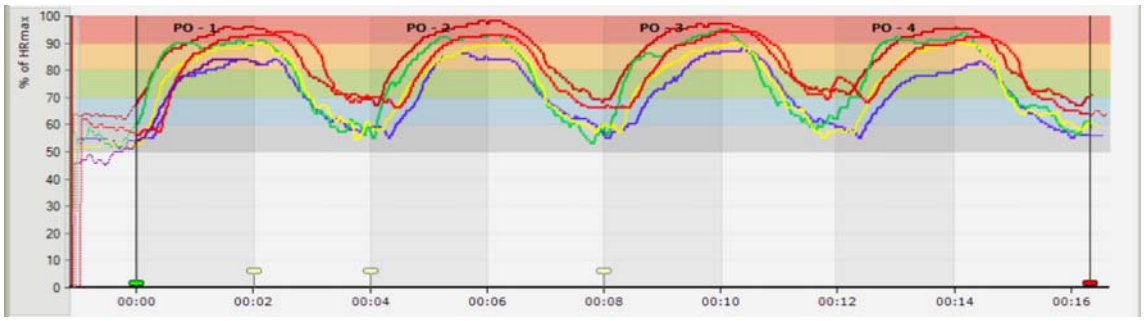

Figure 4

Physiological curves of the monitored soccer players in SSG4

In the above stated Figure 4 the internal reactions of the soccer players´ organism to the load during the entire SSG4 is represented.

The observed soccer players spent during the different forms of SSGs in advance selected intensity load zones different length of time. In table 3 you can see the average time values

and the percentage representation of players´ remaining in different training load intensity zones.

Table 3

Remaining of players in different training load intensity zones

Load zones	**50-59 % HR_{max}**		**60-69 % HR_{max}**		**70-79 % HR_{max}**		**80-89 % HR_{max}**		**90-100 % HR_{max}**	
Intensity	**Very low**		**Low**		**Medium**		**Submaximal**		**Maximal**	
SSG	**[min.]**	**[%]**	**[min.]**	**[%]**	**[min.]**	**[%]**	**[min.]**	**[%]**	**[min.]**	**[%]**
SSG1	0.4	0.31	1.39	9.01	4.15	26.03	4.06	25.41	6.16	38.86
SSG2	0.6	0.63	2.12	12.51	4.04	25.11	3.53	24.51	6.06	37.73
SSG3	0.7	0.66	3.31	21.78	3.23	21.05	4.25	27.41	4.41	29.48
SSG4	1.03	6.28	2.51	17.33	3.24	20.87	4.14	26.11	4.51	29.75

The highest intensity of the training load was recorded during the SSG1, when the SSG was played 3 vs. 3 without any "neutral" player. Monitored soccer players remained through the SSG1 the longest time duration in the load zone of maximal intensity (90-100 % HR_{max})

on average 6.16 minutes (38.86 %) of SSG1 duration. We noted down least time duration in the load zone of very low intensity (50 - 59 % HR_{max}). In this zone remained the players 40 seconds (0.31 %). The lowest intensity was monitored during SSG4, when 3 additional "neutral" players tried to help solving game situations in the offensive phase of the game. On average players spent the most time space of the SSG4 duration in the load zone of very low and low intensity. Between SSG1 and SSG2 the internal reaction of players' organism was on the same rate. We cannot find any significant differences between SSG3 and SSG4 too.

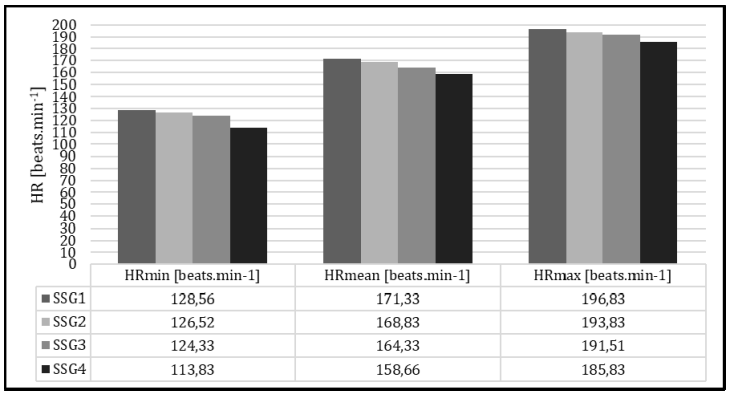

Figure 5

HR values in SSGs

The internal load of monitored soccer player's organism to the training load during SSGs with different number of "neutral" players was observed by recorded the HR values. The highest average value of minimum HR (HR_{min}) was achieved by the observed soccer players during SSG1 (3 vs. 3), 128.56 ± 11.48 beats.min^{-1}. The lowest values were monitored in the SSG4 (3 vs. 3 + 3 "neutral" players), 113.83 ± 9.31 beats.min^{-1}.

The average HR value (HR_{mean}) of the observed soccer players was the lowest in the SSG4 158.66 ±8.09 beats.min^{-1} and the highest during SSG1 171.33 ±9.39 beats.min^{-1}. The recorded average value of maximal HR (HR_{max}) was the lowest in the SSG4 185.83 ±9.06 beats.min^{-1} and the highest through SSG1 196.83 ± 6.96 beats.min^{-1}.

In the SSGs with low number of players (3 vs. 3), the training load is often higher than the competitive match load itself. The recorded ascertained values of HR_{max} show that players performed the training activity at a high level. There are no significant differences between the ascertained percentage values from HR_{max}. We can see that the highest value we recorded during SSG1 (96.66 %) and the lowest in the SSG4 (92.66 %).

Table 4

Values of HR_{max} % of HR_{max} during the individual SSG variation

SSG	**HR_{max}**		**% HR_{max}**	
	[beats.min^{-1}]	SD	[%]	SD
SSG1	196.83	6.96	96.66	2.51
SSG2	193.83	6.82	95.51	2.58
SSG3	191.51	8.68	94.33	3.72
SSG4	185.83	9.06	92.66	4.67

In modern soccer the match load is around the level of the anaerobic threshold (ANT). During the training units in the SSG with different number of players the training load was at a higher level. In this case the time spent above the ANT represents higher values.

Table 5

Time spent above the ANT

SSG	Time spent above the ANT	
	[min]	[%]
SSG1	7.06	43.96
SSG2	7.01	43.61
SSG3	5.36	34.83
SSG4	5.32	34.06

Monitored soccer players spent the most time above the ANT during SSG3, it was up to 7.06 minutes (43.96 %) of SSG1 duration and the least time duration was registered in the SSG4 5.32 minutes (34.06 %) of the SSG´s total time.

On the basis of the One-Way ANOVA results, we can't found out statistically significant differences in average heart rate values after completing the SSGs with different number of "neutral" players ($F = 2.8465$, $p = 0.0635$). The statistical significance between the SSG1 and SSG2 was not proved ($t = 0.5361$, N. S.). The difference between the HR_{mean} was 2.5 beats.min^{-1}. It was probably caused by the fact that the one extra "neutral" player did not significantly influence the physical and game activity of other players, and therefore, the mean values of HR were not significantly different. After comparing mean HR values of SSG1 and SSG3 were not found any statistically significant difference of HR_{mean} ($t = 1.5011$, N. S.). During the SSG1 HR_{mean} was171.33 ± 9.39 beats.min^{-1}, during the SSG3 we recorded HR_{mean} values of 7.00 beats.min^{-1} more, 164.33 ± 8.45 beats.min^{-1}. Statistically significant differences in the HR_{mean} values between the SSG1 and SSG4 were not proved ($t = 2.7162$, N. S). The difference between the HR_{avg} values was 12.67 beats.min^{-1}. Three extra neutral "players" during SSG4 did not significantly affect the internal response of the other players´ organism to the training load during the SSGs. Between the SSG2 and SSG3 no statistically significant lower HR_{mean} values ($t = 0.9650$, N. S.) were found. In the SSG2 the HR_{mean} values were 168.83 ± 5.98 beats.min^{-1}, in the SSG3 HR_{mean} values of 4.50 beats.min^{-1} less, 164.33 ± 8.45 beats.min^{-1} were recorded. The comparison SSG2 with SSG4 statistically significant differences in the HR_{mean} values were not showed ($t = 2.1801$, N. S). The difference between the HR_{mean} values was 10.17 beats.min^{-1}. Finally, the statistical significance between the SSG3 and SSG4 was not proved ($t = 0.2151$, N. S.).

Discussion

Heart rate is a generally accepted and often used physiological indicator of the players´ physical activity during the training sessions (Holienka & Cihová 2016). When talking about the results obtained from the sports testers, we have to respect the general fact that the HR values showing the reaction of the soccer players' organism to the training load during different forms of SSGs are only indirect indicators. We can state that the SSGs in a well-thought training process enables the soccer players to constantly improve and stabilize the technical and tactical side of game situation solving, to increase the rate of creative thinking and their game actions on the soccer pitch. The variable conditions during different forms of SSGs ensure the realization of various series of individual´s game activities and game combinations, which have a positive effect on space-time orientation, physical activity and players´ emotions as well. The contradictory observance of opponent forces the players to quickly change the two main phases of the game, what means that, he can swiftly switch from defensive to offensive game phase and vice-versa and became a universal player. Sometimes soccer players must deal with unequal game situations, solve it with different number of players against different number of opponents. SSGs can prepare players adequately for this situation. The SSGs are a complex form of players´ gaming development, owing to their high level of specificity it is possible to ensure a smooth development of their game performance efficiency (Babic 2016). The author claims that the SSG can be described as a complex element in the player´s specific potential development.

Katis & Kellis (2009) suggesting that the number of soccer players should be carefully considered by coaches in their organization. The authors suggested that SSG with low number of players can deliver a more effective technical training stimulus, since the number of different game situations increases with the decrease of players' number. During our forms of SSGs

the presence of "floaters" enhanced the success of game situation solving.

During training sessions it is common for soccer coaches to select SSG variations that involve a team playing with numerical advantage against another group of players with a numerical disadvantage (e.g., 4 against 3). It is also common to use SSG forms that involve variable "overload" and "underload" game situations, which are achieved using a "floater" or "neutral" player. In our case the presence of the "neutral" player decreased the HR values of participated players.

Hill-Haas et al. (2010) studied the response of athletes to this and they concluded that despite fixed underload teams recording higher RPE compared with the fixed overload teams, there were no differences in physiological responses. During our forms of SSGs with

the increased number of neutral players the cardiovascular response of players gradually decreased. Finally, according to the authors the use of a floaters appears to be more effective in smaller format games. In our conditions the presence of "neutral" player helped to ensure the fluency of the game.

Halouani et al. (2014b) state that the reduction of player numbers may increase the exercise intensity during SSG in team sports, like in soccer. We found out, that the training load intensity was the most demanding during SSG with equal number of players (3 vs. 3).

Moreover, when using an unequal number of players, the intensity of the SSG is significantly higher for the floater than the other players. Therefore, when using unequal player numbers during SSG, coaches should alternate floating players.

All soccer players should be able to solve game situations in offensive and defensive phase of the game and be ready technically and tactically choose the right decision of game situation solving. Hill-Haas et al. (2011) found out that SSGs containing smaller number of players elicit greater HR values. In training situations, SSGs are often implemented that contain teams of unequal numbers. Reasons for creating an imbalance between opposing teams may include technical development and unavailability of players due to injury. Variation in player number involves creating temporary "overload" and "underload" situations between opposing teams, via the use of "floater" player. The aim of this neutral player transitions to the team in possession of the ball is to create temporary "overload" and "underload" situations. This SSG game design is typically used to develop defensive or attacking proficiency or to increase the physical load on the "floating" player.

Lacome et al. (2018) found out that floaters present decreased external load despite almost unchanged HR responses during SSGs. The SSGs performed on smaller playing fields, in which is involved a lower number of players, are ideal for development and improvement of special match condition and game capacity (Peráček et al. 2018a; Peráček et al. 2018b; Mikulič et al. 2018).

In Table 7 is presented the internal response of the players´ organism to the match load according to Mendez-Villaneuva et al. (2013) in the U18 age category. The zones of load intensity were divided at the same rate as in our research work. The intensity of the training load was on the same rate than during the competitive match. In our research was the work interval 2 minutes and the rest interval lasted 2 minutes too.

Table 7

Intensity of U18 players´ match load (Mendez-Villaneuva et al. 2013)

Zones	< 60 % HR_{max}		61-70 % HR_{max}		71-80 % HR_{max}		81-90 % HR_{max}		91-100 % HR_{max}	
Match	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
[%]	2.8 ±5.8	1.0 ±1.6	6.6 ±6.6	8.5 ±5.7	17.3 ±9.6	26.5 ±9.9	36.7 ±13.3	40.8 ±.8.1	36.5 ±22.8	22.6 ±14.4

During the soccer match the internal response of the organism to the load at different levels. A systematic training process has to stimulate all those bio-energy systems, which predominantly require the match. In practice this criterion is applied with the cognition and suitable manipulation of SSG´s variables, including the number of players during the SSGs (Peráček 2014). Coelho et al. (2016) found that the players spent a statistically significant more time above the ANT level in the first half of the match than in the second half. By using small forms of the SSG games, it is possible for us to prepare the players for the load at such level. Soccer nowadays is very physically demanding team sport, SSG with different conditions can enhance the soccer players' capacity. Conditioning preparation through different forms of SSGs are ideal way of improving younger and older players preparedness in fun environment. Our result we can compare with the research work from Bujnovský (2019). During this research program positive changes were demonstrated in physical preparedness of young junior players (U17) after finishing the mesocycle. The author found out positive difference in HR values 1.54 $beats.min^{-1}$. The author noted, that improving player's physical preparedness during SSGs is more effective and enjoyable for soccer players.

Conclusions

The suitable use of modern sports devices in training units, such as sport testers, enable the sports experts to find out the internal response of the soccer players´ organism to the training load and get objective feedback on the adequacy of the training load. Our aim was to point out to the internal reaction of the soccer players´ organism during the SSGs with different number of "extra" players. In our research the HR values in the SSGs were monitored, in which the number of "neutral" players were different. On the basis of acquired data, can be stated that during the SSGs the HR_{mean} values were different. The highest HR values were recorded in the SSG1 (3 vs. 3), without any "floaters". Soccer players in this SSG remained the longest time

in the load zone of maximal intensity and spent the most time above the ANT. That´s why we can claim that the SSG1 was the most intense one. Among these four SSGs variants the lowest HR_{mean} values recorded through the SSG4. It means players spent the minimum of time in the load zone of maximal intensity and above the ANT level as well.

The theoretical part of a modern soccer coach is also based on a training process, which is prepared in advance and well-considered according to the physiological principles. In training units the principles of the player´s organism adaptation changes to training stimuli have to be observed. It is important to prepare the players not only in terms of physical capabilities,

but to focus on their game preparedness as well. Our recommendation is to integrate into the systematic training process mainly SSGs with equal number of players or with one extra player who can help create goal opportunities in the offensive phase of the game.

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THE PHYSICAL CONDITIONS IN EDUCATIONAL INSTITUTIONS AND THEIR RELATIONSHIP WITH THE TEACHING PERFORMANCE IN HIGH SCHOOLS

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Summary. The purpose of this research is to determine the nature of the relationship between the physical conditions and the teaching performance of the teacher of physical education and sport in high schools of Mostaganem (Algeria). To achieve the objectives of the study, the researchers prepared two main questionnaires. The first questionnaire was about the school physical conditions whereas the second was related to the teaching performance. These questionnaires were applied on a random sample that contains 65 teachers across high school level in Mostaganem, using the descriptive correlative approach. Thus, the results revealed there is a positive correlative relation between the physical conditions and teaching performance.

Keywords: physical conditions, teaching performance, teacher of physical education and sport.

Introduction

Many experts and educators believe that the only way to face the twenty first century's challenges is to improve the quality of education and its outcomes. The latter has become one of the most requisite goal that all educational institutions seek to achieve. So, it is important for these institutions to develop and activate the components of the teaching process. In fact, Algeria has given a huge interest to this issue in various fields of education and among different stages, starting from the primary to university. This attention obliged the authorities to ensure that all the elements which lead up to a qualitative education is available in the educational system including its components and levels. Henceforth, the schools physical environment is one of the most important elements that can effect the teaching-learning

process, because it contains the educational process as whole and the environment of practice. In addition, a good physical environment, such as stadiums and sport teaching aids, can help a lot in the teaching –learning process and lead to achieve the desired objectives. According to the experts, the subject of physical education and sport cannot be created in a vacuum, but it is related to the physical environment where the learning process takes place. On the contrary, the poor conditions of the physical environment in schools, such as inadequacy of school buildings, lack of stadiums and teaching aids, and the overcrowded sections, constitute an obstacle to the teaching process. As a result, it may deficiencies that cause the low level and limit the teacher's work considering him as important input in the teaching –learning process. Alkandri (2002) pointed out that it is impossible for any educational system to achieve a higher level than the one of its teachers. (Farhan 2010) also confirms that the teacher is at the head of the teaching process and that he is one of its pillars. Therefore, the teacher is also one of the most important keys that can affect the quality of teaching regarding his acquired skills and competencies.

So, it is possible to say that there is an overlap between the teaching performance and the school physical environment which can affect the teaching quality provided by the teacher and his invested skills and competencies in the teaching process. More than that, the new teaching methods contribute, also to the ska fold of the students' abilities and increase the number of the participants and their interaction with the teacher. This is why it has become an important thing to take into consideration the question of conditioning the physical environment in schools with the new teaching needs and modern educational trends, including the diversification of activities and the development of the relationship between the teacher and learner.

Therefore and after the researchers' observations, the issue of this study reveals that there is a decline in the level of teaching performance of some teachers of physical education and sport. This situation led us to carry out this study in order to shed light on the nature of the relationship between the physical environment and the teaching performance in middle schools. Especially if we know that achieving a high teaching quality does not depend only on the teacher's skills, but it, also, relies on the school physical environment as well. The latter helps the teacher to work easily and encourage him/her to reach the planned goals, so we have been asking the following questions:

1. What is the estimation that high school teachers of physical education and sport in Mostaganem give to physical conditions?
2. What is the reality of the teaching performance in the high schools for the sample search?

3. What is the nature of the relationship existing between the physical conditions and the teaching performance in the high schools?

Methods

1-Participant: The research sample included 65 teachers of physical education and sports distribute in middle schools in Mostaganem, for the academic year 2018/2019.

2- Statistical means: percentages, averages, standard deviation, Pearson correlation coefficient, Ka 2 test.

***3- Variable Search Tools*:** In order to achieve the objectives of this study we build two questionnaires to measure research variables (physical conditions – teaching performance).

The stability of the questionnaire – the researcher apply tools and re-applied with interval between the two phases was estimated at 10 days while maintaining the same variables (the same teachers, the same high school, same time) and that was a sample scoping study estimated at 13 teachers, and the results of the two applications after statistical treatment calculates the Pearson correlation coefficient as follows:

Table 1

Illustrates the coefficients of correlation of axes degree and total degree of tools and coefficient of stability

Statistical study	Questionner axes	Honesty coefficient	Stability coefficient	Sample size	R Tabular	Degree of freedom	Statistical significance at the 0.05
physical conditions	school buildings	0.83	0.78	13	0.532	12	**significant**
	Sports stadiums	0.95	0.84				**significant**
	Means pedagogical	0.58	0.69				**significant**
teaching performance	Planning	0.84	0.81				**significant**
	Implementation	0.95	0.84				**significant**
	Evaluation	0.62	0.84				**significant**

Result

1. What is the estimation that the high school teachers of physical education and sport in Mostaganem give to physical conditions?
2. What is the reality of the teaching performance in the high schools for the sample search?

Table 2

Shows the levels and frequencies, percentages and Ka 2 to the axis of the physical conditions

Axes	Levels	Duplicates	The percentages	K2 calculated	K2 tabular	Degrees of freedom	Statistical significance at 0.01
School buildings	High	22	%34	12.21	9.21	**2**	**significant**
	Average	33	%51				
	Low	10	%15				
Sports stadiums	High	9	%14	12.58			**significant**
	Average	24	%37				
	Low	32	%49				
Means pedagogical	High	27	%41	11.20			**significant**
	Average	29	%45				
	Low	09	%14				

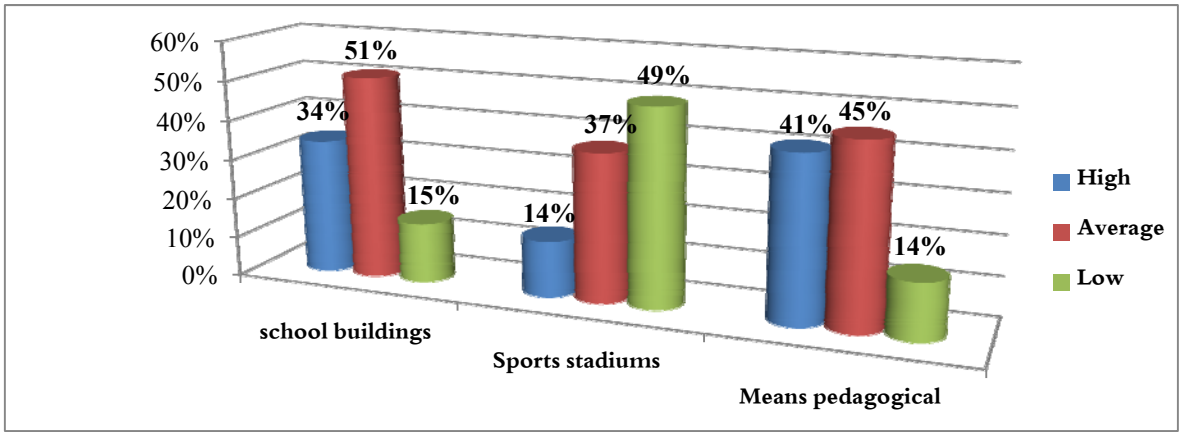

Figure 1

Shows the levels and frequencies, percentages and Ka 2 to the axis of the physical conditions

Table 3

Shows the levels and frequencies, percentages and Ka 2 to the axis of the teaching performance.

Axes	Levels	Duplicates	The percentages	K2 calculated	K 2 tabular	Degrees of freedom	Statistical significance at 0.01
Planning	good	43	%52	24.96	9.21	**2**	**significant**
	average	28	%43				
	Low	03	%05				
Implementation	good	42	%37	25.51			**significant**
	average	37	%57				
	Low	04	%06				
Evaluation	good	42	%37	28.65			**significant**
	average	38	%58				
	Low	03	%05				

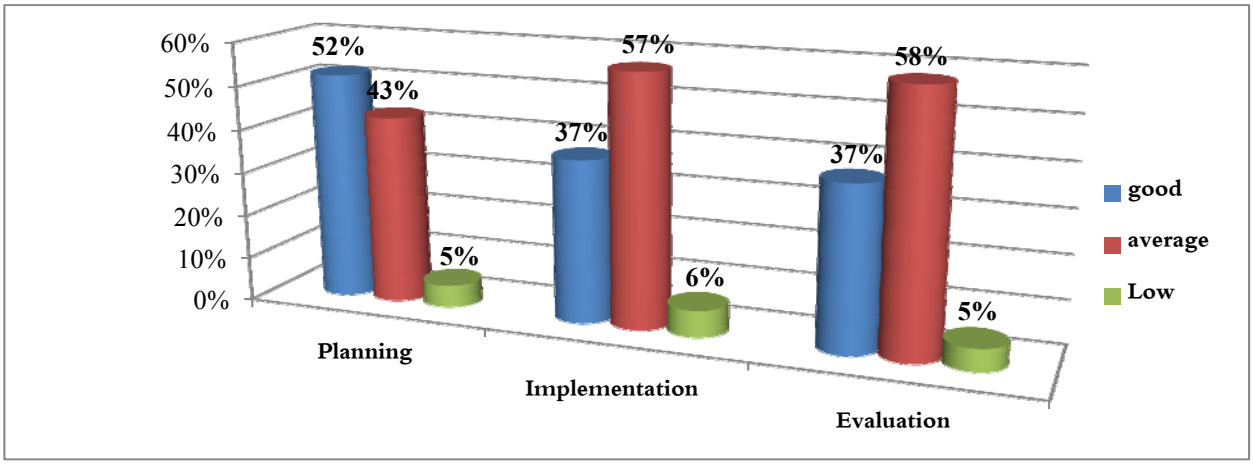

Figure 2

Shows the levels and frequencies, percentages and Ka 2 to the axis of the teaching performance

3. What is the nature of the relationship existing between the physical conditions and the teaching performance in the high schools? Researcher deliberately make sure this relationship by calculating the Pearson correlation coefficient between the results of the forms, where the results were as follows

Table 4

Shows the results of correlation between the physical conditions and the teaching performance

Axes	The value of the correlation coefficient between the physical conditions and the teaching performance	The sample	Correlation coefficient "R" size of table	Degree of freedom n -2	Relationship type	Statistical significance at 0.05
physical conditions / **teaching performance**	0.442	65	0.244	63	positive	**Significant**

Discussion

The data results shown in table 2 and Figure 1 confirmed that the majority of the teachers answers about school physical environment **(**school buildings, sport playgrounds and sport teaching aids**)** were almost about the high schools' level. Because most of the teachers of physical education claimed the inadequacy of school buildings, especially the elements which have relation with modern technological equipements and the availability of libraries containing books on the field.

This result is consistent with the study of (Maalouli 2010, p. 129) who concluded that the school physical environment is still far from the educational development. She, also, showed that the adequacy index of the components is not good in many schools. These results reveals that the school buildings cannot reflect the educational needs, because they are very old and it will be an obstacle to achieve the objectives. According to **(**Alchalabi 2012, p. 2**)** school building is considered as one of the most influential factors in the success of any teaching process.

In fact, the results varried according to the teachers' answers and views on the reality of sport playgrounds in middle schools. However ,most of their answers were about the low level which is a result of a shortage of sport playgrounds or the inappropriate ones. They went on saying that these playgrounds are not sufficient compared to the number of the pupils and sections. Moreover, many schools do not have sport playgrounds at all, which makes them practicing sport outside.

This result is consistent with the study of **(**Ahmed 2008, p. 338**)** found that the middle schools in Mostaganem do not have the facilities and sport aids. The majority of the teachers' answers agreed that there is a lack of concerning the sport aids. This result is consistent with what (Akila 2008, p. 145) has found. She said that the secondary schools in the West Algiers district do not have good materials and equipement which becomes a serious obstacle to the development of the learner. This is to say that what is available now in the middle schools of Mostganem is insufficient and cannot help the teacher to reach his/her educational objectives within the era of new approaches (competency based approach). From the above we can conclude that the first hypothesis has been proven.

The result shown in the Table 3 and Figure 2 reveals that most of the teachers of physical education who plan their lessons reached a good level. This result is consistent with what **(**Alhinai 2010, p. 526**)** has found. She declared that the ownership degree of the sample for the skills of the lesson planning ranged widely. Furthermore, **(**Salma 2009, p. 91**)** said that planning and lesson preparation is a key step in the teaching process. According to Salama, knowledge and experience cannot work without planning. In fact, some educational studies have proved the importance of lesson plans in the success of the teaching process.

These results were achieved after the observations which show that most of the teachers of physical education give a great importance to preparation. The latter includes the use of books in the field and choosing the suitable materials and equipements that fit the learners' abilities (physicaly and psychologicaly) and facilitate the teaching process. Concerning the lesson performance, the results showed that most of the teachers do not adhere

to the the lesson steps written on the plan. This is because they employ the traditional teaching styles based on direct instructions which give explanations graded from the easiest to the most difficult. However, this method cannot help learners to solve problems within the CBA. In fact, it is possible to say that using the traditional way of teaching is due to some obstacles such as lack of material resources, overcrowded classes, and inadequate length of time for the educational units.

The obtained results pointed to the difficulties encountered in the field of class management which may be due to the teaching experience of some samples who cannot control the time or lack of communication skills with learners. We can notice that the majority of the teachers of physical education in the high schools of Mostaganem evaluate the lesson at an adequate degree. This result is confirmed by (Tayeb 2010, p.145) who found the evaluation skills were less practiced by the research samples in the term of performance. More than that, the results revealed that the samples do not care about nutrition and the lack of of the evaluation equipements between the theoritical and applied tests, whereas the teaching process rely also on educational evaluation. From the above data we can conclude that the second hypothesis has been confirmed.

The results obtained from Table 4 showed that there is a statically positive relation between the physical conditions in school and the teaching performance in high schools. These results indicate that improving the level of teaching performance requires an appropriate and stimulating school physical environment which includes all the physical components required by the teaching process (planning, implementation and evaluation). Moreover, it is obvious that relying on the teacher's skills alone cannot help to achieve the objectives unless there is an effective school environment including all the physical elements such as: buildings, sport playgrounds, stadiums, gymnasiums and other equipment. These facilities are the basic requirements for the implementation of physical activities and its success. In contrary a poor school physical environment can be an obstacle to a good teaching performance. According to (Ghazaoui 2000, p. 4), many studies revealed that the optimum use of teaching equipment can help teachers to perform well. She carried out that the use of an audiovisual device can afford 50 % of the lesson's time with the possibility of obtaining a better educational level. (Alotaibi 2007, p. 4) also claimed that the achievement of a high teaching quality and effectiveness depends on the provision of an appropriate school environment. From the above data we conclude that the main hypothesis has been proven.

Conclusions

- The evaluation of the school physical conditions is average in the high schools of Mostaganem.
- The level of teaching performance of the teacher of physical education and sports is average.
- There is a statically positive relationship between the physical conditions and the level of the teaching performance of the teacher of physical education and sport.

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WHEELCHAIR PUSH UP AS A POWERFUL EXERCISES TO INTENSIFY UPPER-BODY STRENGTH AND ENDURANCE AMONG ECTOMORPH STUDENTS

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Summary. Ectomorph often below the average weight characteristics by a "thin frame" and difficult to gain muscle mass and fat. According to similar studies to build their muscle mass under it is necessary to include adequate multiple joints and larger muscle groups in bodybuilding program, in this study by using a wheelchairs, when doing a pushed up. The aim of the study was to improve upper-body strength and endurance among 20 healthy ectomorph male students, selected by the intentional method, according to their weight, which did not correspond to their height. They were controlled while performing push-ups, flexed arm-hangs and chin ups. Our goal was to compare the impacts of two training proposed programs (Traditional with weight (CS) v's wheelchair (ES)). The training programs were applied for 6-weeks with 15-minute warm-ups integrated through their regular PE basketball courses cycle planned in the second semester. Built on statistical apply, we confirmed that wheelchair is a tool that enhances the upper-body muscles of ectomorph-type better than traditional body-weight training. It was approved in the present study through the use of wheelchair push-up, as an excellent means to increase the upper-body muscle-building strength and endurance better than the classic method used by our PE teachers.

Keywords: upper body musculature, wheelchair, ectomorph students.

Introduction

Supported Physical Education and Sport (PE) courses are vital pointers for output public health. Although no studies have testified that using wheelchairs in PE sessions is prompted in the growth of the upper body musculature via the healthy students. Conflicting to rehabilitation studies that uphold the use of a wheelchair to develop strengthening as a valuable method to correct imbalances of the muscles in the upper extremity. Established by (Phil Page 2012) in the context of the consistency of personal trainers that needs to be aware

to develop maximal strength or power (or both), dined by (Jared W Coburn & Moh H Malek 2012) via body-weight training, which will be eliminated because it cannot provide the intensity necessary to develop these physiological adaptations.

From the above and principle that ectomorphs have fragile, delicately built bodies and find it difficult to gain weight or add muscle. Supermodels, ballerinas and basketball players, most commonly fall into this group. Advantages in the present study via physique disability of ectomorphs' body type correlate with height and weight (Frank Galligan, Eric Singleton & David White 2002), as underdeveloped bodies with little muscle and fat (Jane Johnston & Lindy Nahmad-Williams 2014), record via this population.

What is more, those ectomorphs may be underweighting where this disability can limit their physical activity (Tarik Ozmen, Bekir Yuktasir, Birol Yalcin, Mark ET Willems 2014). The case of our sample record is in underweight for its height, acting in line with Laura K. Guerrero, et al. (2006). Appropriate in rehabilitation studies, as global objectives integrate into their program, it must encompass all the effects of mass distribution, linear acceleration and angular acceleration of the work object and body movement (Mauro Ursino 2005) and the development of muscle strength, cardiorespiratory endurance and bone mineral density depending on previous studies. Based on their use, it demands a high level of conditioning to maintain work intensity and to prevent the injury (Goosey-Tolfrey V 2010).

Documented by a similar training program in the efficiency of the wheelchair, it is a tool that can improve the five major motor abilities, which are endurance, flexibility, coordination, strength, and speed (Kestutis Skucas 2012). The evidence that permits us to consider it as a training tool that can develop upper body musculature among ectomorph students cited in the literature as a body type, fragile, with long, slender, poorly muscled extremities and delicate bones. (Gerald T Mangine, Jay R Hoffman, Adam M Gonzalez, Jeremy R Townsend, Adam J Wells, Adam R Jajtner, Kyle S Beyer, Carleigh H Boone, Amelia A Miramonti, Ran Wang, Michael B LaMonica, David H Fukuda, Nicholas A Ratamess, Jeffrey R Stout 2015).

From the above, our involvement in this study is to incorporate the wheelchairs in the EPS courses for 15 minutes of warm-up, during the basketball cycle. It was implicated in this study as a training tool in the interest of the experimental group (ES), for 6-weeks to compare the impacts of two training proposed programs (Traditional with weight (CS) v's wheelchair (ES)). To assess their progress, we used pre-test and post-test, focused on push ups (PH), chin ups test (CH) and flexed arm-hangs test (FAH).

Methods

Researchers used the experimental method by choosing two groups, homogeneous into their disabilities, thought Body Mass Index (BMI) norms recorded in underweight < 18.5 associated with strength or athletic prowess, such as the upper torso or arms to maintain upper body strength, according (Bob Hill 2004). The progress in the present study was achieved via push up (PH), Chin up Test (CH) and Flexed Arm-Hang Test (FAH). Presented in Table 1. Means ± SD for the two groups (ES) vs (CS) for the two groups (ES) vs (CS).

Table 1

Presents the characteristics through the purpose test used in the present study via pre-test

SAMPLE		N	Mean ± SD	Shapiro-Wilk		Levene's		T	
				Value	p ≤ .05	Value	p ≤ .05	Value	p ≤ .05
BMI	ES	20	18.26 ± 1.06	0.92	0.15	0.25	0.62	0.09	0.92
	CS	20	18.22 ± 1.042	0.97	0.09				
PHT1	ES	20	8.60 ± 0.99	0.87	0.25	0.96	0.33	0.36	0.72
	CS	20	7.70 ± 0.73	0.78	0.28				
CU T1	ES	20	5.15 ± 1.72	0.95	0.17	1.13	0.29	0.21	0.83
	CS	20	5.05 ± 1.23	0.91	0.18				
FAHT1	ES	20	4.15 ± 3.65	0.93	0.19	0.31	0.39	0.11	0.92
	CS	20	4.25 ± 2.86	0.95	0.16				

Participants

Forty students physically active in EPS sessions, from the secondary school of zagllole, Academy Mostaganem participated in this study. Their inability of upper body musculature was determined on the basis of Golding et al. normative data for the push-ups (Pecs) for Men (17-19 years) set by David Nieman (2006, 2007). As well as underweight (BMI < 18.5), admitted by Kenneth F. Ferraro, et al.(2002) as manifested higher disability in most instances (Kenneth F. Ferraro, Ya-ping Su, Randall J. Gretebeck, David R. Black & Stephen F. Badylak 2002).

Interpreting by researchers as the inability of ectomorphs' body type reported in similar researchers as a disability in physique correlates with height relates to weight (Frank Galligan, Eric Singleton & David White 2002), revoked in upper body musculature the case of this study. It was approved by the meaninglessness of independent t-test set in Table 1, in which our sample accepts normality distribution and homogeneity built on Shapiro-Wilk and Levene's.

Assessment that Ectomorphs tend to lack shape because of their low muscle mass and strength perceived by ageing to be associated with increased health care costs (Peggy Mannen Cawthon, Kathleen M. Fox, Shravanthi. R. Gandra, Matthew J. Delmonico, Chiun-Fang Chiou, Mary S. Anthony, Ase Sewall, Bret Goodpaster, Suzanne Satterfield, Steven R. 2009). Confirmed in similar via fragile, poorly muscled extremities and delicate bones (James Burfeind & Dawn Jeglum Bartusch 2015). Their corporal mass (Frank Schmalleger 2009) limits their athletic prowess, especially in the effectiveness of the upper body and arm strength (Brent A Alvar, Katie Sell & Patricia A Deuster 2017).

From this viewpoint, our choice guides us to press up tests to assess the strength endurance of upper body muscles based normative data for the push-ups for men provide by Golding et al. (1986). Supported by (Edward T Howley & Dixie L Thompson 2017) the objective of the Push-Up test is to assess the strength endurance of the athlete's upper body muscles. Flexed Arm-Hang Test and Chin up Test were used to evaluate the arm muscular endurance. It was purposed to determine if the student has adequate upper-body strength according to (Gregory Mast & Hans Halberstadt 2007). For BMI we defined it as weight in kg/ (height in metres) (Zerf Mohammed, Atouti Noureddine & Ben Farouk Abdullah 2017).

Training program

The proposed educating training sessions were carried out on January 18, 2016, until the end of March 13, 2016. Basketball cycle was in the second semester. After the adaptation of our students to use this tool, the researchers applied this training program, which aims to develop upper body musculature base on a wheelchair. The program included three (03) training units in a week of six (06) weeks. 15 minutes of warm-up consisted of:

- All warm-up exercise, both fast and long-duration movements were carried out using the wheelchair. For the ES group in the opposite of the CS group, without chairs.
- All warm-up exercises with balloons were performed using the wheelchair. For the ES group in the opposite of CS groups without chairs.

Warm-up exercises consisted of 6 six exercise stations:

5 min trying to solicit large muscle groups and cardiorespiratory endurance. 10 min Fartlek Training composed of six stations as specific exercises with the ball. See Figure 1.

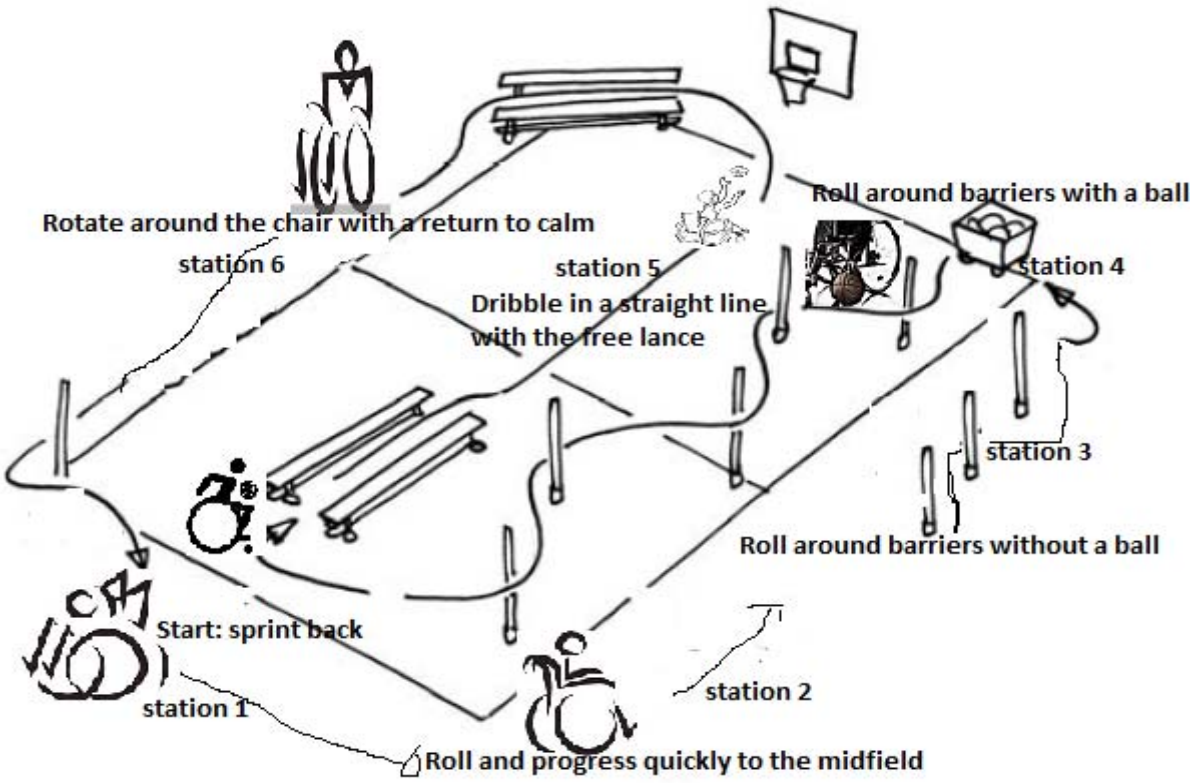

Figure 1

Describes the proposed group of exercises (Mohammed Zerf , Beboucha Wahib, Bengoua Ali 2017)

Statistical Analysis

To identify differences between training protocols on changes in upper-body Musculature strength. The analysis data was counted using a statistical program SPSS 20.0 for Windows. The characteristics of the sample (mean and standard deviations) were computed for all variables. Data from pre-test (T1) and post-test (T2) were compared with the independent t-test. Statistical significance was set at $p \leq 0.05$.

Results

Our results suggest that using a wheelchair as tool-specific muscle training increases the muscle-building. Muscle strength and muscle endurance via students Ectomorph. Top score in the present study in the profits of the ES group. Approved by a similar training program in the welfare of the wheelchair as a tool that can improve the five major motor abilities, which are endurance, flexibility, coordination, strength, and speed (Kestutis Skucas 2012). Underpinned by (David Joyce & Daniel Lewindon 2014) via high strength-to-weight ratios is an important method to select strength-training exercises. Mention by ACSM it is necessary to use at least 8 to 10 exercises of the various large muscle groups with 8 to 12 repetitions (Gloria M Bulechek & Joanne McCloskey Dochterman 1999). To set up the

resistance method training has been demonstrated to increase total body strength, according to (David J Magee, James E Zachazewski & William S Quillen 2007). It was admitted in this study via the independent t-test Table 2., where the use of the wheelchair as tool-specific muscle training had a greater effect on upper body muscle strength, recorded the benefits of ES, confirmed by (Sue Ann Sisto, Erica Druin & Martha Macht Sliwinski 2009) in the use of the wheelchair strength-endurance training (Goosey-Tolfrey V. 2010).

Table 2.

Differences between groups in changes in the effectiveness of muscle strength after 6 weeks of training

SAMPLE		N	Mean ± SD	T	
				Value	p ≤ .05
PHT T2	ES	20	9.55 ± 2.50	3.27	0.02
	CS	20	7.94 ± 1.53		
CU T2	ES	20	9.75 ± 2.17	2.18	0.03
	CS	20	5.55 ± 2.33		
FAHT2	ES	20	8.6 ± 1.76	8.22	0.00
	CS	20	5.65 ± 0.67		

To summarize our results, we agreed with the assumption provided by Vicky Goosey-Tolfrey (2010), that the use of the wheelchair for every day is an excellent way to build strength and improve movement upper body (Vicky Goosey-Tolfrey 2010). The wheelchair pushes increase upper body strength (Fabrisia Ambrosio, Michael L Boninger, Aaron L Souza, Shirley G Fitzgerald, Alicia M Koontz & Rory A Cooper 2005).

Discussion

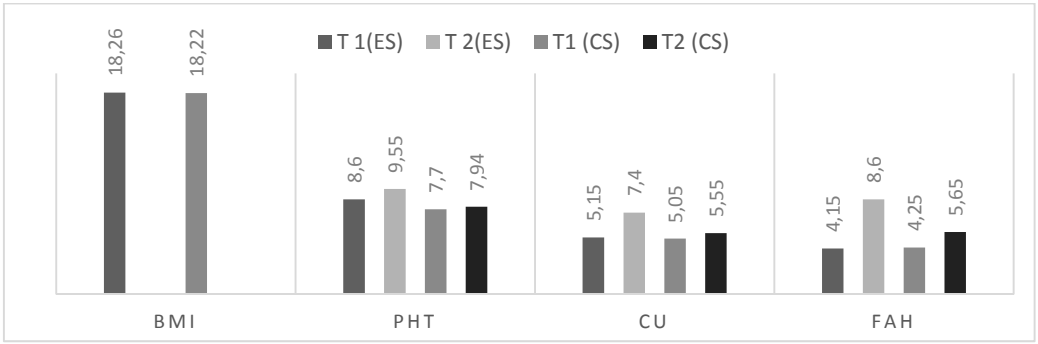

Figure 2

Describes the differences between the two programs in improving the strength of the upper body

The main results of this study indicated those 6 weeks of the wheelchair as a tool for ES Group V's weight for the CS group to improve upper body musculature among ectomorph

students more efficacy than the method used by our PE teachers. See Fig 2. Confirmed by Joel A. DeLisa, et al. (2005) through power used to pushed wheelchair claimed as key muscle groups requesting the recruitments of upper body muscles strength (Joel A. DeLisa, Bruce M. Gans & Nicholas E. Walsh 2004). Considerate by David X. Cifu (2016), manual materials have high strength-to-weight ratios. Knowledge by Jan Thurman et al. (2004) via a few laps with the wheelchair around the gym will improve individuals strength program's upper body productivity. Approved by L.J. Frankel, R. Harris (2012) push-ups have the benefits as suitable loads for the upper body (L.J. Frankel, R. Harris & Sara Harris 1977). Assumed by Barbara H. Connolly, et al. (2004) push-ups increase the flexors and extensors of the trunk as well as its shoulder (Barbara H. Connolly & Patricia Montgomery 2004). To conclude our experience in this topic, guided users agree that a wheelchair is a benefit-training tool for ectomorph body type to develop their upper body (Teresa Pountney & Teresa E. Pountney 2007). Established by Youlian Hong (2013) as an approach that every coaches or educator must take into its account. Certified by (Goosey-Tolfrey V. 2010) it is a beneficial tool that increases the muscular strength, power and/or range of motion as well as any changes in inter-segment coordination, according to (Youlian Hong 2013). Described by Dr Gareth J. Parry, et al. (2007) it is an excellent exercise, including weight lifting to improve upper limb strength (Dr Gareth J. Parry, MB, ChB, FRACP, Joel S. Steinberg, MD, PhD, FICA 2007). It is the most requested and adequate exercise with individual weight, according to (Robert J. Mutchnick, W. Timothy Austin, Randy Martin 2009), which should be considered early via those somatotypes, according to (Michael A. Alexander, MD, Dennis J. Matthews, MD & Kevin P. Murphy 2015). Concluded in this study, it is a beneficial training tool requested to reduce the impact of weight disability that limits Ectomorph physical levels activity, according to (Tarik Ozmen, Bekir Yuktasir, Birol Yalcin & Mark ET Willems 2014), upper-body strength and endurance in the case of this study have the five major motor abilities, like endurance, flexibility, coordination, strength, and speed, according to (Kestutis Skucas 2012)

Conclusions

The results indicate that the PE teacher must take into his consideration the changes in body shapes in the early stage of growth. Confirmed in the present study via ectomorph body type, to use the wheelchair, as a training tool, can improve the five major motor abilities, like endurance, flexibility, coordination, strength, and speed. Claimed in the present study, through the benefits of wheelchair push-ups, we can improve upper body strength at a high

level of conditioning to maintain work intensity and to prevent injury especially among ectomorph body type. The use of wheelchair push-up exercises is very beneficial in gaining quality muscle able to promote arm strength, upper-body strength and endurance.

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EXPLOSIVE STRENGTH OF LOWER LIMBS IN 10 – 12 YEARS OLD ATHLETES OF INDIVIDUAL SPORTS

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Summary. The aim of the study was to determine the levels of lower limb explosive strength of girls in different sport specialization. The sample consisted of 24 girls in aerobic gymnastics (n = 12) and athletic (n = 12) aged 10 to 12 years. To assess the levels of girls' lower limbs explosive strength, we administered the following tests: countermovement jump test, countermovement jump with free arms test, squat jump test, 10-seconds repetitive jumping test. Testing sessions took place in September 2019. To obtain data about the levels of lower limbs explosive strength, we recorded step height (cm) and duration of the flight phase (s). Data about the lower limbs explosive strength were collected using the Optogait system for optical detection. We applied basic statistical characteristics, namely Student's t-test and multivariate linear regression. There were no significant differences between girls in aerobic gymnastics and athletics. We recorded better test results in the group of girl's athletes in the countermovement jump, countermovement jump with free arms and squat jump. In the group of girl's involved in aerobic gymnastics, we recorded better results in the 10-second repetitive vertical jumping and vertical jump strength. According to the collected data, we may conclude that the training process of the selected girls in terms of explosive strength development is significantly different. Girls involved in aerobic gymnastics showed a higher level of performance in the 10-second vertical jump, which results from the structure of sport specificity.

Key Words: jump ergometer, sensitive period, track and field, aerobic gymnastics, youth.

Introduction

Assessment of the current level of explosive strength of the lower limbs and vertical jump itself is an important factor of performance capacity. The level of vertical jump is assessed in almost all sports.

Application of vertical jump diagnostic is frequently used in adult categories and many authors conclude that training process must be more effective of explosive strength. However, the studies of diagnosis of vertical jump of young athletes are relatively at an average level compared to the adult population (Hespanhol et. al. 2013).

In aerobic gymnastics, as well as in other sports, improving sports performance limits the level of fitness and coordination skills in interdependence with the rational technique of individual movements and difficulty elements. They are physiological mechanisms for building up motor habits, coordination abilities, physical abilities and movement skill as well as the anatomical and functional peculiarities, biomechanical characteristics of movements, pedagogical prerequisites and the difficulty elements' performance by optimum technique (Sergiev 2004; Perečinská et al. 2018).

The explosive strength in gymnastics sports shows itself in the major part of movements and elements performed by the gymnasts, particularly in the jumps, which are fundamental corporal movements in this sport. The training directed to the development of jumping capacity presents a large quantity of exercises, which aim to improve muscular strength in the lower limbs and therefore the impulsion capacity (Santos et. al. 2015).

According to Kyselovičová (2010) is explosive strength one of the most significant factors in aerobic gymnastics performance because gymnast must demonstrate intensive, dynamic and rhythmic sequences of high and low impact aerobics movements with difficulty elements. To compare strength in the active phase of take-off and height of the jump in maximal and during modified aerobic gymnastics routines is important to monitoring.

Explosive strength can be classified as a factor in the structure of sports performance, which directly affects performance itself (Šimonek et al. 2007). Explosive strength is characterized by several authors (Šimonek et al. 2007; Sedláček & Lednický 2010; Feč & Feč 2013) as the ability of the organism to generate maximum power in the shortest possible time. The explosive strength cannot be directly bounded, because it is also often associated with strength abilities for the strength component is a part of explosive strength. Besides strength component is in close relationship with coordination components based on optimal coordination of individual muscle groups involved in movement (Sedláček & Lednický 2010). The most intensive development period (sensitive period) of explosive strength is approximately in 11-12 years old girls (Belej 2001), which correspond to our groups of tested girls.

Methods

We diagnosed current level of the explosive strength of lower limbs in different sport specialization. The two samples consisted of 24 girls in all, involved in aerobic gymnastics (n = 12) and athletic (n = 12) aged from 10 to 12 years (born 2008 to 2010). A both groups were tested in September 2019. To compare the groups, we have used somatic measurements that may affect performance in the motor skills test:

- measurements of body height by anthropometer,
- measurements of body weight by digital weight (with a measurement deviation of +/- 0.1 kg).

To determine the level of explosive strength of the lower limbs we used following motor skills test:

1. Countermovement jump (Fig. 1)

Monitored parameter: height of jump (cm), time of flight jump (s).

Diagnostic device: OPTOGAIT- jump ergometer.

- participant must maintain hands on the hips for whole time of vertical jump.

Figure 1

Countermovement jump

2. Countermovement jump with free arms (Fig. 2)

Monitored parameter: height of jump (cm), time of flight jump (s).

Diagnostic device: OPTOGAIT- jump ergometer.

- participant must maintain the arm swing as a potential benefit during vertical jump.

Figure 2
Countermovement jump with free arms

3. Squat jump (Fig. 3)

Monitored parameter: height of jump (cm), time of flight jump (s).

Diagnostic device: OPTOGAIT- jump ergometer.

- participant must maintain 90 ° knee angle during squatting positions 1 – 2 seconds.
-

Figure 3
Squat jump

4. 10-seconds test of repetitive jumps (Fig. 4)

Monitored parameter: height of jump (cm), time of flight jump (s).

Diagnostic device: OPTOGAIT- jump ergometer.

- participant must maintain hands on the hips during 10-second repetitive jumps, if not, the test must be repeated.

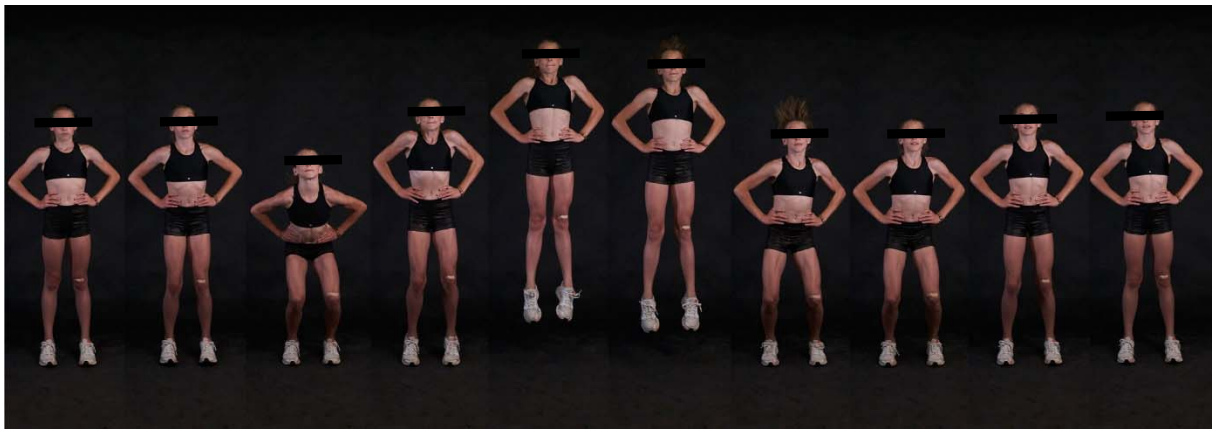

Figure 4
10-seconds test of repetitive jumps

For the data statistical processing we used the central tendency rate, median (Me) due to the sample size. In addition to the basic statistical characteristics, we applied a statistical test to compare and confirm statistical significance between the monitored groups. We applied basic statistical characteristics, Student's t-test and multivariate linear regression to assess relationship between samples. We used the Shapiro-Wilk test to verify normality in the sample.

Results and Discussion

Based on the monitored indicators we reached individual conclusions. In comparing the body composition of girls with different sports specializations, we can state the following:

Table 1
Somatic measurement of experimental subjects

	n	Average of age	Body weight [kg]	Body height [cm]	BMI
Athletic	12	11.7	34.6	145.1	16.5
Aerobic gymnastics	12	10.9	34.8	147.7	16.1

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In Table 1 we recorded the values of the monitored somatic indicators of both groups in individual sports. In both research samples there were the same number of 12 girls, which we considered as low. Based on the low sample size, we used the median (Me) of the basic statistical characteristics, which represents Me = 11.7 years at the age of athletes. Aerobic competitors were 0.8 years younger than athletic competitors. In comparison of body height, we noticed a difference of 2.6 centimeters, in favor of aerobic competitors. Based on the available sources aerobic competitors, along with girls with specialization on gymnastics, achieve on average lower body height values than girls with other sports specializations

(Mineva 2014). However, it was not confirmed in our case. When comparing the monitored groups, namely from the measurements of girls' body height, the claim (Mineva 2014) is not confirmed. In comparison of the monitored groups and the monitored body weight indicator, we can find a difference of 0.2 kg in favor of aerobic competitors. The body mass index (BMI) is in athletes group at the level of 16.5 that we evaluate positively and we expected results to be in the norm in both monitored groups. Aerobic competitors achieved almost identical level of monitored body composition index compared to girls with athletic specialization (Table 1).

Table 2
Body compositions measurement of experimental subjects

	Muscle mass [kg]	**Fat mass [kg]**	**Visceral fat mass [cm^2]**
Athletic	15.4	4.8	14.6
Aerobic gymnastics	15.6	4.9	19.2

The body composition of the both groups is presented in Table 2. The most important indicator of the body composition of our observation is the muscle mass indicator. The total muscle mass ratio was recorded in athletes, which was 0.2 kilograms lower compared to aerobics counterparts. Comparing visceral fat disproportion, we conclude that athletes performed better with a difference of 4.6 cm^2 than aerobic competitors. Considering body fat mass, athletes reached 0.1 kilograms' higher value compared to aerobic competitors.

The indicators presented in Tables 1 and 2 were selected intentionally, with the aim of monitoring the statistical causality in performance of each test items focused on the level of explosive strength of the lower limbs. After obtaining the variables we assumed causality with the results of individual tests. Subsequently, we found out the relationship between the jumps height and series of variables that seemed to be the most important in explaining the variations in our research. The t-test showed the significance of the regression as the p value came below the 5% significance level ($p < 0.05$). During the linear regression calculations, we followed the sequence of regression specificities.

When comparing individual tests that focus on the explosiveness of lower limbs between athletes and aerobic competitors, we found out whether the factor of sport selection at a young age plays a statistically different role in physical ability. With significantly different results in height jumps, we would get a p value that would confirm the significance of the difference in performance. The p-values obtained are recorded in Table 3.

Table 3
Results of countermovement jump

	Countermovement jump		Countermovement jump with free arms	
	Time of flight [s]	**Height of jump [cm]**	**Time of flight [s]**	**Height of jump [cm]**
Athletic	0.426	22.25	0.472	27.45
Aerobic gymnastics	0.425	22.10	0.465	26.45
P-value Height of jump	0.983		0.904	

Table 4 presents the results of the participants in countermovement jump test and countermovement jump with free arms test. As Vavák (2014) states, the influence and potential of arm swing is an essential factor in a vertical jump. When practicing the swing of the arms, there is a sum of the acting forces in the direction of jump, where, in addition to the lower limbs, the upper part of the body, namely the arms, is significantly involved in the monitored performance. Moreover, Sedláček and Lednický (2010) point out that other segments and muscle groups of the body, such as the upper limbs and torso muscles are also involved in the vertical jump. Comparing research groups, we concluded in countermovement jump test that the achieved results did not show a significant difference in the vertical jump performance. The difference was recorded at a level of 0.15 centimeter at the height of the jump and 0.001 seconds at the time of the flight phase of the jump. The test results did not show a statistically significant difference between the observed groups ($p < 0.05$) in the jump height indicator.

In the calculation of linear regression, we finally obtained the significance of one variable, namely muscle mass, which reached p value of 0.0004, which we consider as statistically significant. The other monitored physical parameters were marked as non-influencing and statistically insignificant in the maximum vertical jump test item.

In the countermovement jump with free arms test, we noticed better results of athletics competitors compared to aerobic competitors. Athletes achieved better performance results in the test item by 1 cm. We believe that the observed difference was influenced by the fact that athletes practiced the training and the development of the high jump in the training process. Moreover, the practicing of arm swinging exercises in the vertical plane during the training process also influenced and distorted the test results. Aerobic competitors use arm swing in

the training process, but with variations in the direction and height of arm movement within aerobics exercises variations and exercises shapes difficulties. We also decided to compare the performance of the girls by applying different exercises that could affect the results of the test item in both research groups.

From the statistical point of view, the significance of the performance in comparison of both monitored groups was not confirmed. Comparing the linear regression of the groups, we can conclude the relationship between the muscle mass ($p = 0.007$) of the girls and the visceral fat ($p = 0.001$), which was also confirmed statistically and can be considered as a significant relationship.

Table 4
Results of squat jump and 10-second jump test

	Squat jump		**10-second test of vertical jumps**		**Power of jump [W/kg]**
	Time of flight [s]	**Height of jump [cm]**	**Time of flight [s]**	**Height of jump [cm]**	
Athletic	0.421	21.75	0.408	20.46	23.46
Aerobic gymnastics	0.418	21.40	0.424	21.9	26.53
P-value	0.952		0.922		0.879

Results in Table 5 indicate that in a vertical jump performed from the squat starting position athletics competitors showed a higher performance by 0.35 cm compared to aerobic competitors. When comparing the length of the flight phase, this is a 0.03 second difference. In verifying the significance of the results, we conclude that the test item of a squat jump is not statistically significant in comparison to the monitored groups of girls of different sports specializations. We reaffirm the relationship between the height of the jump and the muscle mass of the girls at $p < 0.00015$ and the relationship to the visceral fat at the $p < 0.02$. The data obtained about the variables relationships are statistically significant, which we consider to be very important.

We found out a significant difference in the vertical jumps for 10-seconds test compared to the basic statistical characteristics. Comparing the jumps, the aerobic competitors showed higher measured values by 1.44 cm, which is directly proportional to the indicator of the flight phase of the jump, namely 0.016 s. Compared to athletics competitors, aerobic competitors exert a greater force in the active phase of vertical jumps by 3.07 W/kg. The records reflect the need for long-term dynamic movement of aerobic competitors in aerobic ties and difficulty elements. The reason may be that gymnastic routines contain more

dynamic elements and therefore gymnasts should be provided a higher level of jump capabilities compared to the group of athletics (Mlsnová, Luptaková 2017).

In conclusion, we can point out the relationship between vertical jumps in 10-seconds and the muscle mass of girls at $p < 0.02$, which we also assumed.

Conclusion

During the testing we did not gain sufficient evidence against the null hypothesis, which meant equality of observations at the measured values. The result obtained by Student's T-test on the significance level $p \leq 0.05$, was not statistically significant in the comparisons between research groups. Athletes and aerobic competitors do not significantly differ in vertical jump performance, meaning that performances is not visibly affected by specific and heterogeneous training processes in selected sports. Statistical significance was also assumed by looking at relatively identical research samples characteristics and performance in individual test items.

By testing individual performances in test items with selected variables (age, body weight, body height, muscle mass, fat component, visceral fat) we obtained results using linear regression. Significant relationship in the test items like vertical jump, vertical arm-jump, squat vertical jump and vertical jumps for 10-seconds is manifested with the variable muscle mass. Muscle mass showed the most significant dependence on the explosive strength of the lower limbs. It is interesting to note that variables such as body height, body weight and fat component did not appear to be limiting factors in the explosive strength of the lower limbs. Visceral fat was the second factor to confirm in vertical arm-jump and squat vertical jump.

During the analysis of the results we came up with an absent variable that can influence the individual results of the competitors. An important variable can be the sports age or previous sports activity. In conclusion, with the possibility of re-diagnosing the explosiveness of the lower limbs, we would recommend focusing on the muscle distribution of the lower limbs, not just the total muscle mass. We assume that the muscle distribution of the lower limbs has an impact on the height of the flight phase in different jumping techniques in the individual test items and consequently a direct proportion in the height of the vertical jump.

Considering the measured results, we assume that the training processes in both sports indicate a balanced general movement base. This is based on results in which we do not

observe extreme deviations in the explosive strength of the lower limbs and in the basic anthropometric characteristics.

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GENDER DIFFERENCES IN SUBJECTIVE QUALITY OF LIFE OF ELITE AND COMPETITIVE SPORTS GAMES PLAYERS

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Summary: The objective of the present study was to analyse subjective quality of life (S-QOL) throughout the quality of life indicators' (QOLIs) and quality of life domains' (QOLDs) satisfaction, and overall S-QOL among elite and competitive sports games players (i.e. players) and compare the S-QOL between the male and female. The research sample comprised of 106 male players (mean age 27.2 ± 1.96 years) and 28 female players (mean age 24.9 ± 1.45 years). A standardized Subjective Quality of Life Analyses (S.QUA.L.A.) was used as a primary research method. No significant differences were found in overall S-QOL neither in QOLDs' satisfaction between male and female players. Male players present significantly higher satisfaction with leisure activities, sport and work than females. Both genders equally declared the highest S-QOL by social relation and physical health/level of independence and the lowest level of S-QOL by psychological health/spirituality.

Keywords: elite and competitive athletes, sports games players, male and female players, indicators, domains

Introduction

Elite athletes' lifestyles are subordinated to sport, which becomes a way of their life (Stambulova 1994) and significantly affect their quality of life (QOL) from different perspectives. High-performance sport (elite and competitive), because it is highly organized, physically and mentally challenging, including its environment, may not lead to the improvement of a quality of life improvement and may even seriously undermine it (Simon & Docherty 2014; Ruiz et al. 2004). The World Health Organization (WHO) defines Quality of Life (QOL) as an Individual's own subjective perception of their position in life in relation to their particular goals, expectations, standards and concerns. It is a broad-ranging subjective

quality of life (S-QOL) concept affected in a complex way by the person's satisfaction with physical health, psychological state, level of independence, social relationships, and their relationship to salient features in their environment" (WHOQOL Group 1995). High-level competitive athletes (elite and competitive) participate in sport under conditions that present considerable physical and psychosocial stressors (Lundqvist 2011). Elite and competitive athletes, sports game players (i.e. players) are not an exception, must continually strive for a success in a highly competitive and stressful environment; thus, high-level competitive sport can have either a detrimental or beneficial influence on the S-QOL and health of athletes (Bartholomew et al. 2011). Training and exercise are crucial components of elite and competitive athletes' daily lives (Durand-Bush & Salmela 2002) and are often mentioned as reasons for their S-QOL (Loland 1999). Most elite and competitive athletes report high S-QOL (Stephan & Bilard 2003) because of the euphoric effect of exercise (McAllister et al. 2001) and the intensity emerging from the lifestyle in high level sport (Gearing 1999; Mikulič et al. 2015).

The objective of the present study was to analyse subjective quality of life throughout (1) QOL indicators' (QOLIs) satisfaction, (2) QOL domains' (QOLDs) satisfaction and (3) overall S-QOL among elite and competitive sports games players and compare the S-QOL between male and female players.

Methods

Participants and data collection

The research sample comprised of 134 elite and competitive sports games players (ECSGPs; i.e. players) categorized by gender: (1) male players (n = 106; mean age 27.2 ± 1.96 years) and (2) female players (n = 28; mean age 24.9 ± 1.45 years). 40.7 % were football and indoor football players, 16.4 % ice hockey and floorball players, 15.7 % tennis, table tennis and badminton players, 10.4 % volleyball players, 12.0 % basketball and 8.2 % handball players. Participants were contacted through representatives of national sport organisations/associations around Slovakia. Some questionnaires were sent electronically by representatives of the organisations and some were passed out at the different meetings organised by national organisations. All data were collected for 2019 year's period and participants agreed to participate in the study and gave their written informed consent. The Ethics Committee of the Faculty of Physical Education and Sports, Comenius University in Bratislava (ref. no. 10/2019) had approved this research.

The Subjective Quality of Life Analysis (S.QUA.L.A)

The World Health Organisation Quality Of Life (WHOQOL)

A standardized The Subjective Quality of Life Analysis (S.QUA.L.A) was used as a primary research method. S.QUA.L.A. is a multidimensional instrument. This multidimensional self-assessment method was created by Mathieu Zannotti in 1992 (Zannotti & Pringuey 1992). This scale includes 23 indicators of life (QOLIs). It covers traditional areas (food, family relation etc.) and more abstract aspects of life (politic, justice, freedom, truth, beauty and art, love). We used second part of S.QUA.L.A. where for each QOLI, participants were asked to evaluate their degree of satisfaction using the 5-point rating scale. Score 1 (high satisfaction) meant the highest satisfaction and in the same time the highest level and score 5 (total disappointment) expressed the absolute insignificance of the particular indicator in life. The lower mean point score meant higher satisfaction with particular QOLI. For this study we modified the S.QUA.L.A. questionnaire by including one more indicator No. 16 "sport". We unified all 24 S.QUA.L.A. QOLIs into five quality of life domains (QOLDs) following WHOQOL (WHO User Manual 1998): (1) Physical Health and the Level of Independence; (2) Psychological Health and Spirituality; (3) Social Relationships; (4) Environment. Overall S-QOL was calculated by summarizing scores of all 24 QOLIs. In this study a Slovak version of the S.QUA.L.A. was used (Nemček et al. 2011).

Data analyses

The program IBM SPSS Statistics version 23.0 was used for data processing. The data were described using absolute and relative frequencies, including the mean ($\bar{x}$) and standard deviation (± SD). The Kolmogorov-Smirnov test was used to evaluate data normality and non-parametric Mann Whitney *U*-test was used to assess differences between two independent groups of male and female players. The rate of dependence (effect size) between the two samples of features was conveyed by means of the coefficient *r* ($r > 0.90$ - very large effect size, $r = 0.70$-0.90 - large effect size, $r = 0.50$-0.70 - medium effect size, $r = 0.30$-0.50 - small effect size, $r < 0.29$ - very small effect size) proposed by Pett (1997). Wilcoxon Signed Ranks Test was used to determined differences between QOLDs (two related samples). The rate of effect size between the two related samples (QOLDs) was conveyed by means of the coefficient *d* ($d > 1.30$ very large effect size, $d = 0.50$ - 0.80 large effect size, $d = 0.20$ - 0.50 medium effect size, $d < 0.20$ - small effect size) proposed by Cohen (1988). The significance level was set at $\alpha \leq 0.05$ (*) and $\alpha \leq 0.01$ (**). In the current study, only one measurement has been made and two main groups of ECSGPs formed the study.

Results

Table 1

S-QOL differences between male and female players (S.QUA.L.A.)

QOLIs/Overall S-QOL	**Male players** (n = 106)	**Female players** (n = 28)	***U***	***p***
	$\bar{x}$/ ± **SD** (mean point score)			
General health	1.934 ± 0.820	2.250 ± 0.887	1184	0.080
Physical wellbeing	1.915 ± 0.782	1.929 ± 0.900	1463	0.901
Psychological wellbeing	2.057 ± 0.728	2.214 ± 0.686	1301	0.257
Home environment	1.848 ± 0.731	1.964 ± 0.838	1379	0.578
Sleep	2.000 ± 0.781	2.036 ± 0.744	1419	0.699
Family relations	1.783 ± 0.828	1.893 ± 0.916	1397	0.605
Relations with others	1.934 ± 0.666	2.000 ± 0.608	1412	0.641
Children	2.100 ± 0.775	1.923 ± 0.760	347	0.492
Self-care	2.009 ± 0.710	1.857 ± 0.651	1299	0.253
Love	2.000 ± 1.028	2.107 ± 1.499	1403	0.693
Sexual life	2.114 ± 1.031	2.346 ± 1.231	1240	0.450
Political situation	3.505 ± 0.959	3.750 ± 0.967	1234	0.215
Religion/Spirituality	2.657 ± 1.073	2.571 ± 1.069	1362	0.529
Rest in leisure	2.217 ± 0.840	2.286 ± 0.937	1436	0.770
Leisure activities	1.755 ± 0.645	2.071 ± 0.663	**1114***	**0.020**
Sport	1.642 ± 0.746	2.036 ± 0.744	**1037****	**0.007**
Safety	2.124 ± 0.717	2.036 ± 0.793	1363	0.515
Work	2.123 ± 0.859	2.857 ± 0.932	**838****	**0.000**
Justice	3.010 ± 1.014	2.964 ± 0.793	1465	0.976
Freedom	2.295 ± 0.940	2.074 ± 0.917	1239	0.270
Beauty and art	2.472 ± 0.707	2.357 ± 0.911	1355	0.441
Truth	2.604 ± 0.953	2.643 ± 0.678	1360	0.463
Finances	2.664 ± 0.888	2.741 ± 1.059	1394	0.952
Food	1.906 ± 0.684	1.786 ± 0.568	1368	0.468
Overall S-QOL	**2.196 ± 0.406**	**2.289 ± 0.458**	**1344**	**0.443**

*Note. U = Mann-Whitney U-test statistics; p = statistical significance (p-values *≤.05, **≤.01).*

Mean point scores analyses of QOLIs'satisfaction in the group of male players showed the highest satisfaction with sport (1.642 ± 0.746 points), leisure activities (1.755 ± 0.645 points), family relations (1.783 ± 0.828 points), home environment (1.848 ± 0.731 points), food (1.906 ± 0.684 points), physical wellbeing (1.915 ± 0.782 points), social relations (1.934 ± 0.666 points), altogether with the general health (1.934 ± 0.820 points). The mean scores of mentioned QOLIs didn't exceed 2.0 points of satisfaction rate (Table 1). The group of female

players declared the highest satisfaction in their life with food (1.786 ± 0.568 points), self-care (1.857 ± 0.651 points), family relations (1.893 ± 0.916 points), children (1.923 ± 0.760 points), physical wellbeing (1.929 ± 0.900 points) and home environment (1.964 ± 0.838 points) - QOLIs that did not exceed 2.0 points of the mean scores. On the other side, both groups of male and female players are the most dissatisfied in their life with the current political situation (males, 3.505 ± 0.959 points; females, 3.750 ± 0.967 points).

S-QOL evaluated by QOLIs' satisfaction according to participants' gender revealed significant differences only in three from twenty-four items (Table 1). Concretely, male players presented significantly higher satisfaction in their life with leisure activities (U = 1114, p = 0.020, r = 0.235), sport (U = 1037, p = 0.007, r = 0.256) and work (U = 838, p = 0.000, r = 0.379) compare female players. By mean point scores evaluation we found that male players were more satisfied in their life with 66.7 % of QOLIs by lower mean point scores achievement compare female players. Summarising all twenty-four QOLIs we found out no significant differences in overall S-QOL between male and female players (Table 1).

Table 2

S-QOL differences between male and female players (WHOQOL)

QOLDs	**Male players** (n = 106)	**Female players** (n = 28)	***U***	***p***
	$\bar{x}$/ ± SD (mean point score)			
Physical health and level of independence	2.028 ± 0.467	2.125 ± 0.441	1328	0.388
Psychological health and Spirituality	2.463 ± 0.550	2.476 ± 0.577	1446	0.834
Social relations	1.986 ± 0.572	2.066 ± 0.657	1382	0.574
Environment	2.254 ± 0.456	2.380 ± 0.584	1344	0.441

*Note. U = Mann-Whitney U-test statistics; p = statistical significance (p-values *≤.05, **≤.01).*

Table 3

Differences between QOLDs in male players

QOLDs	Physical health and level of independence	Psychological health and Spirituality	Social relations	Environment
Physical health and level of independence	1	**6.772**** **0.000**	1.143 0.253	**5.515**** **0.000**
Psychological health and Spirituality		1	**7.036**** **0.000**	**4.857**** **0.000**
Social relations			1	**4.933**** **0.000**

*Note. Wilcoxon Signed Ranks Test statistics; * and ** - p-values, statistical significance (*≤.05, **≤.01).*

Mean point scores analyses of QOLDs'satisfaction in the group of male players show the highest satisfaction with social relations (1.986 ± 0.572 points) and physical health and level of independence (2.028 ± 0.467 points) and the lowest satisfaction with psychological health and spirituality (2.463 ± 0.550 points). The group of female players displayed the same results than male players as they showed the highest satisfaction in their life also with social relations (2.066 ± 0.657 points) and physical health and level of independence (2.125 ± 0.441 points) and the lowest satisfaction with psychological health and spirituality (2.476 ± 0.577 points) (Table 2). No significant differences were found between two first QOLDs (social relations and physical health/level of independent) in both evaluated groups of male and female players, that indicates equally the highest satisfaction with social relations as well as with physical health/level of independence in S-QOL of male and female players (Table 3, 4). Significantly lowest S-QOL in male as well as female players were displayed by psychological health and spirituality domain (Table 3, 4). In the group of male players significantly the highest dissatisfaction with psychological health a spirituality was declared in comparison with all QOLDs satisfaction as follows: social relations (Z = 7.036, p = 0.000, d = 0.850), physical health/level of independence (Z = 6.772, p = 0.000, d = 0.852) and environment (Z = 4.857, p = 0.000, d = 0.413) (Table 3). In the group of female players significantly the highest dissatisfaction with psychological health a spirituality was revealed in comparison with two QOLDs satisfaction as follows: social relations (Z = 3.656, p = 0.000, d = 0.663) and physical health/level of independence (Z = 2.955, p = 0.003, d = 0.683) (Table 4).

S-QOL assessed by QOLDs' satisfaction according to participants' gender revealed no significant differences in either QOLD (Table 2).

Table 4

Differences between QOLDs in female players

QOLDs	Physical health and level of independence	Psychological health and Spirituality	Social relations	Environment
Physical health and level of independence	1	**2.955**** **0.003**	0.815 0.415	**2.484**** **0.013**
Psychological		1	**3.656****	0.718

health and Spirituality			**0.000**	0.473
Social relations			1	**2.665**** **0.008**

*Note. Wilcoxon Signed Ranks Test statistics; * and ** - p-values, statistical significance (*≤.05, **≤.01).*

Summarising observed data of the present study we can confirm no differences in satisfaction with QOLDs neither in overall S-QOL between male and female players. Male players show significantly higher satisfaction in their life with leisure activities, sport and work than female players. In 87.5 % QOLIs'satisfaction were not revealed significant differences between male and female players. The highest S-QOL assessed by QOLDs' satisfaction was declared by social relations and physical health/level of independence in male as well as female ECSGPs and the lowest by psychological health/spirituality.

Discussion

The Slovak population (n = 1107) assessing their S-QOL more positively (Nemček, 2016a). The Slovak population is the most satisfied in their life with QOLIs social relations, family relations, food and home environment. Negative S-QOL of the Slovak population pointing to political situation and justice (Nemček 2016a) The objective of the present study was to analyse S-QOL throughout (1) QOLIs' satisfaction, (2) QOLDs' satisfaction and (3) overall S-QOL among elite and competitive sports games players and compare the S-QOL between evaluated groups of players according to their gender. The results of the present study revealed the highest satisfaction with sport, leisure activities and family relations – as QOLIs in the group of male players and the highest satisfaction with food, self-care and family relations in the group of female players. Many studies were published investigating gender differences in S-QOL (Ladecká, Nemček & Harčaríková 2019; Joanović et al. 2019; Nemček, Kurková & Wittmannová 2019) and some researchers investigated S-QOL among males and females according to sport participation (Nemček 2016b; Nemček 2017; Pačesová, Šmela & Kraček 2019). In the study of Tanabe at al. (2010) female athletes presented significantly lower health related quality of life scores on the happiness subscale and psychological well-being than male athletes. Comparing the results of the current study, male players achieved significantly higher satisfaction only with 12.5 % QOLIs concretely sport, leisure activities and work than female players. But on the other side, no significant differences were found in QOLDs' satisfaction between male and female players. Elite athletes, in general without gender differentiation, report high life satisfaction during their

career because of the living, loving relationship they develop with their sport (Werthner & Orlick 1986). In the study of Correia et al. (2017) elite volleyball players (n = 32) declared significantly higher level of physical, psychological and social QOLDs comparing normative data – regular citizens. In the study of Nemček, Kraček & Peráčková (2017) was found the highest S-QOL in the group of elite and competitive athletes comparing recreational athletes and inactive individuals, but not significant differences in S-QOL were found between elite/competitive athletes and recreational athletes.

The present study further revealed the highest S-QOL by the highest satisfaction with social relations and physical health domains declared by both genders of players. Following the results of Correia et al. (2017), the highest satisfaction with social relations can be explained by the fact that the athletes are inserted in a team ideal, where bonds of friendship are created due to the daily coexistence (Smith 2003), and focused on a common ideal: the success of the team. The scientific literature shows that competence in the areas of physical activity can often lead to social competence or social acceptance (Weiss & Duncan 1992; Nemček 2014; Labudová, Nemček & Bardiovský 2014; Eime et al. 2010). High satisfaction with physical health can be explained by the fact, that the players practice daily physical exercise, monitored by coaches and physical trainers, have qualified medical and psychological assistance in their respective teams and have balanced diets (Correia et al. 2017). These results reinforce the close association between sport and health, due to the role attributed to sport practice in the configuration of healthy lifestyles (Omorou 2013).

The results of the present study confirmed the lowest level of psychological health/spirituality in both genders of elite and competitive sports games players. These results can be caused by the findings of Rice et al. (2016) who suggested that elite athletes experience a broadly comparable risk of high-prevalence mental disorders (i.e. anxiety, depression) relative to the general population. Evidence regarding other mental health domains (i.e. eating disorders, substance use, stress and coping) is less consistent (Rice et al. 2016). Concretely, Australian elite athletes in the study of Gulliver et al. (2015) displayed depression (27.2 %), eating disorder (22.8 %), general psychological distress (16.5 %), social anxiety (14.7 %), generalised anxiety disorder (7.1 %), and panic disorder (4.5 %) as the reasons of very low psychological health domain in S-QOL of elite and competitive athletes.

Conclusion

Observed data of the present study reported no significant differences in overall S-QOL as well as in QOLDs' satisfaction between male and female elite and competitive sports games players. In S-QOL male players present significantly higher satisfaction with leisure activities, sport and work than female players. Both genders equally showed significantly the highest S-QOL in social relation and physical health/level of independence and significantly the lowest level of S-QOL in psychological health/spirituality.

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THE EFFECT OF TRAINING METHODS AND EYE-FOOT COORDINATION ON DRIBBLING ABILITIES IN STUDENTS AGED 12 – 13 YEARS

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Summary. The purpose of this study is to examine: (1) the difference in the effect of the method of dribbling sprinting and sprint interval training on the ability of dribbling; (2) the difference in influence between high-eye coordination and low-foot coordination on the ability of dribbling; and (3) the interaction between training methods and eye-foot coordination on dribbling skills. Participants in this study were 37 soccer students aged 12 – 13 years (M = 12.38; SD = 0.49). This research method is an experiment with a 2x2 factorial design. The instrument for measuring ankle coordination is the Soccer Wall Test and for measuring the ability of dribbling is the Short Dribbling Test. The data analysis technique used is two-way ANOVA at the significance level α = 0.05. The results of the study are as follows. (1) There is a significant difference in effect between the method of acceleration dribbling and interval running training on dribbling ability, as evidenced by the value of F = 14,032; p value = 0.002 < 0.05. (2) There is a significant difference in the effect of high eye-foot coordination ability and low-foot eye coordination on dribbling ability, as evidenced by the value of F = 27,685; p value = 0,000 <0.05. (3) There is a significant interaction between the training methods (acceleration and interval running dribbling exercises) and eye-foot coordination (high and low) on the dribbling ability of students aged 12-13 years, as evidenced by the value of F = 21,780 and the p value = 0,000 <0.05.

Keywords: Training Methods, Sprinting, Interval Running, Dribbling.

Introduction

One of the basic techniques of soccer that must be mastered is the basic technique of dribbling. From some basic techniques of playing soccer, dribbling is one of the basic techniques that is quite dominant among the other basic techniques of playing soccer (Burhaein 2017b; Huijgen, Elferink-Gemser, Post & Visscher 2010). Dribbling in soccer

games is often done by players in determining whether or not the team game or individual players themselves.

Talented players can also be seen from the dribbling capabilities of the players (Ali 2011). Dribbling is defined as the movement to run using the foot to push the ball to roll continuously on the ground. Most dribbling is done using the outside of the foot because it is on the foot that there is a wider surface for players to dribble the ball, thus providing better ball control. In addition, the outer leg is a more appropriate surface for dribbling.

Soccer dribbling ability is inseparable from the ability to support good physical condition, one of the factors that can affect soccer dribbling ability is eye-foot coordination (Sabdono, Sutapa & Phytanza 2019). Eye-foot coordination plays a role in soccer dribbling, which is when dribbling a soccer player must pay attention to the ball and the game situation. When dribbling a player does not have to keep his head down to pay attention to the location by continuing to see the ball, but must pay attention to the situation of the game. It is true that students who have good eye-foot coordination are also good at dribbling skills (Prasetyo 2019). It seems that this needs to be questioned again, because the ability of soccer dribbling is not only influenced by eye-foot coordination, but there are other factors for example, physical conditions (flexibility, speed, agility), length of dribbling practice time training every day and so forth. The factors that determine and support success in playing soccer, among others, namely: physical condition, technique, tactics, training intensity, and mentality (Mustofa, Mansur & Burhaein 2019).

A survey by a previous study revealed a problem conducted on students aged 12 – 13 years (Phytanza, Burhaein, Sukoco & Ghautama 2018; Tarista & Jayadi 2017), the problems experienced are: (1) the foot is not aligned with the direction of the target or the tip of the foot toward the target, (2) the students is not accustomed to bending the knee, so that the knee is not perpendicular to the top of the finger, (3) the part of the student's foot that hits the ball is not the inside but the sole of the foot, and the imposition on the ball is not in the middle-middle of the back of the ball but on the ball, (4) the position of the body is not balanced when dribbling. In soccer dribbling with the outer legs the problems found were: (1) the foot used by dribbling the ball was not lifted backward with the position of the foot perpendicular to the target with the foot supported, (2) the students had not made a bowing motion forward, (3) students do not see the ball being herded. Solving problems faced by students, researchers will apply the method of dribbling sprinting and sprint interval training, because they see weaknesses that occur during the training process.

If you want to be a good soccer player, then the player must put a lot of emphasis on the moving speed, because in this modern soccer era the speed of movement plays a very important role in determining the outcome and course of the game, to move quickly must be trained quickly too (Purnomo, Tomoliyus & Burhaein 2019). Given the importance of moving speed when dribbling in order to outwit and break through the opponent's defence, so that the opportunity to create goals to the opponent's goal is more open, then in providing training must put a lot of emphasis on the element of speed by not ignoring other important elements that support in soccer. Many methods or training methods that can be used by the coach to develop the moving speed of the players, one of them is the method of acceleration sprint training and the method of sprint interval training, where both of these training methods are very good for developing speed, because in the acceleration sprint type exercise is almost the same as dribbling until it really leads to the training goal (Burhaein 2017a; Stone & Oliver 2009). Movement starts from slow running progressively increasing speed, in slow running motion the player can control the ball tightly so that the ball remains sticky to the feet. Practice dribbling with acceleration sprints can improve the ability of dribbling speed with tight ball control, with the ability to control the ball when dribbling, players can change direction quickly to get through obstacles or opponents while carrying the ball (Mustofa et al. 2019; Taskin 2008). Likewise with interval running exercises (interval sprints) players are required to make a run with the maximum speed repeatedly, so that the running speed of students can increase. When a player runs dribbling with maximum speed forward, an increase in dribbling speed can be achieved.

Methods

Participant

Participants in this study were 37 soccer students aged 12 – 13 years (M = 12.38; SD = 0.49) taken by ordinal pairing technique from a population of 52 students.

Research methods

This research method is an experiment with a 2x2 factorial design (Biddle, Markland, Gilbourne, Chatzisarantis & Sparkes 2001). This experimental study used two groups that received different treatments, namely the provision of training methods for acceleration dribbling and interval running. Here is a research design in this experimental research.

Table 1

Factorial Research Design 2x2

Exercise Method (A) / Coordination Eye-Foot (B)	Run Acceleration (A1)	Interval Running (A2)
High (B1)	A1. B1	A2. B1
Low (B2)	A1. B2	A2. B2

Information:

A1B1: Group of students who are trained using the acceleration dribbling exercise method with high ankle coordination.

A2B1: Group of students trained using the interval dribbling exercise method with high ankle coordination.

A1B2: Group of students who are trained using the acceleration dribbling exercise method with low ankle coordination.

A2B2: Group of students who are trained using the interval dribbling exercise method with low ankle coordination.

Data collection technique

The instrument to measure ankle coordination is the soccer wall test and to measure the ability of dribbling is the short dribbling test. Soccer wall volley test has a validity of 0.778 and a reliability of 0.860 (Ismaryati 2008). Short dribbling test emphasizes the speed of dribble time (AFC 2012). Data collection techniques used in this study were tests and measurements. Before the pretest and posttest measurements were taken, the samples were firstly measured for ankle coordination, to determine the coordination of high and low ankles. The initial test (pre-test) was carried out in order to find out preliminary data from research subjects about soccer dribbling. The test in this study used the Short Dribbling Test instrument. An initial test (pretest) is carried out to determine the ability of dribbling before any treatment or training. The implementation of the final test or post-test in this study is the same as the implementation of the initial test, namely by using the Short Dribbling Test, the purpose of the final test (posttest) to determine the difference in dribbling scores after treatment or practice. The difference in dribbling scores can be seen from the comparison of scores between before (pretest) and after (posttest). Treatment is carried out following a training program that has been prepared. Before being used for research, first the exercise program was validated by two experts namely Prof. In the field of physical training and PhD in the field of Soccer, so this training program is suitable for use in research. This experimental research was conducted during 16 meetings not including pretest and posttest.

Data analysis

Data analysis technique in this research, used was two-way ANOVA at the significance level $\alpha = 0.05$.

Results

A. The hypothesis of the difference in the effect of the method of dribbling sprint and interval sprint training on the ability of dribbling soccer.

The first hypothesis reads "There is a significant difference in effect between the method of dribbling sprinting and interval sprint training on the dribbling ability of soccer students aged 12-13 years". If the results of the analysis show a significant difference, then the training method gives a different effect on the ability of soccer dribbling. Based on the analysis results obtained by the data in Table 2 as follows.

Table 2

Two-Way ANOVA Results of Experiment Groups Using the Dribbling Exercise Method for Acceleration and Interval Running

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Exercise Method	3.050	1	3.050	14.032	0.002

From the two-way ANOVA test results Table 2 above can be seen that the significance value of p is 0.002. Because the significance value of p is 0.002 < 0.05, and an F count of 14.032 means that Ho is rejected. Thus there is a significant difference in the effect of acceleration and interval dribbling training methods on soccer dribbling skills of students aged 12 – 13 years. Based on the results of the analysis it turns out that the interval dribbling training method is higher (good) with an average posttest score of 11.827 seconds compared to the acceleration dribbling exercise method with an average posttest score of 12,608. This means that the research hypothesis, which states that "there is a significant difference in effect between the method of dribbling sprinting and sprint interval training on the ability of dribbling soccer for students aged 12 – 13 years", has been proven.

B. The difference in the influence of the ability of high eye-foot coordination and low-eye eye coordination on the ability of soccer dribbling.

The second hypothesis which reads "There is a significant difference in effect between the ability of high-eye coordination and low-foot coordination on the ability of soccer dribbling of students aged 12-13 years". If the results of the analysis show significant differences, then high ankle coordination and low ankle coordination have an influence on the ability of soccer dribbling. The calculation results are presented in Table 3 as follows.

Table 3. Two-Way ANAVA Results High Differences in Coordination and Low Coordination in Soccer Dribbling Ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Coordination	6.017	1	6.017	27.685	0.000

From the two-way ANAVA test results in Table 3 above, it can be seen that the significance value of p is 0,000. Because the significance value of p is 0,000 < 0.05, and an F count of 27.668 means that Ho is rejected. Based on this, it means that there is a significant difference between the ability of high-foot and low-foot coordination on soccer dribbling skills. Based on the analysis results it turns out students with high ankle coordination ability is higher (good) with an average posttest score of 11,669 seconds compared to students with low ankle coordination with an average posttest score of 12,766 seconds. This means the research hypothesis which states that "there is a significant difference in effect between high-eye coordination and low-foot coordination on the soccer dribbling ability of students aged 12 – 13 years", has been proven.

C. Interaction between training methods (acceleration and interval running dribbling exercises) and eye-foot coordination (high and low) with soccer dribbling skills.

The third hypothesis reads "There is a significant interaction between the training methods (acceleration and interval running dribbling exercises) and eye-foot coordination (high and low) on the soccer dribbling ability of students aged 12 – 13 years". The calculation results are presented in Table 4 as follows.

Table 4

Two-Way ANOVA Results Interactions between Training Methods (Dribbling Running Acceleration and Interval Running) and Eye-Foot Coordination (High and Low) on Soccer Dribbling Abilities

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Training Method *	4.734	1	4.734	21.780	0.000

Coordination					

From the two-way ANOVA test results in Table 4 above it can be seen that the significance value of p is 0,000. Because the significance value of p is 0,000 < 0.05, and an F count of 94.340 means that Ho is rejected. Based on this means the hypothesis stateing "there is a significant interaction between the training methods (acceleration and interval running dribbling exercises) and eye-foot coordination (high and low) on the soccer dribbling ability of students aged 12-13 years", has been proven.

A diagram of the results of the interaction between the training methods (acceleration and interval running dribbling exercises) and eye-foot coordination (high and low) on the soccer dribbling ability of students aged 12 – 13 years can be seen in Figure 1 as follows.

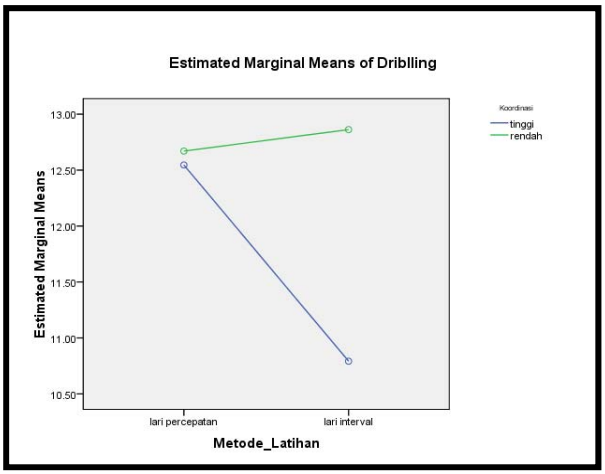

Figure 1
Interaction Results between Exercise and Coordination Methods

After testing the interaction between the training methods (acceleration and interval running dribbling exercises) and eye-foot coordination (high and low) on the soccer dribbling ability of students aged 12 – 13 years, it is necessary to conduct further tests using the Tukey test. The results of further tests can be seen in Table 5 below.

Table 5
Summary of Post Hoc Test Results

Group	Interaction	Mean Difference	Std. Error	Sig.
A1B1	A2B1	1.7540*	.29485	.000
	A1B2	-.1240	.29485	.974
	A2B2	-.3160	.29485	.711
A2B1	A1B1	-1.7540*	.29485	.000
	A1B2	-1.8780*	.29485	.000
	A2B2	-2.0700*	.29485	.000

A1B2	A1B1	.1240	.29485	.974
	A2B1	1.8780*	.29485	.000
	A2B2	-.1920	.29485	.914
A2B2	A1B1	.3160	.29485	.711
	A2B1	2.0700*	.29485	.000
	A1B2	.1920	.29485	.914

Based on Table 5 the Tukey test results on the Sig. (*) show that the pairs that have significantly different interactions or pairs are: (1) A1B1-A2B1, (2) A2B1-A1B2, (3) A2B1 - A2B2. Thus it can be concluded that:

1) If a group of students trained using the acceleration dribbling exercise method with high ankle coordination is paired with a group of students who are trained using the interval dribbling exercise method with high ankle coordination there is a significant difference in influence. The group of students who were trained using the interval dribbling exercise method with high ankle coordination was better than the group of students who were trained to use the acceleration dribbling exercise method with high ankle coordination, with a significance value of 0,000 < 0.05.
2) If a group of students trained using the interval dribbling training method with high ankle coordination is paired with a group of students trained using the acceleration dribbling training method with low ankle coordination there is a significant difference in influence. The group of students who were trained using the interval dribbling exercise method with high ankle coordination was better than the group of students who were trained to use the acceleration dribbling exercise method with low ankle coordination, with a significance value of 0,000 < 0.05.
3) If a group of students who are trained using the interval dribbling exercise method with high ankle coordination are paired with a group of students who are trained using the interval dribbling exercise method with low ankle coordination there is a significant difference in influence. The group of students who were trained using the interval dribbling exercise method with high ankle coordination was better than the group of students who were trained using the interval dribbling exercise method with low ankle coordination, with a significance value of 0,000 < 0.05.

Whereas the other pairs stated do not have different effects are: (1) A1B1-A1B2, (2) A1B1-A2B2, (3) A1B2-A2B2. Thus it can be concluded that:

1. If the group of students trained using the acceleration dribbling exercise method with high ankle coordination is paired with the group of students trained using the acceleration

dribbling exercise method with low ankle coordination there is no significant difference in influence, with a significance value of 0.974 > 0.05.

2. If a group of students trained using the acceleration dribbling exercise method with high ankle coordination is paired with a group of students trained using the acceleration dribbling exercise method with high ankle coordination there is no significant difference in influence, with a significance value of 0.711 > 0.05.
3. If a group of students trained using the acceleration dribbling exercise method with low ankle coordination is paired with a group of students trained using the interval dribbling exercise method with low ankle coordination there is no significant difference in influence, with a significance value of 0.914 > 0.05.

The results of paired variance analysis with Tukey's further tests showed that there were significantly different pairs, namely: (1) A1B1-A1B2, (2) A1B1-A2B2 pairs, while the other pairs stated no difference, namely: (1) A1B1-A1B2, (2) A1B1-A2B2, (3) A1B2-A2B2.

Discussion

1. Differences in the effect of the method of dribbling sprint and acceleration sprint training on the ability of dribbling soccer.

Based on hypothesis testing, it is known that there are significant differences in the effect of the method of dribbling sprinting and interval sprint training on the dribbling ability of soccer students aged 12 – 13 years. The interval dribbling training method is higher (better) than the acceleration dribbling training method for soccer dribbling abilities. As the name implies, interval running training (sprint interval) is a running exercise that is carried out interspersed with breaks between repetitions (repetition). Progressive interval training is a series of running exercises that are given a certain break and controlled intervals (Fox, Klinzing & Ragg 1977). Interval running training is a running training system interspersed with intervals in the form of periods of rest (Bravo et al. 2008). Where if the short work interval will involve the participation of anaerobic metabolism, so that programmed interval training will increase leg muscle power and result in increased running speed (Powers & Edward 2007).

At intervals the rest is done is by jogging. The rest interval is due to the depletion of energy due to work intervals that use high intensity. A rest interval in the form of a jog will result in energy replenishment by activating a backup system called the phosphagen system

(ATP-PC). The phosphagen system is a system in which creatine phosphate, which is a high-energy phosphate bond, will be broken down to absorb ATP to be used as energy when ATP supply cannot be fulfilled by the tissue. Energy replenishment for 30 – 60 seconds will result in rapid recovery and limit the production of excessive lactic acid when the muscles relax, so that the next exercise will not experience significant fatigue (Powers & Edward 2007).

The method of running interval training is a form or form of running training where the determined distance is travelled repeatedly and interspersed with stoppages or periods of rest that do not reach full recovery and are carried out at high speed or near maximum load. This interval running exercise occurs gradually from the synchronization of work exercises, where the specified distance is not travelled at a constant speed, but the distance is divided into several short distances and travelled by sprinting and interspersed with periods of passive rest (walking in place) which is time-limited and controlled. This interval running training activity is carried out alternately precisely between work and rest and the way its development is influenced by previous work and rest.

The application of the interval running method process needs to understand the terms or elements that exist in interval running training. This is as a reference in the preparation of interval running training programs. Implementation of interval running training programs there are several elements that need attention, including distance, speed, repetition and rest (Bravo et al., 2008). The elements of the exercise above can be divided into two main elements, namely the work interval, namely the portion of the training interval consisting of heavy work, and the rest interval (relief interval), which is part of the training interval where the body is given a break. Determination of the above mentioned elements clearly and in detail makes it easy in the implementation of training, because this can provide clearer instructions for both students and coaches. The success of interval running training programs, among others, depends on the accuracy in determining, work intervals, breaks, determining the number of sets and the number of reps (Powers & Edward 2007). Interval training very much depends on the purpose of the exercise itself. If the purpose of the exercise is to increase speed, then a better and more effective rest interval for use in training is a passive rest interval (Young, Dawson & Henry 2015). The purpose of the rest interval is for recovery after work. Recovery is needed after high-intensity work during training. With the interval of rest or recovery carried out between work hours has several benefits or advantages. The benefits of this recovery include: "(a) Avoiding overtraining, and (b) Providing opportunities for the player's organism to adapt to the previous training load", with sufficient recovery, the body will be ready to return to carry out further training activities.

2. The difference in the influence of the ability of high eye-foot coordination and low-eye eye coordination on the ability of soccer dribbling.

The analysis showed that there was a significant difference in effect between high eye-foot coordination and low-eye eye coordination on the soccer dribbling ability of students aged 12 – 13 years. Students with high ankle coordination skills are higher (better) than students with low ankle coordination. Soccer dribbling ability is influenced by the coordination of eye and foot movements (Zago et al. 2015). Dribble is influenced by coordination, sensory acuity, speed of movement, feeling of movement and movement technique itself. Added in the Special Olympics Soccer Coaching Guide (Phytanza et al. 2018; Pramantik & Burhaein 2019) that when dribbling, the most important aspects are balance and coordination. To get around the player, the body must be flexible enough to change direction by shifting body weight quickly, while maintaining balance and the ability to think fast. When asking a player to run around the field to warm up, it is better to do this by using the ball at his feet to help increase confidence in ball control when running.

Eye-eye coordination as the main capital to dribble soccer. Eye-eye coordination is the ability that underlies the motion of a person. Eye-foot coordination is a very important element for players, because eye-foot coordination is the basis for forming player skills. Eye-foot coordination can support the success of soccer dribble achievement by controlling the movements of the techniques that are carried out to be more accurate. Players who have high eye-foot coordination have the ability to master soccer dribbling faster than players who have low-eye coordination. The success of soccer dribble achievement is influenced by the ability of players to carry out movements in an integrated and harmonious manner. Strengthened by the results of Hartanto's research that there are differences in the influence of high ankle coordination and low ankle coordination on improving dribbling skills in college students (Hartanto, 2015). Coordination has a harmonious relationship of various factors that occur in a movement without tension in the right order and make complex movements smoothly without excessive energy expenditure depending on the coordination owned by a player.

Coordination is a combination of movements of two or more joints, which are interrelated in producing one movement skill (Kristiawan & Sukadiyanto 2016). The more complex the motion carried out, the greater the level of coordination needed to carry out agility. Coordination is closely related to other motor skills, such as balance, speed, agility. Balance is defined as the ability to maintain the attitude and position of the body in the fulcrum when standing (static balance) or when making movements (dynamic balance).

Eye-foot coordination is an integration between the eye as the holder of the main function in this case seeing the ball and the game situation encountered when kicking the ball and the foot as the holder of the function that performs a movement that is, touching or kicking the ball in order to move from its original place. Good soccer dribbling skills are influenced by eye-foot coordination. Integration that involves two parts of the motion namely the eyes and feet must be arranged into a pattern of good and harmonious movement to support soccer dribbling. Coordination is the ability to make movements with various levels of difficulty quickly and efficiently and with full accuracy. The level of good or bad coordination of one's movements is reflected in his ability to make a movement smoothly, precisely, quickly, and efficiently. Students with good coordination are not only able to perform a skill perfectly, but also easy and fast in doing skills that are still new to him. Good coordination can change and move quickly from one pattern of motion to another so that the movement becomes effective.

Soccer is a sport game that has quite complex elements of movement. Almost all soccer games require eye-foot coordination. This is because almost all soccer games require good eye coordination. Soccer dribbling is a form of soccer skill that demands good quality eye and foot coordination. In other words, whether or not good soccer eye-foot coordination will affect soccer dribbling (Huijgen et al. 2010)

Players who have high coordination, in doing soccer dribbling will differ greatly from players who have a low level of coordination. In this regard, Bompa suggests that children who coordinate well will always acquire expertise quickly and can do it smoothly, compared to children who move with rigidity and difficulty, a young students who coordinates well will spend energy less for the same performance, therefore good coordination results will be more effective in a skill (Bompa 1996).

3. Interaction between training methods (acceleration and interval running dribbling exercises) and eye-foot coordination (high and low) on soccer dribbling skills.

Based on the results stated in the results of this study, there is a significant interaction between the training methods (acceleration and interval running dribbling exercises) and eye-foot coordination (high and low) on the soccer dribbling ability of students aged 12 – 13 years. The results showed that the interval dribbling interval training exercise method was the most effective method used for students who had high ankle coordination and the acceleration dribbling exercise method was more effectively used for students who had low ankle coordination. From the results of the interaction form it appears that the main factors of

research in the form of two factors show significant interactions. In the results of this study the interaction which means that each cell or group there are differences in the influence of each group that is paired. Couples who have significantly different interactions or partners are as follows.

a. The group of students who were trained using the interval dribbling exercise method with high ankle coordination was better than the group of students who were trained to use the acceleration dribbling exercise method with high ankle coordination, with a significance value of 0,000 < 0.05.
b. The group of students who were trained using the interval dribbling exercise method with high ankle coordination was better than the group of students who were trained to use the acceleration dribbling exercise method with low ankle coordination, with a significance value of 0,000 < 0.05.
c. The group of students who were trained using the interval dribbling exercise method with high ankle coordination was better than the group of students who were trained using the interval dribbling exercise method with low ankle coordination, with a significance value of 0,000 < 0.05.

Conclusion

The conclusions in this study are: (1) There is a significant difference in the effect of the method of dribbling sprint and acceleration sprint training on the dribbling ability of soccer students aged 12 – 13 years. The interval dribbling training method is higher (better) than the acceleration dribbling training method for soccer dribbling abilities. The group of students who were trained using the interval dribbling exercise method with high ankle coordination was better than the group of students who were trained to use the acceleration dribbling exercise method with high ankle coordination, with a significance value of 0,000 < 0.05; (2) There is a significant difference in effect between high eye-foot coordination and low-eye eye coordination on the dribbling ability of soccer students aged 12 – 13 years. Students with high ankle coordination skills are higher (better) than students with low ankle coordination. The group of students who were trained using the interval dribbling exercise method with high ankle coordination was better than the group of students who were trained to use the acceleration dribbling exercise method with low ankle coordination, with a significance value of 0,000 < 0.05; (3) There is a significant interaction between training methods (acceleration and interval running dribbling exercises) and eye-foot coordination

(high and low) with the soccer dribbling ability of students aged 12 – 13 years. Couples who have significantly (significantly) different interactions or partners are as follows. The group of students who were trained using the interval dribbling exercise method with high ankle coordination was better than the group of students who were trained using the interval dribbling exercise method with low ankle coordination, with a significance value of 0,000 < 0.05.

The implication of the results of this study is that the application of the method of dribbling sprinting and interval sprinting exercises has a significant effect on the ability of soccer dribbling. This gives a clue that in training soccer dribbling skills, the application of the method of instrual dribbling practice is more appropriate in improving soccer dribbling skills. From these implications, this study contributes as a consideration for coaches, in creating training programs that are suitable for improving soccer dribbling skills. Thus the training will be effective and will get results in accordance with what is expected by the trainer. This research is certainly not perfect because of the limitations in conducting research, namely; 1) During the exercise or application of treatment, all groups are not collected or quarantined so there is no control over what activities are carried out outside the training sample, but rather stay in their respective homes. This can indirectly affect the results of research; 2) Due to erratic weather conditions caused by rain, so at the time of the training it was less conducive because the field was flooded and muddy. Future similar studies should pay attention to the limitations of this study.

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Conflict of Interest - The author states there is no conflict of interests.

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