DOI 10.2478/afepuc-2019-0001
© Acta Facultatis Educationis Physicae Universitatis Comenianae 2019, 59(1): 1-12

PHYSIOLOGICAL ASPECTS AND INJURIES IN MIXED MARTIAL ARTS

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Summary: Mixed Martial Arts (MMA) has become an independent sport discipline with its own distinctive aspects. It can no longer be perceived as before, as a compilation of other martial arts. MMA shows originality in training methods, health aspects, performance requirements or even moral-volitional qualities. The aim of the paper is to analyse the physiological aspects of MMA in both training and combat loads, to discuss the issue of injuries in MMA and to provide a comparison with other martial arts. Studies focusing directly on MMA wrestlers have been selected. These have included both amateur and professional athletes. The databases Pubmed, Scopus, Web of Science, and Scholar were used as sources. MMA ranks among sports with high-intensity workload, wrestlers achieve high levels of lactate and other metabolic markers. They need above-average aerobic capacity and perform well in upper body strength tests. Injury rates in MMA do not differ significantly from those in professional-level martial arts. Most injuries are associated with lacerations on the head. The requirements of extensive workload during performance must be reflected in training. Encouragement of aerobic and anaerobic endurance abilities in conjunction with optimum strength training seems crucial. It is essential to include prophylaxis as regards head concussions and strive for maximum safety of the sportsman during combat. Further research is required to confirm some of the conclusions, the limitations of which are due to the number and quality of the selected studies.

Keywords: mixed martial arts, physiology, injury

Introduction

Mixed martial arts is a relatively young sport discipline. Its recent history can be dated back to the 1990s. The birth of MMA is associated with an American organization called UFC (Ultimate Fighting Championship), which organized its first event, in 1993 (Savage-West 2015). Growing popularity brought about a rapid boom and the number of fans rocketed, as the current transmissions of foreign and domestic gala evenings show.

Although there were tendencies throughout the world towards combats with rules more lenient than those of current traditional sports, the course of MMA was set by the USA. From the very beginning, MMA had many opponents because of the toughness of combats, which led to its ban in 40 US states. Over the years, with the growing number of supporters, the rules have stabilized and UFC together with other organizations have created a recognized sport discipline. Gradual amendments of rules concerned especially wrestler‘s safety (e.g. attack aimed at the eyes or neck, kicking a lying opponent) (Lystad 2014). This is also a reason why research dealing with MMA environment appears as late as long after 2000.

At the beginning, MMA was perceived as a compilation of individual martial arts, which was reflected in the approach to training. Over time, however, an independent discipline has formed, the performance and training principles of which cannot be easily transferred from other sports (martial arts).

During the analysis, research of "similar" sports, such as boxing, kick-boxing, Greco-Roman wrestling, judo, etc. were also used to a certain extent, due to lack of direct MMA studies. However, the conclusions can be applied only partially (although some elements are very similar).

From a varied spectrum of analyzable aspects of a particular sport discipline, physiological workload and the issue of injuries were chosen. The conclusions drawn from their analysis capture important health aspects and may be used for refining the workload during training or combat. The text below focuses mainly on MMA wrestlers and their environment during training or combat. The used source databases were Scopus, PubMed, Web of Science, Scholar.

Physiology

MMA is classified among sports with high demands on high-intensity performance. The usual structure of a match is three five-minute rounds with one-minute breaks in-between (with

an exception of championship matches, which have five rounds). However, also ten-minute rounds may be seen (see the Rizin organization), which to some extent change the concept of the match. It is obvious even to a regular viewer that the workload is high and associated with strength and fitness effort (Schick, 2012). It is difficult to interpret the course of the match from the aspect of physiological processes due to its enormous variability. Wrestlers may fight in a separated stand-up position, in clinching position, on the ground, or in various combinations. This places different requirements on the aspects of strength, fitness, and coordination.

The common approach to setting optimum training loads is to get close to the official match. Amtman (2008) observed the differences in the workload of a circular training with specific elements of combat sports, a 2 x 4 min sparring match and an interval protocol Tabata 8 x 20 – 10 s. Lactate levels and RPE (rating of perceived exertion) values on the Borg scale were the outcome measures. Lactate levels of the sample (n = 6) reached 8.1 – 19.7 and 10.2 – 20.7 $mmol.l^{-1}$ after sparring, which correlated with Borg values of 15 – 19 and 13 – 19, respectively. The values reached in Tabata intervals were lower. The resulting low values were due to prematurely terminated sparring in some cases (submission, knock out). Therefore, sparring must be well-organized, otherwise the sportsman may fail to achieve the desired workload. This applies to both the wrestler who gains the upper hand and to his opponent.

In a pilot study (Brasweel 2013), selected physical parameters were measured in MMA fighters and compared to those of karate fighters. Neither anthropometric parameters nor stress test results (vertical jump, repetitive push-ups, sit-ups, grip strength, bench press) were significantly different. One of the conclusions stated very good aerobic capacity based on VO_2 max values. Unfortunately, the full text of the study is not available and the abstract does not describe further details.

Gochioco (2010) reports similar results in MMA wrestlers, i.e. 53.44 + - 5.77 $ml.kg^{-1}. min^{-1}$. This group was also tested for maximum performance in squats and bench press, recalculated per body mass with a result of 1.45 and 1.25, respectively. The author also added that the stress test results were closest to judokas, whereas Greco-Roman wrestlers achieved lower values. Amateur level wrestlers who are expected to show lower values than professionals were tested.

VO_2 max level was also tested by Alm (2013), and the measured capacity was around 60 $ml.kg^{-1}. min^{-1}$. The authors also compared running on treadmill and arm cycling, which did not show different outputs. Upper body performance parameters appeared to be more significant for overall performance than those of the lower body were. Therefore, the authors proposed to include the mentioned arm cycle in testing. Another conclusion was high tolerance

to elevated lactate levels in elite wrestlers. They have to cope with this condition during the combat having only one minute between rounds for some recovery. If lactate levels are too high or persist for too long, it has a negative impact on both physical and mental aspect of the performance.

Addressing the physiological profile, Schick (2010) confirms above-average VO_2 max values, i.e. 55.5 ± 7.3 $ml.kg^{-1}. min^{-1}$, in wrestlers with a minimum of two years MMA fighting experience regardless of their performance level. The study compares the results, among others, to other martial arts, however, in our opinion it is impossible to compare amateur wrestlers to elite international level athletes. Compared to Gochioco (2010), the volunteers achieved similar results in strength tests. For the upper body bench press was selected and the average measured was 1.2 kg per kg of body mass.

A comparison of official and sparring matches was carried out in a group of professional fighters (Coswig 2016). Post-match lactate levels were comparable with mean values of 16.9 and 16.8 $mmol.l^{-1}$, respectively. Some tested subjects reached values exceeding 20 $ml.l^{-1}$. This study reported no differences between winners and losers (as opposed to Amtman 2008). Athletes could use regular protective equipment during sparring, however, the motivation and coaching provided was similar to official matches. Biomarker levels (creatine kinase (CK), aspartate aminotransferase, alanine aminotransferase), showed no significant muscle damage during the match. CK values were not as high as in other studies (Weichmann 2016; Ghoul 2017). Samples were collected immediately after exercise, i.e. increase of biomarkers within 24 hours could be expected.

Weichmann (2016), who focused on muscle damage, also performed analysis of blood samples collected after official matches. Monitored markers were CK and myoglobin; high values thereof corresponded to high physical load. Peak CK values averaged 829 U/L^{-1}. Nevertheless, the results were comparable to those reported for other sports, such as rugby. Also Lindsay (2017) arrived to similar conclusions, although different markers (neopterin, myoglobin) were monitored. The authors also suggest that increased levels of selected parameters could reflect un/successfully executed kicks and punches. However, they do not provide any relevant confirmation of this hypothesis.

High physiological load associated with CK elevation after exercise is described by Ghoul (2017). Specifically, average CK values 24 hours after a simulated match moved around 600 U/L^{-1}. This study simultaneously monitored fluctuations of testosterone and cortisol, which were comparable to those described in more intense activities. This research included, among others, also the effect of cold water on various blood values and performance tests. For this

intervention, the conclusions were not in ambiguous, especially in the dynamic-strength tests. To speed up the overall regeneration after a very demanding MMA training as much as possible, cold water seems to be a possible means (see also Tabben 2018).

Research focused on other martial arts, such as boxing, kick-boxing, judo, greek-coronet wrestling, taekwondo, and so on, provides a certain comparison. In general, the tested athletes reached higher VO_2 values, the highest ones, about 60 $ml.kg^{-1}. min^{-1}$, being reported in boxers (Lenetsky 2012). The results confirm that very good aerobic fitness is important for most combat sports. In upper body strength testing, bench press is included serving as a good indicator of pressure strength and absolute strength. High performance is typical for judokas and Greco-Roman wrestlers. This component appears to be a good testing criterion for MMA. The statistics also show that taekwondo and thai boxing share the fewest common physiological traits with MMA. These conclusions should be taken into account when implementing specific training methods that should be optimized specifically for MMA.

Some studies (Ghoul 2017; Alm 2013; James 2016) have investigated performance in various strength and dynamic-power techniques. However, these data are too scarce for any conclusions. So far, the most frequently used test is the bench press, which seems to be a good indicator of performance (as opposed to the back squat). However, the researchers are moving towards analyses of exercises where athletes use their own body or towards conversion of performance relative to body mass, which could be more informative than the absolute performance. Due to the great variability of MMA, it is difficult to find adequate strength tests overlapping with the overall performance of the wrestler. However, performance of different weight categories should be distinguished because, as results from other sports disciplines show (Storey 2012), they cannot be considered as constant.

Figure 1 lists studies dealing with physiological aspects. So far, their number is relatively small. We are sorry to say that the evidence of most research is weak. Investigated samples usually include only a small number of subjects showing, moreover, different performance levels. Weight categories with their logical differences are not sufficiently respected either.

Injuries

MMA ranks among those martial arts that logically attract attention to the aspect of injuries. Here we mean especially injury caused by the opponent, no matter if it is during training or a match. Again, examples may be taken from other martial arts such as boxing, kick boxing, Brazilian jiu-jitsu, judo, and others (Pocecco 2013). However, even here, MMA has its

specifics and a complex combination of various combat styles in synergy with its own techniques extends the repertoire of possible injuries.

A study by Jensen (2017) compared MMA and other combat sports from the aspect of injuries. Its statistics yielded that most injuries occur during training and only a third to a fifth thereof during the match itself. Injuries vary also depending on the nature of the sport. Typical injuries in judo or Greco-Roman wrestling are joint injuries (elbows, shoulders), in boxing or kick-boxing they are primarily head and face injuries. This indicates that in injury prophylaxis attention should be paid to preparatory periods.

In this context (Miarka 2018) states that the main reason for a doctor to stop a match (doc-stoppage) are head injuries in more than 90 % of cases, namely lacerations (80 %). Interestingly, this most often happens during the second round, due to so-called striking. In an analysis of 635 matches from 2002 – 2007, Ngai (2008) reports injury rate of 23 %, of which 3 % were severe concussions. According to the author, these numbers are comparable to those in other stance combat sports (see also Bledsoe 2006), which is, however, in disagreement with other authors (Lystad 2014; Pocecco 2013).

A MMA-only meta-analysis showed that the most commonly injured region was the head, accounting for 66 – 78 % of injuries, followed by hand and wrist accounting for 6 – 12 % of cases (Lystad 2014). The most frequent injury types were laceration (36 – 59 %), fractures varied from 4 to 43 %. As regards injury rate, MMA ranks among martial arts with the highest number of injuries per 1 000 matches (athlete-exposure). These findings agree with Lystad (2015), however, the highest absolute number of head injuries was reported for boxers.

The risk factor of injury constantly rises with increasing weight category and is also higher in title matches. It is not surprising that the risk of injury is three times greater in losers than in winners. Curran-Sills (2018) arrived to comparable conclusions with Canadian professional wrestlers. Over five years, there were 162 injuries (in 686 athletes) during 35 events. Again, the most common was head injury. Ji (2016) stated different results in Korean wrestlers, reporting arm and neck as the most commonly injured body parts, the head coming next. However, at the same time, lacerations and brain concussions were reported as the most common type of injury.

The analysis by McClain (2014) provides a more positive statistic showing "only" an 8.5 % risk of injury, as opposed to that of 23 – 28 % reported elsewhere (Bledsoe 2006; Ngai 2008 etc.). However, the diverse performance levels, including amateur matches, should be taken into account. It is possible that it is just in lower performance level matches where the risk of injury is not so high. However, this is still an unconfirmed hypothesis.

Hutchison (2014) performed an analysis of UFC matches dating from 2006 – 2012. Knockout or technical knockout was recorded in 31.9 % of cases. Although this is not directly linked to an obvious injury, knockout presumes strong blows to the head often associated with short-term unconsciousness or other trauma. Given these findings, the authors propose to forbid MMA in wrestling form to children and youth. The concept of events and the sport itself seem problematic in this respect. Unlike other sports, where after a strong blow the athlete is sent to the ground (knock down) and the match is in fact interrupted so that the referee may check the health status of the fighter. In MMA, the whole action must be judged by the referee "on the move" during the match and the moment when the referee intervenes means the end.

Martial arts are mostly a male affair, however, at a professional level, women form a regular part of MMA events. Research studies involving female wrestlers provide little information so far to enable any conclusions (Thomas 2018).

Thus, MMA is classified among sports with frequent blows to the head. This probably represents the highest risk as regards to serious permanent consequences. However, little information is available so far on the long-term effect on the neurological apparatus of MMA fighters. Box, where the risk is similar, can be regarded as a relevant comparison. A review by Heilbronner (2009) lists many studies documenting the impact of boxing on various neuropsychological markers. It should be noted that there is also research reporting no difference in cognitive abilities between boxers and a control group. The frequency of concussions appears to be the main problem. This has also been confirmed by Mishra (2018), where cognitive impairment has been reported in boxers and MMA fighters using magnetic resonance imaging.

It is certain that MMA ranks among risky sports as regards injuries (both during matches and during training). However, as regards health condition of the athlete, long-term consequences due to serious injuries and repeated head concussions are much more important. It is in this very respect that further research is needed (see also Thomas 2018).

Conclusion

Studies show that in MMA wrestlers high lactate levels are observed during standard load that corresponds also to subjective RPE. High intensity is characteristic for not only training but also official matches. However, its specific nature is not invariant and depends strongly on the course of the match. Nevertheless, the wrestler must be physically and mentally

ready to work with that. Very good physical condition necessary for MMA is reflected in VO2 max testing, where above-average results are achieved. High cardiovascular muscle load manifests as a rise in blood markers such as CK. This implies that it is necessary to regularly include units with a high RPE in the training and, at the same time, to emphasize observing consistent regeneration time associated with optimum workload of the athlete.

Although results are not unambiguous, MMA does not stand out from other combat sports as regards injuries. From a probabilistic point of view, the risk of injury is higher, especially as regards head injury. Attention should be paid not only to matches, but also to training sessions.

They also bring a higher risk of injury because of specific high-intensity preparation (e.g. simulated match - sparring). Because of frequent blows to the head, wrestlers risk permanent consequences. Therefore, this aspect must be taken into account in the overall concept of training and sports career. It is important to emphasize that most of the presented data is more than 10 years old. MMA is a fast-changing sport, and there is a positive trend in considering health condition of wrestlers (referee interventions, forced breaks after knock out, mandatory examinations, etc.).

Further research is necessary to confirm some of the conclusions. The main limitation is the size of the monitored subject samples, which is often small and very heterogeneous (different performance level, weight category, etc.) or not so up-to-date data.

	N	sex	age	training experience	V̇O2max (mL/kg/min)	lactate (mmol.L^{-1})	CK (U/L)	total neopterin (mmol/SG)	main outcome
Amtmann (2008)	6	male	21-41	amateur		8,1-19,7/ 10,2 - 20,7 (postbout)			high level of lactate during training, interval training as an important part of training
Braswell (2010)	12	male	18-36	professional, amateur					comparable results of VO2 max with karate
Alm (2013)	5	male	29,5 ± 5,5	elite	60,5 ± 5,1	14,02 ± 5,16			high aerobic capacity, no significant improvement in physical parameters during the year
Coswig (2016)	25	male	26,5 ± 5	professional		13,8 - 23,5/ 12,3 - 19,2	159,7-394, 5 / 208,5 - 403,5		official and simulated matches have a comparable load, glucose level rises before the official match
Ghoul (2017)	12	male	26 ± 5	professional		13,6 ± 1,4	598 - 451		correlation between biomarkers, motor tests and RPE
Lindsay (2017)	15	male	28,3 ± 5,7	semi-professional				14000	high structural and inflammatory stress, cold water immersion as useful recovery strategy
Schick (2010)	11	male	25,5 ± 5,7	amateur, professional	50,6 - 60,4				comparable parameters with judo, wrestling, average grip strength
Tabben (2018)	12	male	26 ± 5	professional					same study - Ghoul (2017), mixed effect of applying cold water to physiological markers and performance
Weichman (2016)	10	male	28,3 ± 5,7	elite			829±753		pronounce increase of CK and myoglobin after official match
Gochioco (2010)	8	male	26,8 ± 6,06	amateur	53,44 ± 5,77				lower values than judoist, comparable to wrestlers

Figure 1

Summary of studies examining physiological aspects in MMA

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DOI 10.2478/afepuc-2019-0002
© Acta Facultatis Educationis Physicae Universitatis Comenianae 2019, 59(1): 13-20

THE ONTOGENETIC DEVELOPMENT PREREQUISITES OF PHYSICAL ACTIVITIES IN THE AQUATIC ENVIRONMENT IN EARLY CHILDHOOD

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Summary: The text deals with neurophysiological and kinesiological developmental principles associated with the early development of young children as the fundamental prerequisites for physical education in the aquatic environment. Swimming in infancy and early childhood using the developmental principles and understanding of individual variability represent enormous potential to create a positive attitude of the child to exercise in aquatic environments. We believe that the experience with these basic tasks can play a key role in future exercise habits and swimming literacy of the individual. Parents attending infant swimming courses led by an instructor acquire practical skills and deeper insight into principles of their child's motor learning. All activities in the aquatic environment at an early age should allow transfer of child´s experiences to preswimming education and result in full swimming literacy.

Key Words: Swimming literacy, infant and toddler swimming, neurophysiological prerequisite

Introduction

Understanding the neurophysiological and kinesiological principles of motor development is essential for the evaluation of preparedness of young children to be introduced to targeted physical activities. Physical education leading to a satisfactory level of physical literacy can result in building a routine of adequate physical activity throughout life and can be started in the aquatic environment. Introduction to swimming literacy often occurs during early childhood, usually in the preschool period (Nováková et al. 2015). An adequate level of physical literacy is required for width and quality of sport training and specialized high-performance sports (Whitehead 2010; Bailey et al. 2010; Balyi et al. 2013; Giblin et al. 2014, Giblin, Collins & Button 2014; Kyselovičová et al. 2016).

Another health benefit of swimming (or another effective physical activity in the aquatic environment) performed throughout the entire life can be reduced risk or at least delay of the onset of the civilization diseases. Swimming can also full fill the role in prevention of childhood obesity. Additionally, exercise in the aquatic environment has a positive effect on delaying and possibly reducing the onset of dementia, ischemic heart disease, myocardial infarction and diabetes (Findholt 2007; Khan 2009; Rolland et al. 2008; Verghese et al. 2003).

Training of skills forming the primary swimming competency is offered as a service in the baby clubs for early childhood (infant, toddler). It is not possible to agree fully with it, although some elements of water competency a child can learn at this age. Follow-up swimming literacy is related with the quality of swimming locomotion. The availability of swimming movements is required for everyone on own his/her musculoskeletal system level. We focus on efficient swimming technique characterized by correctly mastered swimming position, swimming breathing and symmetry in model stroke movements (Nováková et al. 2015; Langendorfer & Bruya 1995).

The authors of this paper assume that the introduction to controlled movement experience in water normally begins after the first year of life. Further studies show a positive influence of repeated movement experience in the aquatic environment on the child during a period right after the disappearance of primitive reflexes. The positive effect is particularly noticeable on the rate of acquiring some of coordination skills in water at a later age (Zelazo & Weiss 2006). This early period ends when the fundamental pattern of coordination is combined and elaborated into context-specific movements (Clark 2005). The text deals with the period from new-born until four years of age also known as the “pre-beginner” period.

The analysis of published works shows a clear tendency to use the widest possible comprehensive concept of physical literacy. To achieve physical literacy, the focus should be on encouragement of acquisition of all partial and significant components in parallel rather than in a serial fashion as is done in many swimming education programs. An important prerequisite of these concepts is the establishment of the link between unique and individual aspects of motor ontogenesis and the common principles of motor development as both are embodied in movement education (Nováková et al. 2015; Langendorfer & Bruya 1995; Benčuriková & Putala 2017, Logan et al. 2015).

Neurophysiological and kinesiological prerequisite for the effective (reasonable) physical activities in the aquatic environment in early childhood

Humans are born physically (in terms of movement control) immature. Only the gradual development of the central nervous system (CNS) accompanied by purposefully experimenting with basic trial and error muscle functions and the postural development subsequently allow goal-oriented postural and locomotor movements to emerge in a young child's movement repertoire. Every movement is unique and is adapted to the particular situation. Postural control changes only gradually from the second month on. Postural strategies are one motor development example that illustrates how qualitative and quantitative changes depend on the character of the environmental context and on the complexity of the goal of the motor task (Faladová & Nováková 2009).

Early movement behaviour is accompanied by the child's mental activity of discovering. The sensory inputs are the most common basis for motivation to move. The evaluation of the importance of sensory perceptions for orienting responses in young children is basis for the early initiation of motion. The voluntary correction and anticipation mechanisms come forth with increasing experience and difficulty of the tasks. Cortical parts of CNS provide integration and memory functions that underlie movement patterns as a basis for voluntary physical activity. Some very basic reflexive, non-voluntary movements may be controlled by primitive subcortical structures in the brain and are associated with certain simple stimuli. Subcortical brain structures implement less differentiated functions which are already automatized, instinctive or reflexive (Véle 2006).

Until the beginning of the second year of age the child does not independently orientate in space and usually does not evaluate the speed of surrounding objects or people. Consequently, the small child doesn´t respond to these environmental and task constraints during movement and still usually fails to identify his/her own body or to react effectively to obstacles in the way.

Interestingly, the period between the first and third year of life is characterized by the fear of unknown or unfamiliar experiences. This fear may significantly affect the child's primary motivation for physical activity in the aquatic environment. During this same period, new motor skills emerge resulting the child freeing their hands from support and postural functions (e.g., crawling). At the same time improving vestibular function and oculomotor coordination enable more differentiated and advanced voluntary movements.

During the toddler period (i.e., years two and three) children begin to learn how to use movement purposefully and create relationships to movement (locomotion, sport) that extend to the remainder of their lives. Postural control (especially in the vertical position) and stability increase dramatically during this period. Children acquire the ability to predict dynamic changes in their surroundings and use them for their self-chosen and directed goals. Children can adjust their postures, which allow them to move with anticipated consequences. There is an enhancement in the coordination of individual components of movement that allows children to use movement patterns more effectively for chosen activities. Significant changes in the quality of coordination of motor skills occur from the second to sixth year of age (Kobesová & Kolář 2014).

Between the fourth and sixth year the myelination of pyramidal pathways occurs. More advanced cerebellar functioning manifest in development of equilibrium skills, fine motor skills, and speech, and higher-order cortical functions become more adult-like. Somatesthesia and kinesthesia are important for the perception of motion, error detection and possible corrections. The role of somatesthesia, vision and tactile input into the motor control greatly increases in this period. From the sixth year children can use kinesthesia to copy the movement of the arm and head in space without optical control (Kobesová & Kolář 2014; Kučera et al. 2011).

Rhythmic skills in movement develop from three years of age on and eventually are manifested by the ability to handle a sequence of jumps on one or both legs. During pre-school period the opportunity to improve the quality of complex movements with independent movements of limbs results in the body synkinesis. It improves the overall dynamic coordination of cyclic and acyclic movements (Kolář 2009).

The positioning in the aquatic environment requires coordination of a specific postural motor situation. The aquatic environment creates conditions that are different from the terrestrial environment, especially in the sense of equilibrium functions resulting from gravity. Thus, the aquatic environment brings other exteroceptive (temperature and water flow) and proprioceptive stimuli (the "relief" of the body by the overhanging, the reduction of the loading load of the joints, the water resistance against the body segments), which are processed in the CNS. Extension of the range of sensory exteroceptive, proprioceptive and vestibular system stimuli is appropriate for

development or maintenance of motor control. Repeated experience can increase the quality of somatognosis, feedback or feedforward relationships that are indispensable in the process of posture acquisition and voluntary movement control (Nováková & Čechovská 2012).

The developmental examples of limitation in the preswimming skills

We present developmental parameters that influence the child's motor behavior in the aquatic environment under the assumption that all other conditions are optimal (the child motivation, no fear of water, adequate environment...).

Presence (emergence) of primitive reflexes (Piek 2006) causes reflex motor responses (reflex grip, lateroflexion of trunk in Galant reflex or startle response) in the case of manual contact at the trigger point of the reflex reaction or unstable body position in the water. It occurs from birth to about 3 months of age.

The "flexed" or "extended" developmental period (Kobesová & Kolář 2014) with change in the basic muscle tone is the prerequisite for child tendency to respond with primarily flexed or more straighten position of the trunk - two periods are described as flexion (0-1 month, 4 to 9 month) and two as extension (2 to 3 month, 10 to 12 month of age). Whether the infant tolerates individually positions in water, the range of motion in joints or level of general relaxation in floating are developmentally dependent on the flexed or extended period.

Level of the postural stabilization (Kobesová & Kolář 2014) improves from 3 months of age on with the progressing postural development. Increased ability to stabilize the trunk improves range of motion in proximal joints and allows more precise differentiation of the extremities muscle function. Prone position in case of not stabilised upright cervical spine is impossible to perform safely. Even the ability to grasp a toy or balance for assisted gliding skills will depend on a sufficient level of stabilization of axial system (head, spine, pelvis).

Orientation in water is dependent on **visuomotor coordination**, which develops significantly starting at 6 months of age (Shumway-Cook & Woollacott 2007). **Preferred position in the spontaneous motor behaviour** predetermines the child's reaction to different positions in the aquatic environment. A typical example is decreased level of relaxation in floating when they are offered the non preferred position: in the 3rd trimenon infant uses almost exclusively the prone position, which corresponds to his/her sensory needs. During this period most infants have the tendency to scroll to the prone position from a position on the back in the aquatic environment.

Low differentiation of limbs movement (Piek, 2006) before locomotion in the terrestrial environment (creeping or crawling) limits dissociation of arm/leg function before the half of the 3rd trimenon (limbs work reflectively without selective alternating movement). The level of

verticalisation (the ability to hold the body against gravity) always determines a suitable position of the child in the aquatic environment, but also limits the practice of his/her entry or fall to the water.

Conclusions

Alarming rate of obesity and declining physical fitness in both paediatric and adult population raises concerns for all experts. The so called infant (baby) swimming in compliance with the principles of development and understanding of individual variability brings enormous potential to develop a positive lifelong relationship of the child to exercise in general. Exercise in a specific aquatic environment is a benefit for the child's future physical literacy, in particular swimming. Another positive aspect is the participation of the child's parents in the swimming courses. There is a prerequisite for a shared physical activity in the aquatic environment as the basis for influencing the exercise habits of children but also of the parents themselves as well. Parents attending infant swimming courses led by an instructor acquire practical skills and deeper insight into principles of their child's motor learning.

All activities in the aquatic environment at an early age should allow transfer of child´s experiences to pre swimming education and result in full swimming literacy. For this reason, it is important not to develop the pathological movement stereotypes (due to the high difficulty of rebuilding them) in the aquatic environment in infants and toddlers.

Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

This study was conducted with support from the Ministry of Education, Youth and Sports of Czech Republic and Charles University in Prague in research project Development Scientific Areas Programme projects P15 The school and the teaching profession in the context of the growing demand for education, P38 Biological aspects of exploring human movement.

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DOI 10.2478/afepuc-2019-0003

© Acta Facultatis Educationis Physicae Universitatis Comenianae 2019, 59(1): 21-32

DEVELOPING EXPERTISE IN SPORT COACHING THROUGH ENGAGEMENT WITH DISABILITY PROGRAMMES

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Summary: Numerous academic and practitioner research has examined the role of Higher Education Institutions (HEI) in the development of sport coaches in the UK (e.g. Crisp 2018; Stoszkowski and Collins 2018). However, whilst most fields related to coach development have significant bodies of work underpinning them, there is a dearth of information related to best practice within the context of disability sport coaching. Given that both coach learning in the HEI context and disability sports coaching are significant areas worthy of further exploration, this work investigates how learning can be developed through disability sport coaching in the HEI context. The aims of this study were to gather the perceptions, thoughts, and experiences of ten student-coaches enrolled on an HEI coaching programme who were completing a year long placement module that included sessions for participants with disabilities. Data were collected through two focus group meetings with the student-coaches and the submission of learning journals. Inductive analysis showed that coaching disability groups facilitated learning through generating knowledge from practice through a process of reflection, higher order thinking, and meta-cognition. This suggests that using disability coaching can be a useful tool for HEIs to use in terms of challenging student-coach practice and education.

Key words: sports coaching, meta-cognition, disability, reflection, coach-learning

Introduction

This study illustrates the findings of an evaluation of student experiences/perceptions across a programme of disability coaching within a Higher Education Institute (HEI) coaching placement module. The central aim of this research was to assess the effectiveness, and resultant satisfaction, of the students' learning journey regarding the community programmes that they assisted in on site (at the University) as part of a one year coaching placement module. In addition to this broad aim, the purpose of the study was threefold: To identify key learning dispositions within this cohort of student-coaches related to the theories, skills and knowledge which sports coaches use in their work; to examine whether the students' personal capacities, knowledge and process skills related to learning and coaching are developed in the context of disability coaching; and to use this analysis to examine the extent to which independent learning and meta-cognition play in the development of student learning. What comes next is a more thorough outline of coaching skills and practice, and an overview of disability sports coaching in the UK.

Coaching skills, coaching practice

At a basic level, the nature and practice of sports coaching can be reduced to what might be considered minimum standards for deployment, with certain key elements such as leadership, planning, and communication to the fore (North 2009; Navin 2011;). However, understanding what sports coaching is, how to define it, and outlining what are considered to be the necessary core skills for delivery can prove to be problematic. This is particularly so once we add in the conundrum of coaching 'others' who are different to ourselves and that we have no experience of working with.

However, the use of the term the coaching process is helpful. This refers to the way in which performance, be it a specific skill, technique, or even the way in which someone can interact with others, is improved through a relationship between coach and performer **(**Cross & Lyle 2003; Lyle 2008; Robinson 2010). So there is a clearly established recognition of how we can approach any understanding of sports coaching, perhaps irrespective of where it sits in a diverse and wide scope. Nevertheless, there continues to be an awareness within sports coaching literature that the organisational culture and provision of disability coaching is lacking (Townsend et al. 2015). Few may dispute this belief, and much of this is due to the acknowledgement that sport coaches, in the UK, have limited knowledge about impairment

and disability. This is certainly true in the sense that the width and scope of disability coaching needs to first consider how disabilities are conceptualised.

Disability coaching

Disabilities are explained through the medical model, one that fundamentally positions disability through the lens of impairment (Shakespeare 2006) and the social model, one that sees disability as a product of society (Antonak & Livneh 2000). The key tenet here is that society decides on the categories that are enabling and disabling. Both models include physical and learning impairments and given this, it is possible to surmise that working with people with impairments necessitates a focus on knowledge, context, and the developmental needs of coaches and organisations.

We can consider that anyone working with people with disabilities should have the capacity to understand context, diagnose issues and find solutions. Yet this suggests that these same 'workers' have a suitable breadth of experience, knowledge, and prior practice. In all likelihood, many sports coaches' learning in the UK will not have been augmented by any significant training programme/s specifically related to disability sports. The perennial problem then lies in how individuals need to draw from previous experiences and understanding of contexts, in this case various ones related to disability, in order to demonstrate expertise. But given the dearth of training available (certainly in the context of UK sports coaching), and the wide, shifting, complexities of defining and thus understanding disabilities, this proves to be a particularly unique problem. Whilst there is some literature pertaining to sport and disability, much of it is centred on performance sport (White & Duda 1993; Townsend et al. 2015), carers (Melville et al. 2009) and teachers (Belley-Ranger et al. 2016).

In all likelihood coaches, or indeed anyone, will probably feel less enabled and more constrained in their working practice with people with disabilities if they have not received prior training; or do not fully understand the very construct of disability itself (Duarte & Culver 2014; Townsend et al. 2015). Yet these are perennial problems that present themselves across a variety of relationships with people from all spectrums of ability, or disability.

In sum then, whilst we can look to define coaching and disability sports coaching, there remains the continuing issue of how best we can develop coaches within the context of disability. The next section looks to extend this by outlining coach education practice, assessment, and effectiveness – with a focus on learning in HEIs.

Coach learning and the role of UK HEI's

The manner in which sports coaches learn best is articulated well through Cushion et al.'s (2010) systematic review of coach learning literature and the resultant schema they presented. Here the current understanding is that, as well as formal (most significantly through the mechamism of national governing body awards and official accreditation) and non-formal learning (an approach that incorporates a variety of methods such as workshops, small courses and general continuous professional development), the role of informal coach learning seems to be more significant in developing coaches. This approach, one that incorporates relatively unstructured, non-accredited and non-assessed methods of learning, seeks to avoid what can be seen as systems learning that can perhaps offer just a limited parameter of skills and competencies to learn from (Jones et al. 2004; Gilbert & Trudel 2006; Cushion et al. 2010; MacDonald et al. 2010; Crisp 2018). This focus on non-formal learning highlights the way in which learners use self-directed and non-assessed learning that places reflection and experience first and foremost. The central premise of this approach is that this is the most effective way of learning meaningful skills and developing attributes.

In highlighting this idea of longer term learning, the fact that much of the formal coach education in the UK context takes place in what can be considered particularly short (in terms of contact hours) and/or compressed programmes at levels one and two (of a one to four model) reinforces what are seen as their potential shortcomings (Gilbert & Trudel 2001; Mallett et al. 2009). These short courses, the necessary qualification levels for working in the UK, often take place over no more than two weekends, and are normally set up as programmes of group-learning. These are facilitated by more experienced coaches who have been trained to help participants on the courses meet minimum requirements necessary (Cushion et al. 2010).

Much of this reliance on a formal coach education system, by its very nature, mitigates against the possibility of ensuring that a substantial engagement with the process of informal learning can take place. However degree courses, generally taken over three years in the UK, can specifically address engagement with longer learning processes by following designed learning opportunities and structures within this three year framework. Indeed, HEIs can, alongside developing what are seen as key transferable and critical thinking skills for graduates, support vocational and disciplinary identified core competencies for work related activities. For example, in the context of coaching, HEIs can offer supported coaching placements to extend opportunities for experiential learning to take place (Crisp 2018).

These extended opportunities allow a greater, deeper engagement with the process of reflection, something seen as key to accumulating knowledge and iterating through a cycle of

experience, reflection and action (Schön 1987; Knowles et al. 2006). One widely acknowledged consequence of using and adhering to reflective practice is that it develops greater self-awareness and offers opportunities for participants, in particular to develop strategies that help orchestrate best practice in work. It is noteworthy then, that there is an interface between reflective practice and meta-cognition. The theory of meta-cognition is used to explain the deep level and self-regulated skill that develops awareness, and control, of learning (Poitras & Lajoie 2013; Ferreira et al. 2015). The work of Flavian (2015), for instance, illustrates the way that metacognitive activities can be seen as "one's ability to monitor, control, set goals, regulate thinking, and reflect" (p. 92).

By considering these themes, we are able to see that similar patterns of active control over thinking processes and developing independent learning are evident within both reflection and meta-cognition (Biggs & Tang 2007; Vickerman 2009). For example, the previously mentioned ability to develop strategies for improving learning and performance. Yet the issue concerning the development of coaches within the HEI system is not simply whether prolonged passages of reflection can contribute to achieving specific outcomes and knowing about one's own and others' thinking. Rather, it is asking how the higher order thinking involved in decision making and knowing what 'works' or might 'work' can be developed.

Methodology

The central aim of the study resulted in the formulation of the following three questions.

1. How can emerging, learning coaches in HE benefit from coaching and reflection over a one year module that includes the provision of regular external group coaching?
2. How do we determine the extent to which core coaching skills (i.e. communication, group management) of coaching can be developed within the context of disability?
3. What is the role, function, and impact of meta-cognition in developing effective student/coach learning?

These questions were explored by cataloguing and then analysing the perceptions and experiences of ten student-coaches enrolled on a HEI coaching programme. Specifically, these ten student-coaches were all involved in the direct delivery of a community engagement programme, run under the auspices of a one year coaching placement module, that focused in significant part on participants with disabilities. Criterion for the participants in the present study included that they had: a) never coached people with disabilities before, b) still

considered themselves to be 'learner-coaches' (defined by the fact all had less than one year's part time coaching experiences and that all of them had no higher than a Level 1 equivalent coaching qualification**)** and c) by the end of the module had all completed at least 30 hours of direct coaching (leading sessions) within this disability programme.

The data collection began in earnest near to the end of the module when two focus groups and evaluations were held. In these the student-coaches were asked to clarify their views regarding the module, as well as asked to define specific advantages or disadvantages they might have gained from participating in the disability programme. Additionally, the student-coaches submitted reflective journals as part of their module assessment, and the information in these relating to their development and perceptions of taking part in the disability programmes were compared and combined with the data from the two focus groups in order to identify the key words, responses and phrases that kept appearing across them all. The key themes, codes, and patterns were then aggregated into three main sections that were considered to represent the totality of the central topics. These were: *'Time – continued delivery, reflection, and meta-cognition'* and *'Configuring individual practice: Meta-cognition'*.

Results/discussion

Time – continued delivery and reflection

Time, in the context of the student-coaches in the present study, was considered to be a hard won commodity. Given the pressures of various student, work, family, sport, and recreational demands, it was extremely difficult for the student-coaches to actively engage with periods of self-reflection. This meant that the process of experiential learning proved to be difficult to implement without opportunities to actively reflect on what they had done, and their practice as a whole. Having the opportunity to talk, practice, and reflect with a group of other coaches was warmly welcomed. One student-coach (number two) described this opportunity as a particularly helpful interlude to much of the rest of the "chaos" that they were experiencing. Of particular note, they mentioned the difference between their own coaching placement (one that they had organised) and the one that the University offered on site:

SC2*:* "I believe that this experience has allowed me to see things from a different perspective, and not to take myself too seriously as a coach, a contrast from my primary placement and student life in general I faced many different challenges in my secondary

placement compared to my primary placement. I found that my role as a coach changed completely."

Similarly, all the student-coaches stressed that the programmes helped facilitate a process of reflection that was essential to promoting change within their development and practice. An example here is how student-coach seven stated that.

SC7*:* "It also made me reflect afterwards, and how inspirational the people that took part in the sessions are, no matter what their disability was, they tried their hardest. Knowing this, it changed my outlook on coaching and that you cannot discriminate against anyone. When I first started coaching, I realised that coaching is being able to make instant decisions, where they need to have a rational decision behind them."

This type of analysis was consistent with many of the other student-coaches' feelings about how much being together for a set period of time helped. It became clear that the context of disability coaching within which they operated necessitated a significant commitment to group work and communication, all of which – irrespective of the nature and expertise of the respective student-coach – meant that coach learning was facilitated by the provision of time, mutual dependency, and reciprocity of support. In fact, the student-coaches' initial understanding of their limitations in developing their coaching craft was allied to the fact that they considered it particularly difficult to develop the skills necessary for self-reflection, given their time constraints. This acknowledgement of the considerable difficulties they faced were evident within the student-coaches' reflections, and were consistent across the whole cohort. Whilst some of this was, no doubt, due to the similarities in the developmental level of the learners, what was of note was that the time to develop the tools and "know-how" to coach was thought to be significantly lacking. Student-coach six explained this in detail.

SC6: "This placement was a fantastic opportunity to immerse myself in an area of coaching that I had never experienced before. What I really noticed was that it gave me the time and space to really think about what I was doing, alongside my fellow students. Whilst I do a fair amount of coaching outside of these programmes, that's all pretty much on my own, and I don't get the opportunity to work in a group or talk to other coaches who have the same needs as I do. I'd say the rewards have been noticeable."

These recollections related to the time that it took to more completely engage with a deeper development of knowledge. Many authors within the field of coach education are in agreement that accruing hours and reflecting on their practice is a cornerstone of how coaches can generate knowledge (Gilbert & Trudel 2006; MacDonald et al. 2010). The findings in this study corroborate this, in the sense that the student-coaches felt that the time they needed to

allocate to the planning and delivery for the community engagement sessions was very helpful. The times allocated here were, in fact, indicative of a system that whilst simplistic in nature, necessitated a more compartmentalised, contextualised and supported system of co-learning.

Configuring individual practice: Meta-cognition

Encouragingly, all of the student-coaches seemed aware that this issue of a lack of time was one that, whilst constraining in many respects, was also something that could be overcome with good planning:

SC1: "Since starting my coaching placements back in September, I have learnt a lot about myself, a lot more than I thought I would. Some things I learnt about coaching are more positive than others, as this coaching placement has opened my eyes to see things about finding the time to reflect and learn that I did not know were there." The whole cohort also agreed that as developing student-coaches they benefited from being placed in an environment where they needed to "make quick decisions about what to do" and use a mixture of different types of reflective practice "before, during, and after sessions". Student-coach ten explained how the contrast in their coaching roles between performance sport and disability/community sport made them realise that they had to mentally adapt to the different challenges they faced: "it made me stop, think, reflect, and react to the different type of sessions we needed, not just drill based or technique based".

The student-coaches also described how they needed consistent engagement with the practice of coaching, something that the programmes offered, to fully immerse themselves in the process of reflection. An example here is student-coach five that stated.

SC5: "When I was coaching on these programmes, I was actively using reflective practice, to make sure that I developed as a coach. I used a variety of different methods of reflective practice, the majority of this being clear reflection on the action through. Although for various sessions, I would analytically reflect, this would help me dissect my style of coaching, which at times was quite autocratic, and this was the right style for some of the participants." The present study earlier outlined the concept of meta-cognition, one that encapsulates deep learning and problem solving. Nisbet and Shucksmith (1986, p. 30) explain this concept as the ability to "to know about one's own knowing". Using this explanation allows us to understand how adherence to a set programme allowed a more complete, holistic engagement with the process of thinking. This is in terms of the aforementioned set programme, the times it took to plan, and the co-work that it necessitated. Indeed, much like Vickerman's (2009) argument that meta-cognition helps organise and amplify individual

conceptions of how oneself and others think, the student-coaches thought that they were becoming, through the demands of the programme, more capable of appropriate decision making and contextualised thinking: all indicative of higher order thinking.

There is, however, one caveat left in terms of the community engagement programme. This is that the very fact that they were coaching participants with a variety of disabilities made them reflect, react, and consider different approaches to their practice. Student-coach two summed this up with their thoughts that.

SC2: "With the disability programmes, there's more to think about. Genuinely. You can't just have one way of coaching, you can't rely on one way of doing things, you do have to come up with a much bigger range of opportunities and ideas to implement. You've just got to think more about what you're doing and how you've done things. It's a great way of really making you focus and consider your overall coaching practice and behaviours."

In sum then, all of the student-coaches were using forms of deep reflection within their one year learning journey on a disability sport community engagement programme. Admittedly, at times this was in a less formal manner. For instance, one student-coach (nine) explained that whilst they had not specifically set out to consider their working practice, by the end they believed they had "strongly developed as a person with changing environments". In all, all of the student-coaches had explicitly valued the time, support, and ability to co-work and reflect over a long period of time. One student-coach (four), for instance, stated that the community engagement project had helped them "considerably develop as a coach from when I first started", and that they had "grown in confidence because of my greater ability to think about what I do". Here, these recollections have shown how the use of meta-cognition can make sense of the deeper, more self-regulated skill of reflection and determining strengths, weaknesses, and individual practice beyond isolated theory (Biggs & Tang 2007; Ozsoy et al. 2009; Vickerman 2009). Subsequently, meta-cognition can quite consistently help explain the enduring application of deeper level thinking that the student-coaches engaged with, in this instance facilitated by working in the community engagement programme.

Conclusion

In this paper I have sought to explain the views, recollections, and learning journey of ten student-coaches on an HE coaching programme. Their perspectives revealed several particularly salient features regarding the pre-eminence of deep reflection and mutual

dependency within the learning process, and also strongly suggested that taking part in co-working within learning was highly effective in developing their practice and contributing to their personal satisfaction. Whilst the significance of this might not lead to any substantive change in the way that their views and practices develop, the manner in which they could focus on learning undertaken through the prism of disability certainly held some significant promise in terms of the development of alternative coach-learning practices. Finally, the data from this study demonstrated that the continual engagement in the programme of learning and the programme of disability coaching seemed to emphasise, and enable, the use of deeper, critical thinking and meta-cognition.

However, although the current study offers new ways of considering coach-learning, it is not without its limitations. Given the small sample size the results of this study may not be applicable or generalisable to other groups. And whilst the qualitative approach led to a deep and thoughtful level of understanding, the data is based on personal recollections and as such, may have involved a degree of personal bias. A recommendation would be for future research to develop and build upon the findings of this study by examining the impact that disability coaching can have on larger cohorts, and potentially more experienced coaches.

In essence then, the paper presents evidence that coach practice and learning, in the context of sport, participants, and provision, needs to recognise that the use of disability coaching to enhance core coaching skills can lead to more marked performance levels in terms across coaching domains, as well as lead to a deeper awareness and critical self-reflection.

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DOI 10.2478/afepuc-2019-0004
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THE EFFECT OF HEAVY WEIGHT TRAINING ON PHYSIOLOGICAL ABILITIES OF SOCCER PLAYERS UNDER THE AGE 21 YEARS OLD

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Summary: The objective of the study is to design a specialized training program in modern weighting methods for under-21 soccer players to develop muscular strength and to identify the effect of the training program on weighting exercises on some physiological variables (some aerobic and anaerobic abilities such as VO_2max heartbeat and backstage). Researchers in this study that weight training for soccer players will have a clear impact on both the development of muscle capacity and improve some functional abilities. The experimental method was used to design two samples, a experimental sample and a control sample of under-21 soccer players who were selected by a team of Mustaganem teams. Each sample consisted of 18 players. The experimental sample was applied to the weight and control program. For four months. The study showed that the experimental sample achieved a significant increase in muscle strength measurements as well as some physiological variables in all measured tests compared to the control sample. This is the result of the proposed training program applied to the experimental sample.

Keywords: heavy weight training, muscle strength, physiological abilities, Soccer players.

Introduction

Muscle strength is one of the most important skills of fitness. Those skills should be available to soccer players; they have to be strong in most large muscle samples in the body(Suchomel, Nimphius & Stone 2016), to overcome a number of factors imposed by the nature of the game on which the movement and the physical performance depends on ,in soccer practice (Halson 2014). The results of some researches and studies (Akubat, Patel, Barrett & Abt 2012; Ali 2011; Garganta 2009; Janelle & Hillman 2003), showed that muscle strength is a fundamental factor which (Carroll, 1993) develops the motor performance of soccer players, because of their association and impact to other physical abilities related to performance such as speed, endurance, agility and flexibility(Franks & Goodman 1986).

Heavy weight training has been for a long time a subject of controversy among specialists in the preparation and training of the development of muscle strength in soccer players(Zatsiorsky & Kraemer 2006). Some of them (Garganta 2009)opposed that training with heavy weights reduces their motor speed , the range of motor joints as well and causes the degree of stiffness in the muscles. As an objective means of developing the different types of muscle strength that any player needs and which helps in developing physical abilities and improving performance.

Most of the results indicated that heavy weight training has become an effective and necessary tool for development of different types of muscle strength (McBride, Triplett-McBride, Davie & Newton 2002). It has direct and essential impact on the degree of development and improvement of all elements of overall fitness which is considered to be the fundamental pillar of motor capacity and speed (Serrano, Shahidian, Sampaio & Leite 2013). Heavy weight training does not only affect the musculoskeletal system, but extends to the physiological positive effect on functional efficiency such as the heart and the circulatory and ventricular organs (Nystoriak & Bhatnagar 2018; Vigorito & Giallauria 2014). Regarding the process of heavy weight training, in the basis is a physiological process aimed at improvement of the functional efficiency of the body(Mayer et al. 2011). so its physiological effect leads to an increase of muscle inflation, which helps stimulate blood circulation and increasing blood flow and muscle retention(Kang, Lin, Kuppermann, Melero-Martin & Bischoff 2017; Loos, Opdenakker, Van Damme & Proost 2009),the wideness of capillaries, improvement of oxygen uptake (O2) and aerobic and anaerobic energy production as well (Bassett & Howley 2000; Bogdanis 2012).

Muscle strength is one of the most important physical qualities, and is considered to be an important physical characteristic, physiological ability and a dynamic element among the other physical characteristics of the soccer player (Akenhead 2014). The development of muscle strength in heavy weights in soccer is a technique based on exercises that require a rapid muscle strength in the sense of reaching maximum strength in a short period of time during implementation(Silva, Nassis & Rebelo 2015) ; but physiologically is the muscle efficiency to produce the anaerobic energy used by the player to perform strong and fast movements for few seconds(Zemková & Hamar 2018).

Many studies confirm that heavy weight training aims at improving the functional efficiency of the body and increase the size of the rib cage and the efficiency of the breathing muscles (Ali 2011; Mayer et al. 2011; Russo, Santarelli & O'Rourke 2017; Serrano et al. 2013; Silva et al. 2015). Muscle training also helps the heart to increase its activity by stimulating the blood circulation in increasing blood flow and improving oxygen utilization(Delp et al. 2001; Joyner & Casey 2015) and to improve aerobic energy production (Yousuf Lazem Kemash - Saleh Bashir Saad 2006). In fact, the Algerian soccer sport lacks of well-planned and carefully prepared heavy weight training programs such as supplementary exercises or integration into physical preparation stages. We can confirm that at least 90 % of the sports teams did not undergo any weight training programs throughout the training seasons, focused on muscle strength development , and researchers were able to determine the extent of knowledge of these trainers(Belkadi et al. 2015) about the nature of weight training. The problem is not in heavy weight training in general, but in the chosen and appropriate exercises, which are focused on suitable muscle work of a soccer player. The lack of knowledge of these changes and adaptation that occurs in the functional body systems as a result of these exercises because the scientific researches and previous studies confirm the correlation between the functions of the heart, lungs and blood circulation and the muscular system in the degree of consumption of oxygen and in the production of energy.

Methods

Participants

Thirty six soccer players were recruited for this study; The data collected was separated into two groups Experimental group EG (N = 18) and Controlled group CG(N = 18) based on their level of practice (Table 1) participated in the study after receiving a comprehensive explanation of the procedure. The study was planned according to the Helsinki Declaration

(World Medical Association 2013) and was approved by the scientific institute of sports ethics committee. Based on the accuracy results of a self-reported questionnaire (Cherara, Belkadi, Asli & Benbernou 2019), no subject had been treated with any medication or physiotherapy from severe injury during the first three months. Both teams are active in the national championship section one Algerian professional the homogeneity of the sample members was taken into account in some variables of muscular and physiological capacity, so that the procedure can be adjusted for a set of variables.

Procedures

Anthropometric data from each participant was completed by the coaching staff that regularly performed these measurements as a part of their evaluation routine. Body mass and height were respectively obtained from a Connected Scales 700 (Geonaute, France) and a Stadiometer HM200P Portstad Portable (Charder, USA).

Maximum muscle strength test (1-RM)

Diagnosing the percentages of progression of strength of different muscle samples of the experimental research sample.

- Laying down test: (Hammad 2000, p 68) to measure the strength of muscle samples of the upper limbs (chest, back, shoulders, arms).
- (Abdominal) test: (Al-washahi 1994, p 142).
- Full bending test (1/2- squat) (Cometti 1993, p 103): Measurement of strength muscles of the lower limbs (the two legs).

30 Metre Acceleration Test

The objective of this test is to monitor the development of the athlete's ability to effectively and efficiently accelerate from a standing start or from starting blocks to maximum speed.

Mini-Cooper VO_2max Test

The objective of the Cooper test is to predict an athlete's VO_2max. The test comprises of seeing how far an athlete can run/walk in 5 minutes. The assistant should record the total distance covered.

VO_2max maximum aerobic speed (VMA)

$VO_2max\ (ml.kg^{-1}.min^{-1}) = 2.27(km/H)v + 13.3.$

$VMA = 3{,}6 \times \text{distance (m)} \div \text{time (s)}.$

Where the 3.6: constant value: -distance through 5 min.

Study Design

General planning of the program

The study took into consideration that the duration of the weight-training program coincided with the preparation period for the training season (2016 – 2017) as a component of the general training program for a team. Duration of the program consisted of approximately 4 months and 3 training courses with weights of 5 training units per week - during the general and special preparation period, per week in the period of competition. The researchers took into account the principles of training in the design of the programme especially the principle of privacy and overload, adaptation, sequential measurements after each training period. To determine the new weight to be trained in the following period through the maximum weight (RM) tests with different frequency of performance appropriate for each training period where the intensity of the training increases and the frequency of repetitions decreases as the program progresses. With the development of all types of muscle strength beginning with the development of tolerance of strength and strength characteristic of speed and then explosive power, and allocated time for each training module (30 – 40 minutes).

Result

Table 1

Presentation and analyses the results of the physiological tests (pre- and post-tests) of the experimental sample

Tests	Pre- A.V	S.D	Post- A.V	S.D	Sample	Liberty degree	Significance level	Tabular T	Calculated T	Statistic. Significance
Maximum anaerobic capacity Running (30 m)	5.21	0.25	4.60	0.18	18	17	0.05	1.74	2.03	Significant
Brikci test (running 5 min). VO_2max	51.70	1.41	55.91	153					2.03	Significant
Maximum aerobic capacity. Brikci test (5 min).	17.57	0.84	19.94	0.67					2.21	Significant
Pulse (/) during rest	71.86	2.23	64.05	2.13					3.96	Significant
Ruffier for measuring capacity	11.06	3.59	9.34	1.94					3.46	Significant

Table 2

View and analyses of the results of physiological tests (pre- and post) of the control sample

Tests	Pre- A.V	S.D	Post- A.V	S.D	Sample	Liberty degree	Significance level	Tabular T	Calculated T	Statistic. Significance
Maximum anaerobic capacity Running (30 m)	5.27	0.23	4.67	0.24	18	17	0.05	1.74	4.00	Significant
Brikci test (running 5 min). VO_2max	51.17	1.16	55.28	1.13					2.55	Significant
Maximum aerobic capacity. Brikci test (5min)	17.06	0.86	19.21	0.70					1.95	Significant
Pulse (/) during rest	72.56	3.82	68.11	2.92					2.65	Significant
Ruffier for measuring capacity	11.93	2.42	10.50	2.53					2.35	Significant

Table 3

Presentation and discussion of the results of the physiological tests of the two research samples in the post-test

	Tests	Statictical Study	Samp le	Degree of liberty	Significance level	Tabular value	Calculated value	Statistical significance
Physiolgical testso	Maximum anaerobic capacity (run 30 m)		36	34	0.05	1.69	2.50	significant
	Brikci test (running 5 min) VO_2max						2.44	significant
	Maximum aerobic capacity Brikci test (5 min)						2.48	significant
	Pulse (/) during rest						2.12	significant
	Ruffier for measuring capacity.						1.93	significant

Table 3 Shows the value of calculated (T) in the post physiological tests of the two samples of the research.

Discussion

From the foregoing, within the scope of the methodology used, the proposed program and the sample applied to the study, the following conclusions were reached.

In the course of the survey, we concluded that although the trainers have long field qualifications and experience, they still lack some scientific methods and information about weight training, in addition to the opposition of many of them to these exercises on the pretext

that they lead to muscle inflation and to reduce the motor range and muscle stiffness. They do not have sufficient knowledge or information about the impact of weight training on some physiological functions such as improving heartbeat and breathing in increasing blood circulation activity in general and physical fitness in particular in increasing aerobic and anaerobic energy production (al-Mawla 1999, p. 134). The statistical results of the physiological tests showed that the experimental sample achieved the best mean for the control sample in all these measurements (maximum O_2 - VO_2max, maximum air velocity (VMA), maximum anaerobic capacity , Pulse measurement at rest, and back-to-back).

The researchers attributed this to the fact that the process of weight training in the basis of physiological process aimed at the development of muscles and improvement of the efficiency of the functional body and stimulation of the blood circulation by increasing the blood float and the wideness of capillaries and improvement of the degree of utilization of oxygen O_2 and improvement of the production of aerobic energy. And that weight training increases the chest cavity and increases the efficiency of the respiratory muscles and thus improve (maximum consumption of O_2 (VO_2max) and maximum air velocity (VMA) and also leads to the development of functional changes in the heart is the expansion of the heart cavities and increase the strength of the heart muscle and increase in size The heart and low heart rate during rest, which is an indicator of high physical fitness of the athlete. The muscular ability to make a job depends directly on the efficiency of the heart, blood vessels and lungs in supplying muscles with energy. Which leads to an increase of blood pressure to meet the high blood pressure during training and thus improve the ability to return and pulse. This is consistent with the scientific sources and some previous studies that confirm the correlation between cardiovascular function and the circulatory system and the muscular system of the benefit of O_2. DELLAL (2008) confirms that the training of muscle strength with the weights enhances the strengthening of the tendons and ligaments and connective tissue in the muscle by increasing the number of capillaries and the stock of energy substances in the muscle such as calcium and ATP-PC, The muscle system is the determining factor in aerobic efficiency and not the transfer of O_2 to the muscles. If the respiratory system supplies the circulatory system with greater amounts of O_2, it is transferred to the muscles, Muscle cannot consume all O_2 contained by the circulatory system, so that the muscular system is the largest responsible for aerobic capacity, and also called VO_2max during muscle work using 50 % of the muscles of the body (Salah 2004, p 174).

This result also helps researchers answer several questions by opposing some trainers to heavy weight training for young people on the grounds that they affect some of the maximum

anaerobic abilities and other physical attributes such as speed. Weight training is a training program to develop anaerobic ability with a wide range of soccer Based on exercises that call for rapid muscle strength in the sense of reaching maximum strength in a short period of time during implementation. One of the studies pointed out by (Serrano, Shahidian, Sampaio & Leite 2013) that certain weight training programs can lead to the development of periodic and respiratory stress by improving the efficiency of the work of the heart and circulatory system and VO_2max.

The ability to exercise directly depends on the efficiency of the heart, blood vessels and lungs in the supply of muscle energy, and increases the maximum consumption of O_2 under the influence of muscle strength exercises, especially when the use of circular training system, but this increase is not equivalent to what can be achieved through endurance training programs (AL-DDINE 2004, p 64). Therefore, we can say that the hypothesis of the research that the proposed heavy weight training program positively affects the improvement of some functions and physiological variables of soccer players have been achieved.

Conclusions

The statistical results of the physiological tests showed that both experimental and control tests achieved significant differences between the results of the pre and post test in favour of the post-test - in all measured tests (VO_2max), maximum pneumatic speed (VMA), maximum anaerobic capacity. The measurement of the pulse during rest and to return to training programs of the two samples of general preparation and training on the endurance, and through the improvement and the difference in the averages between the two samples we note that the experimental sample achieved the best average arithmetic compared to the control sample in all these The results of the study are consistent with the results of the previous studies in that the weight training process is basically a physiological process aimed at developing muscles and improving the efficiency of the functional body and activating blood circulation in increasing the blood flow and muscle density and the wideness of capillaries and improve the degree of utilization of oxygen O_2 and improve aerobic energy production, weight training increases the chest cavity and increases the efficiency of breathing muscles, thus improving the maximum VO_2max and VMA. This training also leads to functional changes in the heart, Heart, increased heart muscle, increased heart volume, decreased heart rate during rest, which is an indicator of increased physical fitness of an athlete. Muscle capacity to perform a job directly

depends on the efficiency of the heart, blood vessels and lungs in supplying muscles with energy. Which leads to increased blood pressure to cope with high blood pressure during training and thus improve the ability to return and pulse. This is consistent with the scientific sources and some previous studies that confirm the correlation between the functions of the heart and lungs and blood circulation and the muscular system of the degree of utilization of O_2.

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DOI 10.2478/afepuc-2019-0005

© Acta Facultatis Educationis Physicae Universitatis Comenianae 2019, 59(1): 44-68

INTENSITY OF SOCCER PLAYERS´ TRAINING LOAD IN SMALL-SIDED GAMES WITH VARIOUS CONTENT FOCUS

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Summary. The aim of this research was to make reference to the difference in heart rate values (HR) of soccer players in small-sided games (SSG) with various content focus. We assumed that the aim at the content in small-sided games would significantly affect the HR values of participating soccer players. The research group was comprised of players (n = 6) of the soccer club FK DAC 1904 Dunajská Streda (U15) at the age of 14 ± 0.7 years. The HR values were evaluated on the basis of collected data, which we obtained using sport testers and special software POLAR TEAM[2]. In order to find out the statistical significance of the difference in HR was used the One-Way ANOVA and the Bonferroni post hoc test. The level of statistical significance was set at 5 %. We found out that by the change of the small-sided game´s content focus, the internal reaction of players´ organism to training load was at different level. In the SSG3, with the emphasis on the improvement of individual´s final offensive game activity – shooting, was recorded the highest achieved HR_{avg} value of the monitored players (181.83 ± 7.11 beats.min^{-1}). This form of the SSG was the most intense. However, there were no significant differences in HR values among the individual forms of the SSG. Our recommendation is to employ in the systematic training process small forms of small-sided games with various content focus, because by the means of it we can adequately prepare the players for the match load itself.

Key words: soccer, training load, heart rate, small-sided games

Introduction

The constant development of contemporary soccer is also influenced by the quality of the systematic, long-term and purposeful training process. Increasing the level of the training process brings about important questions for coaches, including the optimization and intensification of soccer players´ training load. In the training process of soccer players have an inevitable role the small-sided games with different parameters. By small-sided games, it is possible to raise the level of skill potential, tactical management, fitness capacity and emotional intelligence of players. During the small-sided games have to the players solve various complicated, complex game situations under time-space deficiency and under active pressure of opponent. The conditions in the small-sided games are closely related to the match conditions.

A systematic training process helps to increase the adaptation capacity of player´s organism to the load, with which are players confronted in the game itself, or more precisely in the match (Holienka 2004). The training process is oriented on the creation of a specific adaptation change in the player´s organism, which is induced by repeated adaptation stimuli (Holienka 2012). When the dosing of training stimuli is thought-out and systematic and contributes to the development, progressive increasing, stabilization and preservation of the training experience state, then we talk about training load (Kačáni 2005).

Holienka (2012) states that indicators of internal load, including the heart rate (HR), make it possible to determine the useful and effective level of training load. Measuring devices of heart rate can record HR values with high accuracy and reliability. These devices provide accurate feedback on actual reactions of the internal state of players´ organism to the training load. The HR is a widely accepted and frequently used physiological indicator of the players´ physical activity in the training process (Holienka 2016). During last years has the monitoring of HR become an inseparable part of the training load research in collective sports and many authors dealt with this issue in their research (Križan 2011; Teplan et al. 2012a, 2012b, 2013; Aktas et al. 2014; Halouani et al. 2014a, 2014b; Randers et al. 2014; Bujnovský et al. 2015; Gonzáles-Rodenas et al. 2015; Hůlka 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; Hůlka et al. 2016; Owen 2016; Sannicandro et al. 2016; Semjon 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; Kunzmann & Bujnovský 2019; Nagy & Babic 2019; Obetko et al. 2019). 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 to a large extent implemented in soccer training, which include various forms of small-sided games. It is also used in youth soccer to gain and understand the physiological parameters of soccer trainings and matches load (Owen 2016).

Holienka (1998) claims that the principle – all with the ball - which is currently required in training activities of soccer players, fulfils the game training (GT). The dominant position in it have various forms of small-sided games, which include a several game situations that are similar to the real game situations occurring in the match. Training activity of players in sports games should take into consideration the specific, technical, tactical, physiological and psychological demands of individual game performance (Christopher et al. 2016; Zapletalová et al. 2017). Therefore, the SSG have become a favourite part of the soccer training when increasing the level of game preparedness and fitness capacity of players. By applying the principle of "adequate coverage theory", we try to model in the training process through small-sided games such game conditions, which are similar to real match conditions.

Small-sided games with various content focus improve the individual´s game activities and game combinations in the development of youth soccer player´s potential. Small-sided games are widely used also in daily practice in the training process of the lower age categories. By the SSG, the players gain experience in solving unique game situations, which are regularly occurring during the match. When solving various complex game situations during soccer trainings, the participating players are able to improve their technical side of game preparedness, tactical variability, coordination – condition capabilities and they can increase their mental endurance as well. Soccer coaches are able to influence the intensity of the training load in small-sided games if they adequately manipulate the variables, which affect the intensity of small-sided games. Among these variables are for example: size of playing field, number of players, coaching, game rules, content focus of the game, goal size, number of goals, presence of goalkeepers, dosing of load interval and rest interval (Aktas et al. 2014; Halouani et al. 2014a, 2014b; Randers et al. 2014; Young & Rogers 2014; Gonzáles-Rodenas et al. 2015; Hůlka et al. 2015; Köklü et al. 2015; Los Arcos et al. 2015; Torres-Ronda et al. 2015; Asci 2016; Holienka 2016; Hůlka et al. 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; Jara et al. 2018; Lacome et al. 2018; Mikulič et al. 2018; Nagy & Holienka 2018; Peráček et al. 2018a, 2018b; Sarmento et al. 2018, Sgro et al. 2018; Nagy & Babic 2019).

Methods

In our research was applied a pedagogical experiment within the scientific field of sports kinanthropology. We monitored the internal load of players´ organism expressed by the HR level in various forms of small-sided games (SSG). The research was comprised of the monitoring of individual selected physiological and functional load indicators in the training process. In our case, these were the HR values of young soccer players in the SSG games with various content focus. The dependent variable was the internal load of players´ organism, expressed by the level of HR, and the independent variable was the content focus of the SSG.

The research group was comprised of players (n = 6) of the soccer club FK DAC 1904 Dunajská Streda (U15) at the age of 14 ± 0.7 years. The monitored players were participants at the highest competition of this age category in Slovakia.

The main method used to obtain the research data was the measuring of heart rate (HR). The maximal heart rate values (HR_{max}) were obtained by using the Hipp´s field test (2007). The measuring of HR_{max} were realized on artificial grass in the MOL sports facility of Academy in Dunajská Streda.

Course of the testing HR_{max}

During the testing had to the tested participants run 50 metres in a defined area, which they overcame with various intensity. The test included 6 repetitions in every single set of run. The players went through 4 sets and in each one of them was the intensity gradually increased to the maximal subjective intensity.

The test included - field width run (50 m):

- low-intensity run (warm-up run) – 6 times (120 – 130 BPM),
- medium intensity run – 6 times (130 – 150 BPM),
- submaximal intensity run – 6 times (150 – 170 BPM),
- maximal (subjective) intensity run – once.

There was a 30 seconds long rest interval between the repetitions and 60 seconds long rest interval between the sets. After determination of the maximal heart rate (HR_{max}), 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 HR 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 was used the sports test device POLAR TEAM PRO. The calculation of the percentage and time representation of HR values in individual zones of load intensity and determination of various HR values, % of HR_{max} and time spent above the anaerobic threshold (ANT) was done by using special software POLAR TEAM^2.

Small-sided games

Before the realization of the SSG were the players divided into two teams (3:3) according to their performance-related level. The players remained in the selected team during all three variants of the small-sided game. Goalkeepers did not have the sports test devices on themselves, since we did not monitor the level of their HRs. The playing field with the size of 450 m^2, (width = 18 m, length = 25 m) was marked out with cones. The small goals had the size of 2 x 1 m, the portable goal had a standard size, the height of 2.44 m and width of 7.32 m.

During the SSG were prepared 9 balls, 6 of them spread around the field, 2 of them were in goals and with one of them was played the game. In this way, we tried to ensure a smooth course of the game and to maintain the intensity of the players´ load. There were a minimum of coaches´ interference in the game with verbal instructions and players could be verbally encouraged with the aim to maintain the intensity of the SSG.

In the course of the SSG were recorded the minimal, average and maximal values of HR, abidance of players in individual intensity load zones and time spent above the ANT. We determined the HR values in three SSG variants, in which the number of players, the size of the playing field and the ratio of load interval to rest interval were the same. In the course of the SSG were changed by intent only the content focus of SSG´s and the way of scoring a goal or points. The load interval lasted 2 minutes, the rest interval was 1 minute (the ratio

of LI to RI was 2:1). The content focus of SSG was aimed at improvement of offensive individual game activity (OIGA) – ball dribbling, passing and shooting.

Table 2

Variants of small-sided games

SSG	Players	GK´s	Field dimensions		Size of field	Dosing of load				
	(n = 6)	(n = 2)	width [m]	lengt h [m]	[m^2]	LI [min.]	RI [min.]	NR	NS	Load [min.]
SSG1	3/3	0/0	18	25	450	2	1	4	1	12
SSG2	3/3	0/0	18	25	450	2	1	4	1	12
SSG3	3/3	1/1	18	25	450	2	1	4	1	12

SSG1 Focus: improvement OIGA – ball dribbling

Game description

Players played the game in a defined area with an unrestricted number of ball contacts. On both sides of the playing field width was created an area (1 m), into which the players had to move and stop the ball. In this way, they scored a point. If the ball got outside the playing field, then the team put the ball into play from the place, where the ball left the playing field.

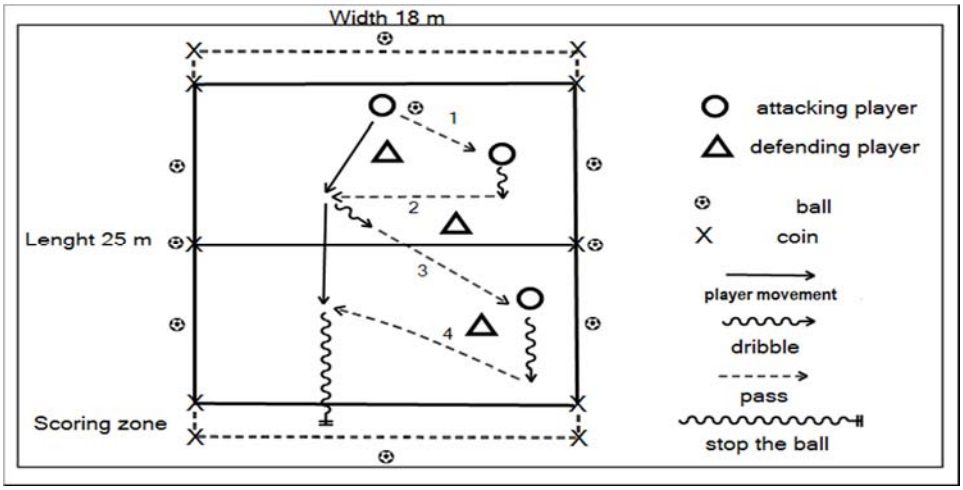


Figure 1

SSG1 – improvement OIGA – ball dribbling

SSG2 Focus: improvement OIGA – passing

Game description

Players played in a defined area with an unrestricted number of ball contacts. They tried to work adequately with the space, to constantly search for the free areas in order to cooperate with their teammates. The players had to make at least 3 passes between each other, and then they could pass the ball into a small goal (2 x 1 m) and thus score a point. If the ball got outside

the playing field, then the team put the ball into play from the place, where the ball left the playing field.

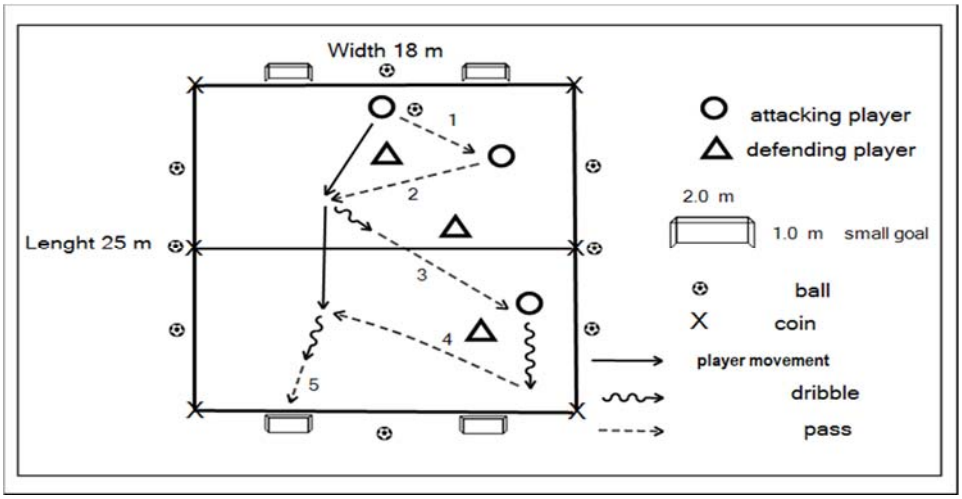


Figure 2
SSG2 – improvement OIGA – passing

SSG3 Focus: improvement OIGA – shooting

Game description:

Players played the game in a defined area with an unrestricted number of ball contacts. They could pass the ball between themselves six times at most, then had to be the offensive phase of the game finished by shooting on the goal. After scoring the goal, the game started from the goalkeeper, whose team received goal.

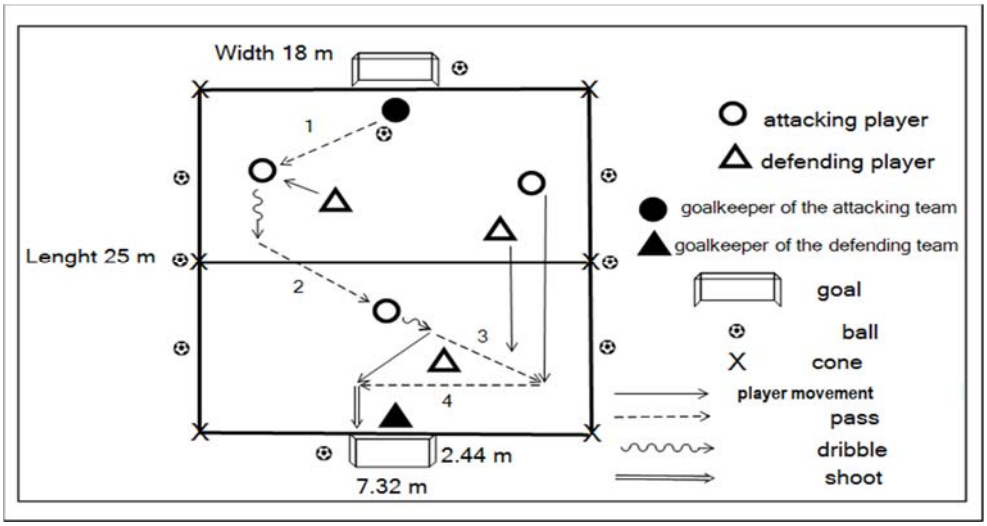


Figure 3
SSG3 improvement OIGA - shooting

Statistical analysis

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

Results

The main aim in the SSG1 was to improve the offensive individual game activity - ball dribbling.

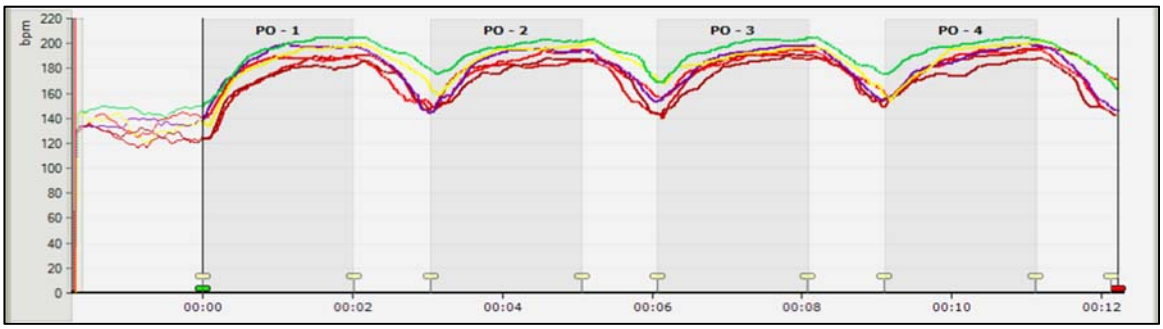


Figure 4
Physiological curves of the monitored players during the SSG1

In above stated Figure 4 are depicted physiological curves of the monitored soccer players during the SSG1. On this physiological curve, we can see a graphic illustration of the soccer players´ load during the SSG1 with four different vertices, which represent four repetitions. The main aim in the SSG2 was to improve the offensive individual game activity – passing.

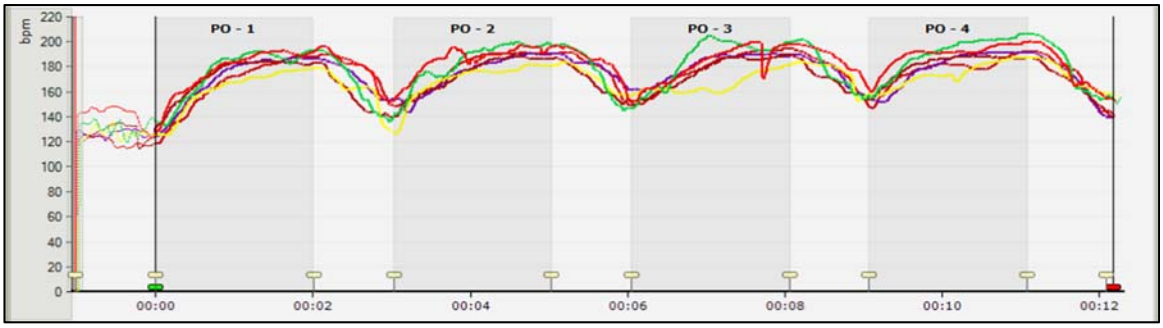


Figure 5
Physiological curves of the monitored players during the SSG2

In above stated Figure 5 are represented physiological curves of the six monitored soccer players during the SSG2. On this physiological curve, we can see a graphic illustration

of the soccer players´ load during the SSG2 with four different vertices representing four repetitions.

The main aim in the SSG3 was to improve the final offensive individual game activity – shooting.

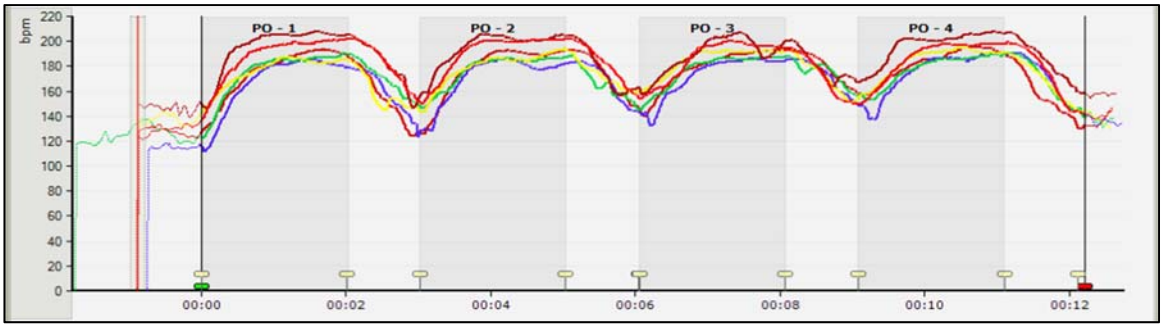


Figure 6

Physiological curves of the monitored players during the SSG3

In above stated Figure 6 are represented physiological curves of the monitored soccer players, which refer to the inequality of the dosing of load and rest interval in four repetitions during the entire SSG3.

The monitored players spent during the individual variants of SSG in selected intensity load zones different time. In table 3 are presented the average time values and the percentage representation of players´ remaining in each load intensity zone.

Table 3

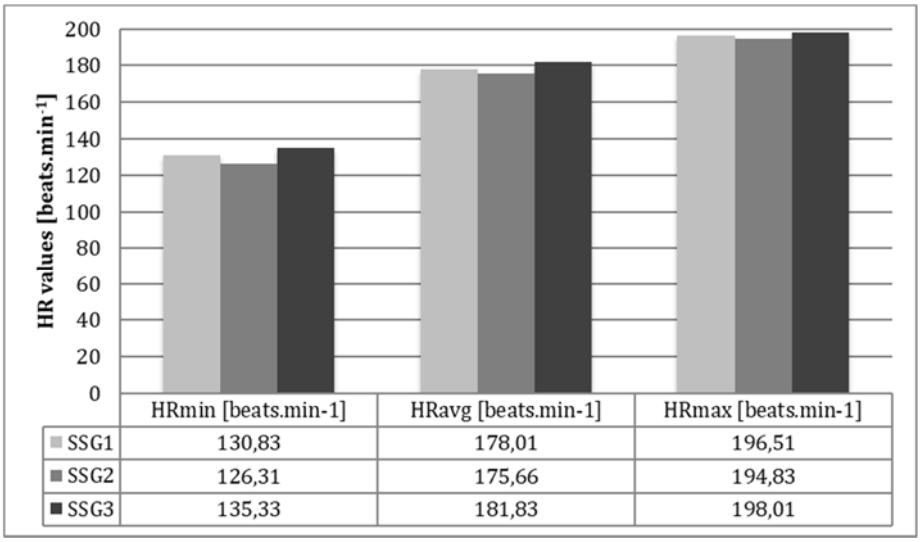
Remaining of players in each load intensity zone

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	0.03	0.25	0.32	2.67	1.78	14.83	2.79	23.25	7.08	59.00
SSG2	0.03	0.25	0.30	2.50	2.27	18.92	4.02	33.50	5.38	44.83
SSG3	0	0.00	0.10	0.83	1.32	11.00	3.28	27.34	7.30	60.83

The highest intensity of the training load was monitored in the SSG3, in which the main aim was to improve the final offensive individual game activity – shooting. Players remained in the SSG3 the longest time period in the load zone of maximal intensity (90 – 100 % HR_{max}) on average 7.30 min. (60.83 %) of SSG3 duration and at least in the load intensity zone, which was sufficient to accelerate the regeneration of players (50 – 59 % HR_{max}). In this zone remained the players not even for a second. The lowest intensity was monitored in the SSG2, in which was the content focus of SSG aimed at improvement of a pass. On average spent players

5.38 min. (44.83 %) of the SSG2 duration in the load zone of maximal intensity. In SSG1, with an emphasis on the improvement of the OIGA – dribbling spent the players in the load zone of very low intensity 0.03 min. (0.25 %) of the SSG1´s total time. The average value in the load zone of maximal intensity represented 7.08 min. (59 %). In the SSG2 remained the players the most time in the load zone of submaximal intensity (80 – 89 % HR_{max}), on average 4.02 min (33.50 %).

The internal response of organism in individual forms of SSG games with various content focus was monitored by using the HR values. The recorded values are stated in Figure 7.



	HRmin [beats.min-1]	HRavg [beats.min-1]	HRmax [beats.min-1]
SSG1	130,83	178,01	196,51
SSG2	126,31	175,66	194,83
SSG3	135,33	181,83	198,01

Figure 7
The average HR values in individual SSG forms

The highest average value of minimum HR (HR_{min}) was achieved by the monitored players in the SSG3 with focus on the OIGA improvement – shooting, 135.33 ± 11.01 beats.min^{-1}. The lowest values were monitored in the SSG2, in which the SSG aim was to improve the ball passing, 126.31 ± 5.11 beats.min^{-1}. In the SSG1 with a focus on the ball dribbling was the HR_{min} 130.83 ± 13.48 beats.min^{-1}.

The lowest average HR value (HR_{avg}) of the monitored players was in the SSG2 175.66 ± 5.57 beats.min^{-1} and the highest HR_{avg} in the SSG3 181.83 ± 7.11 beats.min^{-1}. In the SSG1 was the 178.00 ± 7.48 beats.min^{-1}. The recorded average value of maximal HR (HR_{max}) was the lowest in the SSG2 194.83 ± 7.46 beats.min^{-1} and the highest average in SSG3 198.00 ± 5.05 beats.min^{-1}, in the SSG1 was recorded HR_{max} 196.51 ± 7.14 beats.min^{-1}.

In small forms of the SSG, in which the players played in the ratio of 3:3, is the training load often higher than the match load itself. The recorded ascertained values of HR_{max} show that players performed the training activity at a high level.

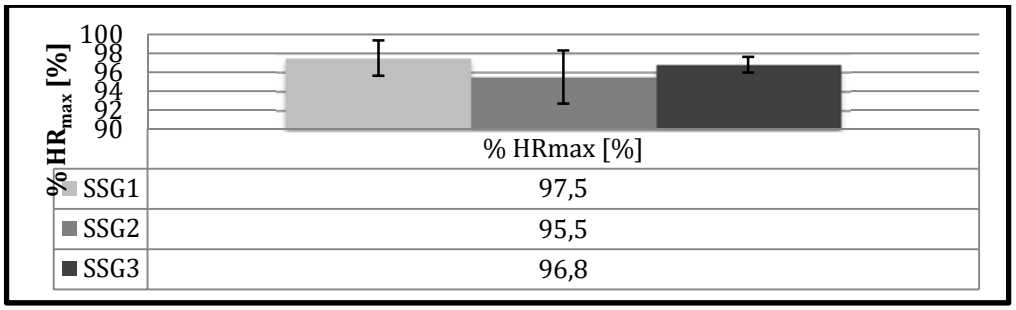


Figure 8
Percentage representation of load achieved from HR_{max}

Differences between the ascertained percentage values from HR_{max} (Fig. 8) are at a low level. We can see that the highest value was in the SSG1 (97.5 %) and the lowest in the SSG2 (95.5 %).

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	196.51	7.14	97.5	1.87
SSG2	194.83	7.46	95.5	2.81
SSG3	198.00	5.05	96.8	0.83

In contemporary soccer is the match load at the level of the anaerobic threshold. During the training process in the individual forms of SSG was the training load at a higher level. Time spent above the ANT represents higher values.

Table 5
Time spent above the ANT

SSG	Time spent above the ANT	
	[min.]	(%)
SSG1	7.62	63.50
SSG2	6.20	51.67
SSG3	8.18	68.17

Players spent the most time above the ANT in the SSG3, it was up to 8.18 min. (68.17 %) of SSG3 duration and at least in the SSG2 6.20 min. (51.67 %) of the SSG´s total time. In the SSG1 the time spent above the ANT 7.62 min., what represents up to 62.35 % of the SSG.

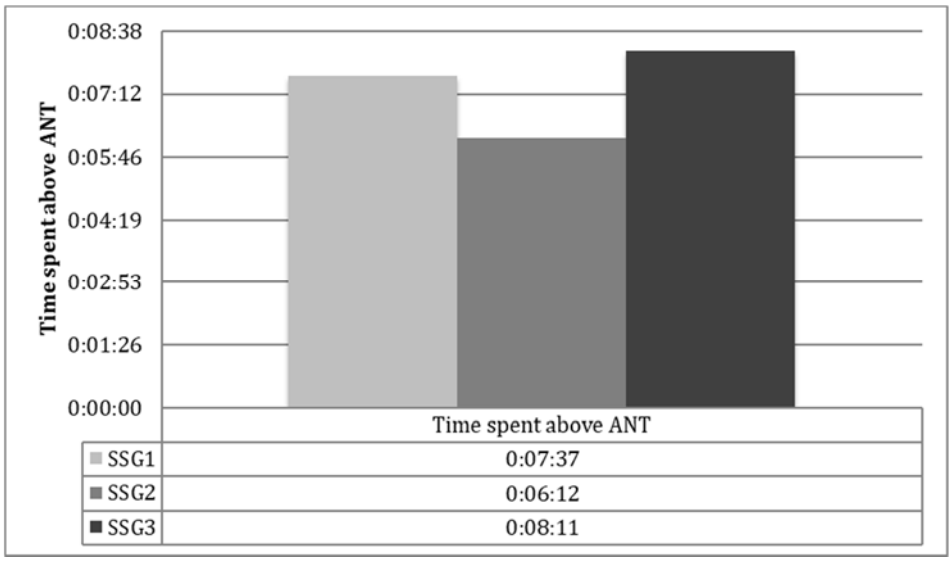


Figure 9
Time spent above the ANT

On the basis of the One-Way ANOVA results, we can state that there is a statistically insignificant difference in HR_{avg} values after completing the SSG with various content focus ($F = 1.2679$, $p = 0.8099$).

The statistical significance between the SSG1 and SSG2 was not proved ($t = 0.5967$, N. S.). The difference between the HR_{avg} was 2.34 beats.min.$^{-1}$. It was probably caused by the fact that the change of SSG´s content focus did not significantly influence the physical and game activity of players, and therefore, the average values of HR were not significantly different. In the SSG1 were not found any statistically significant lower HR_{avg} than in the SSG3 ($t = 0.9802$, N. S.). In the SSG1 it was 178.00 ± 7.48 beats.min.$^{-1}$, in the SSG3 were the recorded HR_{avg} values of 3.83 beats.min.$^{-1}$ more, 181.83 ± 7.11 beats.min.$^{-1}$.

Statistically significant differences in the HR_{avg} values between the SSG2 and SSG3 were not proved ($t = 1.5769$, N. S). The difference between the HR_{avg} values was 6.17 beats.min^{-1}. The content focus of SSG did not significantly affect the internal response of the players´ organism to the load during the SSG.

Discussion

Heart rate (HR) is a generally accepted and often used physiological indicator of the players´ physical activity in the training process (Holienka & Cihová 2016). When speaking about the results obtained from the sports devices, one has to respect the fact that

the HR values showing the training load intensity of the soccer players´ organism in different forms of small-sided games are only indirect indicators.

The SSG in a systematic training process enables the players to improve and stabilize the technical and tactical side of game activities, to secure the development of creative thinking and their actions on playing field. The conditions of SSG ensure the realization of various series of individual´s game activities and combinations, which have a positive effect on spatial orientation, physical activity and players´ emotions as well. The contradictory activity of opponent forces the players to flexible change the individual phases of the game, what means that their game capacity, or more precisely the swift switch from defensive to offensive game phase and vice-versa, is developing. The set training aims and tasks are fulfilled by appropriate changing of the SSG rules and their content focus.

The small-sided games are a complex form of players´ game development, owing to their high level of specificity it is possible to ensure a smooth development of their game performance efficiency (Babic 2016). Claims that the SSG can be described as a complex element in the player´s specific potential development, which can we by laying down our rules, precisely aim at the goal that we want to achieve in training. It is very important to make the SSG rules and content focus clear to all players, who have to agree with the SSG goal. Incorporating of the SSG games into a soccer training is a very effective part of training activity. All age categories are developing their special persistence in them, thereby is their level of training experience on the increase and the players are in a constant contact with the ball. Soccer players are improving their technical side of the individual´s game activities, participating in the course of game actions, trying to anticipate the opponent´s actions and operatively reacting, which means they improve their tactical skills as well. Well-designed small-sided games can direct the players to the goal, which they want to achieve in training, and increase the level of their game preparedness.

Los Arcos et al. (2015) claims that the SSG games are more effective than interval training by maintaining of young soccer players´ aerobic abilities at the end of a competition. Players during the SSG games showed more joy in physical activity than during the interval training. By the SSG it is possible to maintain the level of anaerobic abilities by specific means and to increase the players´ motivation. The SSG games 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).

Small forms of SSG games (3:3) with the rule of stopping the ball in a defined area of playing field represent for coaches an alternative to increase the demands on the cardiovascular and metabolic system of young players (Halouani et al. 2017). The HR values in the SSG1, in which the team scored a point after the ball was stopped in a predetermined defined area, were higher than in the SSG2, in which players had to hit a small empty goal.

Castellano et al. (2013) claim that the intensity of the training load was highest in the SSG game with a focus on ball holding. If they played on goals of standard size with goalkeepers, or on small goals, then the HR values were significantly lower. Gonzáles-Rodenas et al. (2015) confirmed in their study, that the SSG games with a focus on ball holding caused the highest internal response of the players´ organism. This can be due to the fact that the players have to constantly work with the space, free themselves of the opponent and adequately make a free space for their teammates. If there were no small goals on the playing field, but only a goal of a standard size, then would have the players more possibilities to deal with game tasks, because they could cooperate with the goalkeeper.

Table 6

Percentage representation of time spent in the maximal intensity load zone in the SSG

Authors	**Brandes et al. (2017)**	**Our research**
Zone	**90 – 100 % SF_{max}**	
SSG-SB/SSG1	36.2 ± 26.1	57.96 ± 5.47
SSG-2G/SSG2	28.3 ± 29.7	44.28 ± 19.42
SSG-1G/SSG3	42.8 ± 25.5	59.85 ± 5.78

In Table 6 is shown that in various forms of the SSG the players spent different periods of time in the load zone of maximal intensity. The most intense was the SSG1 with the aim to improve the shooting. The minimum time was spent in the zone of 90 – 100 % HR_{max} in the SSG2 with the content focus on improvement of the passing. Similar results were presented also by Brandes et al. (2017), in their study had the SSG a longer duration and because of this could be the intensity lower.

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 U15 category. The zones of load intensity were divided at the same level as in our research. The intensity of the training load was higher than the match load.

In our research was the LI 2 minutes and the RI lasted only 1 minute. Because of it spent the players more in the load zone of maximal intensity (90 – 100 % HR_{max}).

Table 7

Intensity of U15 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
(%)	0.5 ± 0.5	1.6 ± 1.5	2.0 ± 2.9	6.9 ± 5.6	12.7 ± 7.7	22.3 ± 10.4	38.0 ± 14.3	39.6 ± 10.8	44.9 ± 21.0	25.8 ± 17.1

During the match is the internal response of the organism to the load at different levels. A systematic, purposefully thought-out training process has to stimulate all those energy systems, which predominate in the match. In practice is this criterion replaced with the cognition and adequate manipulation of SSG´s variables, including the aim and content focus of SSG (Peráček 2014).

Halouani et al. (2014a) found out, that players had statistically significant higher HR values (178 ± 3 beats.min.$^{-1}$) in the SSG, in which was the aim to stop the ball in a defined area. When they played the small-sided game on a small empty goal, then the HR values were lower (174 ± 3 beats.min.$^{-1}$). The results of the above stated author are corresponding to ours. The HR_{avg} value in the SSG1 was 178.00 ± 7.48 beats.min.$^{-1}$, in the SSG2 175.66 ± 5.57 beats.min.$^{-1}$. In terms of load intensity is the SSG1 more effective for the development of players´ potential.

In the study of Halouni et al. (2017) is stated that the monitored players had higher HR values in the SSG, in which the players had to stop the ball in a defined area, than in the SSG in which they could score a goal in a small empty goal.

Table 8

Comparison of HR values and % of HR_{max} in various forms of the SSG

	Halouani et al. (2017)	**Our research**
Number of players (n)	3:3	3:3
Playing field [m]	20 x 25	18 x 25
Load interval (min.)	4	2
Rest interval (min.)	2	1
Number of repetitions	4	4
SB-SSG/SSG1	181 ±2.86 beats.min.$^{-1}$	178.00 ±7.48 beats.min.$^{-1}$
SB-SSG/SSG1	87.5 %	97.5 %
SG-SSG/SSG2	176 ±2.73 beats.min.$^{-1}$	175.66 ±5.57 beats.min.$^{-1}$
SG-SSG/SSG2	85 %	95.5 %

In Table 8 we can also see that the SSG, in which the players had to stop the ball in a defined area of playing field, were the HR_{avg} values higher than in the SSG, in which played the players on a small goal. The acquired values of % HR_{max} were also higher in the SSG, in which were the players tasked to stop the ball, than in the case when they had to dribble the ball and subsequently end the offensive phase on the small goal. In our case are the percentage values of HR_{max} at a higher level. We can claim credit for the load dosing. The ratio was the same (1:0.5), but the load interval by Halouani et al. (2017) lasted 4 minutes and in our monitored SSG it was only 2 minutes.

The internal response of the players´ organism was different, when the rules concerning the way how they can score a goal were changed (Halouani et al. 2017). The same was found in our research. The internal response of the organism during the various SSG forms with various content focus was at different levels. The highest values were found out in the SSG3, if there were goalkeepers present and players could score a goal on a goal of a standard size.

Table 9

Comparison of HR values in individual SSG variants

SSG	Brandes et al. (2017)	Our research
	HR_{avg} [beats.min.$^{-1}$]	**HR_{avg} [beats.min.$^{-1}$]**
SSG-SB/SSG1	173 ± 7	178.00 ± 7.48
SSG-2G/SSG2	169 ± 8	175.66 ± 5.57
SSG-1G/SSG3	175 ± 8	181.83 ± 7.11

In Table 9 we can notice that the internal response of the players´ organism to the load in SSG with various content focus is at different levels. Our results are corresponding to the results of Brandes et al. (2017). Also in their study, the lowest values of HR_{avg} were found in the SSG, in which could the teams score a goal on 2 small goals on the playing field and the highest values were monitored in the SSG, in which was the emphasis on the improvement of shooting on one goal.

Švihorík (2005) claims that, when concerning the SSG rules, it is necessary to be mindful of stopping and preventing the frequent intermittence of game continuity. These rules should force the players to play and move constantly.

In the SSG2 the players had to make between themselves at least 3 passes. It was very challenging without adequate physical activity, the ball often got outside the playing field. Although the reserve balls were prepared around the playing field, when the game started again, the players couldn´t keep the HR values at a high level.

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.

Table 10

Comparison of the HR_{avg} values of the monitored players in competitive matches

Author (year)	HR_{avg} [beats.min^{-1}]	Level	Country
Capranica (2001)	180	U12	Italy
Helgerud et al. (2001)	171	U19	Dennmark
Rodrigues et al. (2007)	166	U17	Brasil
Strøyer et al. (2004)	174	U13	Dennmark
Castagna et al. (2009)	170	U15	Italy

Castagna et al. (2009) found out that the HR_{avg} values during the matches of the U15 age category are higher than 170 beats.min.$^{-1}$. HR_{avg} values in individual forms of SSG with various content focus were higher than 170 beats.min^{-1}. The internal load of players´ organism points out to high physical activity in individual forms of SSG.

The average HR values found in individual forms of SSG are at a similar level to the values recorded in competitive matches at different levels and in various age categories (Capranica 2001; Helgerud et al. 2001; Strøyer et al. 2004; Rodrigues et al. 2007; Castagna et al. 2009).

Conclusions

The use of modern technologies in soccer trainings, such as sport testers, enable the sports experts to find out the internal reaction of the players´ organism to the load and get objective feedback on the adequacy of the training load. Our aim was to point out to the internal response of the players´ organism in the SSG games with various content focus by/widening the knowledge of this not much examined research issue. Coaches have to include into the conspectus of soccer trainings also the SSG, that are closely related to the aim of the soccer training. In our research were monitored the HR values in the SSG, in which the aims of the SSG game were different. On the basis of acquired data, can be stated that in the SSG with various content focus the HR_{avg} values in individual forms of SSG were different, but not significantly. The highest HR values were recorded in the SSG3. Players in this SSG game 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 SSG3 was the most intense one. Among these three SSG variants were the lowest HR_{avg} values recorded in the SSG2. It means players spent the minimum of time in the load zone of maximal intensity and above the ANT level as well. In the SSG1 were recorded lower HR values than in the SSG3, but the internal response of the organism was higher than in the SSG2.

The theoretical part of a thoroughgoing soccer coach is also based on a training process, which is prepared in advance and well-considered according to the physiological principles. In soccer trainings have to be observed the principles of the player´s organism adaptation changes to training stimuli. It is important to prepare the players not only in terms of fitness, but to focus on their game preparedness as well. Therefore, the SSG games with various content focus are ideal for the realization of soccer trainings according to the need of the entire team, group of players or individuals.

Acknowledgments

This study is part of research SVV 2017-2019-260466, This study is part of research UNCE HUM/032, This study is part of research GAUK 7841.

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DOI 10.2478/afepuc-2019-0006

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ALGERIAN SPORT HIGH SCHOOL AS COMPREHENSIVE APPROACH FOR IMPROVING PUBLIC EDUCATION SYSTEM

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Summary. In 2001 Algerian Governmental created Sport High School (HSA). Its main mission is education, training and development of young talents by providing all the conditions to serve their healthy sports path. Firstly, by intensifying their daily sports as school-based health education program designed to improve their physical status relates to their healthy lifestyle. Disclosed by evaluation tool design to detect their physical abilities as well as their longitudinal followings. Used in present as evaluation scale to inspect imprudence related to the objectives of Algerian public schools (HPA). For proposing this comparative study test 1 000 High School student, 800 boys and 200 girls for academic years 2017 – 2018. The evaluation focused on measuring anthropometric parameters - age, weight, height and BMI as well as physical qualities - speed (30 m), the explosive force vertical (VJ), explosive force of the arms (medicine ball throw 3 kg (MB), flexibility trunk (FT)), endurance abdominal muscles (maximum of <4 sit-ups > in one minute (EAM) and aerobic endurance (20m shuttle test (VO2max)). Controlled by rating scales produced by Iaiche Rezoug. Based on the scale provided by this latter, our results proclaims the generalization of perspectives implemented in Algerian Sport High School as school-based physical health education program designed to reduce the consequences of overweight on health-related to physical performance. Estimated by rating scales produced by Iaiche Rezoug, which could serve as a model database refining the impact of the two Algerian educational systems, as an approach suggesting a clear direction for the development of adequate programs for the larger populations of Algerian scholars.

Keyword: Sport High School, Public High School, policies, physical health and well-being.

Introduction

In recent decades the role of recess during the school day has been called into question. Reviewed by (Bohn-Gettler & Pellegrini 2014) to ensure the best practices are being utilized, school policies should be based on scientific investigations. Proclaims by Ling Qian, Lok-Wa Yuen, Yonghua Feng, Ian Newman, Duane Shell, Weijing (2018) via a school-based comprehensive health education program that would effectively increase children's physical activity level. Support the encouragement of physical activity facilities and opportunities, under the school environment that encourages teenagers to be active around after time school. Below its administration, that allows 60+ minutes per school day for physical activities, and assigning quantities of homework that restrict play outside of school hours (Feng, Wei, Lin, Maddison, Ni Mhurchu, Jiang et al. 2017). However, this practice in Algerian educational system is in conformity with Algerian High School Sport created in 2001; its main mission is education, training and development of young talents (Aiche Rezoug 2007). In the opposite of public school where the time of physical lessen is limited to 2 h/weeks in middle or high school (Zerf 2016). From this perspective, our outcome in this study reveals the result of these contradictions two Algerian governmental educational approaches that one of them support sport-school-based intervention programs. As policies classrooms for health education by facilitating exercise daily practice as beneficial health related to fitness and well-being (Wang, Cai, Wu, Wilson, Weston, Fawole et al. 2015). Where the other reduced time of physical activity improves the academic results. Dined by Algerian studies as sedentary time physical inactivity contribute substantially to the global burden of disease. Affirmed by Zerf (2016) as based school ideal environment for delivering obesity interventions to children because students spend most of their waking time at school (at least eight hours per day) (Mohammed 2017). Assumed in present by evaluation scale developed by Iaiche Rezoug (2007) in its aim is to refine the detection of the physical aptitudes of young sports students. In addition to present study, that their aims are to revel imprudence interconnected to the objectives of Algerian public schools. Indicated by similarities through the implementation of more time of physical lessons or additional physical program look at increase of relationship physical health indicators and reduction of to obesity and other syndromes. Report Physical Fitness and Health Surveillance Survey(NPFHS) as comprehensive school-based interventions may assist in tackling the rising prevalence of child and adolescent obesity scholars.

Method

Study population and design

Our aim in this study is to reveal the impact of two Algerian governmental educational approaches: High School Sport (HAS) created by Algerian Governmental, versus Algerian public schools (HPA) conducted in "PE Institute" University of Mostaganem for academic years 2017-2018. The research samples were selected by intentional manner included 800 male secondary high school students and 200 girls, their age are around 16 years. All participants were healthy with good habits not taking any medication on a regular basis. Their results were compared by in one hand by a scale developed by Iaiche Rezoug (2007) as well as its study results. All contributors were informed about procedures and all participants provided their written consent. The study protocol was accepted by the Institute of PE. The study was conducted based on the field tests physical qualities and BMI, third semester, 19 May 2018 on the student festival in the Mostaganem sports complex:

- Speed (30 m): The test involves running a single maximum sprint over 30 meters, with the time recorded. Below are average for the 30 m SPRINT (Davis, Phillips, J. Roscoe & D. Roscoe 2000) for age 14 to 18 years.

Table 1

Norms 30 m sprint for age 14 to 18 years (Davis, Phillips, J. Roscoe & D. Roscoe 2000)

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	<4	4.0 - 4.2	4.3 - 4.4	4.5 - 4.6	>4.6
Female	<4.5	4.5 - 4.6	4.7 - 4.8	4.9 - 5.0	>5.0

- Explosive force (VJ)): also known as the vertical jump test (Davis, Phillips, J. Roscoe & D. Roscoe 2000) for ages 14 to 18 years.

Table 2

Norms of vertical jump test for age 14 to 18 years (Davis, Phillips, J. Roscoe & D. Roscoe 2000)

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>65 cm	50 - 65 cm	40 - 49 cm	30 - 39 cm	<30 cm
Female	>58 cm	47 - 58 cm	36 - 46 cm	26 - 35 cm	<26 cm

- Explosive force of the arms (medicine ball throw 3 kg (MB)): This test measures upper body (arm) strength and explosive power, the distance from the starting position to where

the ball lands are recorded. Medicine ball – 3 kg request weight up to 65 kg body weight. For ages 14 to 18 years (Howley & Thomas 2016).

Table 3

Norms of the explosive force of the arms for age 14 to 18 years (Davis, Phillips, J. Roscoe & D. Roscoe 2000)

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>6,5 m	5,0 – 6,5 m	4,0 – 4,9 m	3,0 – 3,9 m	<3,0 m
Female	>5,8 m	4,7 – 5,8 m	3,6 – 4,6 m	2,6 – 3,5 m	<2,6 m

- Flexibility (bending of the trunk (FK)): The objective of this test is to monitor the development of the athlete's lower back and hamstring flexibility. The assistant records the distance reached by the athlete's fingertips (cm) and following table is for 16 to 19-year-olds (Davis et al. 2000, p. 126).

Table 4

Norms of trunk flexibility for age 14 to 18 years (Davis, Phillips, J. Roscoe & D. Roscoe 2000)

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>14	14.0 - 11.0	10.9 - 7.0	6.9 - 4.0	<4
Female	>15	15.0 - 12.0	11.9 - 7.0	6.9 - 4.0	<4

- Endurance abdominal muscles (maximum of <4 sit-ups >> in one minute (EAM)). This test requires the athlete to complete as many curl-ups as possible at a rate of 20/minute. The athlete is to perform as many curls as p he assistant is to count and record the total number of curls which is then used to assess the athlete's performance possible until they are unable to keep in time with the metronome. The following normative data is available for this test (Hyde 2002).

Table 5

Present the norms of the endurance of abdominal muscles for age 14 to 18 years (Davis, Phillips, J. Roscoe & D. Roscoe 2000)

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>55	54.0 - 49.0	48 - 47.0	46.9 - 40.0	<40
Female	>50	49.0 - 45.0	44 - 40.0	39 - 31	<30

- Aerobic endurance (through the 20 m shuttle test (VO_2max)): designed to determine the maximal aerobic power of schoolchildren, healthy adults attending fitness class and athletes performing in sports with frequent stops and starts (e.g. basketball, fencing and so on). Subjects run back and forth on a 20 m course and must touch the 20 m line; at the same time, a sound signal is emitted from a pre-recorded tape. Frequency of the sound

signals is increased by 0.5 km h-1 each minute from a starting speed of 8.5 km h-1. When the subject can no longer follow the pace, the last stage number announced is used to predict maximal oxygen uptake (VO_2max) (Y, ml kg-1 min-1) from the speed (X, $km.h^{-1}$) corresponding to that stage (speed = 8 + 0.5 stage no.) and age (A, year): Y = 31.025 + 3.238 X - 3.248A + 0.1536AX, r = 0.71 with 188 boys and girls aged 8-19 years (Léger, Mercier, Gadoury, Lambert 1988)

- Anthropometric parameters: we calculate age by years, weight (kg), height (cm) and body mass index (BMI) by formula BMI = weight/square meter size (Mohammed 2017).

Statistical analysis

The study was not a research project, but an evaluation comparative of educational practices in our educational settings. Descriptive analysis of students based on means and percentage drives from physical tests, according to (Iaiche Rezoug 2007) scale results and battery tests. Present in this study as fugues 1, and 2.

Result

The results of figure 1 showed that Algerian Governmental High School Sports students obtained higher scores than students Algerian public schools. Records in all parameters studies. Support by Algerian studies that inactive course and lack of sport are predictors of health problems that may lead to severe consequences (Zerf 2016). Demonstrated by reviews studies through a comprehensive sport based-school health education, that includes effective instruction for developing knowledge, skills, motivation, and changes to the school's physical and social environment (Ling Qian, Lok-Wa Yuen, Yonghua Feng, Ian Newman, Duane Shell, Weijing 2018). Deduce by this study through school-based interventions effective for reducing BMI in teenagers, with a change of BMI ranging from -0.04 kg/m2 to -3.27 kg/m2, according to Wang, Cai, Wu, Wilson, Weston, Fawole et al. 2015). Top scored in actual study in figure 2 following standardizing data obtainable by (Iaiche Rezoug, 2007). See figure 1.

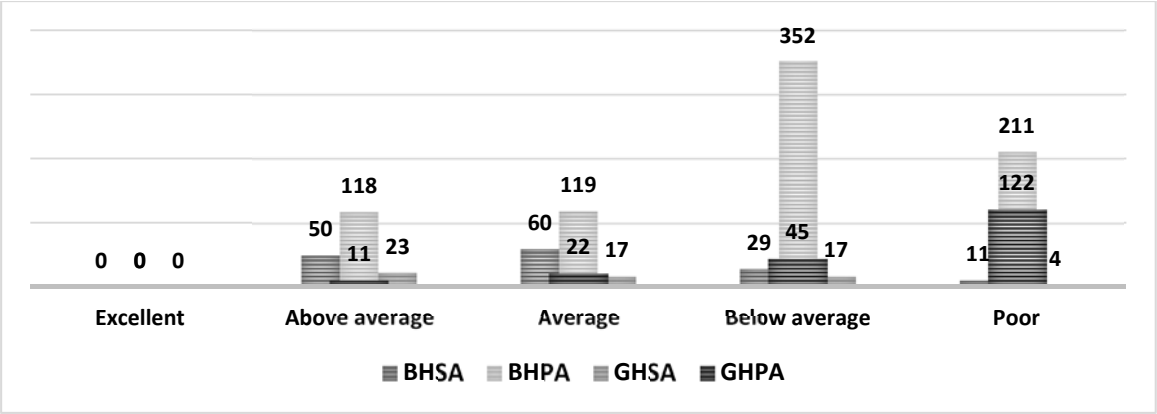


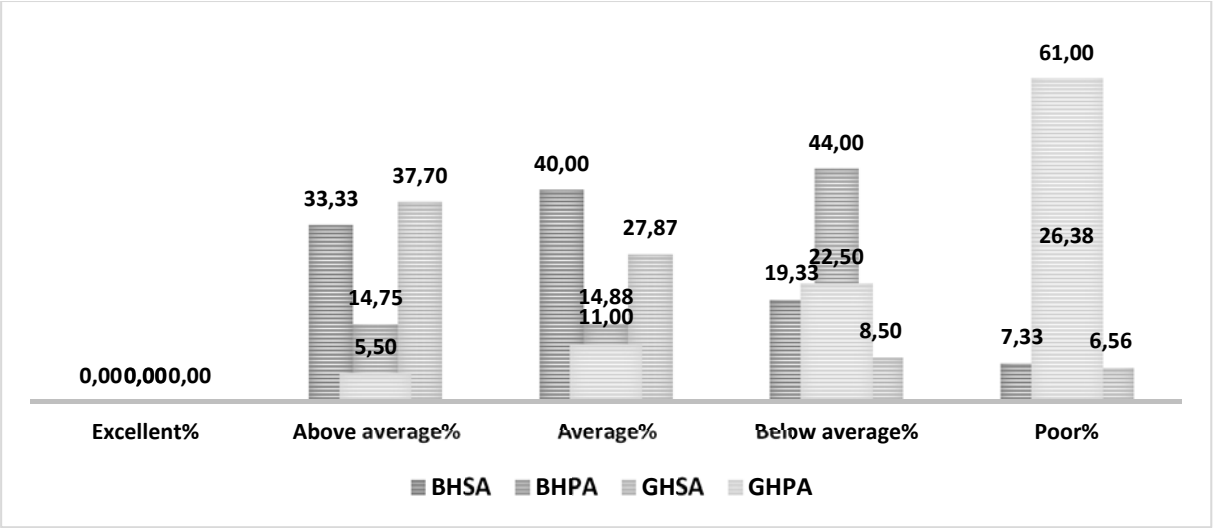
Figure 1

Characteristics of the two samples following normative data obtainable by Iaiche Rezoug (2007)

Recommend in Algerian studies via the subject of significant time physical education course as a treatment to inactive course elements. Recognized as a significant risk factor for multiple causes, like increases of stroke, cardiovascular, elevated blood pressure, low HDL ("good") cholesterol and diabetes (Zerf 2016). Conclude in the case of this study via the principle that any work domain demands some strength and physical capacity. In respect to the relationship between fitness practice and educational global programs (Cook 2016). Report as just cause motion in figure 2.

Figure 2

Percentage of physical of the two samples following normative data obtainable by Iaiche Rezoug (2007)



In benefits of Algerian Governmental High School Sports students (BHSA and GHSA) as efficacy school-based comprehensive physical and health education program in all variables

studies. The opposite of students Algerian public schools that the mode of school is associated with exercise intolerance and many adverse health consequences related to weight- obesity, overweight, upper BMI, adiposity, and an increase of fat, dined in Algerian studies (Mohammed 2017). Confirmed by standard battery test proposed by Iaiche Rezoug (2007). Stated by (Mohammed 2017) as missing Health Fitness Control Practices in Algerian Secondary School. In the benefits of extracurricular physicals relate to fitness, as both missing health-fitness control and practices in PE Algerian public school curricular Secondary School.

Discussion

Our results confirmed that school-based interventions Algerian public schools are associated with many adverse health consequences, including exercise intolerance, upper BMI, and negative self-body image and physical performance (Ebbeling, Pawlak, Ludwig 2002). Confirmed via this study Algerian Governmental High School Sports students (BHSA and GHSA) as efficacy school-based comprehensive physical and health education program in all criteria studies. Admitted by Yang (2014) that School Sports Prescription" seemed to be an effective physical activity intervention widely applied in treatment studies, which generally organized more minutes physical activities guided by specific prospectuses after class in school days, focused on moderate intensity aerobic exercise complementary with strength and fitness training. Shown by Algerian studies that specific enhancements to PE classes can effectively increase levels of physical activity and improve physical fitness among children and adolescents. Extra benefits may include improved flexibility, muscular endurance, and exercise-related knowledge and motivation (Mohammed 2017). Report by (Bohn-Gettler & Pellegrini 2014) via the activity levels of PE classes can be enhanced by adjusting curricula, teaching practices, or policies. The case of Algerian Governmental High School-based Sports students (BHSA and GHSA) that activity levels of PE classes by improving the Algerian high school academic curricula, teaching practices, or policies. Admitted by our government as specific strategies by increasing the time or level of physical activity in those specific classes by altering the rules of games or using teaching techniques to maintain all students engaged and active; adding PE classes to the school day or week; or extending the length of PE class time (Iaiche Rezoug 2007). Show in the present as healthy implements that must be globally applicable to public elementary, middle, and high school students to aid them achieve the recommended 60 minutes of activity every day (Feng, Wei, Lin, Maddison, Ni Mhurchu, Jiang

et al. 2017). Purposed in similarities as school-based physical programs that increase daily students' physical activity levels by encouraging them to improve their fitness levels. As practice to maintain a healthy weight and potentially improve their health outcomes over time. Evidence confirmed by reviews that these interventions are associated with beneficial effects on BMI and obesity prevention (Mohammed 2018). Our results caution against school-based time active versus inactive on levels of health relate to fitness. Below the implements difference between sport high school and public Algerian secondary academic system. Admit in five motor abilities namely strength, speed, endurance, flexibility and coordinative abilities, agreeing to present study. Reported in the benefit of student scholar in sport Algerian high school in competences with public students' school. From that, our outcome in this study reveals the contradictions between those two Algerian governmental academic approaches that one of them supports sport-school-based intervention programs. As policies classrooms for health education by facilitating exercise ordinary practice as beneficial health related to fitness and well-being (Wang, Cai, Wu, Wilson, Weston, Fawole et al. 2015). Claims by Algerian studies the case of public schools as sedentary time physical inactivity increases global burdens of disease. Affirmed by Zerf (2016) as based school ideal environment for increasing obesity. Since students spend most of their waking time at school (at least eight hours per day) (Mohammed 2017). Expected in present by the scale developed by (Iaiche Rezoug 2007) to jug the physical aptitudes of adolescent students. Present via this study as missing healthy fitness control practices in Algerian Secondary School to revel rashness interconnected to the objectives of Algerian public schools. Indicated by similarities through the effecting of more time of physical lessons or supplemental physical program Look at increasing of relationship physical health indicators and reduction of obesity and other syndromes. Report Physical Fitness and Health Surveillance Survey (NPFHS). As comprehensive school-based interventions may help in tackling the rising frequent incident of children and adolescent obesity scholars (Qian, Yuen, Feng, Newman, Shell, Du 2018)

Conclusions

Longitudinal data have shown that for each weekday that normal weight adolescents participated in physical education, the odds of becoming an overweight adult decreased by 5 percent. Estimated via this study standards measure test and time physical practice. Which support a comprehensive school physical activity program and emphasize daily and minimum

time necessities, curriculum and assessment standards, and certified teachers with appropriate class sizes and equipment. Concludes by review studies to be up to an hour of daily physical activity programs. Which can be added to a school curriculum by taking time from other subjects without hurting students' academic achievement in those subjects. Reported in the present study at benefits of Algerian students' academic in sport Algerian high school in compares with Algerian public students' school. Claims by present as physical healthy implements, that must be globally applied to public elementary, middle, and high school students. To aid them for achieving the recommended 60 minutes of activity every day. Show through this study as missing policies promoting standards for instructors' qualifications, fitness testing, or performance in Algerian public schools. Where majors studies in this topic admitted that it does not enhance the students' grades either in these subjects or in their physical fitness.

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