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EFFECTS OF STATIC AND DYNAMIC POST-ACTIVATION POTENTIATION PROTOCOLS ON CHANGE OF DIRECTION PERFORMANCE IN ADOLESCENT SOCCER PLAYERS

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Summary: Purpose: The study aimed to investigate the temporal effects of static and dynamic post-activation potentiation (PAP) conditioning activities on agility performance. **Material and Methods:** Fourteen male adolescent soccer players participated in the study. Participants performed three different conditioning activities randomly on non-consecutive days. Conditioning activities consisted of static, dynamic, and control protocols. The dynamic protocol was performed with the dynamic squat at 85% of 1-repetition maximum while the static protocol was performed 3 repetitions x 3 seconds of the isometric squat. The control protocol only completed a standardized warm-up. After the baseline measurements were taken, all protocols completed the agility test in 15th seconds, 2,4,6,8,10,12,14th minutes. Repeated measures in ANOVA were used to determine differences between PAP protocols and the Bonferroni post hoc test was employed to determine which protocol caused a significant difference. **Results:** There was no significant difference between protocols in baseline (p<.925, ηp2 = 0.006), however, the control protocol caused a significant difference in 15th seconds and 2nd minutes compared to static and dynamic protocols (p<.001, ηp2 = 0.73, 0.72, respectively). In the 4th and 6th minutes static and dynamic protocols caused a significant difference compared to control (p<.001, ηp2 = 0.46-0.89, respectively), and in the 8th-minute static and dynamic protocols reached the peak performance (p<.001, ηp2 = 0.96). Although in the 10-12-14th minutes static and dynamic protocols' performance values gradually reduced. However, they always were better compared to the control protocol (p<.001, ηp2 = 0.91-0.93-0.96, respectively). **Conclusions:** Adolescent soccer players can benefit from both static and dynamic PAP protocols before competition or halftime to improve performance.

Keywords: Isometric, Agility, Football, 1RM, Puberty, Manoeuvrability.

Introduction

The muscle's reaction to a movement is related to the previous contraction history of that muscle. During the implementation of movements, muscle fatigue can impair force production or power output, thereby reducing explosive performance over a period of time (Blazevich & Babault 2019). Although muscular contraction creates fatigue, it leads to potentiation in the muscle. The occurrence of fatigue normally weakens muscle contraction. However, Post-Activation Potentiation (PAP) also known as conditioning activity (CA), causes increased contractile response after contractions due to myosin light chain phosphorylation (Robbins 2005; Till & Cooke 2009). It is accepted that the increase in fatigue and contraction response develop together, and the force is produced by the muscle after contraction is the result of the balance between fatigue and potentiation (Gossen & Sale 2000; Rassier & Macintosh 2000).

The effects of PAP are well studied for change of direction, repeated sprint, straight sprint speed, and jump performance (Low et al. 2015; Mcbride et al. 2005; Sanchez-Sanchez et al. 2018; Sole et al. 2013; Till & Cooke 2009; Zois et al. 2011). However, the temporal effects of PAP conditioning activity were not investigated in these studies. Studies examining the temporal effects of PAP showed that the PAP effect occurs at different minutes. In support of this, it was indicated in a study that back squat conditioning activity produced better results in the vertical jump performance in the 4^{th} minute than in the 5^{th} minute (McCann & Flanagan 2010). Bevan et al. showed that the jump squat conditioning activity caused better sprint performance in the 8^{th} minutes than 4-12-16^{th} minutes (Bevan et al. 2010). In another study Orjalo et al. (2020) showed that the barbell hip thrust conditioning activity led to an improvement in the change of direction performance in 4-8-12, and 16^{th} minutes. In addition to the importance of rest intervals to create the PAP effect (Bevan et al. 2009, 2010; Kilduff et al. 2008; Zois et al. 2011), it is well-known that the PAP mostly is a personalized response (Lockie et al. 2018). In these mentioned studies, it was well examined the effects of PAP on the types of contractions and gender-related temporal responses. However, any of these studies' experimental groups did not consist of the adolescent population.

The increase in the number of adolescents who specialize in a single sport and train for a sport throughout the year gradually increases, and parallelly the sport demands more performance from adolescents. The rise in demands (Brenner et al. 2007, 2016; Fitness 2000) creates a necessity of designing a study on the adolescent population to investigate the effects of PAP. Agility, coordination, power, and speed are significant skills for athletes and continue to develop during adolescence. Therefore, it is pivotal to examine the effects of PAP in the adolescent population, especially on agility which is an ability that is frequently used by athletes

during training or competition (Nimphius 2021). As a result, practitioners can use these methods to optimize or provide further development of agility performance (Chatzopoulos et al. 2007; Docherty et al. 2004; French et al. 2003; Okuno et al. 2013; Pääsuke et al. 2000).

A study showed that PAP activity did not cause a significant difference between male adolescents and preadolescents in plantar flexor performance (Pääsuke et al. 2000). Another study showed that isometric half-squat PAP conditioning activity did not improve the squat jump performance of the adolescents while enhancing the squat jump performance of male adults in the 20^{th} seconds and 4^{th} minutes (Arabatzi et al. 2014). Only one study examined the temporal effects of change of direction in the adolescent population, and the study indicated that isometric PAP conditioning activity in 1-3-5 and 7^{th} minutes did not reveal a positive effect on the change of direction performance (Marshall et al. 2019). Since there are a few studies that investigated the temporal effects of PAP in adolescents, more studies are needed considering the type of muscle contraction and different load responses to the PAP protocols. Thus, the present study aims to examine the temporal effect of different PAP conditioning activities on change of direction in adolescents. The study hypothesizes that both two different (static and dynamic) PAP conditioning activities with different types of contraction will positively influence temporal agility performance.

Material and methods

Participants

Fourteen adolescent male soccer players participated in the study (Average Age: 15.2±0.69 years, Height: 1.66±0.08 cm, Weight: 52.07±6.70 kg, Training Age: 5.07±0.61 years). All measurement and experimental procedures were completed in the competition-specific training phase of the preparatory period. The inclusion criteria of athletes were attending 4 times training sessions for at least 2 hours each a week and playing a friendly game once a week. The ethical committee's permission was obtained from the university. The participants and parents were informed about the possible risks of injuries, and the signed permission of parents was taken. In all phases of the study, the "Helsinki Declaration" was followed.

Study Design

The study was designed randomly and counterbalanced to examine static and dynamic post-activation potentiation protocols' effects on temporal agility performance. A familiarization session was performed in the Illinois test one week prior to all the procedures being implemented. The protocols were performed on 3 separate days. Two days before the experimental process, the participants' anthropometric measurements and one-repetition

maximal (1RM) squat strength were measured. Before implementation of all the protocols, the standardized warm-up procedure was followed [jogging (10 minutes), dynamic stretching for lower and upper extremities (5 minutes), and 1 set and 5 repetitions of bodyweight squat with a preferred depth]. After completion of the warm-up, the protocol's (control, static, and dynamic) baseline measurement was obtained. Two minutes later after baseline measurement was completed, participants attended one of the protocols. Athletes performed the Illinois agility test with the maximum effort at eight separate times in the 15th seconds, 2-4-6-8-10-12, and 14th minutes (Figure 1). During the isometric squat, the knee joint flexion angle was set at 120-130 degrees with a goniometer in the feet shoulder-width apart and the toes pointed slightly to the lateral side. Participants performed 3 maximal isometric efforts lasting 3 seconds with 1 minute of rest between efforts (Blazevich et al. 2002). During the dynamic squat, the participants were asked to perform 3 repetitions of squats at 85 % of 1 RM. Squat was performed in accordance with the rules of the International Powerlifting Federation (Technical Rules Book of the International Powerlifting Federation 2022). Forty-eight hours intervals were given between each protocol.

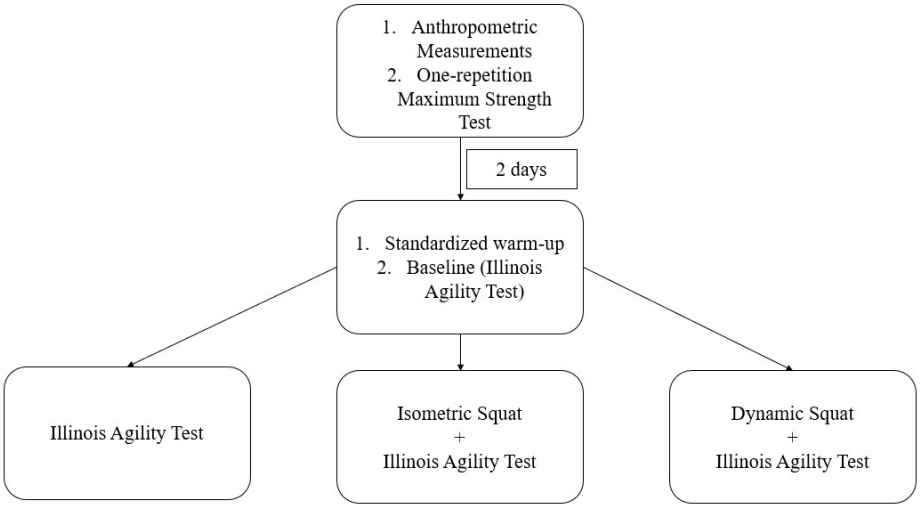

Figure 1
Study Design

Procedures

Determination of One-Repetition Maximal Strength

While calculating the one-repetition maximal (1RM) squat strength, an Olympic barbell and the weight plates that can attach to the barbell were used as material. The 1RM was calculated by the indirect method (estimation). Participants were asked to squat with an estimated weight which was adjusted by the practitioner not exceeding 10 repetitions. Then, using Epley's formula, 1RM squat values were determined (Wood et al. 2002).

Agility Test

Illinois Agility Test was used as the agility test. Photocells were positioned at the start and finish points (SE-200 Photocell Gate, Istanbul, Turkey). Four cones 10 m in length and 5 m in width to each other were placed. The other four cones are sequenced and separated 3.3 m from each other was positioned in the middle of the course. When participants are ready, started the test in the following sequence 1) 10 m run and turn, 2) go to middle and slalom through cones, 3) run to next cone up right corner, 4) run to finish point (Amiri-Khorasani et al. 2010).

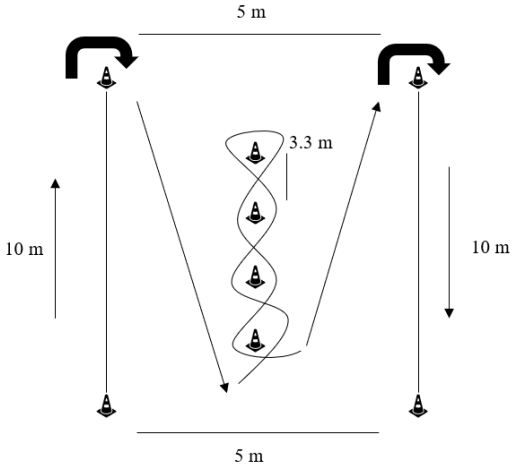

Figure 2
Illinois Agility Test

Statistical Analysis

Descriptive statistics of the study were calculated. Normality values of data were determined by using the Shapiro-Wilk test. Repeated measures in the ANOVA test were used to determine the effects of PAP protocols and temporal differences as the 3 (protocol) x 9 (time) design. Bonferroni post hoc test was used to determine which protocol causes the differences. Partial eta squared was used to estimate inter-group interactions and the interpretations were accepted in accordance with Cohen's guide >0.01 small effect, >0.06 medium effect, and >0.14 large effect (Watson 2021). The statistical significance value was set at $p \leq 0.05$. Jeffrey's Amazing Statistics Program (JASP) was used for the statistical analyses (JASPTeam 2021).

Results

Descriptive statistics of the athletes were shown in Table 1. The temporal effects of protocols were shown in Table 2. The mean values of the protocols were shown in Figure 3. A significant difference was found intra-values of static, dynamic, and control protocols ($p < .001$; $\eta_p^2 = 0.88$, 0.67, and 0.75, respectively). There was no significant difference between baseline

values of the protocols ($p<$. 925; η_p^2 = 0.006). After protocols were performed, there was a significant difference between protocols in 15th seconds, 2-4-6-8-10-12-14th minutes. ($p<$ .001; η_p^2 = 0.46-0.96). There was a significant difference between the control protocol compared to static and dynamic protocols in the 15th seconds and 2nd minutes ($p<$ .001, η_p^2 = 0.73-72, respectively). There was a significant difference between dynamic and static protocols compared to control in the 4th and 6th minutes ($p<$ .001, η_p^2 = 0.46-89, respectively). Dynamic and static protocols' values peaked in the 8th minute and there was a significant difference between protocols ($p<$ .001, η_p^2 = 0.96). Dynamic and static protocols' values started to decrease in 10-12-14th minutes and reached near baseline values, however, a significant difference continued between dynamic and static protocols compared to control protocol ($p<$ .001, η_p^2 = 0.91-93-96, respectively).

Table 1

Descriptive Statistics (N = 14)

	Mean	**Standard Deviation**
Age (years)	15.21	0.69
Height (cm)	166.0	0.08
Body Mass (Kg)	52.07	6.70
Training Age (Year)	5.07	0.61
1RM (Kg)	59.92	5.83

Table 2

Temporal Effects of Protocols (Mean and Standard Deviation)

	Control Protocol	**Static Protocol**	**Dynamic Protocol**	**F Value**	**Significance Level**	**η_p^2**
Baseline	16.83 ± 0.80	16.71 ± 0.92	16.80 ± 0.50	0.078	.925	0.006
15 sec	16.83 ± 0.80	18.56 ± 0.78	18.97 ± 0.67	36.271	.001**	0.73
2 min	17.89 ± 0.99	18.10 ± 0.96	18.93 ± 1.06	33.438	.001**	0.72
4 min	18.03 ± 0.86	17.85 ± 0.89	17.50 ± 1.06	11.262	.001**	0.46
6 min	18.27 ± 0.94	16.74 ± 1.08	16.90 ± 0.90	114.040	.001**	0.89
8 min	18.69 ± 0.85	15.79 ± 1.05	15.71 ± 0.99	384.625	.001**	0.96
10 min	19.00 ± 1.14	16.57 ± 1.09	16.65 ± 1.03	142.718	.001**	0.91
12 min	19.11 ± 0.89	17.09 ± 0.95	17.59 ± 1.04	177.463	.001**	0.93
14 min	20.70 ± 0.91	18.09 ± 0.61	17.27 ± 0.75	326.591	.001**	0.96
F Value	105.735	28.890	43.866			
Significance Level	.001**	.001**	.001**			
η_p^2	0.88	0.67	0.75			

** $p < .001$

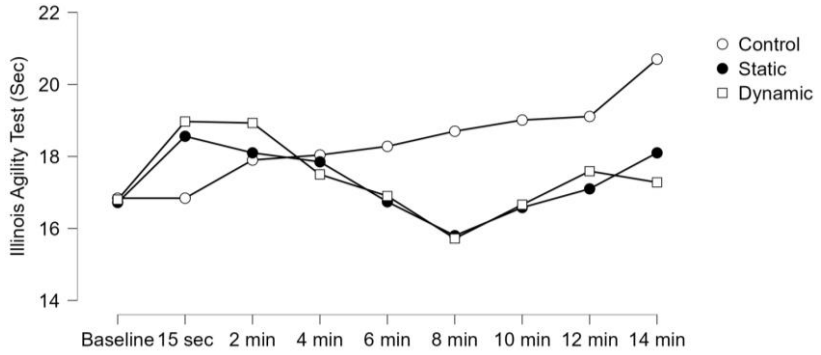

Figure 3

Mean Values of the Protocols on Illinois Agility Test Performance

Discussion

The study was designed to investigate the temporal effects of static and dynamic PAP conditioning activities on change of direction (COD) performance. Although static and dynamic PAP conditioning activities caused performance impairment in the first minutes of the experiment as a result of fatigue, static PAP conditioning activity's performance improved starting by 2nd minute while dynamic protocol's performance increased starting by 4th minute. These two experimental conditioning activities' performances peaked in the 8th minute and then performance gradually started to decrease. Even though this decrement continued until the 14th minute two experimental conditioning activities' performance values were always higher compared to the control activity.

There are only a few studies that investigated the temporal effects of dynamic PAP conditioning activities on COD performance. In the current study, dynamic squat PAP conditioning activity was performed at 85 % of 1RM as 1 x 3 repetitions, and performance started to enhance in the 4th minute, peaked in the 8th minute, and after this time, it gradually decreased. It was reported that post-activity-related decrements in performance occur as a result of fatigue (Blazevich & Babault 2019). Rassier and MacIntosh reported that post-activity strength compression (fatigue) is due to decreased peak or average myoplasmic calcium sensitivity (Rassier & Macintosh 2000). Additionally, the decreased sensitivity is a result of the decreased relationship of calcium/troponin or reduced strength production of cross-bridge formation during contraction (Rassier & Macintosh 2000). Orjalo et al. reported that barbell hip thrust PAP activity (85 % of 1RM, 3 sets x 5 repetitions) positively influenced the change of direction performance of both males (23.95 ± 3.24 years) and females (22.60 ± 2.21 years) in the 4th ($p < 0.001$), 8th ($p < 0.004$), 12th ($p < 0.028$), and 16th minutes ($p < 0.001$) (Orjalo et al. 2020). In the mentioned research, the 5-0-5 test was used for the change of direction performance. The average completion time of this test is 3 seconds, on the other hand, the Illinois test's average completion time is between 13-19 seconds (Nimphius 2021). Hence,

sustained performance improvement for 16 minutes could be the result of 4 minutes long rest intervals for the selected COD test, and it may have helped participants to recover fully. Petisco et al. indicated that conditioning activities performed with loads at 80 % of 1RM with 1 set and 5 repetitions were more effective to create a PAP effect on jumping, repeated, and non-repeated change of direction performance compared to loads at 60 % of 1RM with 1 set and 10 repetitions and 100 % of 1RM with 1 set and 1 repetition in young athletes (21.6 ± 3.2 years) (Petisco et al. 2019). However, this study did not investigate temporal changes. Chatzopoulos et al. showed that 5 minutes rest intervals (d = 1.96, d =1.23) were more effective to improve 10 and 30 m sprint performance compared to 3 minutes rest intervals (d = 0.39, d = 0.27) with the load at 90 % of 1RM (1 set x 10 repetitions) (Chatzopoulos et al. 2007). Nevertheless, again this study did not report the temporal effects of PAP conditioning activity. Rahimi showed that 36.6 m sprint performance improved more with high loads at 85% of 1RM compared to relatively lower loads at 60 and 70 % of 1RM (2 sets and 4 repetitions) after 4 minutes rest intervals were given (d = 4.35, d = 3.16, d = 1.44, respectively) (Rahimi 2007). Based on indicated adult studies and the current study's dynamic conditioning activity findings, it could be said that moderate-high and high loads are more effective to create the PAP effect.

Identical to dynamic PAP conditioning activities, there are limited studies that investigated the temporal effects of static PAP conditioning activities on the change of direction performance in the adolescent population. In the current study, static conditioning activity was performed with a two-side fixed 20 kg Olympic barbell as 3 repetitions x 3 seconds with 1-minute rest intervals. Unlike dynamic PAP conditioning activity, performance enhancement started in the 2nd minute in the static conditioning activity, and similar to dynamic conditioning activity, it peaked in the 8th minute and gradually decreased. Arabatzi et al. investigated the temporal effects of isometric squat on squat jump performance in the 20th second and 4th minute (Arabatzi et al. 2014). In the study, adult males squat jump performance improved in terms of both jump height and peak rate of force development. However, the adolescent population only enhanced the peak rate of force development, and any advancement was not observed in jump height. The authors indicated that jumping is a complex task. Due to this fact, contractile properties of muscle are not the sole decisive factor for jump performance but also motor control and technical competencies may influence performance (Arabatzi et al. 2014). The authors did not report the load of the isometric PAP protocol. It is pivotal to report the load-related information given that relatively long or short rest intervals corresponding to the selected load may cause impairments in the performance (Arabatzi et al. 2014). In the current study, as aforementioned PAP conditioning activity was performed with a 20 kg Olympic barbell, and this fixed load coincided with between 29 and 47 % relative strength levels of the

athlete group. Besides indicated relative strength levels, the group may have benefited from the type of contraction. In support of this, Lim and Kong indicated that isometric contraction efforts cause more muscle fiber activation compared to dynamic contraction efforts (Lim & Kong 2013). Even though they failed in proving the hypothesis which is isometric PAP conditioning activities positively influence sprint performance in athletes (22.4 ± 3.2 years) (Lim & Kong 2013). This explanation may support the current study's static PAP conditioning activity's results on agility performance. Similar to Lim and Kong's study, Till and Cooke showed that 3 x 3 seconds isometric maximum voluntarily contractile PAP conditioning activity did not improve both sprint and jump performance (Till & Cooke 2009). In this study, the rest interval was 1 minute, in their meta-analysis study, Wilson et al. showed that effects size was higher in prolonged rest intervals such as 7 - 10 minutes compared to 3 - 7 minutes (0.70 - 0.54, respectively) (Wilson et al. 2013). Again, it seems like the rest intervals are one of the most important factors to create the PAP effect. Similar to the current study's design, there was only one study that investigated the temporal (1-3-5-7th minutes) effects of isometric PAP conditioning activity on the change of direction performance (Marshall et al. 2019). In this study, elite rugby players (16 ± 0.41 years) performed progressively increasing isometric PAP conditioning activity (50-75-90 % of 1RM) as 3 x 3 seconds and the conditioning activity did not improve the change of direction performance (p> 0.05). Marshall et al. reported that the adolescent growth spurt process of their athlete group may have impaired strength and the change of direction-related performances (Lloyd et al. 2015; Marshall et al. 2019).

Conclusions

Based on the study's findings, both static and dynamic can be used to improve the agility performance of adolescent soccer players in pre-competition or halftime warm-ups. The static protocol may be preferable since high loads may be difficult to reach during pre-competition and halftime. It should be kept in mind that both static and dynamic conditioning activities' performance peaks in the 8th minute and the time adjustment should be in accordance with it. According to the current study's findings, proper rest intervals should be given to benefit the PAP effect in both static and dynamic protocols.

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PHYSICAL ACTIVITY DURING COVID-19 PANDEMIC LOCKDOWNS IN GERMANY – AN OVERVIEW

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Summary: In Germany, different ministries are responsible at state level for sport and physical education. The same applies for Covid-19 pandemic decrees. As a result, different rules and regulations have to be followed depending on the place of residence. The same applies to regulations of physical activity in various settings – kindergarten, school, clubs, municipality. The periods of Covid-19 lockdowns have been marked by nationwide closures of kindergartens, schools and in- and outdoor sport facilities. Resulting in an increase in screen time and sedentary activities (Langmeyer et al. 2020) and a notable decrease in children's daily physical activity to 23.9 minutes (Schmidt et al. 2020). However, during the first lockdown (22. 03. 2020 – 04. 05. 2020), participation in daily activity increased from 108.8 min. per day before the pandemic to 146.8 minutes per day (Schmidt et al. 2021). This development in more casual sporting activities was not sustained into the second lockdown. Daily activity decreased to 62.2 minutes per day (Schmidt et al. 2021). Only organized sport showed a slight increase from 0.0 to 3.7 minutes per day in lockdown two (Schmidt et al. 2021). This was in spite of the fact that high-level athletes were allowed to train and some sport clubs changed to online offerings.

Key words: children, adolescents, Covid-19 Pandemic, Lockdown 1, Lockdown 2, physical activity, habitual physical activity

Introduction

Following the declaration of Covid-19 pandemic as a global pandemic by the World Health Organization in March 2020 (WHO, 2020), Germany reacted to the increasing numbers of infected people with two nation-wide lockdowns to stop the spreading of the virus: The first lockdown took place from the 22nd March, 2020 until the 4th May, 2020. A second lockdown followed in November 2020 (2nd Oct.,2020) divided into a "hard" lockdown (until 16th

December, 2020) and a “light” lockdown (till 31st May, 2021) (Imöhl & Ivanov 2021). Closed schools, kindergartens, and sport facilities, homeschooling and mandated telework reflect the picture of the hard lockdown. Public life was put on hold. Germany is made up of 16 largely autonomous federated states, with a central government responsible for more national decisions. Although broader pandemic policies were set at a national level, the regulations for managing both lockdowns were mainly regulated at state level. As a result, Germany had 16 different sets of Covid-19 pandemic restrictions during the lockdowns.

In addition, each state has a different infrastructure for the management of physical activities, health-related or high-level sports and physical education. For example, in North Rhine-Westphalia (NRW) the Ministry for Children, Families, Migrants and Integration is responsible for sport, while in Baden-Wuerttemberg the Ministry for Culture, Youth and Sport is responsible for sport. Physical education is also often organized differently. Usually, physical education is regulated by ministry for education, on the basis that it belongs to the work of schools. When combined with Covid-19 pandemic regulations, this often means that the same child has to act differently depending on the (sports related) setting it is in. The focus of this review is the physical activity of children and adolescents in Germany during the lockdown periods.

Newspaper article headlines such as “How much children suffer from the lockdown” (Windmann 2021) or “Physical inactivity pandemic – Impact of the lockdown on children’s physical activity behavior” (N.N. 2021) drew attention to the long-term consequences of pandemic regulations for children. The conclusions reached by the journalists in these articles, were largely based on the national study for health in children and adolescents in Germany (KiGGS-study) run by the Robert Koch-Institut. As part of KiGGs, physical activity has been scientifically evaluated in long-term studies of the Motorik-Modul-study (MoMo). The outcome of the MoMo study forms an important part of this paper as it was the first to specifically survey the physical activity of children and adolescents during both lockdowns in Germany.

Methods

To identify studies, which focus on physical activity of children and adolescents in Germany, Web of Science, Pubmed and BISp Surf were screened for articles. The search terms “physical activity AND children OR adolescents AND Germany” were used in both English and German languages depending on the database being queried. After screening the articles, six articles focused on the topic or had some content related to the topic. The following three

out of six studies have specifically surveyed the physical activity of children and adolescents in Germany:

- Physical activity and screen time of children and adolescents before and during the COVID-19 lockdown in Germany: a natural experiment.
- Zur Situation der körperlich-sportlichen Aktivität von Kindern und Jugendlichen während der COVID-19 Pandemie in Deutschland: Die Motorik-Modul Studie (MoMo).
- The Impact of COVID-19 on the Interrelations of Physical Activity, Screen Time and Health-Related Quality of Life in Children and Adolescents in Germany: Results of the Motorik-Modul Study.

The three additional studies dealt with the impact of the lockdown situation on children and adolescents in Germany in general. The methods of the MoMo-study (MoMo = motoric module) will be briefly introduced at this point, because the three studies referenced relied on the Mo-Mo study for the data gathered during lockdown one and lockdown two.

MoMo is a cohort sequence designed longitudinal study with a representative sample of kids aged four to seventeen years tested at 167 different places in Germany (fig. 1) (Schmidt et al. 2021). Wave one of MoMo started 2003 till 2006, the second was from 2009 till 2012, the third started 2014 till 2017 and the fourth was planned and realized from 2018 till 2021 and covered the time of lockdown (Schmidt et al. 2021).

Figure 1
Locations of data acquisition by the MoMo-Study (motorik-modul.de 2021)

Beneath the questionnaires to detect physical activity, answered partly by parents because of the age of the children, a motoric investigation of a trained external test team are

used to collect data on sport and physical activity behavior, to health-related behaviors and to collect data to coordination, strength, flexibility, balance and reaction (Schmidt et al. 2021). For wave four, which began in 2018 and covered the period during the pandemic, the data gathering procedures had to be changed as the pandemic meant that there were limited possibilities to test children and adolescents in person (Badische Turnzeitung 2021). Instead, a specific online questionnaire had to be designed (Schmidt et al. 2021), and the testing of motoric abilities by an external test team was paused.

The first online survey was carried out in 2020 from April 20th till May 1st with 1.717 participants (Schmidt et al. 2021). The second online survey ran in 2021 from January 29th till February 14th and was within the period of the second lockdown (Schmidt et al. 2021). 1.322 participants answered the questionnaire. Figure two visualizes a timeline, which shows events due to the pandemic and the survey context of the first lockdown (Schmidt et al. 2020).

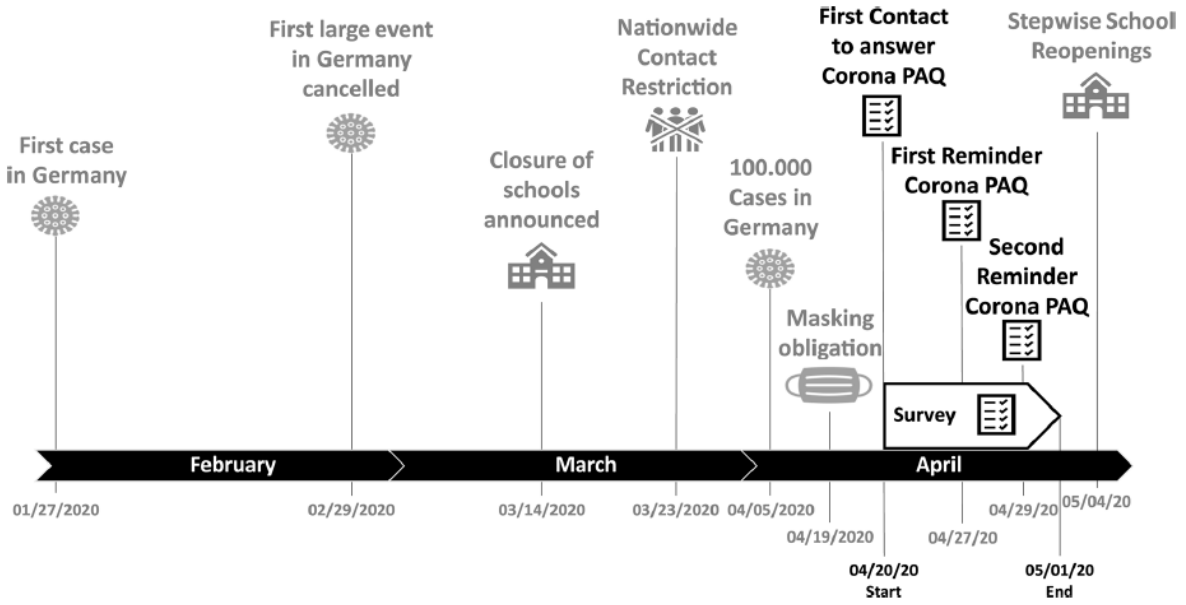

Figure 2

Timeline of events and survey context during the COVID-19 lockdown Germany (Schmidt et al. 2020, p.9)

The online questionnaire – to mention it again – is based on self-reporting exclusively. Self-reporting may lead to other results than combining a questionnaire with the results of an external test team.

Results

Physical activity has to be clearly defined, especially if it relates to data provided by a questionnaire, answered by children, adolescents and – in some cases – by parents. Physical activity is in this case mostly defined as every skeletal muscle activity, which leads to an

increase of energy consumption (Caspersen, Powell & Christenson 1985). To determine changes in physical activity behaviors as a result of the pandemic, it is first necessary to describe the physical activity behavior before the pandemic. The evaluation of physical activity is guided by the WHO recommendation of 60 minutes per day of moderate-intense physical activity (WHO 2020). With reference to the WHO recommendations in the years 2018 till 2020, 18.1 % of children and adolescents aged four to seventeen years in Germany reached 60 minutes of physical activity per day. Based on previous research studies the authors note that, since the first results published in 2003 (25.1 %), fewer children reach the WHO recommendations (Schmidt et al. 2021). The study by the HBSC-Studienverbund (2015; 2020) show similar results. Following on from school closures and the elimination of organized sports, it can be assumed that even fewer children and adolescents will reach WHO recommendations during Covid-19-Lockdown.

However, Schmidt et al. (2021) demonstrated that, contrary to the assumptions based on the previous downward trend, during lockdown one more children and adolescents (4 - 17 years) undertook 60 minutes per day moderate-intense activities. Despite the absence of organized sports and activities, the percentage increased instead of decreasing (Schmidt et al. 2020). Casual sport such as for example, playing soccer in the garden, actually increased (Schmidt et al. 2020). Nonetheless the overall amount of sports activity decreased in total by 10.8 minutes per day (Schmidt et al. 2020). There is still no explanation for the 31,5 % of guideline fulfillment in lockdown one. This requires a closer look at habitual physical activity. Habitual physical activity is characterized by playing outside, walking and cycling, gardening and housework (Schmidt et al. 2020). In lockdown one, the total amount of habitual physical activity increased by 36.2 minutes per day (Schmidt et al. 2020). The following figure shows differences in time spent doing sports activities, habitual physical activity and recreational screen time. The differences in time relate to time spent before the pandemic in comparison to time spent during lockdown one.

According to the HSBC-Studienverbund, prior to the pandemic the level of physical activity of children and adolescents in Germany was already low (HSBC-Studienverbund, 2015; 2020). For a healthy upbringing – which includes also physical activity– we have to have a look at all leisure time activities and the impact of the lockdown situation on children and adolescents in Germany in general (e.g. Langmeyer et al. 2020). Overall, it was noted that German children and adolescents watched more TV, played more board games, listened more to music or played music during lockdown one (Langmeyer et al. 2020). Younger children did more crafts and older ones spent more time on social media (Langmeyer et al. 2020). Moreover,

the influence of their environment had an impact on how the children and adolescents surveyed in the studies spent their leisure time. For example, 44 % of children living in rural areas played outdoors (Langmeyer et al. 2020). On the other hand, only 31 % of children living in larger urban areas played outside (Langmeyer et al. 2020), not least due to the fact that there is less space available to play outside in a safe environment. 59 % of urban children stated that they watched more TV (Langmeyer et al. 2020) whereas only 52 % of children from rural areas indicated watching more TV during the lockdown one (Langmeyer et al. 2020). It is observable that while children and adolescents spent more time in front of screens, as noted by Schmidt and colleagues (2020) (fig.3), habitual physical activity also increased.

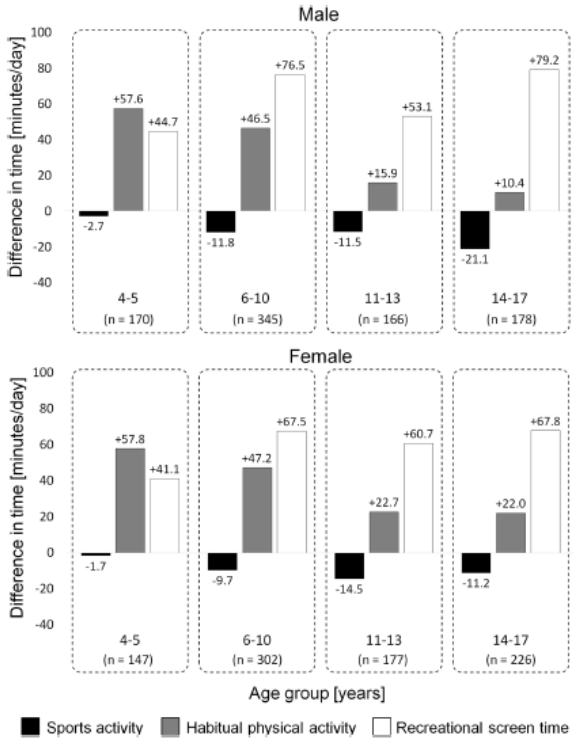

Figure 3

Differences for total amount of sports, habitual physical activity, and recreational screen time among youth in Germany pre and during the Covid-19 lockdown (MoMo study) (Schmidt et al. 2020, p. 3)

It is important to note the effects of the pandemic and lockdown on children's mental and psychological health also. The COPSY-Study Ravens-Sieberer et al. (2021) study showed that 70.7 % of the children and adolescents surveyed felt burdened of the pandemic and lockdown. This stress exacerbated by home schooling, which meant less contact to friends (Ravens-Sieberer et al. 2021). Accordingly, it is not surprising that the quality of life for children and adolescents has deteriorated with the corresponding decrease in health-related life .quality (Ravens-Sieberer 2021; Wunsch et al. 2021). Wunsch et al. (2021) identifies less physical activity and increased screen time as main factors, which have negative influence on

the health-related quality of life. Anxiety among children and adolescents also increased significantly compared to before the pandemic (Ravens-Sieberer 2021). When one looks at changes between the first and the second lockdown, it is important to take into consideration that the quality of the two lockdowns were different and that people might have adapted to limitations during pandemic situations.

The percentage of children and adolescents meeting WHO physical activity recommendations could not be sustained through the second lockdown (Schmidt et al. 2021). Only 16.2 % of children and adolescents (4 - 17 years) met the WHO-guidelines (Schmidt et al. 2021). Without the additional facilities offered by sports clubs or by physical education in schools, the percentage drops beyond the value even before the pandemic (Schmidt et al. 2021). Physical activity could not be increased in the long term (Schmidt et al. 2021).

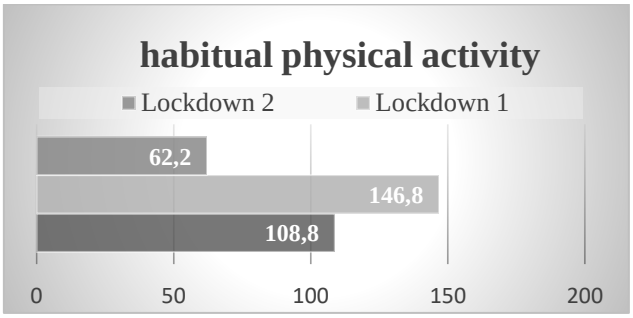

Figure 4
MoMo-key figures "habitual physical activity" to the pandemic average minutes per day (according to Schmidt et al. 2021, p. 13)

Moreover, habitual physical activity decreased from 146,8 minutes per day during lockdown one to 62,2 minutes per day during lockdown two (Schmidt et al. 2021). Sporting activities – see numbers for the organized sport as one possibility below – decreased by 60 % in lockdown two (Schmidt et al. 2021).

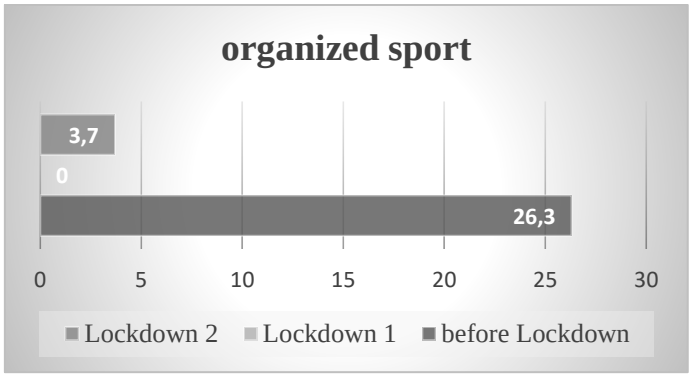

Figure 6
MoMo-key figures "organized sport" to the pandemic average minutes per day (according to Schmidt et al. 2021, p. 13)

As mentioned in the introduction, physical activity was already at a worrisomely low level before the pandemic. Schmidt et al. (2021) and Ravens-Sieberer et al. (2021) declare the lack of motivation to be one cause of the decrease in physical activity. On the contrary, the use of digital media in leisure time increased to a total of 227.5 minutes per day in lockdown two. As Langmeyer et al. (2020) already identified in lockdown one, there is a shift in leisure activities which continued to be observed in lockdown two.

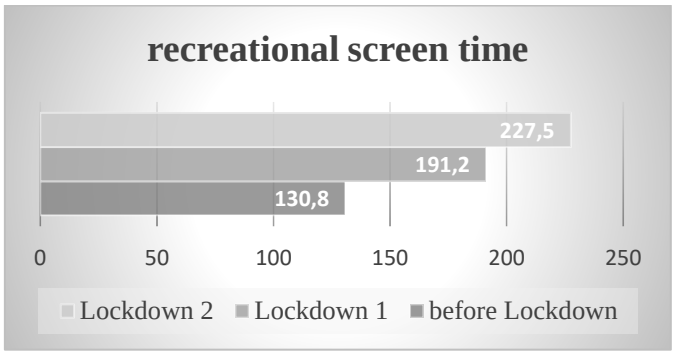

Figure 7
MoMo-key figures "recreational screen time" to the pandemic average minutes per day (according to Schmidt et al. 2021, p. 13)

Environmental possibilities to be physically active were no longer existent or redefined. However, the pandemic seems to have been a facilitator for creating new means for physical activities. As a result of homeschooling, habitual physical activities such as the walk or cycle to school (or kindergarten) no longer belonged to the daily routine. In certain cases, gyms, which are regularly used for physical education in schools or kindergarten, have been transformed into vaccination centers (Kuhlmann 2021; Bundesministerium für Gesundheit 2021). Hygienic regulations declared to manage the pandemic make it complicated to be physically active even in outdoor spaces or to perform physical education (Kuhlmann 2021). However, instead of this resulting in physical education lessons being cancelled or put on hold, a number of organizations designed alternatives to reach out to the children.

Physical activity in the broadest sense was re-thought and adjusted to the circumstances, and digital offers were created: "Beweg dich Schlau!" an initiative for children and adolescents founded by Felix Neureuther a German ski racer, has the aim to motivate children in kindergarten, school and leisure time to move more and specially to move clever (BDS 2021). "Bewegungspause trotz Abstand" created by Herrmann and Hirth (2020) gathered ideas for movement breaks, which can be used not only during Covid-19 pandemic or at school, but in different settings. These developments give children and adolescents incentives to carry out movement breaks despite hygienic measures (Herrmann & Hirth 2020). Further examples are

“Albas tägliche Sportsunde”, “Henriettas bewegte Schule” and many more. Teachers, educators, parents and also children got different exercise sequences for various situations. With the help of digital offers and online options, physical activity and education was not totally put on hold, but it changed in a one-dimensional way, to an activity where the culture of feedback played a less important role.

When one considers the federal states of Germany, at that level there are peculiarities, which also came to surface during the lockdowns. Children live for example in one federal state but visit a school at the neighbour federal state, because they live close to the border. As a result, state level definitions of sport meant that two friends attending the same school got different regulations regarding physical activity in their home sport club. For example, one student is allowed to practice at the elite sport base while the other one is not allowed due to the different regional regulations. This results not least from the different organizational structure for sport in the different federal states.

Another example, which underlines how different regulations impact a sporting activity, is horse riding. The German governing body for riding - Fédération Equetsre Nationale - has not been able to issue uniform Covid-19 regulations nationwide (Deutsche Reiterliche Vereinigung 2020). This was because the government, the federal states, the counties and the various municipalities were each in charge of regulation the sport in their districts (Deutsche Reiterliche Vereinigung 2020). It is not surprising that these different levels of responsibility and bureaucracy result in differing restrictions at local and regional levels (Deutsche Reiterliche Vereinigung 2020). In one municipality horse riders were allowed to go on trail rides while in the next county horse riders were only allowed to ride in the outdoor arena. It is clear from this example that even federal organizations for sport could not always clarify the specific rules of the sport to apply for their members. The different regulations applied to sport clubs from municipality to municipality were not the only difficulties faced by clubs and organizations. Due to the pandemic regulations and to the lockdown, most sport clubs needed to limit their offerings and as a result 7.3 million children and adolescents were not able to participate in any offerings from sports clubs (tagesschau 2021).

Regulations for sport clubs differed between the individual federal states. The regulations for NRW for example prohibited team sports, contact sports or any sport involving more than two person (Soziokultur NRW 2020). In addition, all public sport facilities were closed (Soziokultur NRW 2020). The only exceptions were practice facilities at federal elite sport bases, where sportspeople were allowed to practice (Soziokultur NRW 2020).

In Baden-Wuerttemberg on the other hand there were no exceptions for federal elite bases (Baden-Württemberg 2020). Sports clubs in all federal states have reported a decline in memberships of between 3 – 5 %. Larger clubs have especially reported a significant loss of memberships (Rieger 2021). The Landessportbund NRW for example has had a decline of 16 % in memberships and enrollments, especially in the age group of 0 - 6 years old (Landessportbund NRW 2021a).

Discussion

As already noted, some of these results require further discussion and cannot be taken as logical outcomes from the pandemic. One topic which especially needs to be discussed is whether habitual physical activity can replace organized sport, as a type of sporting activity offered by sports clubs, even taking into account the different levels of intensity. Naul (2021) expresses criticism of this theory, as his study has shown that physical habitual activity does not lead to a significantly higher level of physical activity by children and adolescents (Naul 2021). Taking all evidence into account, Naul (2021) points out that the study results need to be interpreted carefully with regard of the composition of the data.

Additionally, it is questionable if digital offers and virtual solutions really can replace physical education taught by a qualified and educated teacher. The ministry of health in Germany has issued guidance that physical education lessons need to be taught even though the circumstances are not optimal (Bundesministerium für Gesundheit 2021). Physical education needs practical solutions in times of Covid-19 pandemic, but as far as possible, it is necessary to actively teach physical education even in digital formats (Bundesministerium für Gesundheit 2021). The BMG has further identified that physical education is essential to a school's curriculum, because of the positive effects of physical activity on psychosocial and mental health and its contribution to social-emotional developments of students (Bundesministerium für Gesundheit 2021). In addition to that, it should be noted at this point that the WHO have identified inactivity as a risk factor for Covid-19 (Bundesministerium für Gesundheit 2021). The necessity of physical activity in school and kindergarten is therefore a given. It is not yet possible to foresee the consequences of the lack of physical education in schools and physical activity programs in kindergarten on children's motor skills and motoric development (Naul 2021). Further research is needed, and especially in connection with the drastically increased screen times of children and adolescents during the lockdowns, which was noted earlier. The results of the COPSY-study are also of concern. Many children describe a lower life quality due to the pandemic and the lockdown (Ravens-Sieberer et al. 2021). In the context of these

results, physical activity takes on an even greater importance, as studies in the past have already proven that regular physical activity has a positive effect on well-being, and mental and physical health. One way to increase physical activity is to participate in sports clubs, but due to the restrictions, many sport clubs did not and could not offer any services. There is no doubt that sports clubs have also faced multi-faceted problems during the lockdowns. However, the so-called death of clubs should be viewed with caution. Trends were already emerging before the pandemic. In population surveys of the state of North Rhine-Westphalia carried out over the last decade, it can be seen that the number of clubs has been in decline since 2010 (Landessportbund NRW 2016). Rather than being the cause of sudden death for clubs, it is more likely that the pandemic acted as a "facilitator" and accelerated a trend which already existed. The developments in connection with sport clubs and pandemic also need to be critically interpreted against the background of demographic changes.

For many years, the tendency has been for schools and educational facilities to cut physical education (and physical activity) from the syllabus when there is a financial or budgeting problem. During the pandemic this was exacerbated when the gyms were used as vaccination centers and outdoor possibilities for activities were limited. This in spite of the fact that physical activity is widely recognized as an essential part of a healthy lifestyle and even supported by health-insurance-companies.

Conclusion

The present overview suggests that the lockdowns in Germany had a significant impact on the physical activity of children and adolescents. The possibilities for organized sport in kindergarten, schools and sport clubs has been reduced or removed. In addition, a change in the way, how children and adolescents spend their leisure time, has taken place, with the time spent with screen media almost doubled by the end of lockdown two. Overall, less time was spent on physical activity even though in lockdown one more children and adolescents met the WHO guidelines of physical activity. However, the composition of the data should be viewed with caution as it was self-reported by children or their parents, and a comparison before and after the pandemic is therefore difficult. What is certain is that the general quality of life and specifically the health-related quality of life of children and adolescents greatly diminished during lockdown.

An easily applied and useful means to improve the lives and mental health of as many children as possible would be to increase physical education in kindergartens and school. In reality however, physical education especially in schools was reduced or removed, because of

the assumed importance and necessity to catch up in other subjects. However, sport is essential for the holistic development of children and adolescents and it would appear to be essential to reestablish offers for physical activity as soon as possible in order to strengthen the quality of life and health related factors for children and adolescents in Germany.

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SELF-PERCEIVED FATIGUE SYMPTOMS AFTER DIFFERENT PHYSICAL LOADS IN YOUNG BOXERS

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Summary: The objective of the study was to determine the prevalence of self-perceived fatigue symptoms during 48 hours after different physical loads in young male boxers. The research sample comprised a total of 21 adolescent male boxers (mean age 14.00±2.05 years), members of the Slovak club named "Best boxing cub" in Devínska Nová Ves (Slovakia). For 48 hours after one-day national championship and five-day training camp, were young male boxers asked to observe symptoms of fatigue on themselves. The level of self-perceived fatigue (S-PF) was measured with the Training Distress Scale (TDS). In young male boxers was found a very low rate of S-PF during 48 hours after the different physical loads. A lower rate of S-PF was declared after the national championship compared to the 5-day training camp. At both events, fatigue was reported with the same three symptoms of muscle soreness, heavy feelings in arms or legs, and lack of energy. Significantly higher S-PF during 48 hours after 5-day training camp compared to national championship was showed in heavy feelings in arms or legs, restless sleep, being unusually tired during the day, and insomnia. No significant differences in overall TDS between different physical loads were found.

Keywords: young male boxers, fatigue symptoms, Training Distress Scale, national championship, five-day training camp.

Introduction

The physiological and training status of athlete and the environmental conditions may significantly influence fatigue (Bendíková 2017). Boxing is a highly complex motor activity. It may be practiced by professional fighters, competitive athletes or by amateurs – in that case without fights or full-contact sparring. Due to the specific nature of boxing, long-lasting daily

training, consisting of repeated actions of diverse complexity, together with continuous development of physical and psycho-emotional fitness, is indispensable to achieve success (Sienkiewicz-Dianzenza & Maszczyk 2019). A boxing match consists of several rounds lasting 3 min each with 1-min intermissions, the exertions being maximal but non-continuous (Davis et al. 2015). Successful performance in the sport of boxing requires the boxer to deliver impactful punches with both hands despite accumulating fatigue (Haralabidis et al. 2020). Pierce et al. (2007) demonstrated winning boxers deliver higher impact punches compared to their defeated opponents, stressing the importance of both punch force and velocity. The mounting fatigue brings about decreased fight speed and dynamics, the heart rate associated with training or a boxing encounter in the range 160–200 bpm (Ghosh 2010), which classifies boxing as an anaerobic sport. Higher ranked amateur boxers possess greater muscular strength and power, as well as higher aerobic and anaerobic power, compared to those lower ranked (Chaabène et al. 2014). Therefore, boxers are expected to tolerate high exertion, i.e., to perform efficiently at a high heart rate, at high anaerobic heart rate, high anaerobic threshold, anaerobic performance, and muscle strength are essential (Guidetti, Musulin & Baldari 2002). These fundamental physiological components of fitness can be developed through strength and conditioning training (Lenetsky, Harris & Brughelli 2013) and are critical for maintaining punch force and velocity during boxing competition (Chaabène et al. 2014). These factors, in turn, would thus determine the so-called anaerobic endurance, i.e., the capacity to maintain the highest possible level of the measured variable (e.g., running speed) in repeated maximum exercises (Walilko, Viano & Bir 2005). Importantly, bilateral delivery of impactful punches depends, in part, on biomechanical coordination, which may be negatively affected by fatigue (Haralabidis et al. 2020).

The objective of the study was to determine the prevalence of self-perceived fatigue symptoms during 48 hours after different physical loads in young male boxers.

Material and methods

Participants

The research sample comprised a total of 21 adolescent male boxers (mean age 14.00±2.05 years), members of the Slovak club named “Best boxing cub” in Devínska Nová Ves (Slovakia). All respondents participated in the questionnaire survey and informed consent was obtained from athletes’ legal representatives, i.e., the parents. The research was approved

by the Ethics Committee of the Faculty of Physical Education and Sports, Comenius University in Bratislava, Slovakia (No. 3/2020).

Research design

For 48 hours after one-day national championship and five-day training camp, were young male boxers asked to observe symptoms of fatigue on themselves. After 48 hours, they completed a questionnaire where they mediated the level of fatigue symptoms (TDS symptoms) experienced. The 5-day camp took place from 10.01. - 14.01.2022. The young boxers had 9 training sessions and one active recovery in the form of swimming. The morning training unit lasted 1.5 hours and the afternoon training lasted 2 hours. In the one-day national championships the young male boxers averaged 1.47±0.51 bouts. A detailed description of the training units and bouts is given in Dudíková (2022). The level of self-perceived fatigue (S-PF) in young male boxers was measured with the Training Distress Scale (TDS; Grove et al. 2014), a 19-item measure assessing the distress symptoms previously identified by Fry et al. (1994). These symptoms include a variety of complaints related to emotionality, general fatigue, concentration difficulties, physical discomfort, sleep disturbance, and appetite changes. Example items are "lack of energy," "quick tempered," "unable to maintain attention," "muscle soreness," "trouble falling asleep," and "loss of appetite." Young male boxers responded to these items by indicating the extent to which they had experienced each of the symptoms during the past 48 h. All responses were made on a 5-point bipolar scale anchored by the phrases not at all (0) and extreme amount (4). A higher mean point score meant higher experience of TDS symptom as well as higher levels of self-reported fatigue.

Statistical analysis

The program IBM SPSS Statistics version 23.0 was used for data processing. The data were described using absolute and relative frequencies, including the mean ($\overline{x}$) and standard deviation (±SD). The Wilcoxon Signed Rank Test was used to assess the differences between two related samples – national championship versus five-day training camp, and between 19 TDS symptoms. The significance level was set at $\alpha \leq 0.05$ (*) and $\alpha \leq 0.01$ (**).

Results

Analysing the TDS symptoms in a group of young boxers, we found a very low rate of S-PF during 48 hours after the national championships as well as after the 5-day training camp. A lower rate of S-PF was declared by the boxers after the national championship (in 17 out of 19 symptoms; 89.5 %) compared to the 5-day training camp (Table 1). The young male boxers

did not experience fatigue after the national championship even after a 5-day training camp in 15 out of 19 TDS symptoms (78.9 %). 48 hours after the national championship, the young boxers felt a bit of fatigue (range from 1.0 to 1.2 points) in symptoms "joint stiffness of soreness" (1.190±1.327 points), "muscle soreness" (1.095±0.943 points), "heavy feelings in arms or legs" (1.095±1.221 points), and "lack of energy" (1.000±1.303 points). Moderate fatigue 48 hours after the 5-day training camp (ranging from 1.5 to 1.9 points) was demonstrated by the young boxers with symptoms "heavy feelings in arms or legs" (1.904±1.338 points), "muscle soreness" (1.619±1.116 points), "being unusually tired during the day" (1.571±1.287 points), and "lack of energy" (1.476±1.077 points) (Table 1, Table 2). The other symptoms listed in Table 2 were not manifested by S-PF (without TDS symptoms) 48 hours after different physical load in young male boxers.

Table 1

Comparison of S-PFS between different physical loads in young boxers

TDS symptoms	**National championship**	**Five-day training camp**	**Wilcoxon Signed Rank Test**	
	$\bar{x}$/±SD		***Z***	***p***
Muscle soreness	1.095±0.943	1.619±1.116	-1.642	0.101
Lack of energy	1.000±1.303	1.476±1.077	-1.278	0.201
Bad temper	0.286±0.463	0.381±0.589	-0.816	0.414
Not being able to remember things	0.476±1.123	0.428±0.925	-0.142	0.887
Difficulty falling asleep	0.238±0.625	0.428±0.978	-0.686	0.493
Loss of appetite	0.047±0.218	0.095±0.436	-0.447	0.655
Lack of interest in daily activities	0.476±0.813	0.667±0.966	-0.771	0.441
Snappiness with family or teammates	0.095±0.301	0.333±0.577	-1.508	0.132
Not being able to focus	0.428±0.746	0.904±1.338	-1.260	0.208
Heavy feelings in arms or legs	1.095±1.221	1.904±1.338	-1.920*	0.050
Restless sleep	0.095±0.436	0.524±0.980	-2.264*	0.024
Not being able to eat well	0.333±0.730	0.476±0.749	-0.722	0.470
Being unusually tired during the day	0.667±1.016	1.571±1.287	-2.346*	0.019
General irritability	0.381±1.071	0.571±0.925	-0.718	0.472
Mental confusion	0.143±0.358	0.238±0.539	-0.816	0.414
Joint stiffness of soreness	1.190±1.327	1.381±1.023	-0.619	0.536
Loose bowels or diarrhoea	0.286±0.783	0.190±0.511	-0.552	0.581
Insomnia	0.143±0.478	0.476±1.030	-1.929*	0.050
Ordinary tasks require extra effort	0.619±1.071	0.857±1.108	-0.832	0.405

Note. *Z* = Wilcoxon Signed Rank-Test statistics; *p*-values *p≤.05, significant difference between symptoms (National Championship versus 5-day training camp)

The results further revealed that higher levels of S-PF were experienced by the young male boxers during 48 hours after the 5-day training camp in 17 out of 19 symptoms (89.5 %) compared to the national championship except for two symptoms (not being able to remember things and loose bowels or diarrhoea), but no significant differences were found between these symptoms (Table 1). The young male boxers at both events reported fatigue during 48 hours

after physical load with the same three symptoms of muscle soreness, heavy feelings in arms or legs, and lack of energy. During 48 hours after national championship, they perceived fatigue also in joint stiffness of soreness and during 48 hours after 5-day training camp they perceived fatigue also in being unusually tired during the day (Table 2).

Table 2

S-PFS occurrence after different physical loads in young boxers

With self-perceived TDS symptoms		**Without self-perceived TDS symptoms**	
National Championship	**Five-day training camp**	**National Championship**	**Five-day training camp**
Joint stiffness of soreness	Heavy feelings in arms or legs	Being unusually tired during the day*	Joint stiffness of soreness**
Muscle soreness	Muscle soreness	Ordinary tasks require extra effort*	Not being able to focus**
Heavy feelings in arms or legs	Being unusually tired during the day	Lack of interest in normal daily activities*	Ordinary tasks require extra effort**
Lack of energy	Lack of energy	Not being able to remember things*	Lack of interest in normal daily activities**
		Not being able to focus*	General irritability**
		General irritability*	Restless sleep**
		Not being able to eat well*	Not being able to eat well**
		Bad temper**	Insomnia**
		Loose bowels or diarrhoea*	Difficulty falling asleep**
		Difficulty falling asleep**	Not being able to remember things**
		Mental confusion**	Bad temper**
		Insomnia**	Snappiness with family or teammates**
		Snappiness with family or teammates**	Mental confusion**
		Restless sleep**	Loose bowels or diarrhoea**
		Loss of appetite**	Loss of appetite**

Note. Wilcoxon Signed Rank Test to assess the differences between two related samples – TDS symptoms; *p*-values: *p≤.05 and **p≤.01 significant difference between symptoms (with versus without symptoms).

Comparing differences in S-PF during 48 hours after different physical load, we found significant differences between four TDS symptoms. Young male boxers experienced significantly higher S-PF during 48 hours after 5-day training camp compared to national championship in the symptoms “heavy feelings in arms or legs” (Z =-1.920, p = 0.050), “restless sleep” (Z =-2.264, p = 0.024), “being unusually tired during the day” (Z =-2.346, p = 0.019), and “Insomnia” (Z =-1.929, p = 0.050) (Table 1). No significant differences in overall TDS between different physical loads were found in the group of young male boxers (Figure 1).

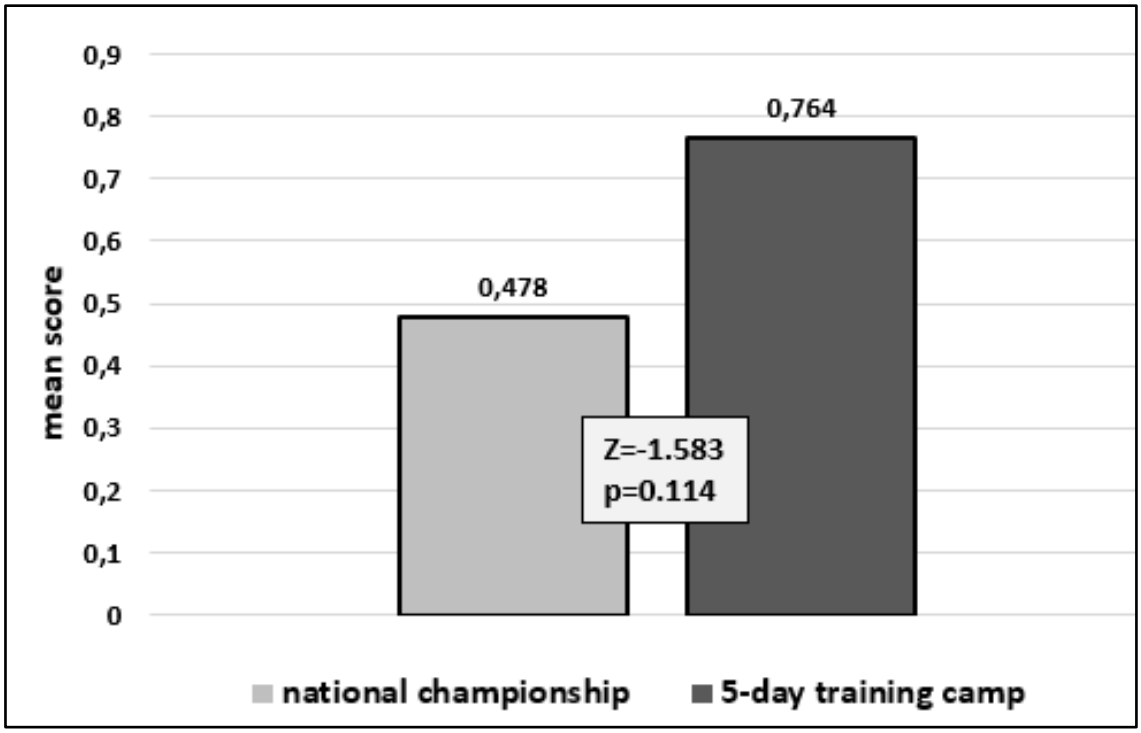

Figure 1
Overall S-PF after different physical loads in young boxers

Discussion

The objective of the present study was to determine self-perceived fatigue during 48 hours after different physical loads in young male boxers. The present study shows a very low rate of S-PF during 48 hours after the national championships as well as after the 5-day training camp in young male boxers. A lower rate of S-PF was declared by the boxers after the national championship compared to the 5-day training camp. They did not experience fatigue after the national championship nor after a 5-day training camp in 78.9 % of TDS symptoms. Athletes in general, show TDS symptoms like "difficulty concentrating" and "fatigue or lack of energy" as an increased risk of poor athletic performance (Takeda et al. 2015). Low fatigue was demonstrated by the young boxers within 48 hours of the national championships with symptoms of joint stiffness of soreness, muscle soreness, heavy feelings in arms or legs, and lack of energy. Moderate fatigue was demonstrated by the young boxers within 48 hours of the 5-day training camp with symptoms of heavy feelings in arms or legs, muscle soreness, being unusually tired during the day, and lack of energy. Repetitive exercises involving eccentric actions of high intensity or duration, can lead to muscle damage (Byrne et al. 2004). Exercise induced muscle damage is associated with a protective inflammatory response (Peake et al. 2005) and changes in the afferent inputs from the muscle spindle, Golgi tendon organ and groups III and IV afferent nerve endings (Komi 2000). A painful sensation when contracting,

stretching, or putting pressure onto the exercised muscle (Weerakkody et al. 2001) is experienced within the first 24 h and last for 1–3 days after eccentric exercise (Proske et al. 2004), which was also evident in a group of young male boxers during the 48 hours after 5-day training camp. 51 - 70 punches are the total number of punches executed per round, which ultimately adds up to 155 to 190 punches in the entire fight. The most numerous strikes are mostly straight front punches, followed by hooks. However, the number of punches that even hit the opponent is only a quarter. The power of the span of the rear lower limb and the striking hand, together with the power of rotation in the torso, influence the strike (Korobeynikov, Aksutin & Smoliar 2015). If we look at the response of the body in terms of the physiology of load and fatigue in a single bout, we find lactate levels within 14 mmol and heart rates in the range above 90 % of maximum (Ghosh 2010; Davis, Leithäuser & Beneke 2014), which may be the reason that the young boxers of our research have a pronounced feeling of heavy arms and legs, being unusually tired during the day and lack of energy.

The results of the present study further revealed that higher levels of S-PF were experienced by the young male boxers during 48 hours after the 5-day training camp (89.5 % of TDS symptoms) compared to the national championship except for two symptoms (not being able to remember things and loose bowels or diarrhoea), but no significant differences were found between these symptoms. The young male boxers at both events reported fatigue during 48 hours after physical load with the same three symptoms of muscle soreness, heavy feelings in arms or legs, and lack of energy. During 48 hours after national championship, they perceived fatigue also in joint stiffness of soreness and during 48 hours after 5-day training camp they perceived fatigue also in being unusually tired during the day. The study of Nemček & Nemček (2021) revealed significant differences in problems with sleep, and unusual fatigue among three samples of elite junior racket sports players, when elite junior tennis and table tennis players declare significantly higher problems with sleep compared to badminton players and elite junior table tennis players can feel significantly more unusually tired compared to tennis and badminton players.

Young male boxers of the present study experienced significantly higher S-PF during 48 hours after 5-day training camp compared to national championship in the symptoms: heavy feelings in arms or legs, restless sleep, being unusually tired during the day, and insomnia. It has been reported that high intense physical load may affect mood states, leading to anxiety, depression, feelings of fatigue and low self-esteem (Fry et al. 1994). In the study of Millet et al. (2005), the relationship between the training loads and perceived fatigue was significant. Linear mixed model analyses of Sargent et al. (2014) study revealed that at nights prior to

training days, time spent in bed was significantly shorter, sleep onset and offset times were significantly earlier, and the amount of sleep obtained was significantly less, than at nights prior to rest days. Moreover, there was a significant effect of sleep duration on pre-training fatigue levels. Specifically, the authors found, that shorter sleep duration is associated with higher levels of pre-training fatigue. Taken together, these findings suggest that the amount of sleep a competitive athlete obtains is dictated by their training schedule. In particular, early morning starts reducing sleep duration and increase pre-training fatigue levels (Sargent et al. 2014).

The present study no significant differences in overall TDS between different physical loads were found in the group of young male boxers. Similar findings were reached by authors Nemček & Nemček (2022), who did not find significant differences in overall TDS symptom rates after motor abilities testing among elite female and male tennis players. Nevertheless, boys of their research experienced significantly higher S-PF compared to girls in the following TDS symptoms: difficulty falling asleep, being unusually tired during the day, joint stiffness of soreness, and ordinary tasks require extra effort. The young boxers of the present research and the young tennis players of the authors Nemček & Nemček's (2022) research experienced S-PF after different physical loads in three common symptoms and those are: heavy feelings in arms or legs, muscle soreness, and lack of energy.

Conclusion

In young male boxers a very low rate of S-PF is shown during 48 hours after the national championships as well as after the 5-day training camp. A lower rate of S-PF is declared after the national championship compared to the 5-day training camp. After the national championship, the young boxers felt a bit of fatigue in symptoms "joint stiffness of soreness", "muscle soreness", "heavy feelings in arms or legs", and "lack of energy". Moderate fatigue was demonstrated after the 5-day training camp with symptoms "heavy feelings in arms or legs", "muscle soreness", "being unusually tired during the day", and "lack of energy". Higher level of S-PF experience young male boxers after the 5-day training camp compared to the national championship supported by symptoms "heavy feelings in arms or legs", "restless sleep", "being unusually tired during the day", and "insomnia". S-PF after both physical load's young boxers experience by muscle soreness, heavy feelings in arms or legs, and lack of energy. There are no differences in overall S-PF after different physical loads.

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HEART DISEASE AFTER COVID: EXACERBATED FUTURE HEALTH RISKS ALIGNED TO PREVIOUS AND EXISTING AAS/ANDROGEN USE

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Summary: In this commentary/short communication we build upon our existing research and viewpoints related to the deleterious effects that AAS/Androgen use has, and the growing body of work and case studies/reports that identify the substantially increased risks that AAS/Androgen use presents to those who have (or have had) COVID-19. We position this commentary/short communication then, as one that builds on our prior calls for public health policy to be in part framed by, or at least to recognise the risks, of AAS/Androgen use. This is of particular contemporary importance now that COVID-19 is endemic, and we report on how long COVID-19 (Post COVID-19 syndrome) can present a wide range of lasting cardiovascular problems, a particular issue given that AAS/Androgen use may well exacerbate future health risks aligned to COVID-19.

Key words: Post COVID-19 Syndrome; Myocardial Dysfunction; Public Health Policy, Anabolic-Androgenic Steroids (AAS) /Androgens

Introduction

The announcement of COVID-19 as a novel coronavirus on 1 December 2020 (WHO 2021) has led to more than 6,522,600 deaths worldwide, reported to the World Health Organisation [WHO] (WHO, 2022), by end of September 2022. This is despite significant attempts to reduce transmission through public health measures such as lockdowns, the advancement and availability of various medicinal treatments (i.e. antibody and antiviral

medicine), and the creation and establishment of highly effective vaccinations. The last of these, effected through comprehensive governmental vaccination programmes that have positioned immunization as a key component of health care, has significantly mitigated the spread and severity of the disease, and reduced deaths attributable to COVID-19 to what are now universally considered manageable and acceptable levels (for instance, more comparable with excess deaths attributable to influenza).

In England and Wales, for instance, whilst the death toll between 13 March 2020 and 1 April 2022 for COVID-19 and influenza (and pneumonia) were 148,606 and 35,007 respectively (where they were identified as the underlying cause of death, not where it was recorded as a contributory factor - Office for National Statistics [ONS] 2022a), and indeed, reported deaths from COVID-19 reached peaks of 1,461 on 8 April 2020 and 1,490 on 19 January 2021, these higher peaks were not sustained. Lockdowns, vaccines, pharmaceutical control measures, and novel medicinal treatment significantly mitigated transmission and infection rates, and by 16 September 2022 COVID-19 deaths were down to 42 per day (coronavirus.data.gov.uk 2022). These numbers are roughly equitable to the aforementioned figure of 35,007 deaths attributable to influenza between 13 March 2020 and 1 April 2022, which equates to approximately 50 deaths a day.

With the key strategy of ensuring ICU occupancy thresholds did not exceed capacity (ONS 2022b), and the fact that the more telling pressures of the worldwide public health emergency have abated (subsequent to the establishment of an effective vaccination programme), the manner in which COVID-19 has affected public services (and the economic implications) are now front and centre of political expediency and COVID-19 scenario modelling and planning. Indeed, as various governments tentatively move to inhabit the new societal terrain of an endemic virus, questions arise as to how proposed approaches address the roles and responsibilities within contemporary emergency and contingencies preparation. Futureproofing for novel viruses, or new variants, and adhering to the views of biomedical scientists highlights the need for working alliances between epidemiologists, economists, and behavioural scientists, and the need for governments to accede some power whilst drawing up robust intervention and prevention methods. It is in the spirit of the principles of prevention, that we present this short commentary to both update some of the latest, confirmatory research related to our previous viewpoints, and continue to espouse public health discourse related to the novel and nuanced problematics related to AAS/Androgen use and COVID-19.

AAS/Androgens are synthetic drugs derived from testosterone (Saudan et al. 2006). These drugs are prescribed for conditions such as hypogonadism as well as chronic

wasting conditions through increased appetite and stimulating muscle growth. However, the adverse chronic health effects they elicit can include, but are not exhaustive to, multiorgan damage (Samaha et. al. 2008), negative cardiac effects (Ismail et al. 2012), increases in mortality risk for users (Pärssinen et al. 2000), as well as a plethora mental health issues (van Amsterdam et al. 2010). These kinds of deleterious effects are also well recognised in terms of scale (significantly higher) when occurring within unsupervised, non-medically supported (illicit), recreational contexts (Sagoe et al. 2014). The work of Wood (2008) and Seear et al. (2015), for instance, illustrate the ways in which addiction and hepatitis risk from injections are areas of particular concern when it comes to unsupervised AAS/Androgen use in the general population.

Our previous ethical considerations and principles of research and commentary have, admittedly, taken on a polemical tone. A tone, however, that has been focused on how AAS/Androgen elicits the aforementioned well-documented, negative health implications, yet has also highlighted more novel discourse related to the identification of possible negative links between recreational AAS/Androgen use and what was (then) fast published data related to compromised immune responses through COVID-19, oftentimes due to hyperinflammatory responses (Crisp & Sims 2020b/2021). Indeed, our overarching aim throughout our papers related to this area has been to strongly recommend that public health discourse and mandates help shift the reality of how recreational AAS/Androgen users make agentic decisions, to one that educates potential users to the emerging empirical evidence that demonstrates how AAS/Androgen use can exacerbate COVID-19 symptoms and negative responses (Crisp & Sims 2020a/2020b/2021).

Moreover, our last paper outlined the pressing issue of how AAS/Androgen use increased post pandemic and lockdowns, thus potentially magnifying future health issues (Crisp & Sims 2022). This short communication acts as a timely update then to this last paper, in that the fast-response literature has started to repeatedly support some of our more suppositional ideas, as well as highlight how - without proper public health discourse related to AAS/Androgen use as another risk factor - some who may present as outwardly healthy may be partially hidden as at risk of heart issues related to COVID-19.

Previous research has demonstrated that AAS/Androgen use can exacerbate respiratory distress for those suffering from pneumonia (e.g. Mayer et al. 2016; Bhanot et al. 2016). Moreover, we surmised the negative effects that AAS/Androgen use could play in compromising immune responses (Crisp & Sims 2020b), something particularly germane in COVID-19 reactions. Related to this, Cadegiani et al. (2021a) outlined the severe response to

COVID-19 suffered by an otherwise healthy 28-year-old AAS/Androgen user, and posited that the mechanisms that fight COVID-19 are impacted by the misuse of AAS/Androgen. Furthermore, Althobaiti et al. (2022) in a study of 520 gym-attending participants, found within this sample that current users of AAS/Androgens were nearly five times more likely to contract COVID-19 than non-users. Indeed, successful early antiandrogen therapy has been shown to be effective in reducing inflammatory responses and other adverse effects caused by COVID-19 (Cadegiani et al. 2021b), thus demonstrating the harmful effects that AAS/Androgens possess.

Whilst there is, admittedly, a more limited amount of direct evidence available that demonstrates case studies of young adults with no previous health concerns suffering severe COVID-19 responses, and where AAS/Androgen use is highlighted as a credible potential link to COVID-19 disease severity because of AAS/Androgen use, more is coming to light. For instance, Al-Hajjaj et al.'s (2022) second case report of a 32-year-old AAS/Androgen user with severe COVID-19 symptoms attributable to AAS/Androgen use and treated with antiandrogen therapy. So whilst is clearly recognised that AAS/Androgen plays a role in immunosuppression, hyperinflammation, and acute respiratory distress, it has also become increasingly acknowledged that these reactions can further complicate COVID-19 infection (Crisp & Sims 2021).

In addition, we now contemplate how long COVID-19 (or post COVID-19 syndrome) may very well change approaches to cardiac event monitoring (NHS 2022). This is particularly in the manner in which specific challenges, issues, and literature outlines how those that have had COVID-19 have increased risk of heart attack, strokes, or other cardiovascular conditions. Indeed, and as Sidik (2022) outlines, it is generally agreed that COVID-19 and long COVID-19 can present a wide range of lasting problems. cardiovascular problems and the heart and circulatory system can be permanently damaged, but also other organ damage (i. e. lungs, brain). The significant issue here then – now that the consensus of research demonstrates possible lifelong risk for heart attacks and other cardiac events following COVID-19 - is gaining an understanding of which at risk groups who have, or had, long COVID-19 can be identified.

Accurate estimation of the prevalence of ASS/Androgen use within the UK population is difficult given the proscribed nature of this behaviour. Despite this, figures from the ONS show an average of 0.8 % of the population of England and Wales aged 16 - 59 years reported illicit ASS/Androgen lifetime use (ONS 2020). Of those engaging in ASS/Androgen use, it is highly likely that is not restricted to a single episode when we take into account that a particularly salient feature of recreational ASS/Androgen use is extended cycling practices (Cohen et al. 2007). Given, therefore, the protracted and insidious nature of many risk factors

that lead to additional mortality and morbidity subsequent to COVID-19 infection, as well as the potential contribution AAS/Androgen use possesses for the lifetime incidence of these risk factors, the likelihood of combinatoric health detriment requires careful screening and planning within health services.

At first glance identifying at risk groups this may well seem simple enough, as existing public health strategies and understanding have long estimated prevalence of those at risk due to morbidity, such as those with diabetes, chronic obstructive pulmonary disease, pneumonia, or cystic fibrosis, or those exhibiting risk behaviours, such as smoking, low physical activity, obesity. However, in line with our previous research and stances related to AAS/Androgens (Crisp & Sims 2021/2022), the fact that AAS/Androgen use is associated with myocardial dysfunction and other cardiac events (Baggish et al. 2017), and the emerging case studies that show otherwise healthy adults who use AAS/Androgens suffering severe COVID-19 symptoms (Cadegiani et al. 2021a; Al-Hajjaj et al. 2022), then if someone takes AAS/Androgens or have done for a period of time, it could well present significant problems at some point in the future. The issue here then is that AAS/Androgens are thus another risk factor, yet one that is partially hidden as many who use them present as outwardly healthy.

Given that medical literature now explicitly outlines the emerging dangers of long COVID-19 for at risk groups, in particular those who have had previous heart issues or who indulge in practices such as smoking and AAS/Androgen use that specifically damages heart tissue and function, then we posit that public health strategies (and discourse) that monitor and mitigate heart risk factors for those who suffer long COVID-19 must also understand and outline how AAS/Androgen use can contribute to severe long COVID-19 responses. We believe, given the potential lifelong risk factors, that this necessitates health work practice and plans that specifically challenges and/or supports AAS/Androgen use in terms of preventative knowledge and education, and that this information must be made part of policy and direction for both users and health practitioners

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TENSIOMYOGRAPHY OF SELECTED UPPER-LIMB MUSCLES IN CROSSMINTON PLAYERS

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Summary. Background: Crossminton is characterized by the repetition of specific one-side movements that is the determining factor of the development of muscle asymmetry and damage to the musculoskeletal system. **Aim:** The purpose of the study was to identify the lateral symmetry between the dominant and nondominant upper limb of crossminton players and to compare the muscle profile of the players with the recommendation values of tennis players. **Methods:** Four elite crossminton players with world ranking position in top 10 participated in our study. We used a tensiomyography to measure the occurrence of functional disorders of the upper limb muscles. Tensiomyography measures were obtained for 8 muscles: m. deltoideus posterior, m. deltoideus anterior, m. pectoralis major, m. biceps brachii, m. triceps brachii, m. brachioradialis, m. flexor digitorum, m. extensor digitorum. We represented the parameters of overall lateral symmetry, maximal displacement (Dm) and contraction time (Tc) for each player individually. **Results:** Individual TMG-derived parameters such as Tc, Dm and lateral symmetry were different between the dominant and non-dominant upper limb. The major finding of this study was that in each crossminton player was found a significantly overall lateral asymmetry of m. triceps brachii. Interestingly, Tc and Dm values were higher in the non-dominant limb in m. triceps brachii compared to the dominant limb for all the crossminton players. **Conclusions:** According to the results of this study, finding the occurrence of muscle asymmetry between the upper limbs, we recommend carry out regular diagnostics of the musculoskeletal system and the inclusion of compensatory exercises, which would prevent or reduce the occurrence of muscle imbalance.

Key words: racquet sport, assymetry, skeletal muscle, TMG.

Introduction

To detail the factors related to the injury in racquet sports is necessary to increase epidemiological description of musculoskeletal injuries (Abrams, Renstrom & Safran 2012). Crossminton is relatively young racquet sport which combines elements of tennis, badminton

and squash. The popularity of this sport has increased in recent years.

Crossminton is a sport in which the player uses the whole body from a kinesiological point of view. Although each player has their own individual technique, the muscle involvement in each stroke is the same and may vary only slightly. According to Vágner (2016), the muscles of the lower limbs, spine extensors, abdominal muscles, muscles of the shoulder joint and forearm are most involved in tennis.

Crossminton is characterized by the repetition of specific one-side movements that is the determining factor of the development of muscle asymmetry and damage to the musculoskeletal system, especially the upper limbs (Sánchez-Alcaraz et al. 2021; Courel-Ibáñez & Herrera-Gálvez 2020; Kozel et al. 2019; Sanchis-Moysi et al. 2013; Abrams, Renstrom & Safran 2012).

Especially the incidence of overuse symptoms in adolescent athletes is increasing (Brenner 2007). For this reason, it´s important to identify youth at risk of overuse (Quarrie et al. 2016; Soligard et al. 2016; Halson 2014). A key component of injury prevention is a regular screening of the player health and neuromuscular function (Hughes et al. 2018). In this context, an effective tool for detecting the bilateral differences of upper limb muscles is tensiomyography (TMG).

TMG is based on the radial deformation of the isolated muscle belly and the time it takes for this action to occur during an isometric twitch contraction evoked by electrical stimul (Simola et al. 2016). The key parameters obtained from TMG are muscle displacement, which is representative of muscle tone and contractile force, and the time of the response, which is related to the speed of force generation (Hunter et al. 2012).

Given the absence of knowledge about functional disorders related to crossminton and the current increase of it among the players, the purpose of the study was to identify the lateral symmetry between the dominant and nondominant upper limb of crossminton players and to compare the muscle profile of the players with the recommendation values of tennis players.

Methods

Participants

Four elite crossminton players with international ICO (International Crossminton Organisation) ranking position in top 10 participated in our study. Two women representing the club TJ Slávia PU Prešov in category Women and two men representing the club SbK Lipany in category Boys Under 18. All the subjects had a minimum of 5 and maximum of 10 years of crossminton professional activity. In the Table 1 we present the characteristics of each of the

players. Players who attend regular training and their average training volume is 5.23±2 hours/week took part in the research. All these players have a dominant right upper limb and have had no serious upper limb injuries so far. Participants were informed of the procedures and risks associated with the study and provided written informed consent before participating.

Table 1

Characteristics of 4 crossminton players

	T.L.	***K.D.***	***J.Š.***	***V.K.***
Gender	Woman	Woman	Man	Man
Body height (cm)	159	169	171	184
Body weight (kg)	50	63	69	73
Decimal age (years)	24	19	15	16
Sport age (years)	10	8	5	5
Category	Women Singles	Women Singles	U18 Male Singles	U18 Male Singles
Position in world ranking	1.	1. (U18 Women Singles)	1.	3.

TMG measuring protocol

We used a tensiomyography to measure the occurrence of functional disorders of the upper limb muscles. Tensiomyography is non-invasive assessment, that measures the specific muscle contraction properties. A displacement-measuring sensor recorded the radial displacement had occurred in the muscle belly when a contraction was produced in response to an electrical stimulus (Valencic & Knez 1997).

We performed the measurement on the dominant and non-dominant upper limb. Tensiomyography measures were obtained for 8 muscles: m. deltoideus posterior (DP), m. deltoideus anterior (DA), m. pectoralis major (PM), m. biceps brachii (BB), m. triceps brachii (TB), m. brachioradialis (BR), m. flexor digitorum (FD), m. extensor digitorum (ED). Measurements were performed under static conditions, with the subject in the sitting and supine position. A digital displacement transducer Dc-Dc Trans-Tek ® (GK 40, Panoptik d.o.o., Ljubljana, Slovenia), which incorporates a spring of 0.17 $N.mm^{-1}$, was set perpendicular to the muscle belly to acquire muscle radial displacement. Sensor location was determined anatomically according to Delagi et al. (1975) and both electrodes (5x5 cm) are placed symmetric to sensor, 5 cm away from the sensor. Individual maximal electrical stimulation was found by progressively increasing the electric current by 20 mA until no further displacement of the muscle belly could be produced. Intervals of 10 s were interspersed between each stimulation to minimize the effects of fatigue and potentiation (Krizaj, Simunic & Zagar 2008;

Simola et al. 2016). Electrical stimulation was made with a TMG-S1 electrostimulator (Furlan Co., & Ltd., Ljubljana, Slovenia)

The TMG displacement–time curve recordings allow muscle contractile properties to be assessed, obtain different parameters, which can inform about muscle stiffness (Pisot et al. 2008). The TMG measures included parameters such as maximum muscle belly radial deformation (Dm) which is representative of muscle tone and contractile force. Contraction time (Tc) is time between 10 and 90 % Dm. Delay time (Td), also known as reaction time, is the taken by the muscle structure analysed to reach 10 % of the total displacement observed. Sustained time (Ts) is the time that contraction is maintained, and is calculated by determining the time period in which muscle response remain greater than 50 % Dm. Half-relaxation time (Tr) r is the time in which muscle response decreases from 90 % to 50 % Dm.

Results are presented individually for each player. We represented the parameters of overall lateral symmetry, maximal displacement and contraction time in figures. Tc and Dm for each muscle were compared between the dominant and nondominant upper limb.

Results

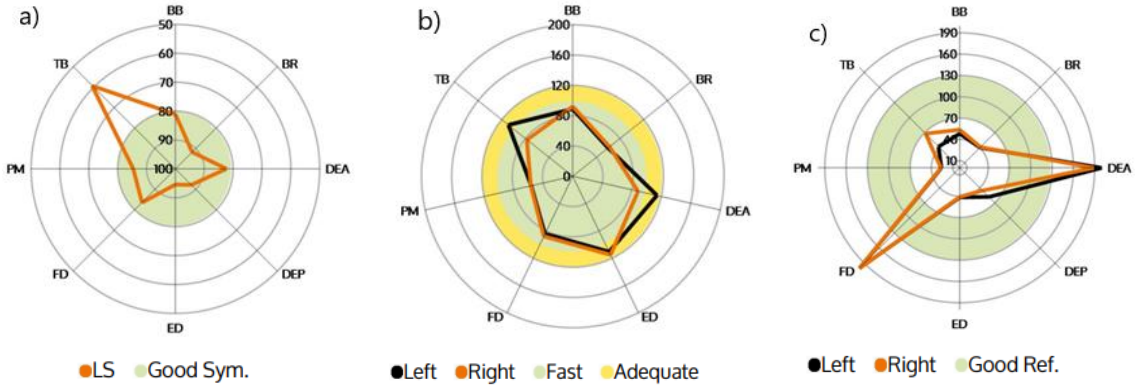
Player no. 1 -T.L.

Player no.1 is a woman with decimal age 24 years and sport age 10 years. The first important parameter that interested us was the lateral symmetry of the muscles of the upper limbs. The overall lateral symmetry of m. triceps brachii was significantly lower than is recommended for the tennis players (59 %). But in m. biceps brachii, m. deltoideus anterior, m. flexor digitorum and m. pectorals major was the overall lateral symmetry compared to the recommendation for the tennis players sufficiently high. Very high overall lateral symmetry was found out in m. brachioradialis, m. deltoideus posterior and m. extensor digitorum (Figure 1a).

Fig. 1b) shows contraction time (Tc) of each muscle and it´s references for the tennis players in %. Player no 1. had a significantly faster m. biceps brachii (right and left upper limb), m. brachioradialis (right and left upper limb) and m. triceps brachii (right upper limb). On the other side, significantly slower than tennis average were m. deltoideus anterior (left upper limb) and m. flexor digitorum (right and left upper limb). Tc values were highest at m. pectoralis major on the right (34.44 $m.s^{-1}$) and on the left side (29.85 $m.s^{-1}$), m. flexor digitorum on the right side (23.90 $m.s^{-1}$) and m. biceps brachii on the left side (23.31 $m.s^{-1}$). The highest differences between the values of dominant and non-dominant limb in Tc were in m. triceps

brachii (difference 10.15 $m.s^{-1}$), m. pectoralis major (4.59 $m.s^{-1}$), m. flexor digitorum (3.79 $m.s^{-1}$) and m. biceps brachii (3.67 $m.s^{-1}$).

The last Fig. 1c) shows the maximal displacement (Dm) of muscles and it´s references for the tennis players in %. Significantly lower values of displacement than tennis average had player no 1. in m. biceps brachii, m. brachioradialis, m. deltoideus posterior, m. extensor digitorum, m. pectoralis major and m. triceps brachii. On the other hand, m. deltoideus anterior and m. flexor digitorum had a significantly higher values of displacement than tennis average. We can state, that vast majority of the muscles had a significantly lower values of displacement than average and these muscles need to be stretched. The highest differences between the values of dominant and non-dominant limb in Dm were in m. deltoideus anterior (2.42 $m.m^{-1}$) and m. triceps brachii (1.92 $m.m^{-1}$).



***Abbreviations**: m. deltoideus posterior (DP), m. deltoideus anterior (DA), m. pectoralis major (PM), m. biceps brachii (BB), m. triceps brachii (TB), m. brachioradialis (BR), m. flexor digitorum (FD), m. extensor digitorum (ED).*

Figure 1
Player no. 1- Lateral symmetry [%], Tc/References [%], Dm/ References [%]

Player no. 2 – K.D.

Woman with sport age 10 years also demonstrates the occurrence of lateral symmetry of upper limbs muscles. We found out, that significantly lower values of overall symmetry than is recommended for tennis players had m. triceps brachii. Slightly lower values that is recommended were detected in m. brachioradialis, m. deltoideus anterior and m. flexor digitorum (Figure 2a).

In the parameter contraction time (Tc) we found out that only m. triceps brachii of left upper limb is significantly slower than tennis average. On the other side, m. biceps brachii (right and left upper limb), m. brachioradialis (right upper limb) and m. flexor digitorum (left upper limb) were significantly faster than tennis average. Tc values were highest at m. triceps brachii

on the left side (36.00 $m.s^{-1}$), m. pectoralis major on the right side (29.44 $m.s^{-1}$) and on the left side (27.12 $m.s^{-1}$). The highest differences between the values of dominant and non-dominant limb in Tc were in m. triceps brachii (11.35 $m.s^{-1}$) and m. brachioradialis (5.52 $m.s^{-1}$) (Figure 2b).

Representative of muscle tone and contractile force is maximum displacement (Dm). Muscles, that have significantly lower displacement that tennis average need to be strengthened. For the player no. 2 it is these muscles: m. brachioradialis (right upper limb), m. deltoideus posterior (left upper limb), m. triceps brachii (left upper limb). On the contrary, significantly higher displacement we found out in muscles: m. brachioradialis (left upper limb), m. deltoideus anterior (right upper limb), m. flexor digitorum (right upper limb) and m. triceps brachii (right upper limb). In m. brachioradialis and m. triceps brachii was lateral symmetry of displacement significantly lower than is recommended. The highest differences between the values of dominant and non-dominant limb in Dm were in m. triceps brachii (5.53 $m.m^{-1}$) and m. brachioradialis (3.26 $m.m^{-1}$) (Figure 2c).

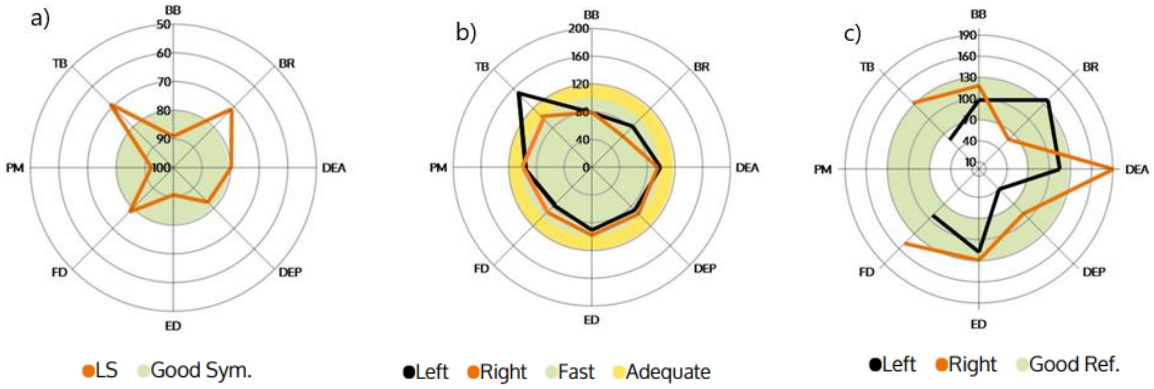


Figure 2
Player no. 2- Lateral symmetry [%], Tc/References [%], Dm/ References [%]

Player no. 3 – J. Š.

For the player no. 3 we found out significantly lower the overall lateral symmetry of m. triceps brachii. Slightly lower the overall lateral symmetry that is recommended for tennis players were in m. deltoideus posterior and m. flexor digitorum (Figure 3a).

In the Fig. 3b) we can see the contraction time of each muscle. M. extensor digitorum (right upper limb), m. pectoralis major (right and left) and m. triceps brachii (left upper limb) were significantly slower than tennis average. We also noticed that lateral symmetry of contraction time of m. triceps brachii was significantly lower than recommended. Tc values were highest as with the previous two players at m. pectoralis major on the right side (40.66

m.s^{-1}) and on the left side (37.65 m.s^{-1}), m. biceps brachii on the left side (32.77 m.s^{-1}) and on the right side (27.50 m.s^{-1}). The highest differences between the values of dominant and non-dominant limb in Tc were in m. triceps brachii (11.52 m.s^{-1}), m. biceps brachii (5.27 m.s^{-1}) and m. extensor digitorum (5.04 m.s^{-1}).

The last parameter is maximum displacement of each muscle (Dm). M. flexor digitorum (right and left upper limb), m. pectoralis major (right and left) and m. triceps brachii (right upper limb) had displacement significantly lower than the tennis average. On the contrary, m. brachioradialis (right upper limb) had a significantly higher displacement than recommended. As for lateral symmetry of displacement, we noticed significantly lower values at m. deltoideus anterior, m. flexor digitorum, m. pectoralis major and m. triceps brachii. The highest differences between the values of dominant and non-dominant limb in Dm were in m. triceps brachii (4.49 m.m^{-1}) and m. biceps brachii (3.66 m.m^{-1}) (Figure 3c).

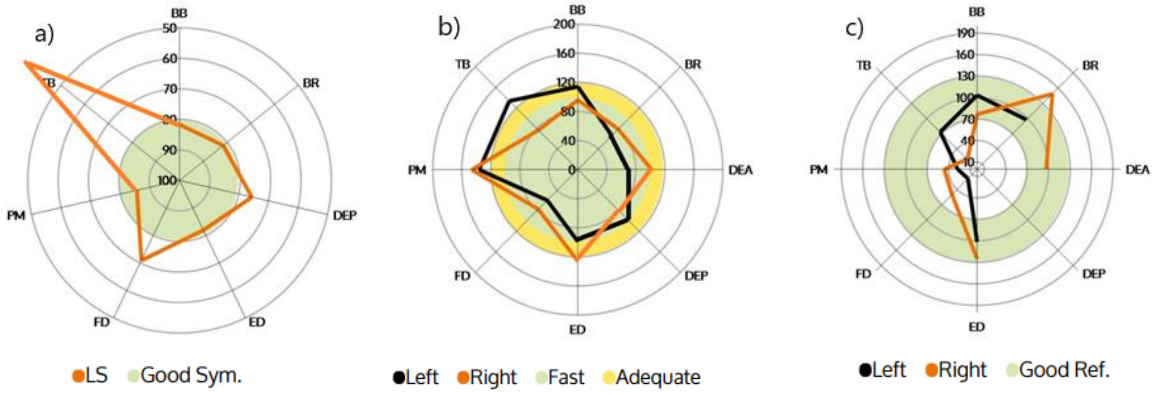


Figure 3
Player no. 3- Lateral symmetry [%], Tc/References [%], Dm/ References [%]

Player no. 4 – V.K.

Player no 4.with sport age of 6 years and decimal age of 17 years also proved like three another players´ occurence of lateral asymmetry of upper limbs. The largest overall lateral assymetry was found out in m. triceps brachii. This player showed the lowest incidence of overall lateral assymetry among all 4 diagnosed players. We only found out that m. triceps brachii and m. deltoideus posterior have slightly lower values of overall lateral symmetry than recommended (Figure 4a).

When we look on contraction time of each muscle and what muscles need to be activated. In player no. 4 we found out, that only three muscles (m. brachioradialis, m. pectoralis major, m. triceps brachii) were significantly faster than tennis average. All remaining muscles meet the recommendation of contraction time of muscles for tennis players. Slightly lower

values of lateral symmetry of contraction time had m. triceps brachii, m. deltoideus anterior and m. brachioradialis. Tc values were highest at m. biceps brachii on the right side (26.54 $m.s^{-1}$) and on the left side (25.63 $m.s^{-1}$) and m. triceps brachii on the left side (21.86 $m.s^{-1}$). The highest differences between the values of dominant and non-dominant limb in Tc were in m. triceps brachii (6,35 $m.s^{-1}$), m. deltoideus anterior (4.39 $m.s^{-1}$) and m. deltoideus posterior (3,23 $m.s^{-1}$) (Figure 4b).

In the last parameter, maximum displacement (Dm), had a player no. 4 slightly worse results. M. pectoralis major showed a significantly lower values of displacement that the tennis average. On the contrary, m. brachioradialis (right upper limb) and m. extensor digitorum (right upper limb) had a significantly higher displacement that is recommended. The highest differences between the values of dominant and non-dominant limb in Dm were in m. biceps brachii (3.17 $m.m^{-1}$) and m. triceps brachii (3.11 $m.m^{-1}$) (Figure 4c).

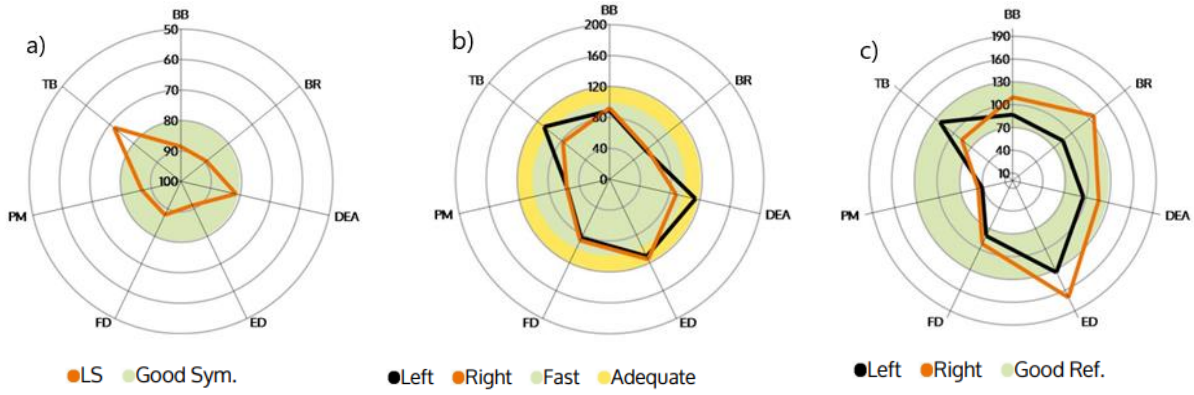


Figure 4
Player no. 4- Lateral symmetry [%], Tc/References [%], Dm/ References [%]

Discussion

To the author´s knowledge, this is the first study that examined tensiomyographic markers of muscle fatigue in elite crossminton players. The present study examined the values of muscle contractile properties in 4 crossminton players. We found significant differences between limbs for the vast majority of variables and muscles examined. Individual TMG-derived parameters such as Tc, Dm and lateral symmetry were different between the dominant and non-dominant upper limb.

The overall lateral symmetry of m. triceps brachii for all the players was significantly lower than it is recommended for tennis players, from 47 to 71 %. Two players had also the overall lateral symmetry significantly lower than it is recommended in muscles m. deltoideus

posterior (75-79 %) and m. flexor digitorum (70 - 78 %). Player no. 2 demonstrated the significantly lower values of the overall lateral symmetry of m. deltoideus anterior and m. brachioradialis (Figure 5). In tennis players, the dominant upper limb displays greater mass than nondominant one (Noffal 1999). This asymmetry between the upper limbs volumes is explained by an increase in bone mass (Kannus et al. 1995) and muscle hypertrophy in the dominant upper limb (Buskirk, Andersen & Brozek 1956; Colak et al. 2004).

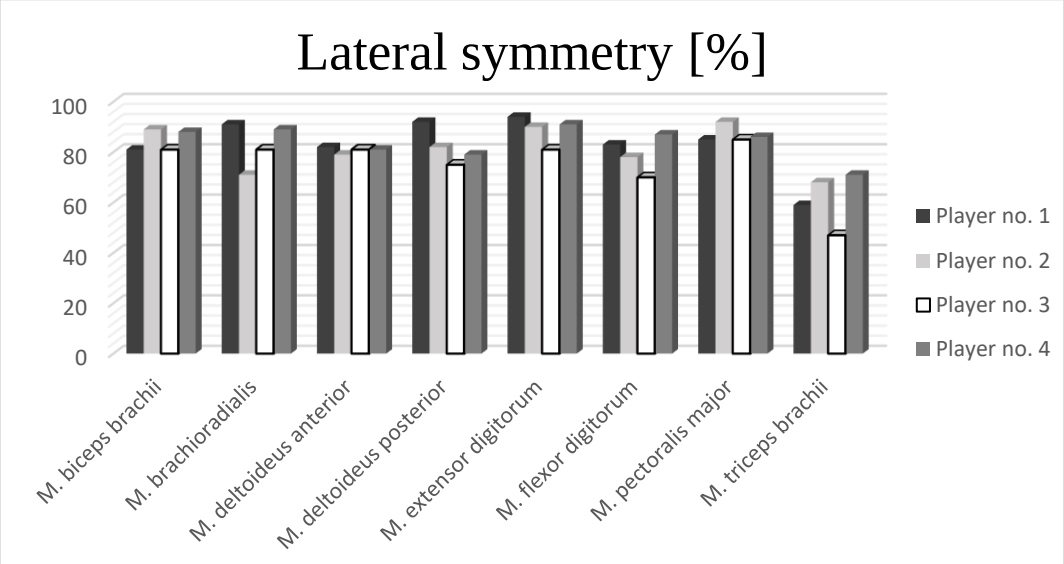


Figure 5
Overall lateral symmetry of all players

The most reliable (Šimunič 2012; Paravlić, Zubac & Šimunič 2017; Tous-Fajardo et al. 2010) and clinically relevant (Pišot et al. 2008; Paravlić, Pisot & Šimunič 2020; Šimunič, Degens & Rittweger 2011) parameter of muscle contraction derivered from TMG are Tc and Dm. Shorter Tc values provide an information about muscles with predominance of fast-twitch muscle fibres (Valenčič & Knez 1997; Dahmane et al. 2005) and Dm values indicate muscle structure. Increased values of Dm indicate decreased muscle stiffness (Pisot et al. 2008). Interestingly, Tc values were higher in the nondominant upper limb in m. triceps brachii compared to the dominant upper limb for all the crossminton players. It means, that m. triceps brachii of the dominant upper limb has predominance of fast-twitch muscle fibres which can be caused by constant repetition of quick swinging movements of dominant upper limb when performing each crossminton stroke.

These findings suggested that functional asymmetries induced by repetitive movements patterns in crossminton players seem to occur in different sports ages. A limitation of this study is the small sample (n = 4). However, it was found that due to the nature of the crossminton, the muscle imbalance occurs regardless of the decimal and sports age.

Conclusions

The number of youth athletes participating in organized racquet sports activities is increasing. On the contrary, one-side specific movements of upper limbs that are repeating in a very short period of time represent a risk of causing injury. The major finding of this study was that in each crossminton player, was found a significantly overall lateral asymmetry of m. triceps brachii. Interestingly, Tc and Dm values were higher in the non-dominant limb in m. triceps brachii compared to the dominant limb for all the crossminton players. Except for m. triceps brachii, we found out the biggest asymmetry in Tc and Dm values of each crossminton player in at least one other muscle. Finding such as adaptations already in adolescent crossminton players points out the importance of carrying out regular diagnostics of the musculoskeletal system and the inclusion of compensatory exercises, which would prevent or reduce the occurrence of muscle imbalance.

Acknowledgment

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IMPROVING PHYSICAL FITNESS LEVELS AMONG 6- AND 7-YEAR-OLD CHILDREN AS A RESULT OF PHYSICAL AND SPORTS EDUCATION

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Summary. The purpose of the study was to extend knowledge about physical fitness levels and their development among first-grade elementary school students as a result of school physical and sports education. A total of 23 children participated in the study, and nine physical fitness tests were administered to determine their physical fitness levels (Měkota & Blahuš, 1983; Šimonek, 2015). The *t* test for dependent samples was used to determine changes in physical fitness levels for both sexes. Boys showed significant improvements in the 20-meter dash, repeated routine with a pole, standing long jump and 4 x 10 m shuttle run. Girls showed significant improvements in the 20-meter dash test and a repeated routine with a pole. The results have confirmed the necessity to enhance physical fitness levels in children and systematically develop all motor abilities in physical and sports education classes.

Key words: physical education process, physical fitness, prepuberty

Introduction

The issue of motor abilities and physical fitness levels among prepubertal students has been addressed in numerous studies (Hands & Larkin 2006; Adamčák et al. 2007; Haga 2008, 2009; Novotná et al. 2009; Antala 2010, 2014; Mužík et al. 2010; Fransen et al. 2012; Podstawski & Boryslawski 2012; Eather et al. 2013; Čillík et al. 2013, 2015; Krull & Novotná 2015; Sujová & Vladovičová 2016; Mandzák & Bujdoš 2018; Mandzák & Mandzáková 2018; Chovanová & Majherová 2018), highlighting the benefits of physical and sports education for healthy development of children.

Motor and physical fitness are determined by the developmental rate of particular motor abilities. Prepubertal age is the most appropriate period for the development and refinement of motor abilities and skills. However, developing abilities and skills is not equally effective, and not every motor ability may be perfectly developed. Prepuberty refers to the time appropriate for developing speed and motor coordination, aerobic endurance, and explosive and dynamic strength (Ružbarská & Turek 2007; Perič et al. 2012; Laczo et al. 2013; Čillík et al. 2014).

Physical and sports education within primary education aims to develop motor, physical, and functional parameters. Most children become familiar with physical exercises during prepuberty, being the most appropriate period for taking up regular exercise. According to Antala (2012), the purpose of school-based physical and sports education is to develop motor abilities, acquire and refine motor skills and habits, promote physical literacy, enhance general physical fitness levels, and have children adopt positive attitudes towards physical activity through performing physical activities. In addition, Dvořáková (2012) states that physical and sports education should aim to promote physical activity levels among all children, not only the athletically gifted individuals.

At present, there are several test batteries that primary education teachers may use to test and monitor children's physical fitness levels. Tests are administered to determine current motor ability levels, assess age- and gender-specific differences in physical fitness, and compare the effects of a variety of physical fitness interventions on physical fitness components. Teachers may find the information about physical fitness levels helpful when developing students' motor abilities and physical fitness. The testing results may also change the attitude towards physical activity adopted by students and their parents (Podstawski & Boryslawski 2012; Sujová & Vladovičová 2016).

Based on the results reported in numerous studies conducted to date, multiple authors have stated that physical fitness levels play an essential role in promoting physical activity levels among prepubertal children. According to the studies, youth with better motor abilities may find it easier to be physically active and may be more likely to engage in physical activity compared with peers with poorer motor competence. The relationship between motor abilities and physical activity is probably one of the critical factors that significantly forms and determines lifestyle during childhood (Losse et al. 1991; Bouffard et al. 1996; Piek & Skinner 2001; Reed et al. 2004; Wrotniak et al. 2006; Vandorpe et al. 2011).

The current trend in physical fitness changes among school populations points to stagnating or decreasing physical fitness levels. Students' fitness parameters in physical and sports education are influenced by various factors, including leisure-time physical activities

(Adamčák & Nemec 2010; Šimonová & Vladovičová, 2010; Lednický & Doležajová, 2011). In their studies, Antala et al. (2010, 2014) emphasize that in recent years the number of children who are active in physical and sports education classes only and do not engage in any other physical activity outside these classes is increasing. The authors emphasize that both the general population and physically active children and adolescents demonstrate declining levels of physical fitness.

The purpose of the study was to extend knowledge about physical fitness levels and development among first-grade elementary school students as a result of school physical and sports education classes.

The following research questions have been formulated to increase the research objectiveness: What are the physical fitness levels of 6- and 7-year-old children? How do physical and sports education classes affect physical fitness components among 6- and 7-year-old children?

Methods

The study sample included 23 first-grade students (9 boys and 14 girls) aged 6 and 7 years (M = 7.35; SD = 0.28 years) from the Šrobárova elementary school in Prešov. The children who participated in this study did not engage in any after-school or club-based organized sports activity. The research lasted for 10 months, from September 2021 to June 2022. As set out in the Framework Teaching Plan for Elementary Schools, students attended 2 physical education classes per week. The testing sessions took place during physical and sports education classes in the school gym. Before administering physical fitness tests, basic somatic parameters were measured. Body height was measured in centimeters to the nearest tenth using a digital stadiometer SECA 217 (Medical Measuring Systems and Scales, Hamburg, Germany). Body weight was measured in kilograms to the nearest tenth using a digital scale (Diagnostic scale, Bosogramm 4000, Bosch + Sohn, Germany). Body height and weight were used to calculate BMI indices for all children.

The following nine physical fitness tests were administered to determine children's physical fitness levels: 20-meter dash (T1), three-ball rolling (T2), repeated stick routine (T3), sit-and-reach (T4), flexed arm hang (T5), standing long jump (T6), 4 x 10 m shuttle run (T7), sit-ups in 1 min (T8), and multi-stage shuttle run (T9).

The Shapiro-Wilk test was used to assess the normality of data distribution. The descriptive statistics were used to compute the mean and standard deviations for particular

somatic parameters and physical fitness tests. The *t* test for dependent samples was used to determine significant differences in physical fitness levels with $p < .05$ considered statistically significant.

Results

Descriptive statistics for children's somatic parameters are presented in Table 1. Measuring somatic parameters is currently considered an integral part of athletes and general population testing. Somatic characteristics are one of the basic parameters indicating the physical growth and development of an individual. Individual growth curves and changes in somatic parameters may either positively or negatively affect physical fitness levels (Jesenský 2018). Somatic parameters after 10 months increased significantly, which may be attributed to natural development. Body height for girls and boys is increased by 4.71 cm and 4.4 cm. Mean increases in body weight for girls and boys were 2.66 kg and 2.63 kg, respectively.

Table 1
Descriptive statistics for somatic parameters

		Boys (*n* = 9)		**Girls (*n* = 14)**	
		Pretest	**Posttest**	**Pretest**	**Posttest**
BH (cm)	*M* ± *SD*	122.00 ± 4.79	126.40 ± 478	125.65 ± 4.62	130.36 ±4.83
	p	**0.00**		**0.00**	
BW (kg)	*M* ± *SD*	22.41 ± 2.97	25.04 ± 3.32	25.15 ± 4.02	27.81 ± 4.68
	p	**0.00**		**0.00**	
BMI	*M* ± *SD*	14.99 ± 0.97	15.61 ± 1.11	15.87 ± 1.86	16.29 ± 2.00
	p	**0.04**		**0.02**	

Note. BH = body height; BW = body weight; BMI = body mass index; cm = centimeter; kg = kilogram; *n* = sample size; *M* = arithmetic mean; *SD* = standard deviation; $p < .05$

Gender differences in physical fitness levels of physically inactive children are presented in Table 2. Boys showed statistically significant improvements in the 20-meter dash (T1), repeated stick routine (T3), standing long jump (T6), and 4 x 10 m shuttle run. Girls showed statistically significant improvements in 20-meter dash (T1) and repeated stick routine (T3). Apart from the three-ball rolling test, the improvements between pretest and posttest were statistically nonsignificant. The results showed that at the end of first grade, boys showed improved levels of running speed and running speed with changes of direction, explosive leg power, and motor coordination. Girls showed significantly improved levels of running speed and motor coordination.

Table 2

Physical fitness levels of physically inactive children by gender

		Boys (*n* = 9)		Girls (*n* = 14)	
		Pretest	**Posttest**	**Pretest**	**Posttest**
T1	*M* ± *SD*	4.57 ± 0.24	4.20 ± 0.22	4.58 ± 0.36	4.38 ± 0.29
	p	**0.00**		**0.01**	
T2	*M* ± *SD*	31.39 ± 8.71	33.77 ± 9.93	32.94 ± 9.31	30.40 ± 5.09
	p	0.38		0.24	
T3	*M* ± *SD*	30.56 ± 4.29	24.01 ± 4.49	30.89 ± 8.81	25.14 ± 4.57
	p	**0.00**		**0.03**	
T4	*M* ± *SD*	2.22 ± 2.44	2.89 ± 2.71	7.71 ± 2.92	9.14 ± 4.99
	p	0.37		0.13	
T5	*M* ± *SD*	10.36 ± 6.54	10.87 ± 4.96	7.72 ± 7.05	9.60 ± 5.45
	p	0.73		0.27	
T6	*M* ± *SD*	110.33 ± 16.86	129.78 ± 7.97	121.21 ± 18.97	126.00 ± 13.31
	p	**0.00**		0.22	
T7	*M* ± *SD*	14.08 ± 1.10	13.32 ± 0.70	14.01 ± 0.91	13.69 ± 0.71
	p	**0.04**		0.06	
T8	*M* ± *SD*	22.67 ± 7.76	26.67 ± 10.04	22.43 ± 10.14	26.00 ± 9.07
	p	0.18		0.20	
T9	*M* ± *SD*	199.56 ± 69.75	188.33 ± 47.38	169.64 ± 68.67	165.21 ± 53.95
	p	0.45		0.83	

Note. T1 through T9 = physical fitness tests; *n* = sample size; *M* = arithmetic mean; *SD* = standard deviation; $p < .05$

Discussion

Monitoring children's somatic parameters is essential in particular for enhancing sports performance and observing healthy physical growth and development in children and youth during various stages of ontogeny (Grasgruber & Cacek 2008). The somatic parameters of physically inactive children included in this study were compared with the data collected within the nationwide survey Physical development in children and youth in the Slovak Republic conducted in 2011. Compared with the nationwide survey data, boys' mean body height and body weight at pretest was 5.46 cm and 5.05 kg lower, respectively. Compared with their age-matched peers, girls' mean body height and body weight was 0.81 cm and 1.35 kg lower, respectively.

During the early years of life, body height and weight increase at a steady rate. According to Perič et al. (2012), body height increases by 6 to 8 cm per year. For this age group, Horváth et al. (2010) found that body height and body weight increased by 5 to 6 cm and 2.3 to 2.9 kg per year, respectively. The body height increments observed for the children included in this study were higher than those reported in other studies. Body height increments for boys

and girls were 4.4 cm and 4.71 cm, respectively. Body weight increments between pretest and posttest corresponded with the above-mentioned norms. Mean body weight of boys and girls increased by 2.63 kg and 2.66 kg, respectively.

At the ages of 6 and 7 years, children are becoming more responsive to motor coordination, movement combination, movement frequency, relative strength, and endurance training. It is critical that children acquire as many motor skills as possible to form a basis for their future specialized activity and performance. Physical fitness levels between pretest and posttest improved, especially in physical conditioning and motor coordination tests. As data presented in Table 2 show, boys and girls showed improved levels of running speed and running speed with changes of direction. For the 20-meter dash, the differences between the pretest and posttest scores for boys were 0.37 s and 0.20 s, respectively. At posttest, children improved considerably in the 4 x 10 m shuttle run, with boys and girls improving by 0.76 s and 0.32 s, respectively.

There were no significant improvements in the motor abilities reliant on physical conditioning, except for explosive leg power at posttest in boys. The difference between pretest and posttest mean scores in the standing long jump was 19.45 cm. Table 2 shows that there were no statistically significant changes in other physical conditioning tests. For the flexed arm hang, which tests endurance, upper-body strength and mean scores for boys and girls improved by 0.51 s and 1.88 s, respectively. Similarly, the improvements in the sit-up test, which assesses abdominal muscle strength and endurance, observed for boys and girls were minimal. The differences in mean scores for boys and girls between pretest and posttest were 4 repetitions and 3.57 repetitions, respectively. The multi-stage shuttle run was administered to test children's cardiovascular fitness. The differences in children's endurance levels between pretest and posttest were statistically nonsignificant. However, at this age, children find it challenging to follow the test instructions. During the test, some children stopped running at the early stages, although they could run more 20-meter shuttles.

There were statistically significant changes between pretest and posttest for the motor coordination tests, which assessed complex motor coordination. The differences in the mean scores for the complex motor coordination test was 6.55 s for boys and 5.75 s for girls. On the contrary, children's spatial orientation levels, demonstrated while rolling three balls, declined at posttest, especially for boys. Girls improved by 2.54 s, but this difference was statistically nonsignificant. Table 2 shows differences in the mean scores for the sit-and-reach test, which assesses children's lower-back and hamstring flexibility. At posttest, mean test scores for boys

and girls improved by 0.67 cm and 1.43 cm, respectively. However, the differences were statistically nonsignificant.

We compared the results of our study with other studies (Šimonek 2017; Moravec 2002; Sedláček 2009; Čillík et al. 2016) on physical fitness of children aged 6 and 7 years. The comparisons are presented in Table 3.

Table 3

Physical fitness levels reported for boys in previous studies

	T1	T2	T3	T4	T5	T6	T7	T8	T9
Šimonek (2017)	-	114.87	32.11	1.45	7.07	120.10	15.67	21	19.03
Moravec (2002)	-	-	-	19.85	9.90	132.52	-	19.01	31.70
Sedláček (2009)	-	-	-	18.00	8.50	125.00	13.60	17	31.00
Čillík et al. (2016)	-	-	-	18.70	16.20	120.50	14.64	13.87	20.45

Note. T1 = 50-meter dash; T2 = three-ball rolling; T3 = repeated stick routine; T4 = sit-and-reach; T5 = flexed arm hang; T6 = standing long jump; T7 = 4 x 10 m shuttle run; T8 = sit-ups in 1 min; T9 = multi-stage shuttle run

Table 3 shows that physical fitness levels demonstrated by the boys from our study were higher than those reported for their peers from Nitra (Šimonek 2017). Compared with the results reported by Moravec (2002), boys did not demonstrate the physical fitness levels of their peers tested 20 years ago. However, we could not compare the scores for the 20-meter dash, three-ball rolling, and repeated stick routine because scores for these tests have not been reported in any of the studies above.

Table 4

Physical fitness levels reported for girls in previous studies

	T1	T2	T3	T4	T5	T6	T7	T8	T9
Šimonek (2017)	-	114.4	30.52	3.73	6.92	110.67	16.23	23	18.3
Moravec (2002)	-	-	-	20.83	8.92	123.46	-	17.61	27.31
Sedláček (2009)	-	-	-	19.00	8.5	120.50	14.10	16.00	26
Čillík et al. (2016)	-	-	-	20.84	14.43	112.00	15.10	12.23	18.39

Note. T1 = 50-meter dash; T2 = three-ball rolling; T3 = repeated stick routine; T4 = sit-and-reach; T5 = flexed arm hang; T6 = standing long jump; T7 = 4 x 10 m shuttle run; T8 = sit-ups in 1 min; T9 = multi-stage shuttle run

Table 4 shows that physical fitness levels demonstrated by the girls from our study were higher than those reported for their peers from Nitra (Šimonek 2017). Mean scores for girls in

this study were similar to those reported for the girls in the studies by Moravec (2002) and Čillík et al. (2016). However, we could not compare the scores for the 20-meter dash, three-ball rolling, and repeated stick routine because scores for these tests have not been reported in any of the studies above.

Conclusion

The research studies on children's physical fitness levels have shown that a child's organism needs sufficient variety of physical activities. By performing physical activities at a sufficient intensity, children develop their inborn motor abilities.

There were statistically significant differences in the explosive leg power for the motor abilities reliant on physical conditioning. The differences in the tests of upper body strength and endurance, abdominal muscle strength and endurance, and running endurance levels were statistically nonsignificant. The results for the conditioning and coordination tests showed statistically significant differences for running speed and running speed with changes of direction. For the motor coordination tests, differences were statistically significant only for the repeated stick routine. There were no statistically significant differences in other motor coordination tests.

The school setting is considered an ideal environment for various physical activity programs for promoting physical activity and fitness in children and youth (Cavill et al. 2001; Dobbins et al. 2009). Therefore, it is essential to build a school environment that promotes everyday physical activity, quality-based physical education, and participation in sports activities. According to the results of our research, we recommend that ISCED 1 thematic units be used to develop students' physical fitness levels in physical and sports education classes. Physical education teachers are encouraged to regularly test students' physical fitness levels and form children's attitudes towards physical activity.

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RATE OF FATIGUE OF EXPLOSIVE FORCE OF LOWER EXTREMITIES OF ARTISTIC GYMNASTS

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Summary: The aim of our work was to find out the level of explosive force of lower extremities and the rate of muscular fatigue of lower extremities of artistic female gymnasts. The research file consisted of 8 female competitors of B category (year of birth: 2010.5 ± 1.20, physical height 148 ± 10 cm, body weight 36.25 ± 5.44 kg, BMI 16,46 ± 0,68 kg/m^2). In our ex post facto research, which took place in gymnastic club PAVLO Trencin, we used measuring device FiTRO Jumper that has been placed on floor exercise. In input and output measurement we found out the parameters of jumps by two standardized tests. The female probands had 2 attempts (IO: 2´) in each motoric test we recorded the better attempt on the tables. We measured the height of upward leap (V.V.) [cm] in vertical jump with countermovement (VVsPP) without swing work of arms. In 10s test of repeated upward leaps without the aid of arms we measured power in active phase of take-off (P_{max}) in [W.kg^{-1}] and fatigue index (I.U.) in [%]. Among measurements the female gymnasts underwent the circular training with 10 exercises (IZ: 40 s, IO: 15 s) and acrobatic preparation. For processing of results we used non-parametric Wilcoxon´s T-test and paired T-test in which we found up significance at the level $p \leq 0.01$, $p \leq 0.05$ and $p \leq 0.10$ of statistical significance level. By comparison of obtained results at the beginning of training unit (TJ) in tests of VVsPP (V.V.= 26 ± 2.12 cm), 10s test of repeated upward leaps (P_{max}= 40.64 ± 7.6 W.kg^{-1} , I.U.= 23.79 ± 8.01 %) and at the end of TJ in tests of VVsPP (V.V.= 24.08 ± 1.36 cm), of 10 s test of repeated upward leaps (P_{max}= 40.71 ± 5.16 W.kg^{-1} , I.U.= 29.46 ± 10.2 %) we found out that the statistical significance was confirmed at the 0.05 % level of statistical significance only in the height of upward jump in VVsPP where significantly lower values were measured at the end of the training unit. Differences in parameters performance and fatigue index did not manifest themselves at the level of statistical significance.

Key words: artistic gymnastics, explosive force of lower extremities, level of fatigue, vertical upward jump with countermovement.

Introduction

Gymnastics is very exacting and complicated sports activity which includes acrobatic exercise forms and their bonds, jumping, vertical landings, distinct acceleration and deceleration of movement. (Dallas et al. 2017) Gymnasts must perform complex routines, which consist of a number of skills, in all disciplines except for the vault. It is estimated that it concern hundreds to thousands of skills, existing links and combinations which are constantly enriched. (Buben 2014) Together with the growing popularity, progress in education and in way of training the artistic gymnastics advances distinctly in the strenuousness of exercise forms. On each from apparatuses the gymnasts perform exercise forms at high level which comprise more saltos and turns than it was imaginable in the past. The exercise forms introduced at the first Olympics became the basis for today´s lower and middle levels of gymnastics. (Kilijanek & Sanchez 2020)

It comes much more sooner to sportive maturity and to top than in other sports. The female gymnasts must have considerably developed speed, strength, endurance and agility ability. Optimally prepared gymnasts will thus be able to reach sooner and more simply a higher level of mental and physical abilities necessary for a good result in sports. (Kvasina & Kalinski 2013). The goal of our work was to ascertain the fatigue rate of the explosive force of the lower extremities of artistic gymnasts. The strength component, take-off abilities and dynamics are limiting for practicing and demonstrating exercise forms. We were interested in how the training unit with take-off character acts on ability of the lower extremities to develop explosive force and changes in increments of fatigue.

Methods

In our work we found out in input and output measurement the level of explosive force of lower extremities and the rate of acute effects of muscular fatigue on performance in vertical upward jump with countermovement and in 10 seconds test of repeated jumps. The measurement was held in natural conditions during the training in main period in gymnastic club Pavlo Trencin. For measurement we used testing device FiTRO Jumper. We placed the device on the floor exercises because it is a natural training also competitive surface for artistic gymnasts, on which they perform a lot of take-offs, but in considerable measure they develop take-off abilities. We defined our research as ex post facto research.

The artistic female gymnasts of junior category of equal performance class took part in measurement. The file consisted of 8 artistic gymnasts of junior age category (year of birth:

2010.5 ± 1.20, body height: 148 ± 10 cm, body weight: 36.25 ± 5.44 kg, BMI: 16.46 ± 0.68 kg/m^2). In time of measurement all probands were competitors of categories of younger and older female pupils „B“. All artistic female gymnasts acted in one training group with equal training stimuli. They trained four times a week in amount of 12 hours a week. The girls dedicated themselves to the artistic gymnastics on average of 6 ± 1.20 years during the testing they were in good health condition without injuries.

The research file underwent the measurements at the beginning and the end of training unit. In each test the female probands had 2 attempts with an interval of 2 minutes repose, and we recorded better result in each measurement in the under-mentioned tables. The gymnasts underwent the measurements within the circular training in which 10 exercises have been ranked focused mainly for development of the explosive force of the lower extremities. Subsequently the acrobatic preparation was a content of the main part of the training unit which consisted of: slow and rapid forward/backward handsprings and their links, front/back saltos, acrobatic series forward/backward. For measurement we utilized 2 standardized tests: VVsPP and test of 10 seconds upward double footed jump

1. Vertical upward leap with countermovement – the starting position is straddle stand the soles of the foot are approximately in shoulder width position. The countermovement is performed so that the proband will do knee-bend (approximately up to 90° in knee joint) subsequently she can impulsively perform the upward leap as high as possible with stretched-out lower extremities DK (McGuigan 2017). The upper extremities are fixed on flanks. The height of upward leap was the criterion of valuation in [cm].

2. 10 seconds test of repeated upward leaps – tested gymnast performs upward double footed leaps by maximum effort in time of 10 seconds, and the upper extremities are fixed on flanks. From the practical viewpoint it is sufficient to monitor 2 reliable parameters: height of upward leap in [cm] and performance in active phase of take-off [W.kg^{-1}]. (Zemková & Hamar 2004). In practice usually the average of best 3 attempts is considered for criterion. We evaluated similarly as (Štefanovský 2015) the best reached performance from the whole 10 second cycle.

We calculated the fatigue index from the measured values of maximum and minimum performance on the basis of formula $P_{(max)} - \frac{P_{(min)} \,.\, 100}{P_{(max)}}$

We used the method of subject analysis and logical thinking for processing and evaluation of results. The results in individual tests are described within statistical analysis by

arithmetic average, standard deviation of choice file, by variation span, mean value, minimum and maximum value. Within determination of the significance of differences between two measurements we used nonparametric T-test, for comparison of significance of differences of average values we used the paired T-test; in both we found out significance at the level $p \leq 0.01$, $p \leq 0.05$ a $p \leq 0.10$ of the level of statistical significance.

Results

In under-mentioned tables and graphs we present the results in input measurement at the beginning of training unit and in output measurement at the end of training unit in vertical upward leap with countermovement. Each female proband performed 2 times maximum VVsPP without swing work of arms we recorded a better attempt in the height of upward leap (V.V.) into the table in centimetres. Valuating the data we found out that the average result was 26 ± 2.12 cm. The highest reached input value was 28.5 cm and the lowest value was 23.3 cm. After loading the average value was V.V. 24.08 ± 1.36 cm. Maximum reached output value was 25.7 cm and the worst result was 21.9 cm. In Table 1 more detailed performances and differences in the measured values are mentioned.

Table 1

Maximum vertical upward leap with countermovement without aid of arms, input and output measurement

Proband No	**Input measurement V.V. (cm)**	**Output measurement V. V. (cm)**
1	28.1	25.3
2	25.9	23.7
3	28.5	23.5
4	28	25.7
5	23.3	23.7
6	26.5	21.9
7	24.1	23.1
8	23.6	25.7
Min	**23.3**	**21.9**
Max	**28.5**	**25.7**
Vr	**4.51**	**1.87**
a	**26**	**24.08**
s	**2.12**	**1.36**
Me	**26.2**	**23.7**

In input measurement in test of 10 second repeated upward leaps with legs together the average result was reached in following parameters: V.V. 27.69 ± 5.86 cm; $P_{(max)}$ 40.64 ± 7.6

W.kg^{-1}; $P_{(min)}$ 30.71 ± 5.87 W.kg^{-1} a I.U. 23.79 ± 8.01 %. The best result in parameter V.V. was 40 cm and the worst one 20.9 cm. The best reached performance was 47.6 W.kg^{-1} and the weakest one was 22.8 W.kg^{-1}. From recorded data in parameter I.U. the lowest percentage of fatigue was 11 % and the worst one was 33.8 %. The measured values stated in Table 3 point out that the female proband No 1 has reached in test distinctly better results than the rest of girls. In output measurement in the test of 10 seconds repeated upward double footed leaps without aid of arms we measured with female probands the average result in parameter V.V. 27.35 ± 2.72 cm; P(max) 40.71 ± 5.16 W.kg^{-1}; P (min) 28.69 ± 5.5 W.kg^{-1} and I.U. 29.46 ± 10.2 %. The highest value in parameter V.V. was 32 cm and the lowest one was 24 cm. Value of the best performance in parameter P(max) bola 45.9 W.kg^{-1} and the weakest performance was 28.8 W.kg^{-1}. In parameter I.U. the lowest value was 19.9 % and the worst result was 51.4 %. The data stated in Table 2 show that the female proband No 1 has reached alike as in measurement before loading distinctly better results than remaining gymnasts.

Table 2

10 seconds repeated upward double footed leaps without aid of arms: input and output measurement

Proband	**Input measurement**				**Output measurement**			
č.	**V.V. (cm)**	**P(max) [W.kg^{-1}]**	**P(min) [W.kg^{-1}]**	**I.U. [%]**	**V.V. (cm)**	**P(max) [W.kg^{-1}]**	**P(min) [W.kg^{-1}]**	**I.U. [%]**
1	40	47.6	41.5	12.8	32	44.2	35.4	19.9
2	26.5	42	29.3	30.2	26.1	42.1	31.1	26.1
3	31.8	41.5	31.5	24.1	29.6	41.7	27.9	33.1
4	20.9	22.8	20.3	11	24	28.8	19.2	33.3
5	25.5	42.6	28.2	33.8	26.1	41.6	32.5	21.9
6	23.7	41.2	31.3	24	25.9	45.9	22.3	51.4
7	25.8	41.2	30.2	26.7	25.5	39.8	28.6	28.1
8	27.3	46.2	33.4	27.7	29.6	41.6	32.5	21.9
Min	**20.9**	**22.8**	**20.3**	**11**	**24**	**28.8**	**19.2**	**19.9**
Max	**40**	**47.6**	**41.5**	**33.8**	**32**	**45.9**	**35.4**	**51.4**
Vr	**19.1**	**24.8**	**21.2**	**22.8**	**8**	**17.1**	**16.2**	**31.5**
A	**27.69**	**40.64**	**30.71**	**23.79**	**27.35**	**40.71**	**28.69**	**29.46**
S	**5.86**	**7.6**	**5.87**	**8.01**	**2.72**	**5.16**	**5.5**	**10.2**
Me	**26.15**	**41.75**	**30.75**	**25.4**	**26.1**	**41.65**	**29.85**	**27.1**

By comparison of obtained values in the height of upward leap of individual probands, which we have obtained at the beginning and at the end of training unit, we found out significant differences which manifested themselves at 0.05 % level of statistical significance. Almost all probands reached at the end of training unit (TJ) worse results excepting probands No 5 and 8 whose height of upward leap has increased. The greatest difference among measurements was

5 cm this has been measured with proband No 3 who reached in the 1st measurement the best result at the same time.

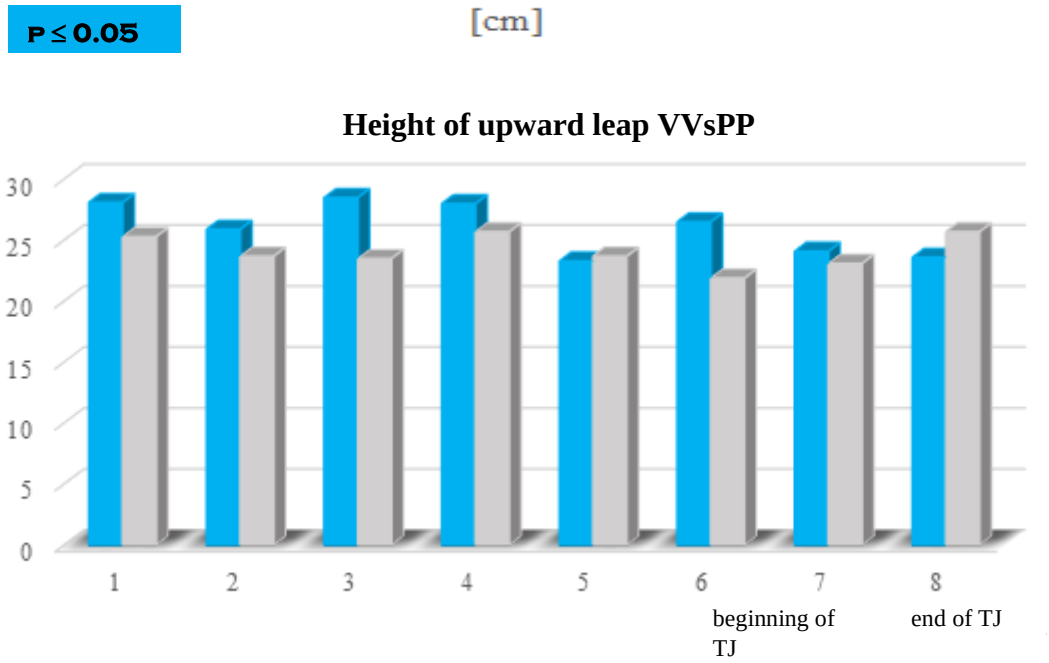

Figure 1

Comparison of the height of upward leap VVsPP of individual probands at the beginning and at the end of TJ

On the basis of comparison of average measured values of VVsPP we found out in parameter of the height of upward leap significantly lower results at the end of training unit, and at the standard of 0.05 % level of statistical significance. On average the file has reached at the end of training unit in V.V. by 1.92 cm less than at the beginning.

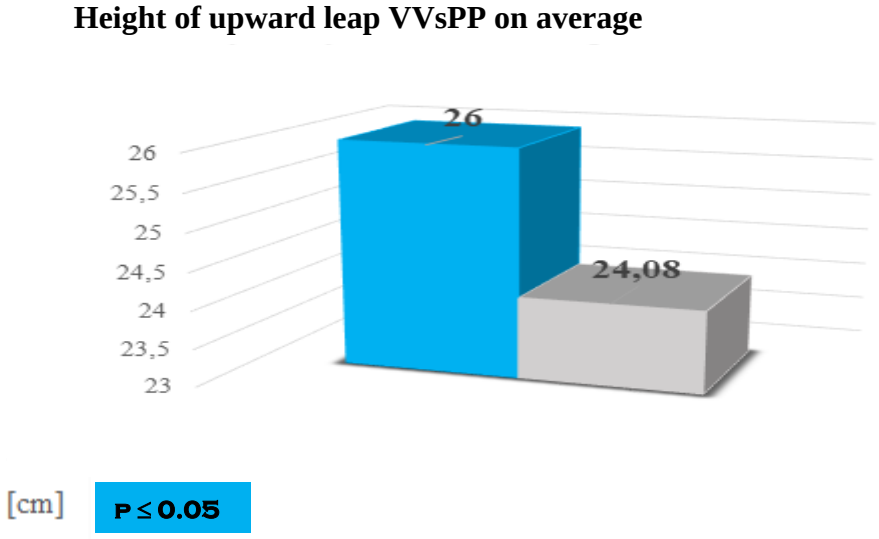

Figure 2

Comparison of the height of upward leap VVsPP on average at the beginning and at the end of TJ

Comparing the performances of individual probands in 10 seconds test of upward double footed leaps we recorded differences which, however, were not statistically significant. The half of the probands reached higher performance at the end of TJ, on the contrary, with the second half of the probands we recorded the decrease in performance. For example the type and ratio of muscular fibres could cause intra-individual differences of the girls. A limbering up with take-off character can energize to female gymnasts with higher ratio of rapid fibres the organism to the better performance. From figure No 3 it results that when comparing the rest of gymnasts with the female proband No 4 lower values in performances have been measured what could affect the average value of group.

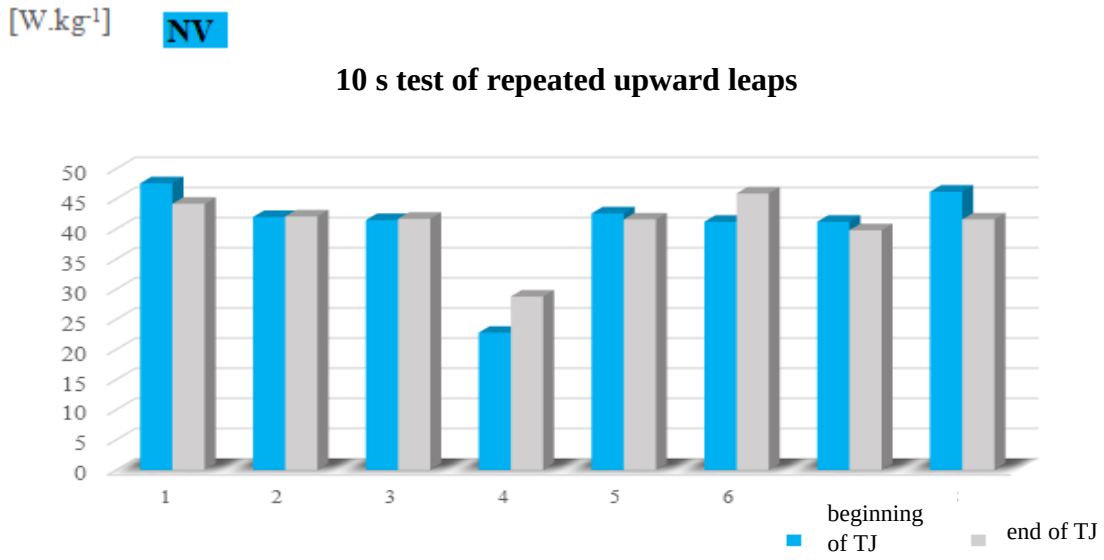

Figure 3

Comparison of performance in 10 s test of repeated upward leap of probands at the beginning and at the end of TJ

Comparing the measured performances in 10 second test of double-footed upward leaps on average we recorded the difference which did not manifest itself at the level of statistical significance. The average performance was moderately augmented by 0.07 $W.kg^{-1}$ at the end of TJ; the difference was so minimal.

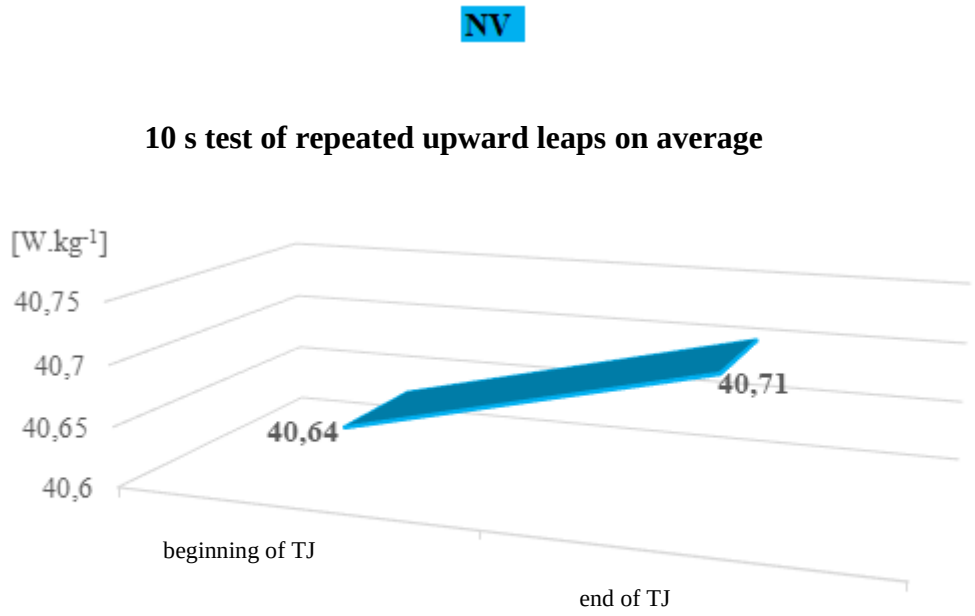

Figure 4

Comparison of performance in 10 s test of repeated upward leaps in on average at the beginning and at the end of TJ

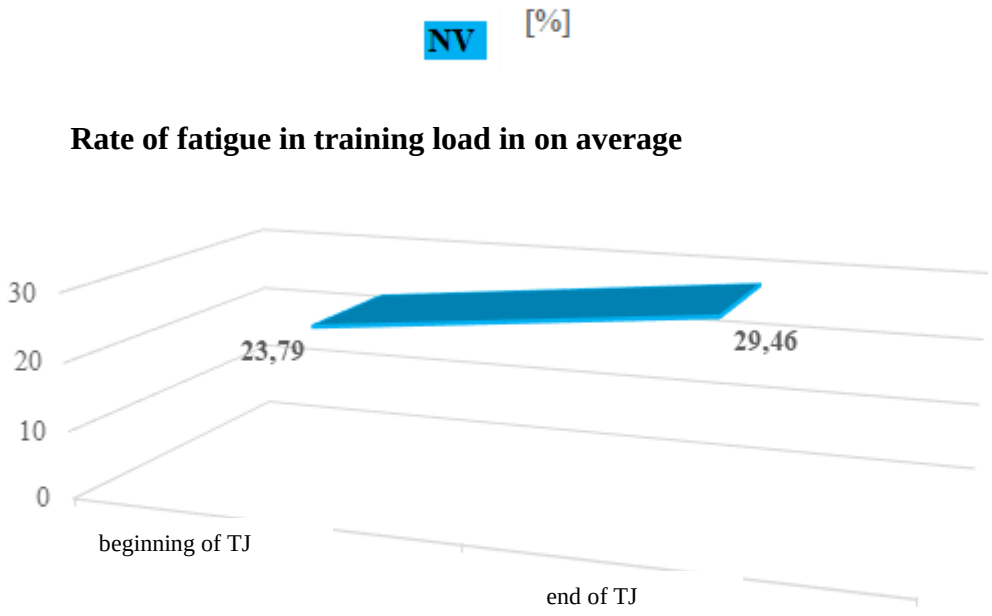

Figure 5

Rate of fatigue in training load in on average

On the basis of comparison of resulting values in index of fatigue on average we found out that the research file has reached after training load the results with percentually higher value by 5.67 % that indicates an enhanced fatigue of organism. The difference did not manifest itself at the level of statistical significance.

Discussion

In our work we measured the level of explosive force and we found out the rate of muscular fatigue with the help of upward leap ergometer FiTRO Jumper. By means of vertical upward leap we can obtain the relevant data about the level of explosive force but we can also analyse the acute muscular fatigue. On the basis of equal procedure, which was chosen in the research by (Palma et al. 2021) we placed the measuring device on floor exercises, which is natural training surface of artistic gymnasts. (Palma et al. 2021) examined in their research the acute effects of muscular fatigue on the performance in vertical upward leap with female gymnasts who dedicated themselves to sport acrobatics. The task of female probands was to perform 6 tucked front somersaults in 12 series. The main conclusion of this study was the finding that the muscular fatigue has not significant influence on the jumping of female probands, however, meaningful change happened in generated pressure at the take-off which was gradually on the decrease. Further finding was that the performing of 15 upward leap (squat vaults) during the limbering up enhances the performance in vertical upward leap in relatively great rate.

According to the results of our measurements it results that the height of vertical upward leap falls together with load. The height of upward leap VVsPP on average fell by 1.92 cm and the height of upward leap in 10 s test of repeated upward leaps on average fell by 0.34 cm. The results, which we recorded in performance in 10 seconds test of repeated upward leaps, were interesting for us. The values in parameter: performance after the training unit rose moderately by 0.07 $W.kg^{-1}$.

In spite of the fact that this was not subject of our research we assume that just the fitness block with focusing on the take-off exercises and acrobatic preparation have activated the muscular fibres and altogether they energized the organism what could manifest itself by enhanced performance in active phase of take-off.

Dallas et al. (2019) and other authors deal with similar problems. In their research they investigated acute improvement of performance in jumping of artistic female and male gymnasts after application of various plyometric stimuli. The first fitness block consisted of 10

round-offs and the second block of 10 squat vaults. They measured the parameters of jumps with help of the drop jump test. They performed the measurements before 1st fitness block immediately after termination and subsequently after 3, 6 and 9 minutes they proceeded alike after the 2nd block. The result is for example finding that after specific exercise form, in which it comes to high-intensive contraction of musculature (in case of research of round-offs), the performance enhanced most distinctly after 9 minutes. They state that the exercises with medium-and high-intensive contraction of musculature performed during the limbering up or training unit (TJ) positively influences the performance during jumping.

From the viewpoint of monitored rate of acute muscular fatigue in training load on average the values in 10 s tests of repeated upward leaps in the second measurement has increased moderately. While the value of 23.79 % that has been measured at the beginning of training unit in the index of fatigue, after the load of the value enhanced by 5.67 %. The obtained data indicate the presence of greater fatigue with artistic gymnasts. (Gathercole et al. 2015) state that the detailed analysis of kinetic and cinematic variables, which are provided by plates with system of scanning the position; provides a better overview on neuromuscular answers connected with muscular fatigue. They found out that the vertical upward leap with countermovement is with its high repeatability and sensitivity to fatigue the most valid test to the detection of muscular fatigue from among other used tests (squat upward leap, sprint, drop jump test).

Conclusions

The results showed us that the height of vertical upward leap with countermovement was on average significantly lower in measurement after the training unit what manifested itself at the 0.05 % level of statistical significance. We assume that the results in explosive test were lower at the end of training unit because also in spite of the fact that the probands underwent load, to which they are used, the fatigue is a natural answer of musculature to physical activity.

We supposed that the performance in 10 seconds test of repeated upward leaps will be on average significantly lower at the end of training unit. The results did not confirm this statement because the performance was higher by 0.07 % on average at the end of training unit. However, it did not manifest itself at the level of statistical significance. We presume that just the fitness block with take-off character and acrobatic preparation promoted the enhanced performance. Quality warming up of intensive activity accelerates blood circulation, heart rate

and the musculature fills with blood subsequently the organism is sufficiently activated to react to training stimuli more effectively.

The results showed that the index of fatigue in 10 seconds test was percentually higher at the end of training unit, however, the difference was not statistically significant. The value in examined parameter increased in average only by 5.67 %. We ascribe the relatively small increment of muscular fatigue to the fact that only 1 training unit will not cause distinct fatigue to the gymnasts because this is a natural load to which they are functionally and motorically adapted.

On the basis of obtained and processed results of our research we can state that in training process the quantity of volume and the kind of intensity have big meaning by which the gymnasts are loaded. The distinct acute muscular fatigue will not appear if the training stimulus has a character to which the organism is used. Another factor, which could affect the little noticeable increments of fatigue after training unit, is adaption on the soft flexible surface. The acrobatic female gymnasts perform the overwhelming majority of movement activity and sport preparation on the floor exercises, and just therefore their musculature is in the long term adapted to this kind of stimulus. To watch the changes in increments of fatigue would be interesting if for example the fitness block including various take-off exercises would be implemented on a harder surface. Also Increasement of repeats and load could manifest itself by distinctly growing fatigue.

Acknowledgement

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CAN THE UNESCO AWARD BE A FACILITATOR TO CHANGE THE QUALITY IN AFTER-SCHOOL PROGRAMMES? - VISIONS FOR FUTURE

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Summary. In April 2021 the "common welfare oriented sports club culture" has been awarded by German UNESCO intangible cultural heritage (ICH). To maintain this award, there has to be a future vision for the immaterial cultural heritage in terms of inclusive, equal opportunity, high-quality education.

In Germany, sports clubs cooperate with (primary) schools in after-school programmes, often organized by the school (ASPO). However, offers of sports clubs are understood as offers for pastime and day-care, on the contrary, offers of other partner of cooperation are regarded as offers of education.

During Corona crises grassroots sports in Germany was forbidden and more than that, ASPO and PE were cancelled immediately, with consequences e.g. for common welfare and health. "Existing concepts no longer work!" (Pühse, oral comment Bratislava 2021). P.E. teachers experimented with homework, but failed. However, exercise instructors and coaches came up with new motivating ideas and sports clubs seem to take over the role of high-quality education. Can the UNESCO award be part of a creative change not only for sports club culture but also for ASPO and excessively so to understanding PE in its multi-perspective? Let´s finally consider it in a future workshop, based on scenario, which reflects the relevant developments.

Key words: after-school programmes, UNESCO, common welfare oriented sports club culture, multi-perspective of PE, corona crises

Introduction

In April 2021 *common welfare oriented sports club culture* has been awarded intangible cultural heritage (ICH) by German UNESCO-commission. "UNESCO's mission is to contribute to the building of a culture of peace, the eradication of poverty, sustainable

development and intercultural dialogue through education, sciences, culture, communication and information." As late as 2013 Germany has joined the UNESCO-contract to preserve the immaterial cultural heritage.

It happened to be that the publication of the award for "common welfare oriented sports club culture" was done during the second lockdown in Germany (02.11.2020 – 31.05.2021), in the "light" phase. The official presentation of the certificate was at 18th of November 2021, when, because of the high incidence rate, the next lockdown was discussed. Prof. Dr. Gudrun Doll-Tepper, DOSB-vice president for education and Olympic education received the document on behalf of sports-Germany (Sportdeutschlands) and nearly 90.000 sports clubs. In her acceptance speech she pointed out, that the social achievement of clubs and of volunteers should be given even more recognition in the future. That has to be reflected in such a way, that sports clubs will not be closed at a possible lockdown, whereby their members would suffer extremely restrictions in physical activity (DOSB 2021).

However, the publication time during the light phase of the lockdown, was only by coincidence. Already in 2017 – when nobody had even thought about the pandemic – the first approach was taken by the DOSB as one arch of civil society to gain this award. But it failed, because the matter of "sport" was not suitable for the concept of UNESCO intangible cultural heritage. Inclusive, equal opportunity, high-quality education are the key terms for ICH, not different sports, but education to sports and education through sports and physical activities.

In an obviously productive communication process with the decision-makers, common welfare was worked out to be an outstanding surplus of the sports club and should be focussed, which can also be seen as a part of a culture. As Doll-Tepper pointed out, sports clubs can also work as educational partners in schools. You do not have to be a prophet, to realize, that the traditional sports clubs-landscape is changing furthermore, due to the development of all-day schools and shortening school-time at secondary schools. Permanent changes in the school system is a big challenge for the organized sport in Germany, because new tasks for sports clubs are generated especially at the cutting edge between sports clubs and schools. (Doll-Tepper 2012, p. 307) Also in the description of the cultural expression in the application form, it is mentioned that sports clubs are the greatest cooperation-partner for schools nationwide (application form 2020, p. 3). They offer after-school programmes with a variety of sports and physical activities, often organized by the school (ASPO). The idea came into action, nation-wide, when children could not join regular sports clubs offers around midday, because their school system had changed to one sort of all-day school, where pupil have to attend obligatory. Organized by the school meant, that the school decides, which sport offer they would take at

which day and which time for which target group, while sports clubs have to find (and pay) competent exercise instructors, but could use the infrastructure of the schools and do not have to pay for the sports-hall during obligatory school program. The surplus behind it is to foster quality in PE and to encourage children to join sports clubs to increase physical activity.

Sport clubs and -federations cooperate very closely with institutions of science and education such as day-care facilities for children, schools and universities, and clubs and societies ("Sportvereinswesen") itself is the matter of scientific discourse (application form, p. 5). Already in 2012, Doll-Tepper pointed out that there is a gap between claim of sports clubs and perception of schools, when she refers to "Studie zur Entwicklung von Ganztagsschulen" (StEG), a study to detect the development of all-day schools: offers of sports clubs are understood as offers for pastime and day-care, on the contrary, offers of other partner of cooperation are regarded as offers of education. As a consequence of this, inclusion of sports clubs by purpose into decision or consulting boards of all-day schools happen only rarely (Doll-Tepper 2012, p. 307). In the meantime, StEG became a longitudinal study in three waves, but the results concerning sports clubs concerning the gap between claim and perception has not changed.

Obviously this UNESCO award, dedicated to nearly 90.000 sports-clubs, might have an influence on school sports too. To maintain the award there has to be a future vision for the immaterial cultural heritage.

"Article 14 – Education, awareness-raising and capacity-building

Each State Party shall endeavour, by all appropriate means, to:

1. ensure recognition of, respect for, and enhancement of the intangible cultural heritage in society, in particular through:
   - educational, awareness-raising and information programmes, aimed at the general public, in particular young people;
   - specific educational and training programmes within the communities and groups concerned;
   - capacity-building activities for the safeguarding of the intangible cultural heritage, in particular management and scientific research; and
   - non-formal means of transmitting knowledge;
2. keep the public informed of the dangers threatening such heritage, and of the activities carried out in pursuance of this Convention;

3. promote education for the protection of natural spaces and places of memory whose existence is necessary for expressing the intangible cultural heritage."

(Text of the Convention for the Safeguarding of the Intangible Cultural Heritage - intangible heritage - Culture Sector – UNESCO.)

So the research question of this chapter is, whether the award can be a facilitator to change the quality in ASPO (and the attitude of schools concerning the potential of sports clubs) in the future.

Few remarks concerning the process of awarding by UNESCO

The *common welfare oriented sports club culture* has been awarded by GERMAN UNESCO. Beneath the international list, there is a national one. The aim of the national catalogue is to make the diversity of immaterial cultural forms in and out of the nation visible. This is the base to be possibly accepted later on in the global list. Proposals are coming out of civil society, in this case, the DOSB (German Olympic Sports Federation) applied for the two (out of five) categories *performing arts* (music, theatre, dance) and *social traditions* (seasonal festivities and rituals). In the requested explanation, the DOSB focused on the social welfare of sports clubs, which had been democratically legitimized 200 years ago (application form, p. 2). De facto this is wrong, because in those days the first German *Turnvereine* were founded, the term of *sport* was not even known at the start of the 19th century. That is why Michael Krüger (2021) used the smart expression of the *German Turner Sports-clubs* in his statement concerning the UNESCO award, celebrating their outstanding and trendsetting qualities: they are creative, innovative and integrative.

The rise of the clubs – but *Turnvereine* – started more than 200 years ago. In 2011, when the German *Turners* celebrated the *Hasenheide* as a place of memory, the subtitle was *200 years of social responsibility*. In the 19th century *Turner* were political active, they used e.g. to work as a fire brigade (voluntary), and even in the period of the national lockdown of *Turner* (1820-ca. 1842) they kept on being in contact, they gathered in the back rooms of pubs to carry on with their activities, political debating as well as physical strengthening. Bonding was from the very beginning an inevitable part of the club culture. During both of the World Wars *Turner* exchanged letters in between their men´s union. After World War II, when sports started again very slowly in Germany, the *Turner* coaches travelled to different groups to carry on with their teaching of this special sport and to encourage others, to be physical active again, even though high bars (made out of metal) had been turned to helmets in war times and wooden apparatus were used for heating, so apparatus were hardly available.

To sum up and be precise, the German *Turner* celebrated (political) assemblies, festivities, created *Turner* songs and rituals accompanied with flags and *Turner* music and bands. Maybe to mention the *Turner* in the title of the application would have been a roundabout way. However, the conservative attitude of Jahn – the *Turnfather* – would have not suited to this UNESCO application that should show, that sports clubs are highly cultural divers (Schulke 2016, 2017). Sports clubs translate recent social-cultural trends at a time and integrate them into their portfolio, e.g. trends of fitness- and youth-culture like *Trimm-Dich-Bewegung* (keep fit campaign) in the 1970er years, aerobics in the 1980s, inline-skating in the 90s or parcour in the 2000 and following. According, the report of sport development ("Sportentwicklungsbericht") 2015/16 sports clubs admit highly to intermediation of values. Sport clubs offer a lot of possibilities of learning and taking over important functions to complement offers of the public educational system. (application form 2020, p. 2)

After the decision and the definition of the matter, there is a process of different steps, set up by national UNESCO commission together with state actors – foremost of the ministry of culture. In the end, the catalogue is far from being a listing of the nation´s heritage. Yet, it shows vivid cultural traditions and expressions, done in the nation. Those cultural forms included in the list are examples for creativity, spirit of innovation and knowledge of society. The awareness shall lead to the sustainability of living traditions, done by groups or communities, should be carried on and developed dynamically. The decision, whether a new ICH is included in the list, is always done by an (inter)national commission. The proof is closely related to the application, the nation has handed in. This should match the requirement of the convention of UNESCO ICH, the closer it sticks to the words, the better the chance to succeed.

A closer look to the matter of sports and sports clubs regarding education

Sport as such is not included into the categories of cultural heritage. Sport is a global phenomenon, since there was the common sense that there are international rules, competitions, judges and referees. Physical activities from different nations have adapted to this (international) frame in a process of sportification (Eichberg 1998), see e.g. apparatus gymnastics (*Turnen*), Judo or Parkour. Their original idea or their philosophy often decreased to a ritual or sometimes the history is mentioned to justify the `new´ sports. However, there might be times when all of a sudden the philosophy becomes importance again, because it is the solution in another setting.

For example, there is the field of physical activity (*Bewegungsfeld*) *fighting with and against each other*, obligatory in secondary schools in Germany. It has been integrated into the

syllabus to strengthen self-confidence, but sports teachers do not know how to cope with it. Judo could help in this case. The sports, which has the meaning *soft way* is based on the principle of easing off. The inventor of Judo, Prof. Jigoro Kano, developed a doctrine for physical education, to keep his pupil healthy and fit, an art of fighting for self-defense and finally an ethic-moral lesson, to generate personality (Pelczarski 2017, p. 7; Stelter 1996). This concept seems to be up to date, but is more than 100 years old. On the one hand, Judo went through the process of sportification, there are national and international competitions in Judo as a sport, athletes prepare for in sports clubs for example, but on the other hand, Judo with its special philosophy can be used for PE also. Maybe, we could take the established concepts of PE even – vice versa – into the sports (clubs) again.

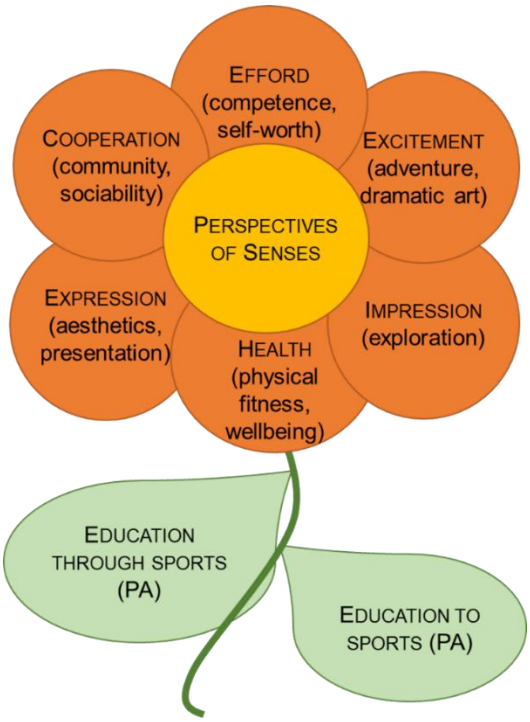

Figure 1
Perspectives of senses (own graphic representation)

There are approaches like the one of "*Sinnperspektiven"* (perspectives of senses, see own presentation adjacent, fig. 1), a German pedagogic approach established in PE (e.g. Kurz 2004), that shows that PE is much more than an obligatory subject, where physical activity is taught, and it emphazises also the importance of a coach or teacher in the process of learning. The topicality of Kurz idea, developed for PE, but is useful in club sports also. However, some clubs follow the idea of Kurz, not knowing there is a concept like that. They target the children and their needs and think about educational concepts to foster their literacy in different ways: Hameln is a town with a great amount of children with migration background. To integrate them into community one of the local sports clubs, by the way it is the *Turn*-Club Hameln 1880

e.V., offer from kindergarten onwards special courses in which language is trained through physical activity.

They have been very successful with that program consisting of 60 different units, a special designed and evaluated syllabus (FoSS - Projekte - Ohne Bewegung keine Sprache (kit.edu)). Especially in the project *without physical activity, no language*, they now, due to the lockdown, detect disastrous consequences concerning the healthy upbringing of children: a decrease of concentration, of social competence and a lack of language skills (for influence of physical activity on language skills see Beck 2019).

The Turn-Club (TC) Hameln has been awarded with the *stars of sport*, the most important national competition of sports clubs in Germany, which decorates clubs for their social engagement. There is high evidence that the TC has been part of the survey, done by DOSB, to find out, whether sports clubs would announce in their (virtual) rooms, that *common welfare oriented sports club culture* might be acknowledged as immaterial cultural heritage, 98% agreed on (application form, p. 7). Even if you cannot transfer the extraordinary acceptance overall into all sports clubs, this result shows impressively, that sports clubs see themselves as an important part of the cultural heritage of our nation (application form, p. 7).

A great amount of sports clubs offer several sports under one roof. So, if the concept of Stelter (1996) is right – you are like your sport, either you chose the sport that suits you or the development of your personality is stamped by certain sports, or both – and even in the sports clubs the training it is based on perspectives of senses (Kurz 2004), individual education as one aim of the UNESCO award would be safeguarded. Ability to work in a team, mutual respect and appreciation, equal opportunities, one´s own initiative and participation – all of that are basic elements, especially adolescents learn and train in sports clubs. (Doll-Tepper 2012, p. 307) However, there is this slightly, but not new, problem of drop-outs in sports clubs, especially at the age from 14 (adolescents) onwards. That leads us to the cultural aspect of sports clubs.

Stability of cultural expressions

In the application form, UNESCO wanted to know about the risk factors of stability of cultural expressions. The answer of DOSB was predictably, sports clubs would develop a creative power, which has been stable, innovative, effective and sustainable, despite of social-political changes and has established remarkable ideal and material values e.g. own sporting facilities.

These days sport and the clubs, where people go in for it, are indispensable for our society - at least that is what Walter Schneeloch says; he was (since 2018) Vice-President of the Grassroots Sports Section of the German Olympic Sports Confederation (DOSB), an umbrella organisation for sport clubs in Germany. Sport has positioned itself as a cross-sectional undertaking that embraces, among other things, education, youth welfare, urban development, integration and health. Sport is no longer the nicest trivial pursuit in the world, but an important policy area, explains the representative from the Olympic Sports Confederation. It is the sports clubs that cement society together (Marschke 2015). In celebrating the UNESCO award it was mentioned, that the clubs even helped to overcome Corona-pandemic (DOSB April 2021).

Approximately eight million volunteers are supporting nearly 90.000 sports clubs in Germany 2021. 23 million hours of work per month on average are done by volunteers. These impressive numbers were recorded before corona. However, even in those days, before corona, volunteer working was (and is) decreasing, despite of the annual *International Volunteer Day for Economic and Social Development*, celebrated since 1985, rewarding common welfare. The number of people engaging in voluntary work lifelong, to consider it as an affair of the heart shrink.

The idea, to encourage young people to take over responsibility in sports clubs, works for a short period of time. But, when they transit into a new phase of life – because e.g. they start their apprenticeship or study - they often cancel their engagement as exercise instructors. To recruit (young) people as long-time volunteers seem to be a challenge for sports clubs in the future. During Corona crises grassroots sports in Germany was forbidden and more than that, ASPO was cancelled immediately, with consequences e.g. for common welfare and health. The amount of new members in clubs - especially at children´s age - decreased of up to 70 %. Chairmen of sports clubs were and are still are begging their members to pay the fee, because otherwise coaches cannot be paid their expense allowance. A sports club is based on a special economic situation, which equals earnings and costs. Coaches and exercise instructors either cancelled their activities, because they experienced what else they could do while there was no chance to teach physical activities in practice or came up with new ideas like online-courses and outdoor offers, but social bonding and personal feedback decreased extremely.

Even in German sports culture such as, sports clubs have to react on or better to foresee social as well as organizational changes. In the end, members are customers. Communal activities, like Calisthenics parks, Frisbee golf, half-pipes or fitness-parkour, seem to match the

attitude towards life of adolescents. They can join in without regularly commitment, there is a culture of informal learning, mostly outdoor.

Some offers of club consulting are now concentrating especially on the age-group of adolescents and – what a surprise – they seem to step back into history and take the "old" *Turn club* into consideration to praise it as a new invention. Obviously, there was no *neat separation* (Reinliche Scheidung,1926), when the culture of *Turnen* had been differentiated from sport, the social engagement in clubs decreased to a teaching of techniques and tactics. Sports clubs of today tie in with the tradition of the 19th century to attract members.

The revival based on the needs of young people in their daily (social) life. There are offers for homework supervision or youth clubs and social engagement as well as different proposals for positive youth development. Sports clubs seem to take over the role of education, however, they do it already – as they are listed in German UNESCO as one out of twenty - in the category of (c) social practices, … , their aim is, to strengthen social bonding, while people come together, self-organized and take part in immaterial forms of culture. The common welfare oriented sports club culture is regarded as an expression of human creativity and cultural diversity, it gains a feeling of identity and is further developed through interaction with its history and environment. (UNESCO) However, if you take the adolescents in focus and their view upon the sports club they regard community, integration and guidance as very important, regularity, competitions and success, further development in sports as more or less important, but still as a benefit. The most important disadvantage or sports clubs are commitment and bindingness, while costs, pressure to perform, monotony and to be other-directed are regarded as rather significant. (Sinus 2020)

Scientific evidence

There is not much research done on the common welfare oriented sports club culture in general. You can find numerous festschrifts of single sports clubs, with a timeline and records and outstanding personalities, and in between the lines sometimes hints to common welfare. Reading such sources, you have to consider, that understanding of history as well as of cultural heritage is changing according to the society interpreting the developments on the base of their living and of their cultural values. To deal with the cultural side of sports or of sports organizations is an important step to foster sustainability. However, this is related to the national cultural heritage. Even though, there might be only a small group of people interested in this approach. Yet, sport is also changing, but globally accepted.

Sports clubs are spread all over the world and e.g. the problem of drop outs in the phase of adolescents is also evident for example in Norway (Lagestad & Sørensen 2018) and Sweden (Jakobsson & Lundvall 2021). So, to focus just this target group in the development of sports culture could have a high relevance for ASPO as well as for the next step concerning the acceptance in the international UNESCO ICH list.

Since at least the educational potential of physical activity, play and sports was distinguished in the 12th report of children and adolescents (*12. Kinder- und Jugendbericht*), the pedagogical importance of sport and physical activity seems to be accepted outside sporting practice and sport sciences also (Neuber 2011, p. 143). But sports clubs are one out of several provider in the field of sport, which is shaped through competition. An immaterial cultural heritage is related to the very culture coming from. While the different sport follow a variety of pedagogical perspectives. So may be the globalized governance of sport helps – looking e.g. to Capoeira – to transport (partly) the idea of immaterial cultural heritage.

Visions for future – a substitute for conclusions

Can the award be part of a creative change not only for sports club culture but also for understanding PE in its multi-perspective? Let´s finally reflect as in a future workshop (The term *future workshop* is closely interrelated with the name of Robert Jungk (1913 – 1992), philosopher, ecologist and futurologist. He criticized missing social and ecological phantasy of power elite. He searched for methods, to achieve a conscious self-determined form of future figuration through civil participation. He assumed, that to solve obtruded problems creative solutions are required. The strategy of future workshops was developed, to act against routine and resignation by phantasy) based on scenario, which reflect divers, may be contrary, but, from an individual point of view relevant developments. They should not be seen as unflexible, but process-oriented and are useful – with the help of expert knowledge – to conduct future appraisal. Finally, scenario help to sharpen the view into future by embedding of feedback-processes (Wopp 1996). In this case that scenario will substitute for some conclusions.

Three scenario of common welfare oriented sports club culture:

1. In 2036 UNESCO cancels the award, because there is no longer volunteer work in Germany.
2. Welfare oriented sports club culture has been integrated in German constitution, regarded as obligatory for a holistic education.

3. Sports clubs are professional led francise-companies with pop-up sportsgrounds. Because they are related to commune, they guarantee ASPO & PA. Cooperation instead of competition.

Three scenarios of education:

1. PE as part of school sports has been eliminated from all German curricula in 2026 due to effects of corona pandemic.
2. (Physical) literacy is regarded essential for life span. Experts, acting on the base of physical youth development, teach an obligatory all-round motoric base training in all settings.
3. Physical education including ASPO are reconstructed on UNESCO base.

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THE INTEGRATION OF MUSCLE STRENGTHENING IN THE IMPROVEMENT OF MUSCULAR AND TECHNICAL PARAMETERS OF YOUNG FOOTBALLERS

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Summary: The study aimed to evaluate the effect of an integrated muscle strengthening program on the improvement of muscular and technical parameters in young football players.

There were two objectives, scientifically to measure the impact of integrated muscle strengthening on young players, and practically to present an educational tool for coaches and students to understand this concept of training. To carry on this research, we proceeded to a development of the 8-week program applied to a sample of 24 well-trained players of the first division under 18 years. The hypotheses put forward, were confirmed through the educational intervention and the results obtained were significant. Our results have increased the importance of strength training integrated into the training of young footballers. The margin progress of the experimental group was significant compared to the control group, and the impact of this concept proved to be positive in the approach to the physical preparation of young footballers. It is recommended to pay attention to the concept of integrated muscle building, with all its technical components.

Keywords: integration, muscle strengthening, improvement, muscular and technical parameters, young footballers.

Introduction

The match is always the goal of training, reflecting the quality of the player and characterizing the efforts made which will serve as a benchmark to guide training (Reilly 1994). Muscle strengthening is an increasingly important place for all serious footballers. It is essential to work on physical parameters, both on impacts and to work on endurance (Bell 2000). The

concept of integration is in fact synonymous with improving physical qualities through the motor skills specific to the activity practiced.

It is a question of making the difference between the purely athletic preparation which, too, can advance the individual, and the * specific football * preparation, which will allow the improvement of the specific qualities which the football player must possess."(Cometti 1993).

Football, being a sport with some physical contact, it is imperative for a high-level player to have a physique capable of absorbing the multiple loads of opponents. Indeed, in a single football match, a player, especially if he plays as a midfielder or a striker, can suffer more than twenty tackles (Dellal 2008). Liveliness will give him confidence in the face of the different loads of his opponents. Liveliness gives the player an explosive power quality, that is, the player can move very quickly on the field.

By following the right weight training program, the player can have a liveliness which can leave much slower defenders in place (Le Gallais 2007). This explosiveness can also allow the player to have a sudden and violent ball strike which can surprise the opposing goalkeeper. Indeed, it allows the player to keep a high level of power throughout the duration of the match. The goal of muscle strengthening training for the footballer is to gain explosiveness and speed, but also to be more solid during contacts, and to win aerial duels, by jumping higher than other footballers (Gorostiaga 2006).

A completely different and completely new approach compared to conventional preparation. It consists in reversing the trends and recommending the parameters of strength and explosiveness as the basis of physical preparation in football (Lambertin 2000). Through this approach, we have allowed ourselves to ask the following main question: Does the optimization of integrated muscle strengthening can be beneficial and contributes to acquire a significant physical potential for the practice of high-level football? And does specific football, muscle strengthening can bring about a significant change in physical potential and the technique of the young footballer without disturbing his harmonious development on the football and physical level?

Our main hypothesis was that the optimization of muscle strengthening and its association with the technical-tactical training of young footballers under the age of 18 can only be beneficial and contribute to the acquisition of significant physical potential in the practice of football. Secondly, the muscle strengthening integrated into the planning of the training has harmful effects on the performance and performance of the young player, that is to say, it is a hindrance to his football development.

Research Objectives. The ambition expected in this research is to know the effects of muscle strengthening integrated into the training of young footballers:

a - From a scientific point of view, try to prove through our experimentation the effectiveness of this approach in the development of parameters of (strength) in young U-18 footballers.

b - However, on a practical level, we will try to orient the coaches and educators of this category as well as the students in STAPS and encourage them to integrate muscle strengthening in their programming in order to achieve their objectives in the training of young Algerian footballers.

It will be devoted to three essential points where we will expose a whole literature which has direct links with our thematic to know at first, the physiological bases of the muscular contraction and the theory of the muscular contraction as well as the maturation at the young football player, while in the second time we will discuss an analysis of football activity and the requirements of football in addition to the distribution efforts in football.

While the third point will be reserved for the analysis of the exercise of muscle strengthening in football and its planning and conduct of the training process and the importance currently occupied by physical preparation integrated into modern training (Cometti 2002).

In the literature on the sport of completion, more and more, we see appearing the notions of the control of the training and the optimization of the training. In the case of the training process, the main part of controlling the training consists above all in checking its adaptation to the ever-changing conditions, with a view to carrying out fundamental training tasks. In planning and managing the training process, it is very useful to logically plan for the future development of the training process and its effects (Abrahams 2013).

Sports theorists admit that when organizing the instruction of players of high-level teams, it is necessary to ensure the operation of a few elements:

- Preventing results and shaping the characteristics of the best athletes and world teams.
- Analysis of physical, technical and tactical preparation while conducting sports combat.
- Definition of the level of mental preparation.
- The development of information which presents the characteristic of the general and specific functional possibilities of the organism of the football player (above all, it is necessary to define the indices of the capacity and the adaptation of the organism to the loads of training).
- Regarding the player's self-improvement″ of knowledge and know-how ″- Knowledge of the level.

- The unity of the training, competition and biological renewal process.

Generally, force, speed, and power form a whole which must tend to approach the conditions encountered in racing. What we are saying is that strength training must be adapted to the race. For middle- and long-distance athletes, it should aim to improve the power and duration of muscle contraction without causing weight gain. The ultimate goal is to improve stride performance in normal conditions as well as in a state of fatigue (Kunz 1991).

Sometimes the three contraction phases - eccentric followed by isometric and concentric - follow each other at such a speed that it becomes impossible to differentiate them. We then speak of Plyometric contraction (Jacques 1997).This type of work of the muscle is particularly interesting because a little like the elastic that one stretches and which recovers by itself, its initial shape (biomechanical sector), it makes it possible to recover the energy stored during the stretching phase (eccentric) for use in the contraction phase (concentric).The consequence is that in plyometrics, the muscle can develop a strength 1.5 to 2 times greater than the maximum isometric force (Legeard 2005).

Methods

In accordance with the aim of the research, it was necessary to accomplish the following tasks:

a) Analysis of the particularities of dynamic training within the experimental group.
b) Determine the effectiveness of this method of improving the parameters of strength or muscle qualities.
c) Compare the results of group 1 and 2.

Participants: Twenty four (24) well-trained players of first division soccer under 18 years were tested. Were followed for 8 weeks (experimental group), one benefited in addition to their weekly training from two integrated weight training sessions lasting 45 minutes, the other group (control group or control group) followed a program without integrated weight training sessions, that is to say ordinary training.

To carry on this study, I took advantage of the practical internship, as part of our first year as a magister to make contact with the coaches and leaders of the club, it is a premeditated choice, or it focused on a population players from the category under 18, the number of which is 24 players, breaks down as follows.

Experimental group: 12 U-18 players "experimental sample" so I was responsible for training during the whole time of the experiment, that is to say 8 weeks.

Control group: 12 U-18 players "control sample" that the coach responsible for the team takes care of separately from the experimental group.

The experiment tests:

[1] Speed (20 m) without Ball (Seconds).

[2] Vertical jump test (Sargent jump test, vertical leap) (centimeters).

[3] The “killy”chair (minutes).

[4] Speed (20 m) with ball (Seconds).

[5] Speed (20m) without Ball and with change of direction (Seconds).

[6] Speed (20 m) with Ball and with change of direction (Seconds).

[7] Ventral sheathing test (minutes).

The implementation process of integrated muscle strengthening training:

a) A quantity of work for our players.

b) An adaptation of the exercises for each.

c) Maximum time for individual coach intervention.

Results

After having exposed the methodology of our study, here are the results of the tests carried out on the two samples (control group and experimental group). In this chapter, we will dissect the results obtained in the Pre-tests and Post-tests, to try to validate the assumptions made in this study. The battery of tests developed for this study made it possible to follow the evolution of the muscular qualities of each player, throughout the experiment, regardless of the group to which they belong to E.G or C.G.

Table 1

The results of the pre-tests of the two groups (E.G and C.G)

	Experimental group		**Control group**		**T Calculated**	**T Board**	**D of F 2N-2**	**Statistical threshold**
	X	S	X	S				
Speed (20 m) without ball	3.75	0 .19	3.73	0.17	2.09	1.71	22	0.05
Vertical jump test	41.83	6.12	37.58	6.33	1.60			
The “killy”chair	2.00	1.05	2.41	1.39	0.67			
Speed (20 m) with ball	4.14	0.03	4.26	0,0006	165			
Speed (20 m) without Ball and with change of direction	7.39	0.32	7.55	0.40	1.05			
Speed (20 m) with Ball and with change of direction	9.75	0.70	10.04	0.58	1.05			
Ventral sheathing test	2.48	0.67	2.66	0.81	0.59			

Legend: E.G: Experimental Group C.G: Control Group

Statistical analysis of the results of the pre-tests represents the data from the tests of the parameters of the strength or muscular qualities (strength-speed, power, explosiveness, strength-endurance) and technics to measure before the intervention experimental, that is to say before the application of the training program, with a statistical threshold of 0.05, a degree of freedom 22, and "t" of Student = 1.71.

We note that the test results are almost identical for the two groups, and the values obtained show that there is no significant difference between the two study groups, and the experiment will confirm or refute us. The assumptions previously made.

Table 2

The results of the post-tests of the two groups (E.G. and C.G.)

	Experimental group		**Control group**		**T Calculated**	**T Board**	**D of F 2N-2**	**Statistical threshold**
	X	S	X	S				
Speed (20 m) without Ball	3.37	0.22	3.75	0.20	4.37	1.71	22	0.05
Vertical jump test	47.83	5.83	40.17	4.80	3.37			
The "killy"chair	3.47	1.23	2.61	1.06	1.75			
Speed (20 m) with ball	3.56	0.25	4.09	0.28	4.68			
Speed (20 m) without ball and with change of direction	6.64	0.23	7.42	0.31	6.75			
Speed (20 m) with ball and with change of direction	8.66	0.66	9.98	0.47	5.40			
Ventral sheathing test	3.43	0.79	2.05	0.65	4.47			

The evolution of the parameters, of the force or muscular qualities at the end of this experiment seems significant, because in the E.G, the driven training shows a significant improvement of the parameters of the force in comparison with the C.G.As mentioned (Bodineau 2007) integrated into global practice, physical preparation can give a dominant work (speed, endurance, muscle strengthening ...) through specific forms (games, duels, exchanges). This approach is tacit in the training of young athletes: they prepare by repeating tactical sequences or technical gesture progressions, however, it is impossible to precisely parameterize the efforts and to define their nature. How to truly develop aerobic power play, speed or strength in random opposition situations dependent on technical-tactical responses"

Comparative analysis of the two groups shows that in pre-tests, they perform similarly, except for almost all the tests. On the other hand, in post-tests, the experimental group differs

from the control group with statistically superior performances for the tests (Speed 20 m without ball, Speed 20 m with ball, 20 m without ball and with change of direction).

Table 3

The results of the pre-tests and post-tests of the experimental group

	Experimental group				**T Calcula-ted**	**T Board**	**D of F N-1**	**Statistical threshold**	**Meaning statistical**
	pré-tests		post-tests						
	X	S	X	S					
Speed (20 m) without Ball	3.75	0 .19	3 .37	0.22	5.06	1.79	11	0.05	Significant
Vertical jump test	41.83	6.12	47.83	5.83	7.71				Significant
The “killy”chair	2.00	1.05	3.47	1.23	6.08				Significant
Speed (20 m) with ball	4.14	0.03	3.56	0.25	9.62				Significant
Speed (20 m) without Ball and with change of direction	7.39	0.32	6.64	0.23	8.05				Significant
Speed (20 m) with Ball and with change of direction	9.75	0.70	8.66	0.66	9.66				Significant
Ventral sheathing test	2.48	0.67	3.43	0.79	13.51				Significant

Discussion

If we notice the results of the pre-tests and post-tests obtained from the E.G., we observe significant improvements in the parameters of the force. What confirms us in our experimental approach, in the sense that a training of muscle strengthening integrated into football training is likely to bring considerable improvements to the physical qualities necessary for good performance as demonstrated (Lambertin 2000). It is the improvement of the physiological potentials of the player in close relation with the motor skills of football activity (Lloyd 2013), show that strength training followed by endurance training allows better development of the strength than in reverse order. So it is all about planning strength training first, then training to develop aerobic capacity.

Whereas (Taelman 2003) suggests also integrating the physiological, technical and tactical parameters of football activity. In fact the player, through the phenomenon of transfers, will benefit from the development of a particular quality to improve other qualities essential in the practice of football. The observations established between the pre-tests and post-tests are confirmed by the study with a significant improvement for most of the tests carried.

By comparing the results obtained by the two groups, we can affirm that the integration of specific muscle strengthening exercises in football training was beneficial for the experimental group. Indeed, we note in the latter significant improvements for the majority of the tests (T calculated, T table 1.79, $p < 0.005$). Improvement of parameters of strength or muscular qualities. These results support certain longitudinal studies in team sports which have also found muscle improvements following specific training (Cometti 2014). Gorostiaga et al. studied the effect of physical preparation on the performance of a male team. The same research team lingered in 2008 on a female team (Gorostiaga 2006).

Conclusion

The development of strength and explosiveness is at the heart of modern physical preparation, and more particularly in a discipline such as football, muscle development is an essential component of training because it allows you to run faster, jump higher, throw harder and dominate your opponent in duels. When you do not integrate the muscle strengthening work into the workouts scheduled for the week, as Carpinelli mentions (Carpinelli 2004), it is rare for the coach to sacrifice time for muscle development. However, it appears that relatively short work, limited in series of effort and not very restrictive, has certain effectiveness". Without good aerobic skills the player has trouble recovering, not only during the match, as a result the defensive folds that the player did while trotting in the first half he makes them by walking in second Half time, which is prejudicial to tactical replacement and in my eyes it is as important as good explosiveness, but also during the work week and the season (Leroux 2006).

In another way the muscle strengthening integrated into the training of young footballers gives significant results and considerably improves the muscular qualities and consequently the physical qualities necessary in the practice of football and contributes to prepare the young player to approach the higher category in all serenity and confidence.

Determining the impact of integrated muscle strengthening on performance among young footballers was our initial ambition. At the end of this work, what assessment can we make?

The aim of this study was to observe and analyse a training process for young Algerian U-18 footballers from standard training sessions and/or exercises (weight training, muscle strengthening and plyometric). The purpose of this analysis was to quantify and qualify the activity of the footballer during a preparation cycle, our study made it possible to determine the specific training of the footballer and the differences that characterize it (Guillaume & Perrey

2005). Some coaches recommend strength training before the season exclusively in the room. These training sessions consist of general and standard muscle building exercises where all disciplines come together, because they would allow a physical effort almost identical to that of physical exercises specific to football. However, these integrated weight training exercises have greater variability than that of indoor exercises (Gaillaud 2010). This form of work does not allow rigorous control of the activity of young players. Thus, in accordance with the training objectives, the trainer will have to choose between conventional controlled physical training (indoor exercises) and an integrated physical training (integrated muscle building) more difficult to control (muscle building exercises integrated into specific training soccer). It has been shown that even in an activity with a strong technical component; physical preparation can be useful, either to reduce the intensity relative to the execution of a given exercise, or to give an additional capacity, which allows the sportsman high level to achieve better performance in physical, energetic, technical and tactical terms (Legeard 2005).

In the field of muscle strengthening, Gilles Cometti recommends chaining in the same session and even alternating between each series the general and specific exercises (Cometti 2014), in order to transfer the physical skills to the technical level. We can also link in the training program a period of strength development and a period of technical work. Integrating a physical component into football training. The transfer will be done directly on the field with specific instructions. The integration of these new athletic qualities of play activities which are complex (also called quality transfer) and primarily on the integration of physical qualities acquired in specific skills to alleviate the problem mentioned above, but in this case the time spent in search of the athletic gain will be less and the athletic gain will be much longer to obtain but on the other hand the specific performance gain will be faster (Hassman & Kentta 1999). In training practices, this category of exercises is often a missing link detrimental to the progress of young players. Is it possible, if not desirable, to want to simultaneously develop non-specific and specific physical qualities (Daniel Le Gallais 2007)?

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TRUNK ROTATIONAL POWER IN FEMALE AND MALE ATHLETES OF GYMNASTICS AND DANCE SPORTS

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Summary. This study investigates between-gender differences in trunk rotational power produced at various loads in athletes of gymnastic and dance sports. A group of 24 female and 15 male competitive aerobic and acrobatic gymnasts, ballroom and rock & roll dancers completed two trials of standing trunk rotations at each side with a barbell of different weights (increasing from 1 kg by ~5 kg up to max. of 20 kg) placed on their shoulders. The power produced during trunk rotations was evaluated using the FiTRO Torso Premium. Results showed significantly higher mean power in the acceleration phase of trunk rotations in male than female athletes at loads of 10.5 kg (206.8 ± 22.0 W and 165.4 ± 17.8 W respectively, $p = 0.033$), 15.5 kg (231.8 ± 27.5 W and 155.6 ± 24.4 W respectively, $p = 0.001$) and 20 kg (196.9 ± 25.3 W and 111.4 ± 20.9 W respectively, $p = 0.001$). Similar significant between-gender differences for angular velocity at weights ≥10.5 kg were observed. Alternatively, power and force were greater at lower velocities in male than female athletes. However, some females were able to produce slightly greater power and force at higher velocities in spite of their lower values at lower velocities when compared to males. This may be ascribed to both the genetic predispositions and the specificity of their acrobatic and dance elements including trunk rotations at various velocities under different load conditions.

Key words: aerobic and acrobatic gymnasts, ballroom dancers, mean power, rock & roll dancers, trunk rotations

Introduction

Core muscle strength plays a significant role in transfering torques and momentum throughout the kinetic chain to the extremities (Shinkle et al. 2012). For instance, effective execution of the golf swing or tennis stroke requires both high limb movement speed and great power production during trunk rotations. Trunk extensors, flexors, rotators, and lateral bend agonists are active throughout the stroke in baseball and tennis as well as the golf swing. All trunk muscles are relatively active during the acceleration phase of the golf swing with the trail-side abdominal oblique muscles showing the highest level of activity (Watkins et al. 1996).

Actually, mean values of power and velocity in the acceleration phase of trunk rotation have been found to be sensitive parameters able to identify group and individual differences (Zemková et al. 2013; Zemková et al. 2014). More specifically, mean power produced with the weight of 20 kg was significantly higher in tennis players than golfers, in rock & roll dancers than ballroom dancers, and in judoists than wrestlers. Comparison of power outputs between individuals showed higher values in ice-hockey player than in karate competitor, in canoeist than in rower, and in weightlifter than in bodybuilder. Furthermore, mean velocity in the acceleration phase of trunk rotation with the weight of 1 kg was significantly higher in tennis players than in golfers. However, its values did not differ significantly between these groups when the weight of 20 kg was used. Significantly higher mean velocity in the acceleration phase of trunk rotation with weights of 1 kg and 20 kg was found in rock & roll dancers as compared to ballroom dancers. On the other hand, there were no significant differences in mean velocity in the acceleration phase of trunk rotation between judoists and wrestlers with weights of 1 kg and 20 kg. There were also individual differences between athletes in mean velocity in the acceleration phase of trunk rotation with weights of 1 kg and 20 kg, i.e. higher values in ice-hockey player than in karate competitor, in canoeist than in rower, and in weightlifter than in bodybuilder.

A comparison of trunk rotational velocity at lower and higher weights (1 kg and 20 kg) in athletes of various sports exercising under different loading conditions revealed significant within and between-group differences (Zemková et al. 2017). Mean velocity in the acceleration phase of trunk rotation with a weight of 1 kg was the highest in ice-hockey players, followed by canoeists, rock & roll dancers, judoists, wrestlers, tennis players, karateists, golfers, and then ballroom dancers. Its values produced during trunk rotations with a weight of 20 kg were the highest in canoeists, followed by ice-hockey players, rock & roll dancers, judoists, wrestlers, tennis players, golfers, karateists, and then ballroom dancers. These findings indicate that such

an assessment of trunk rotational velocity is sensitive in discriminating of athletes of different sports. However, the additional load does not contribute to better differentiation between these groups of athletes.

The question remained as to whether different loads enable better discrimination of athletes. Indeed, sport-specific differences in power-velocity-force profiling during trunk rotations were revealed at loads ≥10.5 kg (Zemková et al. 2020). The highest power is produced by combat sports athletes (boxing, thai boxing, karate, tae kwon do) with a maximum achieved at 10.5 kg, followed by water sports athletes (canoeing, kayaking) with a maximum at 20.0 kg, grappling sports athletes (judo, wrestling) with a maximum at 15.5 kg, and ball sports athletes (golf, hockey, tennis) with a maximum at 10.5 kg (Zemková et al. 2020). Additionally, angular velocity is the highest at lower weights in combat sports athletes and at higher weights in water sports athletes. Alternatively, the highest force is achieved at higher velocities in combat sports athletes and at lower velocities in water sports athletes.

Since body rotations represent one of the essential elements of performance also in athletes of gymnastic and dance sports, we were interested in whether between-gender differences exist in trunk rotational power under various load conditions (Zemková et al. 2022). This study compared power, velocity and force produced during trunk rotations at different weight in female and male aerobic and acrobatic gymnasts, ballroom and rock & roll dancers.

Methods

Participants

Groups of female (n = 24, age 20.1 ± 1.7 years, height 168.5 ± 6.8 cm, body mass 57.5 ± 5.8 kg) and male (n = 15, age 23.1 ± 2.7 years, height 177.9 ± 9.7 cm, body mass 78.3 ± 11.2 kg) competitive aerobic and acrobatic gymnasts, ballroom and rock & roll dancers volunteered to participate in the study. Athletes were all active in particular sports. They were included in the study only if they did not subjectively report back pain. Individuals who had previously undergone surgery or other medically invasive procedures for low back problems were excluded from participation in the study. All of them were informed of the main purpose of the study and related procedures. The procedures followed were in accordance with the ethical standards on human experimentation stated in compliance with the 1964 Helsinki Declaration and its later amendments.

Experimental design

Participants were asked to avoid high intense exercise preceding and during the study. Prior to testing, they were given a demonstration of the proper technique of trunk rotations. The time of day and testing procedures were identical for all participants. The same researchers conducted the testing in all groups. After a warm-up, participants underwent familiarization trials, during which they performed standing rotations of the trunk in a slow and controlled manner while keeping the back straight. Then they performed two repetitions of trunk rotations to each side per load. Bars of different weights were placed on their shoulders behind the neck. The load increased from 1 kg by ~5 kg up to max. of 20 kg. They were asked to perform rotations of the trunk with maximal effort in the acceleration phase. Emphasis was placed on the correct body position during trunk rotations while standing. Participants stood with their feet wider than shoulder width apart and toes slightly pointed outwards while holding the bar on the shoulders with their hands. They rotated their torso from the right (or the left) side towards the opposite side, and then they slowly returned to the starting position. The test was then repeated for the opposite side of the body. They had to engage their core muscles to stiffen the torso and stabilize the spine. A laboratory assistant ensured that participants remained upright throughout the movement and that their head, chest and torso were aligned over the hips. During rotational movement of the trunk with a bar over the shoulders, torque has to be produced to accelerate or decelerate mass on both sides of the bar axis. At the same time, centrifugal forces arise. As long as the weights on both sides of the bar, as well as their rotation radii, remain the same, arising centrifugal forces will be of the same magnitude, although acting in opposite directions. This means they will be fully compensated without putting any stress on the trunk of the subject. In order to quantify the torque produced to accelerate (or decelerate) a rotating bar, one needs to know the mass of the bar and its rotation radius (distance between the center of gravity of rotating masses and the axis of rotation) and instant acceleration. Calculation of the center of gravity of the total rotating masses on both sides (consisting of the bar axis and weight plates) is based on their geometrical dimensions, assuming the same specific mass of the material (iron) used for the bar axis and weight plates. As the rotation radius and masses are set prior to the test, acceleration depends on the subject's effort. For registration of acceleration, the FiTRO Torso Premium (FiTRONiC, Bratislava, Slovakia) was applied. The equipment consists of an inertia measurement unit (a combination of a three-axis accelerometer and three-axis gyroscope) in a small box with an integrated USB interface connected to the computer. While inserted in the bar axis, the inertia measurement unit registers instant angular velocity of rotation movement (rad per second), which is sampled by the computer at a rate of

100 Hz. Special software calculates instant angular acceleration as a derivation of angular velocity. Radius of rotation (the distance between the center of gravity and the axis of rotation) was used for the transformation of angular velocity (rad per second) and angular acceleration (rad per second squared) into real velocity in meters per second and real acceleration in meters per second squared. Torque produced to accelerate or decelerate rotation movement is calculated by multiplying the moment of inertia and the angular acceleration. This is determined by Newton's second law of motion where the force is equated to the product of the mass times the acceleration. Then the power is calculated as the product of force times velocity.

Statistical analysis

The statistical program SPSS for Windows, version 18.0, (SPSS, Inc., Chicago, IL, USA) was used for data analysis. A paired *t*-test was utilized to determine the statistical significance of the differences between mean power in the acceleration phase of trunk rotations in female and male aerobic and acrobatic gymnasts, ballroom dancers, and rock & roll dancers at different weights (1 kg, 5.5 kg, 10.5 kg, 15.5 kg, and 20 kg). The significance level was set at $p < 0.05$. Data is presented as means and standard deviations.

Results

Mean power in the acceleration phase of trunk rotations was significantly higher in male than female athletes at loads of 10.5 kg (206.8 ± 22.0 W and 165.4 ± 17.8 W respectively, $p = 0.033$), 15.5 kg (231.8 ± 27.5 W and 155.6 ± 24.4 W respectively, $p = 0.001$) and 20 kg (196.9 ± 25.3 W and 111.4 ± 20.9 W respectively, $p = 0.001$) (Figure 1 a). Similar significant between-gender differences for angular velocity at weights ≥10.5 kg were observed. Alternatively, power and force were greater at lower velocities in male than female athletes (Figure 1 b, c). However, some females were able to produce slightly greater power and force at higher velocities in spite of their lower values at lower velocities when compared to males. Power produced during trunk rotations at different load showed similar trend also when data of each group, such as acrobatic gymnasts (Figure 2 a), ballroom dancers (Figure 2 b), and rock & roll dancers (Figure 2 c), were analysed.

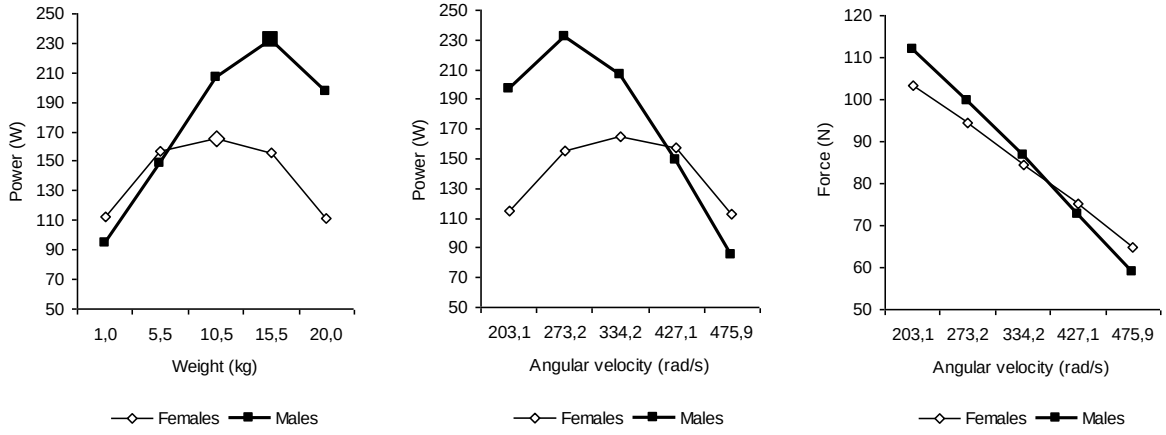

Figure 1

Mean power in the acceleration phase of trunk rotations at different weights (a), power produced during trunk rotations at different velocies (b), and force produced during trunk rotations at different velocies (c) in a group of female and male athletes of gymnastic and dance sports

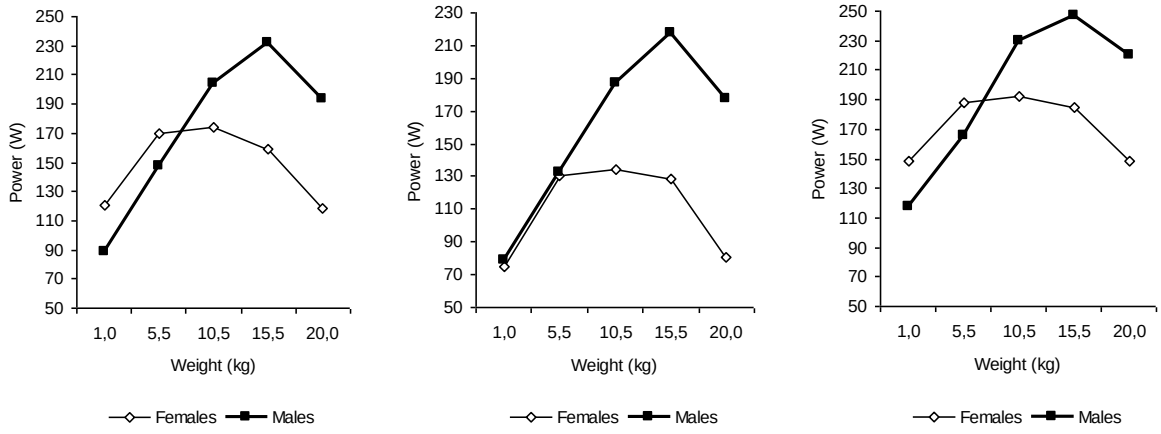

Figure 2

Mean power in the acceleration phase of trunk rotations at different weights in female and male acrobatic gymnasts (a), female and male ballroom dancers (b), and female and male rock & roll dancers (c)

Discussion

Trunk rotational power and velocity were found to be significantly higher in male than female athletes at weights ≥10.5 kg. Alternatively, power and force were significantly higher at lower velocities in male than female athletes. However, some females were able to produce slightly greater power and force at higher velocities in spite of their lower values at lower velocities when compared to males. These between-gender differences in trunk rotational power and velocity may be attributed to specificity of training involving trunk movements of different velocities under different loading conditions. Male athletes need to exert high forces of upper

and lower body in order to lift female counterparts and perform repetitive rotational movements of the trunk.

Core stability and strength represent an integral part of athlete performance in sports based on lifting tasks and trunk rotations, such as rock & roll dancing, gymnastics, aerobic and ballroom dancing. However, in comparison with team sports (e.g., baseball, cricket, football, hockey, netball, soccer, tennis), this is one of a few studies involving athletes of gymnastic and dance sports. There is a lack of research investigating the relationship of body balance and stability of the core with sport-specific performance (Zemková & Zapletalová 2022).

The importance of the core musculature was demonstrated for various tasks, for instance golf swing (Watkins et al. 1996), tennis forehand and backhand strokes (Ellenbecker & Roetert 2004), and baseball pitched ball velocity (Stodden et al. 2001; Aguinaldo et al. 2007). Throwing velocity correlates also with lateral to medial jumps in baseball players (Lehman et al. 2013). Similarly, there is a high correlation between handball-throwing speed and throwing performance with a light but not with a heavy medicine ball (Rivilla-Garcia et al. 2011). However, there is a small shared variance of the scoop medicine ball throw with baseball fielding (agility T-test, standing long jump, and throwing distance) when compared to batting (Kohmura et al. 2008). Also the association of throwing velocity with muscle power highlights its importance for performance in cricket players (Freeston et al. 2016). However, Talukdar et al. (2015) suggests that power obtained from the chop and lift exercise is not an important contributor to throwing velocity in cricket. It seems that general tests have limited applications in testing the specific throwing performance (Rivilla-Garcia et al. 2011).

The demands of joints and muscles proximal and distal to the core in the kinetic chain is necessary to take into account when assessing core muscle strength. The core musculature plays an important role in the transfer of torques and momentum throughout the kinetic chain during sports performance. However, among studies investigating the core stability and core strength in sport, only few of them analyzed force–velocity–power characteristics of exercises involving the use of core muscles (Zemková 2022). Most of them evaluated maximal strengh and endurance of core muscles under isometric and isokinetic conditions. Assessing muscle power during movements involving the use of core muscles close to sport-specific conditions would be more sensitive in revealing within- and between-group differences as well as the efficiency of training programs. For instance, a significant increase of power in the acceleration phase of trunk rotations was observed after both preparatory (at weights from 10 to 26 kg) and competitive training periods (at weights from 6 to 26 kg) in tennis players (Poór & Zemková 2018). Mean power significantly increased also in ice-hockey players after the preparatory (at

weights ≥12 kg) but not after the competitive period (Poór & Zemková 2018). Likewise its values significantly increased in canoeists after the preparatory period only (at weights ≥10 kg) (Poór & Zemková 2018). Similar pre-post training changes were also found for peak values of power (Poór & Zemková 2018). This indicates that muscle power obtained during trunk rotations is able to reflect their training specificity. It also provides useful information for designing training programs aimed at improvements of trunk rotational power under loading conditions. However, further studies are needed to investigate the association of trunk rotational power and velocity with performance variables in athletes of gymnastic and dance sports, as well as their changes during different periods of training.

Conclusion

While the highest power in males is produced at a higher weight of 15.5 kg (in few of them at 20 kg), females are able to generate the highest power at a lower weight of 10.5 kg (or at higher velocities). This may be ascribed to both the genetic predispositions and the specificity of their acrobatic and dance elements including trunk rotations at various velocities under different load conditions.

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PARTICIPATION AND YOUTH SPORT COACHING GOOD PRACTICE - AN OVERVIEW AND REFLECTION OF THE ACTIVE SUSSEX COACH SUPPORT OFFICERS SCHEME

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Summary. In order to meet a wide variety of social policy objectives (such as health, educational attainment, community cohesion etc.), ensuring wide access to community and youth sport programmes remains an objective of many governments. In the UK, the post 2012 Olympic Legacy Strategy, overseen by Active Partnerships under the auspices of Sport England, promoted Sportivate and Satellite Clubs programmes (aimed at increasing participation levels) through most of the rest of the decade. In order to ensure minimum standards of operation and to develop the skills of the local coaching workforce, Active Sussex (one of the Active Partnerships) commenced a Coach Support Officer (CSO) scheme with the support of the University of Chichester from 2013 to (through various iterations) time of writing. Through a longitudinal reflection/summary of the various interventions and data collection points over the last nine years, we present an overview of this scheme. Further, we outline a clear philosophy, guidelines, and accompanying set of values that extol what can be considered good (best) practice for sustainable community sport and physical activity programmes.

Key Words: Community programmes, participation sport, coaching, mentoring, interpersonal skills

Introduction

Whilst there is an international viewpoint to take account of, the UK perspective and history of using sport to address non-sport objectives has a long history. From the key recommendations (principally to start the then Sports Advisory Council in 1965) and explicit reference to using the institution of sport to engage with social problems within the 1960 *Sport*

and the Community - Wolfenden Report (Central Council of Physical Recreation [CCPR], 1960), to the creation of sport development officers through the 1980s 'Action Sport' schemes (after that time period's urban unrest and riots that addressed unemployment and disillusionment within inner cities) and beyond, the UK has championed the instrumentalist possibility of sport within communities (Bloyce & Smith 2009).

Currently then, while definitions of the role, function, and quality of sports coaching are oftentimes aligned to ideas of skilled and competitive performance, there is also a growing use of sports coaches within a variety of projects that advocate the use of sport to address non-sport policy objectives. These community sports coaches, ones that sit outside of traditional youth and recreational sport objectives that still prioritise better performance, oftentimes focus on outcomes that emphasise community regeneration, raising aspirations, improving health, and developing life skills (Pierce et al. 2018).

However, despite a growing body of work (i.e. Bradbury & Kay 2008; Ikramullah et al. 2018**),** there are still questions related to the different levels of coaching knowledge, expertise, and experience necessary to deliver sport in community type settings (Crisp 2020a). In light of this, this paper seeks to contribute to good (best) practice within this field by presenting an overview/reflection of the fundamental community coaching principles and recommendations that have arisen through a partnership project between the University of Chichester and the Active Sussex Active Partnership (AP - although at the commencement of the partnership it was called a County Sport Partnership - CSP) – APs are sub-regional/local agencies under the stewardship of Sport England, Active Sussex is the AP for Sussex. APs were previously known as County Sport Partnerships (CSPs) until 2017/18).

This partnership entailed developing coach support systems for community sport projects over a nine-year period, and the paper operates as an aggregation of various incidences of data collection, synthesis, and resultant findings and recommendations, as well as a wider, overlapping narrative that summarises how the project ran and (presented in broad guidelines) the implications and recommendations for community coaching practice.

Community Sport Coaching, Increased Participation, and Sport England Funding

In the UK, the explicit use of the term community sports coaches gathered pace within the early 2000's with the provision, after the 2002 *Coaching Task Force report,* (Department for Culture, Media and Sport [DCMS], 2002), of funding for 3,000 posts using this umbrella term. The *Coaching Task Force report* recommended that each National Governing Body (NGB) were to appoint a Director of Coach Education, that each CSP should also 'house' regional Coach Development Officers to be appointed, and that 3,000 'paid' coaching roles

were to be created, all through a three year £30m investment. Designed to increase the number of people delivering coaching sessions, and subsequent participation numbers, the use of (and funding for) the community sports coaches continued under the then Labour government, which was particularly apt given their public service agreements that asked for five hours of sport per week for young people (Bloyce & Smith 2010). However, with the world economic crisis in 2008 and the subsequent impact of austerity measures imposed on various services after the election of the Conservative - Liberal Coalition government in 2010, community sport funding was reduced (Parnell et al. 2017).

However, overlapping the transition period of the two governments, the Sport Unlimited scheme (funded by Sport England between 2008 and 2011) sought to bring together school and community sport through using hybrid type sports and/or unconventional settings for ten-week programmes/sessions that focused on motivating young people towards longer-term participation in sport and physical activity. And the Coalition government's commitment to the Olympic legacy programme ensured that Sportivate, a lottery funded successor to the Sport Unlimited programme (in that short projects of six to eight weeks for young people were funded) that ran between 2011 and 2017, and Satellite Club Projects (clubs run as 'extensions' of existing sports clubs/organisations, normally within educational settings and focusing on improving grass roots participation), running from 2013 to date. Both of these projects were and are, respectively, managed and distributed by the AP network, and this sets the scene and context for the last nine (and counting) years' working relationship between the University of Chichester and Active Sussex. What follows next is an overview of the work undertaken in this partnership, outlined in part to set the context within which the paper operates, but also, importantly, to provide a lasting record of the projects and impacts for future reference.

Active Sussex, Participation Sport, and the Coach Support Officer (CSO) Scheme

The authors of the present paper, Philippe Crisp (University of Chichester) and Anthony Statham (Head of Operations [although his title would have been Sports Development Manager for most of the time of the CSO schemes] for Active Sussex,) are the principal architects behind the relationship/partnership between the University of Chichester and Active Sussex having started the 'project' and continuing to time of writing. The beginning of the 'project' started in 2011 with planning and an agreement to research and develop local coaching matters, and in 2012 several forums/workshops with local NGB officers and Local Authority Sport leaders were held. These focused on exploring local issues related to community & participation coaching, how to develop and retain coaches, reflecting on the effectiveness of existing coach deployment, and identifying coach needs and requirements for community programmes and

participation sport. The results of these forums and workshops were disseminated to the attendees and made available as an online resource (see Crisp & Statham 2012). This initial 'scoping' of the local workforce and their needs was followed, in later 2012, by research investigating the impact of a coach bursary fund on recipients' coaching practice (see Crisp 2013a). One of the central recommendations in the ensuing report was that a coach mentoring strategy/project, led by the then CSP (now AP), would be valuable in terms of ensuring good practice and a more effective, local, coaching workforce. Given the AP's responsibility of overseeing significant funding for Sportivate projects in the region, with a wide variety of coaches, these recommendations directly led to the development of a county wide mentoring scheme that would support Sportivate projects.

This CSO scheme started in early 2013 with the recruitment (and subsequent training) of six coaches/practitioners who were highly experienced in the fields of participation, community, and youth sport (alongside other specialisms). A number of Sportivate projects were then allocated to each of them, and each CSO then contacted and met with the individual project leads and a number of site visits were undertaken from which advisory feedback in terms of delivery, execution, and occasionally how best the Sportivate projects could be established was given. Formative feedback then, and inevitably centred on coach needs, requirements, and good practice for community and participation coaching, particularly in terms of youth, disability, and young adult participation. In terms of national policy and recognition, the Child Protection in Sport Unit (CPSU - The CPSU is part of the National Society for the Prevention of Cruelty to Children (NSPCC), the UK's leading children's charity that works with the government to strengthen the rights, through policy and legislation, of children) overviewed the CSO system as a good-practice example – in terms of monitoring and safeguarding requirements (CPSU 2013). Moreover, the programme was well received at the October 2014 CSP Coaching Conference and, following this, over the next few years 12 CSPs implemented (or intended to) similar schemes. Of particular interest from the (then called) CSPs at the conference was how an effective mentoring scheme could be implemented within an informal community setting, as the impression (from the CSP attendees) that existing mentoring schemes tended to be focused and aligned more to NGB schemes that operated in a more traditional (sport specific, oftentimes performance related) environment.

For the Active Sussex CSO scheme, these site visits continued in this fashion until end of 2016, and also incorporated overseeing online communities of practice as well as supporting a talent foundation programme. In 2017, the CSO project shifted priorities to a) ensure that Sportivate and Satellite Clubs projects under the remit of the AP were representing the

necessary requirements for safeguarding and b) collect data on other key participation coaching principles. In 2018, in part due to cost-cutting measures and economising under further reductions in community sport spend from the UK government, there was a shift to inhouse (full time members of staff at the AP) quality assurance of ongoing satellite projects, although there was also a move to ensure that CSO external/self-sufficient communities of practice continued. Throughout 2019 and, despite complications resulting from continuing project work through various lockdowns held to suppress Covid-19, at time of writing, the first and second authors of the paper are developing a new mentoring project looking to support coaches and leaders who focus on increasing activity levels within a region of the AP.

Youth and participation sport - good practice

There are a number of existing models and frameworks that highlight good practice for youth and participation sport, such as those seen in the work of Martinek and Hellison (1997), Nichols (2007), Bradbury and Kay (2008), and Vierimaa et al. (2017). In sum, this kind of research and their findings advocate, broadly, a focus on encouragement, developing supportive adult relationships, empowering the participants, and inclusivity. However, the CSO scheme and the nine-year partnership between the University of Chichester and Active Sussex project that this paper outlines, also helps synthesise a range of interventions that have taken place over the long-term. As practitioners, with significant field experience, we believe we have, in some ways considering the importance of good practice within youth and community sport, a duty of care to share what we consider to be meaningful data, interpretations, and recommendations, that could contribute to socially worthy youth and community sport practice and objectives.

Indeed, and whilst this paper does not operate in a standard study fashion (it does not use a standard literature review, and takes a reflective, archival stance), there is a dearth of literature available relative on how to effectively support projects operating within short timespans, with short lead in times, and with (at times) limited expertise due to a reliance on underdeveloped (at times volunteers, and other times with newly qualified staff) coaches as a consequence of the sector. It is in this context then, that the purpose of our paper (to review the various actions, programmes, and interventions which constitute/have constituted the CSO scheme) is located. As such, the findings, recommendations, and implications for community coaches from this project are hoped to contribute to the body of work representing participation and youth sport.

Methodology

As stated previously, this paper operates as a overview/reflection of various interventions and data collection points, focusing on fundamental community coaching principles, over a nine-year partnership between the University of Chichester and Active Sussex. In this respect, the method for this paper can be summarised as a longitudinal reflection/summary using an aggregation of a range of data from the following: forums/workshops undertaken with NGB leads; a research report/project on a coaching bursary project; a comprehensive research report detailing the impact of one year of Sportivate projects for the county; the three year period (and consistent training and reflection within) whereby the CSO scheme directly oversaw/complimented the delivery of circa £ 600,000 of investment and approximately 500 completed projects; the feedback received from a further round of Sportivate projects that were assessed and supported; and, at time of writing, a new mentoring scheme supporting the development of coaches and leaders focused on activity levels within a region of the AP. In essence then, through focusing on experience over time and using a variety of data collection types and methods, this research took on a longitudinal qualitative research (LQR) approach (Calman et al. 2013; Sheard & Marsh 2019). However, the research approach also sits well within the context of action research guidelines, given that this method (action research) typically uses a critically reflective approach, and explicitly focuses on improving understanding, practitioner competence, and professional practice (Somekh 2005; Thomas 2013). This combined LQR/action research stance then, whilst essentially an effort to express the essential features related to youth and participation coaching practice that the last nine years of the partnership established, was designed to ensure that the aims of the partnership (to support coaching requirements and develop skills relative to the fields of youth, community and participation through coach support systems) could be encapsulated succinctly. In more detail, the various interventions/data collection points that were reflected upon and analysed for this paper are outlined below:

Forums/workshops undertaken with NGB Leads

At the beginning of the partnership two forums/workshops were held with NGB, Local Authority, and local University leads within the area (13 in total including representatives from cricket, football, netball, basketball, badminton, and angling). These forums/workshops were led by the first and second author, and centred on what the participants felt was generalised coaching practice, excellent coaching within different contexts, and how learning could be enhanced by experience and different environments.

Coaching Bursary Project

Between 2011 and 2012, an Active Sussex Coaching Bursary sought to increase participation for young people by providing 75 % funding support towards NGB coaching qualifications, with recipients of the award asked to coach a number of weeks to determine eligibility. To help understand the impact of the bursary on these coaches, the first author undertook a qualitative research report with a number of the coaches (Crisp 2013a)

2013-2016 CSO Support System

In response to the recommendations within the Active Sussex Coaching Bursary report (Crisp 2013a), a coach mentoring strategy led by the then CSP (now AP) was created to help develop a more effective local coaching workforce for funded Sportivate projects. These three years consisted of a process of continual training, mentoring, and evaluations for both the mentees (the local coaching workforce) and the mentees (the CSOs). As part of this system and to ensure a consistent approach was undertaken and that monitoring and evaluation could continue to take place, the CSOs continued to meet as a group with the first and second author on a regular basis over the time period.

2015 – One-Year Impact Report: 'Sportivate - best practice and support: An Active Sussex case study'

During the time period of the delivery of the CSO system, a research report, *Sportivate - best practice and support: An Active Sussex case study* (Sims & Crisp 2015), was undertaken to ascertain good practice for Sportivate projects and the CSO system. The research report used a range of data accrued from April 2013 to March 2014. A mixed method approach was undertaken, including surveys, case studies, the statistical data that the projects had to provide, and data from meeting notes and focus groups. In the one-year timeframe, 221 projects were planned, of which 176 were implemented and completed, and 4080 individual participants attended projects.

2017 CSO Project Analysis and Data Collection

In 2016 and 2017 the CSO scheme shifted priorities (in part due to economies), and the CSOs oversaw online Communities of Practice and supported a talent foundation programme. The scheme also continued to visit Sportivate and Satellite Clubs projects to collect data and ensure minimum standards of operation. Much of this last element of data collection took place between April and July 2017, with over 30 site visits (with the first author undertaking 12 visits and the second author undertaking nine visits). These visits sought to extend and reinforce existing knowledge of the local coaching workforce, and also extended to mirror the principles

of safeguarding and quality assurance. The data collection and analysis helped shape annual responses to Sport England requests for data from the AP.

2019 + Active Workforce Development

At time of writing, although interrupted by the impact of Covid-19 on sport participation and sport workforces, the first and second author are overseeing a new mentoring scheme focused the development of coaches and leaders who prioritise increasing activity levels within a region of the AP. Several meetings and a group workshop have already taken place, and local sport development officers in the targeted region are currently continuing with the project initiative. For the present paper, the data generated from all of these interventions/data collection points and their subsequent results, findings, and recommendations was aggregated and analysed as a whole. This was undertaken in a narrative/reflective fashion (allowing a broad perspective to be given), and a determination of the key points, fundamental principles, and core messages regarding good (best) practice over the last nine years were summarised. Throughout the data analysis and chronicling of the cumulative points of reference and interventions, three broad themes were generally highlighted as the key qualities that provide a strong foundation to community sport work. These were, respectively: *Communication and Interpersonal Skills*; *Practical Delivery: Novel and not necessarily competitive;* and *Support, empowerment, and accelerated mentoring opportunities*, and they are presented in the next section.

Results

As a reminder, the purpose of the partnership between the University of Chichester and Active Sussex was to support local youth, community, and participation coaching requirements through coach support systems, and this paper looks to outline what the partnership highlighted as fundamental principles and recommendations for community sport coaching. The three broad themes related to these areas found throughout the various interventions/data collection points are discussed below.

Communication and Interpersonal Skills

A central element within all of the various interventions that took place over the nine-year period was the emphasis placed upon the importance of communication and interpersonal skills for coaches. All of the interventions, analysis, and their subsequent recommendations outlined the importance of communication. In the context of community coaching, this oftentimes centred on how coaches should interact with others (e.g. eye contact), establish

guidelines for discipline, the value of engagement, and how to react to differences between values, beliefs and behaviours in order to avoid miscommunication and misunderstandings (and even conflict resolution). This is illustrated by some of the key recommendations that arose from the first forums and that were subsequently embedded into the CSO scheme, that emphasised that 'Coaches needed excellent communication skills and also needed to be demonstrably enthusiastic in order to enthuse and engage those participating in the sessions' (Crisp & Statham 2012, p. 21).

Indeed, consistent feedback throughout the entirety of the CSO scheme called for coaches to work with and listen to their participants and, in order to maximise efficiency, emphasise verbal and nonverbal communication skills when working on projects. This kind of communication and understanding was considered necessary for positive interaction and, crucial to project success, the ability to motivate participants. Effective communication then, was called for throughout the projects.

Yet whilst it is evident that the necessity and impact of positive communication skills are found throughout the academic literature pertaining to sports coaching (i.e. see Lyle 2002; Jones 2006; and Robinson 2010), in the present paper, some elements were extended. In particular, the *2015 – one-year impact report* highlighted the importance of using inspirational or highly competent coaches to inspire participants was 'uniformly seen as a positive element within the delivery of sessions' (p.12). Competence in demonstrating sport skill to facilitate inspiration, whilst intuitively correct, was seen as particularly important to both younger client groups and groups participating in alternative (non-traditional) sport sessions. Similarly, promoting new friendships and social elements, through communication, was seen as a key positive outcome for the projects in terms of engagement, retention, and facilitating transition into regular participation post project completion. In sum then, emphasising communication and making/facilitating new group friendships were considered key component necessary for project aims at their outset.

With respect to interpersonal skills, interpersonal sensitivity, and the ability to recognise emotional needs, every intervention/data collection point demonstrated similar recommendations. All of them confirmed that developing coach-participant relationships was highly beneficial, and ensued in greater adherence to projects. The first forums and subsequent CSO delivery, for instance, demonstrated that beyond what were seem as the classic skills necessary for communication (i.e. clarity and voice projection), interpersonal skills were also considered to be essential, in particular: 'The ability to understand other people's backgrounds and behaviours (contextual understanding), and to be aware of how to empathically engage

were considered to be fundamental to the community coach role' (Crisp & Statham 2012, p. 21). As a matter of fact, the complexity of working with different groups (for instance, minority and hard-to-reach groups such as those with learning disabilities, or those from low social economic status or deprived areas), something that many community projects focus on, certainly necessitated an awareness of the need for good interpersonal skills. This was particularly evident throughout the tenure of the CSO scheme between 2013 and 2017, and as the *2015 – one-year impact report* highlighted, coaches 'Appeared to require a blend of skills to ensure that these projects achieved success, and it was important to accept that these projects are part of a wider agenda of preliminary engagement for these client groups' (Sims & Crisp 2015, p. 14).

In this context, and recognising that some participants would bring behavioural issues, coaches needed to be experienced with, or have knowledge of, target client groups and also have been aware of prospective challenging behaviour traits that might arise. However, it is important to point out that, in the context of developing skills for community sport coaching, communication and interpersonal skills did not necessarily just need to focus on the interpersonal relationships (i.e. becoming 'friends') between coaches and participants, but also the interpersonal dynamics of practice (i.e. the delivery style, interventions, group management, leadership, and awareness of cultural differences) and coaching style.

Practical Delivery: Novel and not necessarily competitive

Just as 'communication' and 'interpersonal skills' are qualities that good coaches need to have developed a level of expertise in (Lyle 2002; Jones 2006), the same is also true of how coaches need to have a skillset that allows them to deliver sessions. There is a range of literature that supports the use of less competitive activities (Coalter et al. 2000; Coalter 2005), or at the least the management of competitiveness in community sport (Burton et al., 2011), and every intervention/data collection point this paper draws upon demonstrated similar thoughts. One of the ways participants were seen to gain confidence was through the supportive nature of the activities. This involved decision making that placed, in the first instance, an emphasis on informal sessions and making sure that participants knew they did not need to commit. In this respect, using non-threatening (i.e. not overly competitive) and friendly sessions to promote fun-based engagement with activities proved fruitful in terms of project success, and fostered enjoyment, inclusivity, and allowed participants to experience sessions in informal, fun sessions.

It has to be said, however, that coaches still needed to be mindful that there were some exceptions to this idea of a non-competitive trend within some of the reports that were

submitted and used within the *2015 – one-year impact report.* Moreover, the CSOs were also conscious that some sessions would invariably recruit lapsed, competitive participants and that they also needed to be catered for. One of the ways that this could be, and was, tempered, was through the use of variations of competitive games, involving either reduced numbers playing or new adapted formats that would cater for both competitive and non-competitive participants. Other methods of competition were also introduced, such as 'challenges' rather than strictly competition-based sessions, that allowed participants to practice and master a skill in an informal game and fashion. Of particular note, using this kind of approach was also seen to facilitate differentiation. These approaches, such as using graded challenges and new/innovative activities, were seen to be a key element of success for many projects and coaches. Outside of the way that these types of activities could offer participants a more level learning experience, they also offered more unique ways to engage with sport. And it was not necessarily just the offer of new sports, but also at times 'a 're-packaging' of a traditional sport (e.g. Last Man Stands cricket)' (Sims & Crisp 2015, p. 11).

More often than not, however, whilst this type of coaching provision was considered to be positive, coaches were required to be 'comfortable and confident in the differentiation of meaningful activity for a variety of skill-levels within the same session' (Sims & Crisp 2015, p. 13). This required a good understanding of the difficulties and expertise necessary for coaches in order to promote meaningful and positive experiences for participants

Support, empowerment, and accelerated mentoring opportunities

The third broad theme that was found strongly suggested a unique style to supporting projects and their key workers within the community/participation sport context, and broadens thee literature and practice available that pertain to sport coach and project mentoring. As mentioned previously, when the mentoring programme was created there was a wider industry (coaching) tendency for mentoring schemes to be aligned to NGBs who focused more so on the performance related environment, and oftentimes aligned to specific outcomes determined by individual sporting bodies (for instance, targeted coach support). Moreover, mentoring schemes were normally applied over longer periods of time in order to effect change, with communities of practice often used to facilitate agreed expectations and goals, and to maintain learning and support over agreed durations. The general consensus of opinion is that this 'normative'/standard, long term application of mentoring schemes primarily persists today (Koh et al. 2014; Sawuk et al. 2018). The unique element to the CSO scheme was that the mentoring support was highly focused to the needs of many of the programmes, which were oftentimes just six to eight weeks as a complete lifecycle. As a rule, the CSO supported schemes

showed a significantly higher success rate in terms of satisfaction, and completion. An example was set, and followed, in the first tranche of delivery, where a success rate (measured, in this instance by taking place) against those that were not mentored) for the mentored projects of 11 out of 12 projects, compared to the 18 out of 29 that were not mentored. These are rates of approximately 92 % and 62 %, and the one mentored project that did not run was deferred till the final quarter of yearly delivery (Crisp 2013b).

As a rule, the characterisation of effective practice for the CSOs was through a series of interventions: first, an input into what should constitute the aims of projects, and within this a clear understanding of the roles and responsibilities that people had. Second, and most importantly in that it allowed real-world advisory feedback, two specific site visits per project would take place. This allowed specialised coaching advice, such as helping with facilitating a move from 'instruction' to coaching, ensuring/promoting the idea that coaches should continuously reflect on their coaching – including beforehand, and more contextually specific (in many instances, youth, community, disability) advice. Moreover, project support through advice on recruitment, retention, networks, exit routes, and advice on supporting other coaches/leaders took place.

Discussion/Implications

The major finding of the nine-year partnership is that to coach and run community sessions effectively, three areas were considered paramount: firstly, good interpersonal skills, secondly, the use of novel, and not necessarily competitive activities, and lastly, that accelerated mentoring opportunities within an in-situ, practice-based context. were hugely beneficial. In the first instance, interpersonal skills of coaches were highlighted throughout the data collection/interventions and seen as integral to the success of projects. One of the central elements here was that in community sport, oftentimes there are beginners, lapsed participants, or participants who have not gone through what might be considered 'normal' sporting pathways (i.e., school, clubs, etc.). Here then, the ability for coaches to create a welcoming, fun, friendly and informal atmosphere was seen as particularly important. Interpersonal skills were then, throughout the nine-year period, always mentioned as a fundamental requirement when working with participants of lower socio-economic status or other disadvantaged groups. In much part, this was seen through the recollections and experiences of the CSOs and other coaches who felt that challenging behaviour need to be understood (contextual understanding and interpersonal empathy) whilst also handled in an appropriate manner. There are existing,

broad, theoretical concepts and values that outline how effectively working with others necessitates managing the dynamics of social interaction. The demands of nursing (Stein-Parbury 2017), social work (Kaprowska 2010), the military (Wisecarver et al. 2007), and business (Bedwell et al. 2014), for instance, all demonstrate that there is a large body of research linking interpersonal skills to interpersonal competence, the ability to read behaviour, and bring about desired outcomes. In health and social work, interpersonal skills such as communication and relating well to others, are considered to be essential to facilitate trust (and expedite responsiveness and openness), to determine how the people they work with feel (integral to diagnosis and clinical reasoning), and to ensure a greater chance of competence and expertise in therapeutic care (Kaprowska 2010; Stein-Parbury 2017). In the context of military and business, there are shared connections between how both domains covet people with advanced interpersonal skills who can structure interactions and facilitate change through anticipating reactions, and choosing the most appropriate means of empowering or advantaging both sides of interactions whilst to meeting their objectives (Hayes 2002). These skills are considered particularly useful when bridging or navigating different cultures, such as workplaces or in the instance of military, peacekeeping contexts and missions (Abbe & Halpin 2009).

These kind of conceptual approaches regarding the importance of interpersonal skills for various domains focus on relationship building and fostering cultural cognition, something not that dissimilar to what was found over the nine-year partnership the present paper outlines. Projects consisting of combinations of new, lapsed, and hard to reach groups were invariably seen to necessitate approaches to coaching that recognised how to develop relationships and also identify differences, thus mirroring the core tenets that underpin the use of interpersonal skills in other fields when used to understand and ultimately bridge differences (between groups and people) in order to work together effectively. Participants within the community sport projects this paper has looked at had oftentimes historically struggled with engaging in mainstream sports activities. As participation in sport is an important facet of many peoples' lives, oftentimes for the social benefits that can be accrued, this could be mitigated for and new habits could be formed through the virtue of trying newer activities within non-competitive environments. Here then, and with regards to the second general theme that was considered paramount, the delivery of novel and not necessarily competitive activities was considered helpful. This was particularly so if the coaches could provide a context of support whilst also being able to iterate between the differing demands of groups (i.e., between those who value competitiveness and skill development, and those who would like wider social groups [an

additional extension of community] and motivation). This type of approach reflects existing theory and recommendations that sometimes-conventional sports, with their focus on achievement and results, can be counterproductive in terms of attracting some groups, particularly those that are hard to reach (Coalter 2005). Here, activities that are somewhat less institutionalised, have fewer restrictions, and at times perhaps allow for more individual expression, are considered to be helpful (Beedie 2009). Emphasising the need to reduce formal rules and regulations, or adopt a more egalitarian approach to fostering newcomers or lapsed participants by offering novel activities, can also be explained through Super et al's. (2018) work. Here, they outline the idea that many participants in community sport may lack the requisite experience and psychological tools to deal with competitiveness and losing/failure.

Just as importantly, Super et al. (2018) also focus on how 'fun' should be prioritised in community sport sessions, both as an outlet for existing problems or perceived mundanity of everyday life, and as a means of maintaining retention. Previous research and guidelines for youth and community sport concurs with this type of approach. For instance, the work of Vierimaa et al. (2017) that focused on best practice in youth recreational basketball and outlines how encouragement, inclusivity, relationships, and fun should be prioritised.

Lastly, the general consensus is that traditional coach learning methods do, at times, insufficiently prepare coaches for 'real-world' practice. In all, the short, accelerated system of mentoring that was used – including the actual site visits and specific advisory support based on real-world observations and applied practice (as opposed to reflective practice), helped distinguish between effective and ineffective principles of coaching and project delivery that were taking place, and demonstrated a positive impact upon coach (and project lead) behaviours. This approach to accelerated mentoring sits central to the modus operandi that the short-term projects required, but also unearthed new professional terrain in that the distinctive practice quite clearly 'worked'. Of note, this manner of reflecting on actual task activities, in-situ and in real time, mirrors to some extent the way in which many students and practitioners learn in the 'real-world' (Crisp 2020b), and find greater use of immediate reflexivity rather than the more reflective pattern of learning that traditional mentoring programmes (longer term, using communities of practice) oftentimes facilitate. This reflexivity, whereby practitioners operate in a contemporaneous manner with their environment and immediate practice (Crisp 2020c**)**, ensures that actions, interactions, and the application of knowledge and theory, can take place in supported environments – and it is this process by which the CSO programme operated, that ensured greater learning, productivity, and success in terms of completed projects.

As a whole, the three areas that have so far been discussed can also be placed under the lens of a singular theoretical framework, one that can encompass the social, practical, and interpersonal dimensions that have been found. Here, the manner in which we systematically contrasted and combined our results from, effectively, a collection of data from different manners, in order to identify patterns that showed a wider 'picture', can also be explained within a theory of change (ToC) framework. This is because aspects of project delivery, leadership, and project evaluation. and subsequent learning that we have highlighted, mirror in principle the key characteristics that separate ToC frameworks from more basic evaluation tools (Hill 1997; Bolton et al. 2018). ToC frameworks then, in the main, place specific emphasis on stringently modelling the practice, planning, and pathways of organisations. In this manner, the more explicit and transparent outlines of our three themes, and our intention to reapply these to future iterations of our work and practice, reflect the way that a ToC framework explores existing assumptions and practice, and calls for implementing changes, policies, or practice based on rigorous exploration of data (Davies et al. 2000; Mason & Barnes 2007). These findings from the nine-year project (so far) then, have clear implications for coaches within community sport projects, and these in turn can be synthesised into a series of recommendations which will now be outlined.

Recommendations

In the above sections, good practice and fundamental community coaching principles have been seen to be shaped and understood through interpersonal skills and also novel activities. To clarify, this paper operates as an overview of a long-term project. However, it is worth mentioning that much of the outreach work undertaken within the combined projects was in towns, or small cities. Given this, there are not any particularly specific characteristics within the Sussex area that might influence the oversight and recommendations of the paper, but it is also true to say that the work cannot necessarily be applied to all social mixed (urban/rural) environments. However, the following recommendations, focused on coach behaviours, offer a framework for wider community sport in the context of attracting and maintaining participants. Note, for simplicity, clarity, and accessibility, the first theme (*Communication and Interpersonal Skills*) directly relates to numbers 1-3, the second theme (*Practical Delivery: Novel and not necessarily competitive*), numbers 4-5, and the third theme (*Support, empowerment, and accelerated mentoring opportunities*) relates to number 6.

1. Focus on relationship building. This was a commonly used piece of feedback and advice, and can be facilitated through activities that look to engage all, and ensuring that registration type actions can be used as a catalyst to conversation and checking on well-being. Of note, the importance of rapport and positive coach-athlete/participants relationships (Martens 2004) needs to be embraced by community sport coaches.
2. Stress friendly behaviours and personas. Emphasise communication, learn names, facilitate empowerment and responsibility (to support trust), and put effort into the minutiae of informal outlines and asking questions of how people feel and 'how they are doing'.
3. Actively promote social interaction within the sessions through recognising and encouraging the skill of the coaches and other staff in ensuring this occurs. Look to bring a coherent approach to facilitating friendships which can, if supported and encouraged, lead to expected future engagement. Focus on this as an aim and a required outcome, over and above activity-specific skills.
4. Build upon this construct and philosophy of informal outlines, and promote atmospheres and environments that actively promote the idea of sport without necessarily requiring participants to compete against each other.
5. Position 'fun' and atmosphere as a function of the session. Consider novel, not necessarily sport-specific approaches (i.e. music during sessions) to promote an enjoyable but informal experience for the participants.
6. Prior to beginning their coaching/sessions/programmes, coaches should be encouraged to engage in self-reflection regarding the work they will be asked to do and the aims of the coaching/sessions/programmes. Specifically, coaches need to focus on meaningful, rewarding, and memorable activity that reinforces the rationale for every project

Conclusion

This paper offers an overview of the goals, strategies, benefits, and challenges, that a number of coaches, project managers, support staff, and the authors of this paper, oversaw and reflected upon across a nine-year period. This nine-year period encompassed the delivery of a range of youth and participation projects, principally under the umbrella of the Sportivate and Satellite Clubs programmes that Active Sussex managed and delivered with a range of key partners - including the University of Chichester - in terms of project oversight and to ensure minimum standards of operation were present.

The paper's findings/categories of *Communication and Interpersonal Skills, Practical Delivery: Novel and not necessarily competitive,* and *Support, empowerment, and accelerated mentoring opportunities* indicate that three, broad, areas should be considered for more in-depth (new) training and good (best) practice for youth and community project organisers, in order to help them become more comfortable with their responsibilities and ultimately be more effective in sustaining participation. More specifically, these three areas emphasised the need to focus on the interpersonal dynamics of practice alongside developing relationships, recommended practical delivery that emphasised novel approaches, whilst de-emphasising competitive activities, and strongly suggested that the use of accelerated mentoring strategies supported development. Whilst the first two themes perhaps work in a more confirmatory (of other research) fashion, we believe the third (centred on *accelerated mentoring opportunities)* is more unique and makes a more distinctive contribution to the field. Fundamentally, however, all three of these areas point to potentially more effective delivery methods and success (good [best] practice) in the context of youth and participation sport.

Interestingly, these findings align quite well with work undertaken by the first author within the time period that posited that leadership and group game engineering positively influenced group cohesion in the community sport context (Crisp 2020a). However, given that the methodology used in the present paper essentially comprised of searching an aggregation of multiple data collection methods for common themes, there are limitations. In principle this is because the paper essentially operates as a reflection/summary of various interventions and data collection points, and arguably no 'new' empirical data is provided to support our claims regarding the CSO project. Whilst the data, findings, and indeed the methodology as a whole, offer critical thought, contextualisation, and explanation they are, perhaps in great part, essentially a dual reflection and interpretation of the data. So in some respects, whilst fully adhering to principles of an LQR/action research stance, it is necessary to fully recognise that the research does lack some scientific objectivity, in that recollections and biases have figured markedly in the researchers' reflections. Certainly, the study/paper has specifically positioned itself throughout as an overview/reflection/summary of a nine-year programme and partnership, and as such there is no 'standard' research focus (i.e. *hypothesis or research question)*...etc.). We acknowledge then that the manner in which the study/paper operates is an overview/story/synthesis with recommendations, not a traditional study.

Indeed, even the acknowledgement of the present study's action research stance, whilst genuinely covering this approach's ethos of participatory investigation and efforts to improve rationality and practices, needs to be seen in the prism of self-reflective enquiry. Understanding

this allows the admission that the study may well lack some complexity and perhaps, objective processes. So whilst we contend that the present paper moves well beyond any superficiality and over-simplifications, particularly in light of the expertise and lived experience we have invested, we cannot discard the notion that this is, essentially, a reflective project in many regards. In essence then, whilst we do consider these reflections to provide insight into the project's procedures and good (best) practice, much of this may well be based upon our own interpretations and 'deep-dive' into what is very much our own 'story'.

Nevertheless, the longitudinal nature of this paper (in terms of aggregating, studying, and reflecting on a nine-year period), the fact that it is essentially an oversight of an applied, at arm's length governmental (sport policy and funding) and academic project with a relatively wide scope, and the applied practice, reflections, and iterations throughout the CSO project merit attention. This is particularly so if we wish for 'sport studies' to acknowledge in-situ training and experiences, and project/work applications that may well be relevant to practitioner training. It is hoped then, that this paper contributes to an understanding of how community sport participation can be supported for both practitioners and academics, and that the results may reinforce training for community type coaches in order to help them become more comfortable with their responsibilities, remits, and practice in this environment.

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