MUNI
SPORT

STUDIA SPORTIVA

VOLUME 15/NUMBER 02/2021

STUDIA SPORTIVA

2021 ▪ Volume 15 ▪ Number 2

MUNI

Editor in Chief: Mgr. Ivan Struhár, Ph.D.

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KINESIOLOGY

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Change in Physical Activity and Stress During COVID-19 in a Sample of Older Adults with Exercise Habits

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Abstract

BACKGROUND: The COVID-19 outbreak forced many states to introduce public health and social measures (PHSM), which may pose an obstacle to performing physical activity (PA). METHODS: This study investigated PA levels and their changes and perceived stress in a sample of 193 participants (aged 71.21 ± 4.87 years) engaged in exercise lessons prior to PSHM. Data were collected via an online survey distributed directly to the participants. The survey included two instruments: the International Physical Activity Questionnaire and the Perceived Stress Scale.

RESULTS: The results indicate that sports habits may be a protective factor in staying active and meting PA recommendations. Nevertheless, there were no associations between the number of exercise lessons in the pre-COVID-19 period and PA level or the perceived change in PA during PSHM. Ability to replace the cancelled exercise lesson with PA of similar duration and intensity was negatively associated with PA levels and its change. The PSS-10 score suggests that the sample did not experience a significant increase in perceived stress, but the relationship of this outcome to PA is unclear.

CONCLUSIONS: The promotion of alternative PA that could be performed during PHSM and building long-term exercise habits in older adults should be considered.

Keywords: *SARS-CoV-2 Infection, Coronavirus Disease, Pandemic*

1. INTRODUCTION

The worldwide COVID-19 pandemic forced many states to introduce public health and social measures (PHSM) to maintain social distance and reduce contact to protect people from exposure to infection of COVID-19. Measures such as lockdown, self-quarantine, restriction of outdoor movement, and closing of sport facilities could be challenges for physical activity (PA), perceived stress, or mental health (WHO 2020). The empirical research in older adults showed that COVID-19 PHSM are associated with negative changes in PA (Bourdas and Zacharakis 2020; Di Santo et al. 2020; Eek et al. 2021; Maugeri et al. 2020; Yamada et al. 2020a). This has also been corroborated in various samples of other age cohorts (e.g., (Barkley et al. 2020; Bourdas and Zacharakis 2020; Eek et al. 2021; Jia et al. 2020; Maugeri et al. 2020; Srivastav, Sharma, and Samuel 2021)). The worldwide pandemic has raised interest in the positive effects of PA on physical health. The reduction of PA resulting from established PHSM poses a significant dilemma, as PA is assumed to be a preventive factor against COVID-19 infection and other health issues. Recent reviews have concluded that PA and exercise may help promote health, improve immune response, and prevent chronic and viral infections in older adults. Therefore promoting PA may

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be a good strategy in fighting COVID-19 (Amatriain-Fernández et al. 2020; Damiot et al. 2020; Hall and Church 2020; Sepúlveda-Loyola et al. 2020). Further, staying physically active during restriction is important for preventing future chronic conditions resulting from a sedentary lifestyle (Nyberg et al. 2020; Scartoni et al. 2020). Consistently, an empirical study of lifestyle risk factors showed that physical inactivity is a significant risk factor of severe infection (Hamer et al. 2020). The protective associations of PA on COVID-19 were observed even at relatively low levels of activity (i.e., < 150 min of moderate to vigorous activity) (Hamer et al. 2020).

Other significant aspects of staying physically active are mental health and well-being. The COVID-19 outbreak poses a threat to mental health linked to worries about self and close contact as well as to changes in life routines caused by PHSM. There is an increased risk of isolation for older people, as they are a vulnerable group in the case of COVID-19 illness. Studies investigating the impact of the COVID-19 pandemic and measures reveal that PA positively affects psychological health by enhancing self-esteem and resilience to stress, reducing depression and anxiety and having a positive impact on well-being (Carriedo et al. 2020; Lesser and Nienhuis 2020; Maugeri et al. 2020). Older adults engaged in vigorous and moderate-vigorous physical activity scored higher in self-efficacy, locus of control, and optimism and lower in depressive symptoms (Carriedo et al. 2020). Further, PA may positively affect cognitive function and consequently delay the progression of cognitive impairment in older adults. By contrast, depressive symptoms are associated with cognitive decline in older adults (Sachs-Ericsson et al. 2005). Therefore, staying physically active during the pandemic is important from both short- and long-term perspectives.

Roschel, Artioli, and Gualano (2020) considers the aggravation of PA as a relevant "adverse effect" of the PHSM taken to combat the spread of COVID-19. Despite the differences in PA and exercise recommendations, various global expert organisations have highlighted the importance of increasing and maintaining PA during the pandemic (Sepúlveda-Loyola et al. 2020). Therefore, governments and responsible experts should focus on the maintenance of PA levels, healthy lifestyles, and minimising the negative effects of PHSM on health and quality of life. Understanding the factors that may help older people stay active may be helpful in this issue. It is also important for potential future pandemics.

The current study investigated PA levels and their changes, the ability to replace the amount of time spent on exercise in currently closed facilities with another equally intense sports activity, and perceived stress in older people who were engaged in organised PA lessons prior to the COVID-19 outbreak. Thus, we determined whether exercise habits can help maintain the recommended level of PA during the pandemic.

We further hypothesise that: 1) there will be monotonic trends in PA levels and change in PA for an increasing number of days with more than 30 minutes of exercise prior to COVID-19 measures; and 2) there will be monotonic trends in PA levels and changes in PA for increasing replacement of organised PA lessons with similar PA.

2. METHODS

Research Design and Participants

This study targeted physically active people aged over 65 years who had been taking part in organised exercise lessons before COVID-19 outbreak. Data collection took place from 26 October 2020 to 9 November 2020 via an anonymous online questionnaire, which focused on exercises of older adults. The survey was distributed with the assistance of the staff of the facility used. Data sample consisted of clients from six different institutions. The questionnaire was sent directly to the participants' email addresses by the coaches or heads of facilities to avoid bias. Inclusion

criteria were also checked by demographic and control questions (i.e., age and number of PA lessons per week in the pre-COVID-19 period). A total of 238 fully completed questionnaires were collected during the appointed period. Forty-five of them were excluded. Six respondents stated that the questionnaire was not intelligible for them, and 39 stated that they had serious health or mental problems that prevented them from physical activity. The final data sample consisted of 193 respondents (the description of the sample is provided in Table 1.

Table 1. Sample description

*PA status	Low (n = 11)	Moderate (n = 83)	High (n = 99)	Total (n = 193)
Age (years)	71.09 ± 4.86	71.45 ± 5.36	71.02 ± 4.47	71.21 ± 4.87
BMI	26.37 ± 4.41	25.80 ± 3.49	25.62 ± 4.04	25.74 ± 3.82
Women (N)	8	72	89	169
Men (N)	3	11	10	24
Living with a partner (N)	7	58	48	113
Living with partner separately (N)	3	5	12	20
Single (N)	1	20	39	60
Lives in a town with > 100 000 inhabitants (N)	10	72	81	163
Lives in a town < 100 000 inhabitants (N)		4	4	8
Lives in the village (N)	1	7	14	22
Retire (N)	9	73	91	173
Working without restrictions due to COVID-19 (N)	1	7	5	13
Working with restrictions due to COVID-19 (N)	1	3	3	7

* PA status was determined according to the International Physical Activity Questionnaire scoring.

Government PHSM

The study took place during the second wave of the pandemic. Government measures to prevent the spread of COVID-19 were adopted gradually. Indoor sports venues have been closed since 12 October 2020. Since October 22, the movement of people has been partially restricted, as well as the gathering of two or more people in public places or in groups up to 20 with a spacing of two meters. The operation of sports, cultural facilities, catering facilities, and most small shops was also limited. A curfew after 21:00 was introduced on October 26. Similar measures were adopted in the spring period during the first pandemic wave, so this was a second experience of lockdown during 2020.

Data Collection

The construction of the questionnaire followed a standard procedure (Passmore et al. 2002). The PA was assessed by a short version of the International Physical Activity Questionnaire (IPAQ), which allows the transfer of self-reported PA on METS-minutes. Considering the research sample age cohort, we followed recommendations for using the IPAQ in elderly people (Heesch et al. 2010). The self-reported change in physical activity between the previous week and the typical week of pre-COVID measures was assessed for total volume of PA and each category from the IPAQ (vigorous PA, moderate PA, walk, sitting time). The change was scored on a five-point scale (5 = a lot more, 4 = a bit more, 3 = about the same, 2 = a bit less, 1 = a lot less). Considering

the research sample, the scale was used in the form of a complete sentence, for example, "I was a lot more physically active". A similar scale was used to evaluate the perceived importance of PA during the pandemic in comparison to pre-pandemic period. Further, the questionnaire collected data about the usual frequency of physical exercise longer than 30 minutes prior to the COVID-19 measures and whether this exercise was compensated by another PA with a similar duration and intensity if it was provided by any closed organisation. Respondents stated the number of days with PA lessons, and we subsequently categorised it into four groups of days per week (1 day, 2–3 days, 4–5 days, 6–7 days. The replacement of organised PA was evaluated on a 4-point scale (not – 1; probably not – 2, probably yes – 3, yes – 4), as well as perceived worry about COVID-19 infection. The 10-item Perceived Stress Scale (PSS-10) is a frequently used instrument to measure perceived stress. The PSS-10 measures the degree to which situations in one's life are appraised as stressful (Cohen, Kamarck, and Mermelstein 1983). We use the Czech version (Figalová 2019; Figalová and Charvát 2021) of the 10-item scale (PSS-10), which has been recommended for research usage by authors as adequate to the original 14-item version (Cohen 1988). The PSS-10 in this sample had acceptable to good internal consistency (Cronbach alpha 0.795). The questionnaire was supplemented by demographic and control questions.

Data Analysis

Statistical analysis was performed using IBM SPSS software (version 25). The normal distribution of the data was tested with the Shapiro-Wilk's test, $\alpha = .05$. A Jonckheere-Terpstra test ($\alpha = .05$) was used to determine whether there were statistically significant increasing monotonic trends in examined variables. The medians are reported if the distributions of variables were similarly shaped for all groups, as assessed by visual inspection of a histogram. Results of variables with very dissimilar shapes of distributions are marked, as the Jonckheere-Terpstra test is not appropriate in such case (Laerd Statistics 2017). The Kendall's τ_b was used to determine the effect size for the Jonckheere-Terpstra test (Kraska-Miller 2019) and associations between variables. Average values are reported as mean + SD if the data had a normal distribution; otherwise, the mean with 95% CI is reported. Descriptive data are presented in absolute and percentage frequencies.

3. RESULTS

Table 2 presents a summary of responses to questions related to physical activity and concern about COVID-19. The results showed that 89% of respondents did exercise or played sports two or more times per week and 40% even four or more times per week before COVID-19 measures. About 61% of respondents stated that they were probably not or were not able to replace the time spent on exercise in currently closed facilities with another equally intense sports activity. Despite this result, the research sample could be considered physically active even during COVID-19 measures, as only 6.7% of them were scored as low physically active by IPAQ. Table 2 shows that more than half of the participants (57%) considered PA as more important during the COVID-19 pandemic, while only one respondent reported it as a bit less important. However, there was no significant association between the perceived importance of PA and its change (for all PA categories) or replacement of organised sport activities (Kendall's τ_b $p > 0.146$).

Table 2. Distributions of responses related to PA and perceived worries about COVID-19 infection.

	1 day	2–3 days	4–5 days	6–7 days
Number of days with exercise longer than 30 min prior COVID-19 measures.	21 (10.8%)	93 (47.7%)	55 (28.2%)	24 (12.3%)

	not	probably not	probably yes	yes
Replacement of time spend on exercise in currently closed facilities with another equally intense sports activity.	30 (15.4%)	89 (45.6%)	43 (22.1%)	31 (15.9%)
Worries about COVID-19 infection	21 (10.8 %)	80 (41.0 %)	58 (29.7 %)	34 (17.4 %)

	a lot less	a bit less	about the same	a bit more	a lot more
Perception of importance of PA	0	1 (0.5 %)	80 (41 %)	38 (19.5 %)	74 (37.9 %)
Change in total PA	27 (13.9 %)	46 (23.6 %)	61 (31.3 %)	34 (17.4 %)	25 (12.8 %)
Change in vigorous PA	36 (18.5 %)	38 (19.5 %)	57 (29.2 %)	35 (17.9)	27 (13.8 %)
Change in moderate PA	18 (9.2 %)	39 (20 %)	86 (44.1 %)	33 (16.9)	17 (8.7 %)
Change in walk	25 (12.8 %)	37 (19 %)	71 (36.4 %)	35 (17.9)	25 (12.8 %)
Change in sitting time	14 (7.2 %)	19 (9.7 %)	66 (33.8 %)	55 (28.2)	39 (20 %)

The mean value of the PSS-10 score was 15.46, 95% CI [14.73, 16.19]. Further analysis showed that there was a weak to moderate association between the PSS-10 score and perceived concerns about COVID-19 ($\tau_b = .165$, $p = .002$). On the contrary, no association between perceived concerns about COVID-19 and change in PA (for all categories) was found (Kendall's τ_b $p > 0.411$). Further, no association between PSS-10 score and PA levels or PA change was found (Kendall's τ_b $p > 0.182$).

3.1 Hypothesised monotonic trends

Our hypothesis that there would be monotonic trends in PA levels and change in PA for an increasing number of days with more than 30 minutes of exercise prior to COVID-19 PHSM was not supported (see Table 3). We also hypothesised that there would be monotonic trends in PA levels and changes in PA for increasing the replacement of organised PA lessons with PA of similar duration and intensity. A Jonckheere-Terpstra test determined that there was a statistically significant increasing monotonic trend in all variables related to PA or PA change in the four groups, dependent on the degree of replacement of prohibited PA lessons (see Table 3). However, there was no monotonic trend in sitting time, sitting time change, or PSS for either PA prior to COVID-19 or replacement organised PA lessons.

Table 3. Hypothesised associations between pre- COVID-19 exercise, replacement of organised lessons and observed variables.

Number of days with exercise longer than 30 min pre-COVID 19 per week

	1 day	2–3 days	4–5 days	6–7 days	p	τ_b
Total PA#	3108	2826	3199.5	2139.5	0.315[a]	-0.027
Total PA change#	3	3	3	3	0.204	-0.05
Vigorous PA#	640	720	960	800	0.224	0.043
Vigorous PA change#	3	3	3	3	0.201	-0.051
Moderate PA#	600	600	720	680	0.489	0.002
Moderate PA change#	3	3	3	3	0.343	-0.025
Walk#	1386	1039.5	1188	1039.5	0.151[a]	-0.058
Walk change#	3	3	3	3	0.46	-0.006
Time sitting##	5	5	5	5	0.165	0.057
Time sitting change##	4	3	4	4	0.213	0.049
PSS	16	14	16	15	0.437	-0.009

Replacement of organised lessons by another PA

	1	2	3	4	p	τ_b
Total PA#	1 677.00	2 746.00	2 826.00	4 839.00	<0.001	0.232**
Total PA change#	2	2	3	3	<0.001	0.203**
Vigorous PA#	400	640	960	1 280.00	0.005	0.148**
Vigorous PA change#					0.009[b]	0.142*
Moderate PA#	510	540	640	960	0.015	0.121*
Moderate PA change#	3	3	3	3	0.007	0.150*
Walk#	841.5	1 039.50	1 188.00	1 584.00	< 0.001[a]	0.214**
Walk change#	3	3	3	3	0.01[a]	0.141*
Time sitting##	6	5	5	4	0.253[a]	-0.038
Time sitting change##	4	4	4	3	0.385	-0.107
PSS	14	16	14	14	0.205	-0.047

* two-tailed $p < 0.05$; ** two-tailed $p < 0.01$; [a] distributions are somewhat in shape, [b] distributions are **very dissimilar** in shape, data are presented as median.
#METS-minutes per week, ##h/day

4. DISCUSSION

There is opportunity in every crisis, and the worldwide COVID-19 pandemic is not an exception. Therefore, researchers should focus on both the potential risk and protective factors to help manage not only the current situation, but also those of the future. The sample of participants over 65 years of age who were engaged in regular organised PA lessons prior to the COVID-19 outbreak was assessed in the current study. This allowed us to examine the extent to which an exercise habit could be a protective factor in staying physically active during pandemics or social isolations. The results showed that only 5.7% of the included participants reported low PA according to IPAQ scoring (Anon 2005). Moreover, more than half of the sample (51.3%) reported high PA. As the scoring of the moderate PA category by IPAQ was similar to WHO recommendations for PA in older adults, it could be assumed that most of the sample met WHO PA requirements (WHO 2020). WHO recommends a minimum level of PA to improve cardiorespiratory and muscular fitness, bone and functional health, and reduce the risk of NCDs, depression, and

cognitive decline. For additional health benefits, adults should increase their PA above the minimum requirement (Organisation mondiale de la santé 2010). Therefore, regardless of whether the participants experienced a decrease or increase in PA after the COVID-19 outbreak, it can be concluded that most of them met the minimum requirements for PA to maintain health during the PHSM. The sample in this study (older than 65 years) reported a high average level of PA (3554 ± 2858 MET–min/week; mean). As a comparison, a study of the Italian population using the IPAQ reported a mean of 1473 MET–min/week in people over 60 years (Maugeri et al. 2020), Portuguese older adults > 65 years, 2448 ± 3435 MET–min/week (Antunes et al. 2020), and 47.6% Italian older adults (aged > 60 years) with mild cognitive impairment or subjective cognitive decline were in the low physical activity category (< 600 MET–min/week) (Di Santo et al. 2020). Another study that used IPAQ to examine the change in PA after the COVID-19 outbreak in Japanese community-dwelling older adults reported a median (IQR) of total PA time in minutes per week of 330 (148–600) for "robust" and 270 (120–480) for "pre-frail" subgroups" (Yamada et al. 2020a), which is less than half of that of the sample in this study 684 (420–1080). The research tools used do not allow the assessment of physical fitness, but the mean BMI of the sample (25.74 ± 3.82) was in the optimal range (23.0 to 29.9) associated with optimal longevity (Porter Starr and Bales 2015). This result suggests that older adults with the habit of exercising and engaging in organised lessons may have a greater tendency to stay physically active than the general older population when obstacles appear. However, it must be taken into consideration that the results come from a population of different socio-cultural backgrounds, and the data were collected under different PHSM.

Aside from adherence to recommendations, there is a question of changes in PA patterns during the PSHM. Prior research reported a decrease in PA levels (Bourdas and Zacharakis 2020; Di Santo et al. 2020; Eek et al. 2021; Maugeri et al. 2020; Yamada et al. 2020a) in older adults, except a study on British community dwelling individuals (Richardson et al. 2020). In this study, respondents reported an increase in total PA and each subcategory in approximately 22.9–32.1% cases, whereas a decrease was observed in 29.5–38.3% cases (see Table 2). We hypothesised that there would be monotonic trends in PA levels and change in PA for an increasing number of days with more than 30 minutes of exercise prior to COVID-19 measures (i.e., level of habitual exercise). Contrary to expectations, this study did not find such a trend in any of the PA categories, or even in sitting time (see Table 3). Therefore, it is possible that habitual exercise or sports activity is a protective factor for staying physically active when obstacles occur; however, there was no monotonic trend between frequency of exercise and levels or changes in PA during pandemic. This result is limited by the absence of investigation of the impact of PHSM on various aspects of the participants' lives, which can play an important role in PA levels. Further, it can be assumed that the exercise represented a different portion of the total PA for each individual.

We assume that the extent to which seniors are able to cope with pandemic measures plays an important role in their PA. All participants in this study engaged in organised PA lessons, which were cancelled due to social isolation. We hypothesised that the ability to replace exercise lessons with PA of similar intensity and duration is an important factor in PA patterns during the period of PHSM. Our results revealed a monotonic trend in both the level of PA and its change after introduction PHSM depending on the ability to replace the organised exercise (see Table 3). Effect size was determined by τ_b and ranged from 0.141 to 0.232 for different categories of PA, which represented weak to moderate association. This means that those who were less able to replace their usually organised exercise were less active and more often perceived a decrease in their physical activity in comparison to the pre-COVID-19 period. Moreover, 48.7% of participants reported an increase in sitting time, while only 17% declared spending less time sitting than in the pre-COVID-19 period (see Table 3). No association was found between change in sitting

time and replacement of organised exercise or number of days in which participant exercised in the pre-COVID-19 period. Increasing the time spent sitting while maintaining the level of PA was also reported by Richardson at al. (2020) in a sample of community-dwelling individuals aged >70 years. This result suggests that although the exercise habit may be a protective factor in maintaining PA, the promotion of suitable exercise during PHSM is required, as well as a focus on preventing sedentary behaviour. This may be rather challenging, as the great emphasis in PA promotion programmes is placed on digital technology, which is longstanding less used by older adults (see "age-based digital divide" (Martins Van Jaarsveld 2020)). Nevertheless, governments should prepare strategies to minimise the impact of closing sports facilities.

We consider the study by Richardson et al. (2020) interesting because, unlike most of the results, it highlights maintaining a level of PA in a sample of older adults. Authors had offered an interesting explanatory factors which may played role. The participants in the sample perceived the high importance of staying physically active. Average marks ranged from 8.8 to 9.1 at different time points of the study, where the rating scale was 1–10 (10 being extremely important). Further, the authors pointed to some situational factors, such as good weather conditions and an increase in time spent in gardens, as gardening was the second most popular change to activities. Our finding is consistent with the mentioned study. As our sample population was engaged in organised PA lessons prior to the COVID-19 outbreak, it can be assumed that they found PA as important. Moreover, 58% of the participants stated that they perceived PA as more important since the COVID-19 outbreak, and only one participant perceived PA as slightly less important. Therefore, it is possible that the perceived importance of PA could affect the high level of PA that the research sample reached. Nevertheless, there was no association between changes in the perceived importance of PA and its level or change. Regarding the situational factors, while the weather and sufficient gardening conditions possibly positively affected the PA levels in the study mentioned above (Richardson et al. 2020), our results show a negative association between the perceived replacement of organised PA lessons and PA levels and its change in all categories. The role of situational conditions is also supported by the study of a Japanese sample of older adults (age 73.9 ± 5.6 years), which shows that after lifting the state of emergency and subsequently partially bringing conditions back to the pre-COVID-19 state, the level of PA recovered to the pre-COVID-19 state in most of the participants (except those who were living alone and socially inactive) (Yamada et al. 2020b). In this light, future research and governments should focus on the perceived importance of PA by older adults and on maintaining appropriate conditions for the implementation of PA during PHSM.

The COVID-19 pandemic and the connected PHSM can be considered a stressful period. Hence, we investigated perceived stress to determine whether PA habit can be a protective factor. There are no conclusively adapted cut-off scores for PSS-10 (the authors of the scale did not establish any), and it has been suggested that it should be used in comparison with different samples (Remor 2006). Generally, PSS-10 score tends to lower with age (Cohen and Janicki-Deverts 2012), and despite being at higher risk, older people report lower stress (Adamson et al. 2020). This tendency also occurred in the Czech standardisation study, which showed a negative correlation between age and PSS-10 score $r = -.34$, $p < 0.001$. The mean PSS-10 score in the Czech population sample was 18.04 ± 6.83 (mean ± SD) (Figalová 2019), which is higher than that of this study (mean = 15.46, 95% CI [14.73, 16.19]). It should be considered that women in the Czech population perceived greater stress (19.12 ± 6.75) than men (16.62 ± 6.68), and the sample in this study consisted of 87.6% women (Figalová 2019). Similar trend was in current sample (men = 13.83 ± 4.83, women = 15.69 ± 5.14). Nevertheless, this result is limited by small proportion of men in the sample (n=24).

Interpretation of this result is problematic as we do not have data from the period before COVID-19 outbreak. An interesting comparison may be provided by the comprehensive dataset from the COVIDiSTRESS global survey. This study included a Czech sample of 1995 participants who reported 2.694 ± 0.707 (mean ± SD) (COVIDiSTRESS Global Survey Consortium et al. 2021), which is much higher than the Czech mean value before COVID-19. The mentioned value is the mean for a single PSS item; therefore, for comparison, it is necessary to multiply it by ten. This indicates that there could be an increase in perceived stress linked to the COVID-19 outbreak in the Czech population, which may be due to the strict long-term PHSM introduced by government. Based on our results, we assumed that no similar change was detected in the current sample. It is important to bear in mind that there are significant limitations to this assumption. First, the COVIDiSTRESS sample was younger (33.4 ± 11.5 years) than the population in the Czech PSS-10 standardisation study (44.3 ± 12.8 years) (Figalová 2019) and much younger than the current sample. Further, the COVIDiSTRESS global survey investigated different pandemic periods between 30 March and 30 May 2020. The current study excluded respondents who were unable to do PA due to health issue. Moreover, no association was found between perceived stress and PA level or reported change in PA, number of days with exercise longer than 30 min pre-COVID 19 per week, or replacement of organised lessons with another PA. Therefore, it is not suitable to make any conclusions about the relation between PA and perceived stress in this sample.

Aside from already reported limitations, it is necessary to mention that the results are based on self-reported perceptions of change in PA, which is not standardised, and IPAQ is an indirect measurement tool. To minimise the misunderstanding of the questions and their meaning, we ran a pilot study. Further, we did not assess the individual impact of the COVID-19 pandemic and PHSM, but it can be assumed that each participant was touched by the situation differently (e.g., different obstacles in usual daily routine, health issues of close person, systemic stress load in family).

5. CONCLUSIONS

The current study demonstrated that sport habits can help to maintain a sufficient level of sports activity necessary to promote health in people aged over 65 when pandemic PHSM are introduced (sport venues closed, restricted movement and gathering two or more people in public place etc.). Nevertheless, there was no association between the number of days with more than 30 minutes of exercise activity in the pre-COVID-19 period and reported PA or perceived PA changes during the period of PHSM. The negative association between the reported ability to replace the cancelled organised exercise lessons and PA and its perceived change during PHSM highlights the importance of providing opportunities and ways to replace the PA that cannot be carried out. Despite the limitations of the study design and the impossibility of comparing data with another study on the Czech population of the same age cohort, the results suggest that the participants in the current sample did not experience a significant increase in perceived stress. However, this may be related to age, as there was no association between PA variables and PSS-10 scores.

Funding: This research did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors.
Data Availability Statement: Data are available on request (vajda@fsps.muni.cz).
Conflicts of Interest: The authors declare no conflict of interest.

Ethics: The study conformed to the Declaration of Helsinki. Ethical review and approval were waived for this study, due to research was fully anonymous and voluntary.

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SOCIAL SCIENCES

Editor:
doc. PhDr. Marcela Janíková, Ph.D.

Psychological Skills in Relation to Academic Achievement through Swimming Context

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Abstract

This study aimed to investigate: (1) the level of psychological skills among students enrolled in swimming courses at the Physical Education faculties in the Jordanian Universities. (2) the relation between their psychological skills and academic achievement. (3) the differences in these psychological skills according to gender. The descriptive approach was used to conduct this study. The study sample consisted of (260) male and female students enrolled in intermediate and advanced level swimming courses at the School of Sport Sciences/ University of Jordan. Students' final academic achievement records in addition to the "Life skills through swimming context" scale was used to collect required data. The results of the statistical analysis revealed an average level of psychological skills, significant differences in psychological skills level in favor of female students, A level students, and JU students, and a positive significant relation between psychological skills and academic achievement. In conclusion, it is important to design comprehensive psychological skills-based study plans for swimming courses and in different sports fields. Also, to conduct specified training and guidance courses in this domain to improve psychological skills, teaching competencies and academic achievement.

Keywords: *psychological skills, academic achievement, swimming courses.*

1. INTRODUCTION

Psychological skills (PS) are a group of skills and abilities that enhances peoples' performance and achievement (Ay, 2019; Huzair, 2017). These skills are positively related to sport participation levels (Abdel Wahhab, 2019). Weinberg & Gould, (2018) suggested that PS includes a whole set of trainable skills including emotional control and self-confidence. Self-confidence improves athletic performance (Maqableh, 2019), and along with emotional control and concentration, these skills play an active role in the Olympian's performance (Gould et al., 2009). Motivation is also considered a performance predictor of technical skills (Forsman et al., 2016; Kannekens et al., 2011). Consequently, academic achievement reflects the learner's accomplishment of specific goals by the end of an academic experience in a determined amount of time (Wirthwein et al., 2014).

Psychological skills can be studied and taught through sport contexts (Danish, 1996). Sport psychologists believe that sports are a vehicle for healthy development (Holt et al., 2008). Therefore, the swimming context can be a rich environment to help students develop such skills (Bayyat et al., 2016). Ay (2019) has revealed a moderate level of psychological skills for students enrolled in swimming classes. And AlDababseh et al., (2017) concluded a positive relation between psychological compatibility and academic achievement while learning free-style swimming skills.

All schools of sports sciences at the universities of Jordan offer mandatory, reliable, and valid swimming programs. Students enroll in one of three swimming courses consequently: the basic, intermediate, and advanced level. Each student must pass the previous level to be able to enroll in the next level. In our pursuit to advance the literature in sportsmen development, the authors of this study have decided to investigate the psychological skills of students through the swimming context at Jordanian universities. To expand our research, we seek to examine the following: (1) The psychological skills of students enrolled in intermediate and advanced swimming courses at the schools of sports sciences in Jordanian universities; the University of Jordan (JU), Yarmouk University (YU) and Mutah University (MU) (2) the differences in students' psychological skills (dependent variables) according to socio-demographic variables (independent variables); gender, swimming course level (intermediate and advanced swimming courses), academic achievement level (A (excellent), B (very good), C (Good), D (fair), E (poor) and F (very bad))and university (JU, YU, and MU), And (3) the relation between students' psychological skills and their academic achievement.

2. METHODOLOGY

The descriptive methodology approach was used to fulfill the objectives of the study, we chose to examine students in the intermediate and advanced level of swimming courses conducted at sports schools of three state universities in Jordan; JU, located in the capital of Jordan Amman, YU, located in the northern city of Irbid and MU, located in the southern city of Kerak. Through intermediate course level, students attend a one-hour class/three days a week for four months, while those enrolled in the advanced course level attend a two-hours class/three days a week for four months.

Each course level has its Students' Intended Learning Outcomes that focus on developing swimming skills. By the end of the intermediate level, students are expected to show improvement in stroke technique of the front and back crawl, breaststroke and butterfly stroke, and some basic life-saving skills. Also, by the end of the advanced level, students are expected to advance the quality of all four strokes, and increase the competency of the core aquatic skills and teach/train different swimming skills.

2.1. The Sample of the study

The population of this study was undergraduate male and female students attending both intermediate and advanced swimming courses. They consisted of (n= 314) students enrolled at the schools of Sport Sciences at three state universities: JU 168 (53.5%), YU 123 (39.2%), and MU 23 (7.3%). The Participants were an opportunity sample of 260 students, out of which 133 (51.2%) were male and 127 (48.9%) were female distributed at the JU, YU, and MU as follows; 101 (38.9%) (42 males and 59 females), 137 (52.7%) (82 males and 55 females) and 22 (8.5%) (9 males and 13 females) respectively; 202 (77.7%) were intermediate level students and 58 (22.3%) were advanced level. Their mean age was 19.8 ±1.27, and they all voluntarily participated in this study.

2.2. Instrumentation

2.2.1. Development of the "Psychological Skills Questionnaire."

To collect data related to students' psychological skills, we needed to develop and validate a questionnaire. First, we reviewed literature related to psychological skills in psychology and sport psychology fields (AlGamdi, 2007; Awad, 2010; Ay, 2019; Wahdan, 2011; Zaki, 2010). Secondly, we identified the psychological skills related to the swimming context such as; leadership, emotional

stability, sport achievement motivation, self-confidence, stress management, and attention. Then, we generated a 40 items-questionnaire reflecting the psychological skills previously mentioned by applying both deductive and inductive methods. The items were clear, understandable, reflect the real-life experience of the study population, and not too long in structure.

Content validity

For content validation, the scale was reviewed and assessed by eight qualified expert judges from different related fields (sport psychology, swimming, teaching methodology, scientific research methodology, and kinesiology). They were asked to give their opinion of the suggested PS content representation, their relatedness, clarity, and structure of items.

According to the judges' reviews, we omitted both leadership and emotional stability domains, in addition to several items throughout the questionnaire. We rephrased some items and added others. Again, the scale was reviewed by four judges, who agreed on 80% of the items. Thus, the final version of the "Psychological Skills Questionnaire" questionnaire evolved consisting of four domains including 28 items as follows;

Sport achievement motivation consisted of 8 items (1, 9, 10, 13, 17, 20, 25, 27).
Self-confidence consisted of 8 items (3, 4, 8, 11, 18, 21, 26, 28).
Stress-management consisted of 6 items (2, 5, 7, 14, 16, 24).
Attention consisted of 6 items (6, 12, 15, 19, 22, 23). See Appendix (1)

Construct validity

Table (1) reflects the correlation coefficients of the 28 items of the four domains, acceptable correlation levels of 0.609–0.869 reflect the construct validity of the questionnaire.

Discriminant validity

To ensure that each domain should reflect a different psychological skill, we needed to check that subscales that should not be related to each other will not be or correlate with a minimum degree. Table (2) supports the discriminant validity between the subscales of the "Psychological Skills" questionnaire. We applied Fornel and Larcker criterion to assess discriminant validity (AbHamid, 2018). Correlation coefficients ranged between .71 and .75. They were all under the 0.85 value.

Reliability

For reliability field testing, we distributed the questionnaire to a random sample of 30 students attending swimming classes as target population judges outside of the study sample. They voluntarily and willingly responded to the questionnaire. The alpha reliability coefficient for all four domains was calculated. A score ranged between .93 and .98 reflected that the scale was reliable.

The "Psychological Skills" questionnaire was rated on a five-point Likert type scale from (1) (never) to (5) (always), with a midpoint of (3) for the (moderately), (2) for (occasionally), and (4) for (usually). The estimated answer time was between 15–20 minutes.

The applicated version of the "Psychological Skills" questionnaire was now ready to be distributed to the participants of the study. Participants were advised to ask for clarification of any item when needed.

Internal Reliability: we calculated the Cronbach alpha of each domain and the total score to check the internal consistency of the items within each domain, for all participation responses. All subscales were internally reliable with an alpha coefficient ranging between .813 and .917. According to Taber, (2018) these figures are considered high, see table (3).

A classification criterion for participants' responses based on the five-point Likert type scale was determined as follows; 1–2.33 (low), 2.34–3.66 (moderate), 3.67–5 (high).

2.2.2. Students' academic achievement:
To calculate students' academic achievement, the instructors of the swimming courses conducted a valid and reliable assessment as a pre-midterm, midterm, and final exam throughout the semester, see Appendix (2). The assessment included performance tests and theoretical tests (paper and pencil tests) for each level. All tests had proved to be reliable; Cronbach alpha ranged between 0.83 and 0.88. Final grades were calculated out of 100 for all study sample, then converted to alphabets (A, B, C, D, E, F) reflecting academic achievement level as follows; (90–100 (A; excellent), 80–89 (B; very good), 70–79 (C, Good), 60–69 (D, fair), 50–59 (E; poor) and < 50 (F; very bad)).

2.3. Data Collection
The primary population of the study was 314 students, out of which an opportunity sample of 30 students outside the study sample responded to the 28 items instrument for reliability and validation purposes. The questionnaire was then distributed to 284 students by the second and third authors, 24 questionnaires were illuminated for insufficient data, which leaves us with 260 participants (83% percent of the population), we asked the students to carefully read and answer the "Psychological Skills" questionnaire items, and check the answer that mostly corresponds to them, we advised them to answer all items as possible, and assured them that their responses would be anonymous and for scientific research purposes only. We appreciated their time, effort, and voluntary contribution. The study was conducted during the first semester of the academic year 2019/2020. Permissions and ethical approvals were obtained.

As for the students' academic achievement data, swimming instructors, in cooperation with the authors of the study to achieve reliability and consistency, had concluded all required pre-midterm, midterm, and final tests. During the assessment process, swimming instructors tended to be fair, avoid stereotyping and biases, and students were advised to demonstrate their best.

2.4. Analyzing of Data
To fulfill the first objective of the study, descriptive data were generated to study the nature of psychological skills among the students of the swimming courses (Means and standard deviation). Then, we verified that the distribution of the collected data did not show any evidence of skewness or kurtosis, which means that the distribution was roughly symmetrical and not too flat or too peaked. An independent-sample t-test was conducted to study the differences according to gender and swimming course level (intermediate and advance swimming courses). (ANOVA) was conducted to investigate the differences according to academic achievement level (A, B, C, D, E, and F) and university (JU, YU, and MU), and the Pearson correlation coefficient was used to examine the relation between the psychological skills and the students' academic achievement level. A p-value of ≤ 0.05 was considered significant. All analyses were carried out using SPSS, version 27.

3. RESULTS

Results of descriptive statistics indicated that all four psychological skills of the participants were at a moderate level. Students thought that self-confidence (M = 3.64 (0.72), RI = 72.8%) was the most acquired psychological skill, followed by sport achievement motivation, attention, and stress management.

Table 5 shows students' moderate level of confidence (M = 3.64 (0.72), RI = 72.8), most of the domain items were moderate except for three high-level items, which were; "I manage my time effectively while in class," "I am always ready to perform during the class," and "I feel relaxed

and reassured when the swimming class starts"; (M = 3.74 (0.94), RI = 74.8), (M = 3.73 (0.98), RI = 74.6), and (M = 3.73 (0.91), RI = 74.6) respectively.

Table 6 shows students' moderate level of sport achievement motivation (M = 3.61(0.67), all of the domain items were moderate except for one high-level item, which was; "I work hard to fix my mistakes right away"; (M = 3.73 (0.85), RI = 74.6).

Followed by a moderate level of the attention domain (M = 3.56 (0.67), RI = 71.2) as shown in table 7, all domain items were moderate with no exception.

And finally, in the stress-management domain (M = 3.51 (0.65), RI = 70.2), tables 8 show that all items were at a moderate level.

To fulfill the second objective of this study regarding the differences in psychological skills according to socio-demographic variables. The results were as follows;

Gender

By comparing psychological skills between male and female participants, results revealed significant differences in favor of female participants. On the psychological skills scale, female students reported higher levels of sport achievement motivation (t (260) = 3.99, p = .000), self-confidence (t (260) = 3.93, p = .000), stress-management (t (260) = 4.41, p = .000), and attention (t (260) = 4.31, p = .000) compared to their male peers, see Table (9).

Swimming course level

By comparing psychological skills according to swimming course level, results revealed a significant difference in favor of students of the advanced swimming course. They reported higher levels of sport achievement motivation (t (260) = 3.25. p = .001), stress-management (t (260) = 2.81, p = .005), and attention (t (260) = 3.33, p =.001) compared to their peers of the intermediate swimming classes, see Table (10).

Academic achievement level

Results related to academic achievement level revealed significant difference in sport achievement motivation, self-confidence, stress-management, and attention; F (5,254) = 3.95, p=0.002 and F(5,254) = 5.59, p = 0.000, F(5,254) = 6.21, p = 0.000, F (5,254) = 4.37, p = 0.001 respectively. Post hoc analyses using the Scheffé post hoc criterion for significance indicated that; sport achievement motivation, self-confidence, stress-management, and attention were significantly higher in the academic achievement level (A) (M = 3.91, SD = 0.66), (M = 3.98, SD = 0.68), (M = 3.91, SD = 0.57), (M = 3.93, SD = 0.59) than the (E) group (M = 3.23, SD = 0.96), (M = 3.09, SD = 0.86), (M = 3.08, SD = 0.84), (M = 3.15, SD = 0.82) respectively. Also, self-confidence and stress-management were significantly higher in the academic achievement level (B) (M = 3.70, SD = 0.65), (M = 3.57, SD = 0.57 than the (E) group (M = 3.09, SD = 0.86), (M = 3.08, SD = 0.84 respectively, see Table (11a-b).

University

Results related to the university attended revealed significant difference in sport achievement motivation, self-confidence, stress-management, and attention; F (2,257) = 18.24, p = 0.000 and F(2,257) = 31.81, p = 0.000, F(2,257) = 7.30, p = 0.001, F (2,257) = 22.45, p = 0.000 respectively. Post hoc analyses using the Scheffé post hoc criterion for significance indicated that; sport achievement motivation, self-confidence, stress-management, and attention were significantly higher in the JU group (M = 3.90, SD = 0.58), (M = 4.04, SD = 0.57), (M = 3.69, SD = 0.58), (M = 3.88, SD = 0.63) than the YU (M = 3.42, SD = 0.69), (M = 3.40, SD = 0.72), (M = 3.39,

SD = 0.69), (M = 3.36, SD = 0.63) and MU group (M = 3.39, SD = 0.31), (M = 3.34, SD = 0.46), (M = 3.36, SD = 0.45), (M = 3.32, SD = 0.47) respectively, see Table (12 a-b).

To fulfil the third objective of this study regarding the relation between psychological skills and academic achievement. Table 10 shows positive and significant relations between all psychological skills; sport achievement motivation. self-confidence, stress-management, attention, and academic achievement level as follows; sport achievement motivation ($rs(df) = .16$, $p = .011$), self-confidence ($rs(df) = .17$, $p = .005$), stress-management ($rs(df) = .24$, $p < .001$), and attention ($rs(df) = .20$, $p = .001$). See table 13.

4. DISCUSSION

Results of this study revealed that the participants acquired all four psychological skills at a moderate level. Students agreed that self-confidence was the most acquired psychological skill, followed by motivation, attention, and stress management. Similarly, AlShahed, (2006), Ay, (2019) and AlDababseh et al., (2017) concluded that swimmers acquire moderate levels of self-confidence, attention, and stress management. On the contrary, Boostani, et al (2013) and Yousef, (2015) revealed high levels of psychological skills for Karate players, and for volleyball players. Chu, et al, (2010) found that the psychological skills' levels of table tennis players were low.

Participants of all swimming classes were highly confident and relaxed, they were ready to perform new swimming skills and believed they could manage their time effectively throughout the classes. Yet, they were moderately reassured and thought that their technical abilities enabled them to perform high-level swimming skills and sought to achieve their goals. They approached the swimming pool fearlessly and dealt with unexpected situations during their swimming lessons with moderate confidence. Accordingly, self-confidence was the most acquired psychological skill for swimmers (AlShahed, 2006), and for field training students (Tarawneh, 2016), yet it came in third place for basketball players (Kuraizi, 2008) and fourth for volleyball players (Hatamlah et al., 2011). Nijmah, (2014) emphasized the important role self-confidence play in improving learning and performance.

Sport achievement motivation skill was next in line; results indicated moderate levels of motivation; participants sought to perform difficult swimming tasks; excellency was their main goal. They tried their best, worked hard, and trained for extra hours to improve their swimming skills. They had control over things when responsible and could manage and motivate their teammates. Nevertheless, they were highly motivated to fix any mistakes or difficulties they would encounter immediately.

Following was a moderate level of attention; participants listened carefully to the instructions, focused on all their teammates' performance, they were able to spot their optimum performance or mistakes and were aware of different places in the pool while carrying out the swimming tasks, they even kept track of the time left for class, all at a moderate level. Yeung (2001) and Hadef, (2018) emphasized the importance of self-awareness of abilities, skills, and competencies to maintain attention and focus, and achieve one's goals and tasks. Younes, (2015) concluded that a student gets distracted with too much information and details concerning the presented skill, which might result in lack of his attention and concentration.

Stress management came last at a moderate level; participants felt they could control their emotions and calm down quickly if they got triggered or upset, they were not afraid to perform any difficult swimming skill, they swam calmly, did not fear spectators, and accepted criticism.

All psychological skills' dimensions of female participants were significant in favor of females compared to their male peers. They were more focused, concentrated, confident, motivated to achieve their goals, and sought to manage their stress. These results are in accord with Hatamlah et al., (2011) who revealed the positive significance of psychological skills in favor of female volleyball players. However, the findings do not support Tarawneh, (2016) and Kumar & Bhukar (2013) who concluded that field training course male students were positively significant. Nevertheless, AlShahid, (2006) revealed no significant differences in psychological skills according to gender.

Participants enrolled in advanced swimming courses reported higher levels of sport achievement motivation, stress-management, and attention than their peers in the intermediate swimming classes. In contrast, there were no significant differences in self-confidence. This may be attributed to the students' advanced technical and skill level in the advanced swimming course, who have already passed the intermediate swimming course, and were more experienced.

Results related to academic achievement level revealed significant differences in sport achievement motivation, self-confidence, stress-management, and attention. These skills were higher in the academic achievement level (A) compared to the (E) group. Also, self-confidence and stress-management were significantly higher in the academic achievement level (B) compared to the (E) group.

Results related to the university attended revealed significant differences in sport achievement motivation, self-confidence, stress management, and attention in favor of JU group. JU is located in Jordan's capital, Amman, where availability and access to swimming pools for recreational or training courses are more applicable than in other cities in Jordan. Also, the school of sport sciences in JU plays an active role in marketing swimming courses for the community. This result disagrees with Tarawneh (2016) who revealed no significant differences between university students according to self-confidence.

There was a significant positive relation between all psychological skills and academic achievement level. These skills played an active role in learning how to swim. Students' self-confidence and motivation to achieve encouraged them to practice without any fear or hesitation. Attention and concentration skills enhanced their motor learning and training process. Vice versa, good academic achievement would have boosted the students' psychological skills. Moderate levels of psychological compatibility provide swimmers, football players, volleyball players, badminton, and table-tennis players with the appropriate ground of demonstrating competencies, motivation and abilities to express their thoughts and feelings more, which eventually raises their academic achievement (Ay, 2019; Hidaya, 2011; Huzair, 2017 Mohammadzadeh & Sami, 2014; Zubeidi, 2011).

5. CONCLUSION

The purpose of the current study was to examine the psychological skills of students enrolled in intermediate and advanced swimming courses at the schools of sport sciences in Jordanian universities, the differences in students' psychological skills (dependent variables) according to different independent variables; gender, swimming course level (intermediate and advanced swimming courses), academic achievement level and university. And to highlight the relation between students' psychological skills and their academic achievement. The findings indicated a moderate level of psychological skills, significant differences in psychological skills level in favor of female students, A students and JU, and significant positive relation between psychological skills and academic achievement.

6. RECOMMENDATIONS

These findings could be used to design and implement comprehensive psychological skills-based study plans of swimming courses and in different sport fields. Also, to conduct specified training and guidance courses in this domain to improve psychological skills, teaching competencies, and academic achievement.

7. LIMITATIONS

A possible limitation in this study is the limited access of students to swimming pools, and the rare occasions students get to practice swimming in their spare time.

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COVID-19 versus Physical Activity in the Context of University Students

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Abstract

PURPOSE: *The aim of the paper is: (1) to outline a general view of the implications of the population's sporting activity restrictions in light of the government's measures related to COVID-19; (2) to present, in the broader context of the issue, the results of the Institute of Physical Education and Sport (hereafter referred to as the IPES) from February 2021, to investigate whether, during the ongoing pandemic associated with the spread of the COVID-19 disease, at a time of restriction of physical activities and cancellation of contact physical education (hereafter PE) in schools, students of the VSB-TUO engage in specific sport and physical activities within their possibilities.*

METHODS: *To meet the objectives of the research survey, the method of questioning – an online questionnaire – was chosen. The total number of the university students who were addressed was 1164-first-year students from all seven faculties of VSB – Technical University of Ostrava (hereinafter referred to as VSB-TUO) answered. The questionnaires were subjected to the statistical classification of the first-level data. Another method was the comparative method of working with documents, comparing with the results of comparable questionnaire surveys from 2015 and 2018, and relevant scientific discussion in this context.*

RESULTS: *The results of the research confirmed that first-year students of all VSB-TUO faculties, who as graduates of the relevant secondary school could no longer complete the subject Physical Education due to pandemic measures, preferred unorganized physical activities in accordance with the situation, such as walks, including walking the dog. 34.8% of respondents answered that they "did not miss sport" or that they "were not interested in sport at all". A high percentage of respondents (44.3%) admitted that they "did not miss" organized Physical Education lessons "at all", while some (31.3%) stated that thanks to the subject Physical Education, they were able to play sports "at least once a week".*

CONCLUSION: *Due to the high number of interviewed first-year students of VSB-TUO, it can be assumed that we would reach similar results in a vast population of peers, and the findings can be generalized. The study summarizes the latest reflections on impersonal forms of the teaching of Physical Education on the motivation and intensity of sports and physical activities within the general level of foreign surveys as well. Relevant research in our cultural setting coincidently concludes the indispensable importance of the growing role of regular physical activity in school, family and leisure, including its attractive innovation during the lockdown pandemic.*

Introductory note

The rapid and inexorable worldwide spread of SARS-CoV-2 – the coronavirus which causes the disease known as COVID-19 – presents Physical Education professionals with new and unforeseen challenges related to an unpredictable situation. Campus closures due to the pandemic created an urgent need in schools and higher education institutions to consider available alternatives to in-person programmes. Most notably, online Physical Education, which previously stood in the periphery of the field's vision (Ferdig & K. Kennedy; 2014, pp. 201–222), is now a subject of central focus. Online Physical Education can offer the swift response needed in the context of COVID-19. This specific way of teaching is a potential solution to a problem and part of a growing presence in education, marked by the increasing viability of virtual alternatives to traditional

brick-and-mortar format classes and in-person instruction. While most school systems typically require daily physical attendance during weekdays and bring students together in large groups to learn in a collective endeavour, the closing of schools and the months of social distancing have shifted the site of learning to the home, where students learn primarily alone or with the help of family members through the technologies available. Physical Education (PE) and organized active recess time that would typically occur in school have been either cancelled or made a part of digital home-schooling. Distance education and online learning have been gaining momentum in recent years (Kooiman, 2017), and technologies, such as virtual reality and artificial intelligence, offer new possibilities for education. The present pandemic in such a perspective has merely punctuated the need to explore integrating such innovations into 21st-century teaching and learning. Traditional Physical Education has faced challenges related to equity and access, such as language barriers, funding limitations, and inadequate physical spaces for participation (Collin et al., 2020).

An important question at this critical juncture in the evolution of the profession is whether online Physical Education can be optimized in ways that leverage the efficacy and impact of in-person Physical Education programmes for diverse communities and settings. Notably, a body of evidence already exists to suggest that, when supported with appropriate pedagogical practices, digital technologies, such as social media, blogs, video analysis, and video games, can be effectively integrated into Physical Education to enhance students' learning (Bodsworth & Goodyear, 2017). Barriers and facilitators to using digital technologies in the Cooperative Learning model in Physical Education (Bodsworth & Goodyear, 2017). Moreover, findings from a recent study reflecting new challenges of pandemic situation, have shown that secondary school students enrolled in online health and Physical Education had more favourable perceptions of their learning experience (e.g., teacher feedback and responsiveness, understanding and interest related to the content, and perceived health gains) compared to students enrolled in in-person programmes (Williams at al., 2020)

All current developments in society have been marked and subjected to the fight against the spread of the Covid-19 viral disease in our public space for many months. The effort of society and the imperative of each individual's behaviour and actions is to protect themselves, their families and the people around them from COVID-19, while maintaining the usual quality of life. The ongoing COVID-19 pandemic is currently a global societal crisis affecting all areas of human activity, including sport.

Temporary measures to prevent the spread of COVID-19 also apply to the physical activities of the general population. The need to stay mainly in the home environment has led to a reduction in physical activity and exacerbation of the negative attributes of a sedentary society. The result is sedentary, physically inactive activities in most professions, in the environment of households and individual forms of transport (Sekot, 2015). Cancellation or extreme restrictions of the school subject Physical Education, organization of sports clubs, and closed sports grounds make it impossible in a completely unprecedented way to conduct sports leisure activities, which has a negative effect on the physical fitness of children, youth and adults, and, in the medium or long term, also on their wellbeing, and, therefore, the state of health. At the same time, physical activity is one of the strongest weapons in the fight against diseases of civilization, it serves to strengthen physical and mental health (Sekot, 2015; McElroy, 2002).

The importance of sports activities

Experts, medical doctors and educators had pointed out the crucial importance of regular physical exercise and the consequences of physical inactivity long before the outbreak of the COVID-19 pandemic (McElroy, M. 2002; Nieman et al. 1990). With increasing urgency, it is emphasized

that regular physical activities as an integral part of lifelong individual "rituals" are a prerequisite for the individual's overall development on the path to physical and mental health. E.g., exercise performed with a medium intensity of 20–30 minutes 3–4 times a week significantly strengthens the immune system and thus reduces the risk of possible viral infection. (Nieman et al.; 1990). At the same time, it is recalled that, on the other hand, a single high-intensity exercise in untrained individuals can lead to impaired immunity and an increased risk of infection. (Simpson et al., 2020)

During the COVID-19 pandemic, the WHO (World Health Organization) currently recommends moderate-intensity physical activity in the public virtual Internet space for 140 minutes a week (WHO, 2021). Adequate physical activity is prevention of many diseases, supports the proper function of the immune system, and contributes to better coping with stressful situations. Exercise is an integral part of mental hygiene, and stress management appears to be essential in demanding quarantine conditions and implementing all pandemic measures (Wright and MacDonald, 2010). Specific recommendations of sport science relating to given populations are recommended (Powell, et al., 2018).

In their article dealing with physical activity during the COVID-19 pandemic, the authors Pudilová and Tuka from the Czech Society of Sports Medicine emphasize several rules for physical activity of the population that would not contradict government measures and are, at the same time, safe for those who perform physical exercises (link https://www.kardio-cz.cz/2020-03-28-pohybova-aktivita-v-dobe-pandemie-covid 19):

- Avoid very high-intensity physical activities.
- Do not exercise if you have symptoms of incipient viral infection.
- After the viral infection has subsided, start physical activity slowly.
- Adjust the intensity and strenuousness of physical activity to your personal level of training.
- It is necessary to consider the previous restrictions resulting from your internal diseases or diseases of the musculoskeletal system.
- If any pain occurs during a particular physical activity, do not try to overcome it.
- Do not forget a regular drinking regime, a healthy diet, and enough sleep.
- Even when releasing the quarantine, it is better to avoid indoor sports grounds and places with a higher concentration of people, especially if you are being treated for a chronic disease or you belong to the risk groups.
- Be in a positive mood. Remember that keeping yourself merry and cheerful is key to staying healthy.

The idea that physical activity has a positive effect on physiological functions was developed at the end of the last decade to claim that physical activity can positively affect the symptoms of stress due to health threats and, last but not least, contribute to reducing stress related to isolation and limiting social contacts (Powell et al., 2018). The role of Physical Education lessons for pupils and students are accented is accented as an indispensable part of the school curriculum (Mužík & Krejčí, 1997).

The impact of COVID-19 on physical activity and wellbeing

Since its onset, the COVID-19 pandemic has spread to almost all countries of the world. Social and physical distancing measures, lockdowns of businesses, schools and overall social life, which have become commonplace to curtail the spread of the disease, have also disrupted many regular aspects of life, including sport and physical activity. This policy briefly highlights the challenges COVID-19 has posed to both the sporting world and to physical activity and wellbeing, including marginalized or vulnerable groups.

The global outbreak of COVID-19 has resulted in the closure of gyms, stadiums, pools, dance and fitness studios, physiotherapy centres, parks, and playgrounds. Therefore, many individuals are not able to actively participate in their regular individual or group sporting or physical activities outside of their homes. Under such conditions, many tend to be less physically active, have longer screen time, irregular sleep patterns, and worse diets, resulting in weight gain and loss of physical fitness. The benefits of periodic exercise in such new and unpredictable situations have proved that physical activity is very helpful, especially in anxiety, crisis, and fear. There are concerns that, in the context of the pandemic, lack of access to regular sporting or exercise routines may result in challenges to the immune system, physical health, and it may lead to the commencement of or exacerbating existing diseases that have their roots in a sedentary lifestyle (Roe et al., 2021)

Lack of access to exercise and physical activity can also have mental health impacts, including stress or anxiety that many will experience in the face of isolation from everyday social life. In addition, possible loss of family or friends due to the viral infection and the impact of the virus on people's economic wellbeing and access to nutrition will exacerbate these effects.

For many, exercising at home without any equipment and limited space can still be possible. For those whose home life can involve long periods of sitting, there may be options to be more active during the day, for example, by stretching, doing housework, climbing stairs or dancing to music. In addition, particularly for those who have internet access, there are many free resources on how to stay active during the pandemic. Physical fitness games, for example, can be appealing to people of all ages and can be used in small spaces. Another important aspect of maintaining physical fitness is strength training which does not require large spaces but helps maintain muscle strength, which is especially important for older persons or persons with physical disabilities.

METHODS

A survey method, specifically an electronic questionnaire available at http://accounts.google.com, was used, including statistical processing of the data using the 1st stage classification and graphical display in the form of pie charts.

The respondents were first-year students of all seven faculties of VSB – Technical University of Ostrava. Physical Education is a compulsory subject in the first year. A total of 2,302 students enrolled in Physical Education in the University Edison electronic system as of 15 February 2021 were contacted. Altogether, 1,164 students finally participated in the survey, which is 50.54% of all respondents.

The questionnaire included introductory information for the students, a request to complete the questionnaire, and information on the research purpose. The questionnaire was anonymous and contained eight questions, seven closed questions and one semi-closed question. Altogether, 758 males and 406 females participated in the survey. The most significant number of them were from the Faculty of Economics of VSB-TUO, the largest faculty at VSB-TUO.

Individual questions of the survey:

1. Do you miss the opportunity to play sports due to restrictive government measures?
   Yes
   No
   I am not interested in sports.

2. In the pandemic period restricting physical activity you:
1. Exercised at home.
2. I took the opportunity to play sports outdoors.
3. I did not do much physical activity.
4. I did not do any physical activities.

3. As part of compliance with the government's measures related to the COVID-19 pandemic:
1. I exercised regularly at home.
2. I went for walks, including walking the dog.
3. I practised brisk Nordic walking.
4. I jogged.
5. I cycled.
6. I went cross-country skiing.
7. I did other physical activities.

4. When the VSB-TUO outdoor sports facilities – gym, aerobic hall (with restrictions related to the number of people doing exercises) – were open (with restrictions) due to epidemic measures:
1. I used this possibility frequently.
2. I used this option occasionally.
3. I did not use this option at all.

5. Training videos were regularly posted on the YouTube channel of the Institute of Physical Education and Sport (IPES).
1. It inspired me to exercise at home.
2. I did not use the videos for home exercise.
3. I did not know about them.

6. TV classes organized by the Institute of Physical Education and Sport:
1. I miss them very much.
2. Thanks to the lessons I had the opportunity to do sports at least once a week.
3. I do not miss them at all.

7. Faculty
EKF
FAST
FBI
FS
FMT
HGF
FEI

8. Sex
Female
Male

RESULTS

Opinions of university students on the changing conditions of Physical Education

Physical Education at schools is thus limited or completely suspended during the fight against the pandemic. Due to the nature of this subject, a remote approach is almost impossible; in addition, preference in teaching was given to theoretical subjects. The term school Physical Education refers to children, youth and adults from primary and secondary schools to universities. Gradually, Physical Education teachers began to engage in contact with pupils and students using mobile applications or online teaching. Without previous experience, they started shooting training videos, encouraging regular sports activities, and emphasizing the importance of indoor activities.

Teachers at the Institute of Physical Education and Sports (hereinafter referred to as IPES, formerly the Department of Physical Education and Sports – DPES) were also fully aware of the risks involved in banning full-time Physical Education. The impossibility of contact with students led to the severance of relations between the IPES (teaching, winter and summer sports courses) and students of all grades. The consequences of the cancelled university PE at VSB-TUO for first-year students of all faculties are particularly noticeable in terms of the offer of physical exercises and the equally significant level of limiting social contacts. Students of the first years of universities in the academic year 2020/2021 are also those who completed their secondary school studies at the pandemic and were affected by epidemiological measures in the final year of secondary school. After about 14 days of full-time teaching at the university, they were again dependent on the distance form of education. They did not have enough time to get acquainted with the course of study at the university, they did not gain contacts with students in higher years, and probably they did not even know the other members of the created study groups.

IPES at VSB-TUO has long been interested in the opinions of VSB-TUO students on teaching PE, and their leisure-time physical activities. Whenever it has been possible, IPES has always adapted the offer of physical exercises to the requirements of the respondents – VSB-TUO students. Research surveys with the aim of finding out students' opinions on teaching PE and its quality, on the possibilities of sports at VSB-TUO, on the level of the sports environment has been conducted repeatedly since 1998, the number of respondents ranged up to 500 respondents. The survey took the form of filling in questionnaires in paper form, since 2015, using modern electronic technologies. The last research before the COVID-19 pandemic took place in 2018 (Durdová, 2018); 530 respondents, students of all years and all faculties of VSB-TUO took part in the online survey out of 2469 students who had been addressed. We were interested in the choice of sport, in satisfaction with sports activities at VSB-TUO, in preferring a specific day and time to exercise during the day. We were also interested in how many times a week students use the IPES' offer for their leisure activities. This research survey showed a positive evaluation of the work of the IPES (23% of respondents were very satisfied with the programme offered, and 47.5% stated that they were rather satisfied, while only 5.8% were somewhat dissatisfied and 1.5% were very dissatisfied). Similarly, students evaluated the possibilities of PE and sport at VSB-TUO – 28.3% were very satisfied, and a total of 49.4% of respondents were satisfied. We also obtained very similar results as in the questionnaire survey from 2018 by the survey in 2015 (Sekot & Durdová et al., 2015). The discussed research is supposed as the fundamental explorational study of the proposed relevant topic, "the role of university study physical education for motivation and adherence of sportive activity". Hoping that virus limitation has been, not only for the time of being, alarming episode of our time.

The IPES has always been very focused on building a relationship with students interested in virus limitation sports. Most often, contacts took place during TV lessons, sports courses or during trainings of the university sports club (USC at VSB-TUO). The IPES has regularly organized

a number of sports events for students (or employees). It had a daily offer of physical activities in the afternoon and evening at the VSB-TUO sports grounds. The IPES has come up with a wide range of physical exercises during each exam period. The IPES has regularly organized traditional university-wide large sports events with the support of the Rector of the university – e.g. VSB-TUO Sports Day, VSB-TUO Technika Run running race, a weekly suburban sports camp for children of VSB-TUO employees, once a week exercises for school kindergarten children.

The last targeted survey of VSB-TUO students under the auspices of IPES took place in February 2021, at the time of the PE ban and the consequences of measures related to limiting the spread of COVID-19. In this survey, we were mainly interested in first-year students. As previously mentioned, these students did not have continuous teaching of PE in the second half of the last year at the secondary school (2019/2020) or in the winter semester of the academic year 2020/2021.

The online questionnaire survey in February 2021 was attended by 1164 respondents, the 1st year students of all seven faculties of VSB-TUO. There were 758 men and 406 women, 32.2% of whom were students of the Faculty of Economics and 22.8% of the Faculty of Electrical Engineering and Computer Science. The other five faculties did not differ much in the number of respondents, and it was 10 -16% of the total number of respondents.

When asked whether students currently, at the time of epidemiological measures, miss sports activities, 65.2% answered "yes, I do", 25.3% "No, I do not", and 9.5% answered that they were "not interested in sport".

Another question concerned physical activities that respondents could perform themselves during epidemiological measures. The answers can be summarized as follows:

- I did exercise at home (42.5%),
- I took the opportunity to play sports in nature (31.4%),
- I did not regularly engage in physical activities (22.3%),
- I did not perform any physical activities (3.8%).

By asking about specific regularly performed sports activities, the following order of activities was created:

1. walks, including walking the dog,
2. regular exercise at home,
3. running,
4. cycling,
5. Nordic walking
6. other physical activity.

In other questions, we were interested in the involvement of respondents in activities offered by the IPES VSB-TUO at the time of the release of epidemiological measures (outdoor sports ground, gym, aerobic hall – always in compliance with the permitted number of people and all epidemiological measures). 74.1% "did not use this option at all". This fact is certainly influenced by the fact that students accommodated at VSB-TUO university dormitories moved out and went to their places of permanent residence. 15.4% of respondents used the opportunity to play sports at VSB-TUO sports grounds (albeit with restrictions) "very often" and 10.6% of respondents "occasionally".

When, due to the worsening pandemic situation in the Czech Republic, all sports activities were banned, the IPES offered short video training (aerobic exercises, stretching, Pilates, circle training) on its Youtube channel, which could be used for doing exercise at home.

When asked whether these videos were a stimulus or inspiration for doing exercise at home, the vast majority of respondents (73%) answered that they did not know about these videos at

all. At the same time, notifications about the possibility of training online under the guidance of the IPES teachers were announced on the IPES website or the IPES Facebook.

The answer of the respondents to a specific question also leads to reflection: "Do you miss organized Physical Education at VSB-TUO?". Their answers:

- I miss it very much (24.4%),
- Thanks to teaching PE, I had the opportunity to play sports at least once a week (31.3%),
- I do not miss it at all (44.3%).

It should be reminded again that the respondents – first-year students, due to government measures and the introduction of distance learning, practically did not have time to look around the university, did not get acquainted with the university environment and university specifics. They did not find opportunities for sports at VSB-TUO and did not get acquainted with the offer of sports activities of IPES. Since mid-September 2020, when the distance form of teaching was introduced, it has been impossible to play sports and use the well-equipped VSB-TUO sports grounds. We firmly believe that we will once again continue the regular teaching of PE, the traditional offer of the IPES sports activities in the academic year 2021/2022. Unfortunately, we have lost the students of the first years of the academic year 2020/21 and let us hope that the IPES will have to strive for them with a well-established offer of sports activities in the nearest possible future.

CONCLUSION

The COVID-19 pandemic has forced an unprecedented global shutdown that has dramatically changed what it means to be a teacher, a student, and even a parent in the months that schools have been closed. While most school systems typically require daily physical attendance during weekdays and bring students together in large groups to learn in a collective endeavour, the closing of schools and the months of social distancing have shifted the site of learning to the home, where learning happens primarily alone or with the help of family members through the technologies available. Physical Education and organized active recess time that would normally take place in school have been either cancelled completely or made a part of digital home-schooling. In different cultural, economic and political settings, social distancing measures require people to stay apart from each other and avoid gatherings with anyone other than their closest family members. These measures have resulted in the cancellation of all organized afterschool sporting activities. Across the world, millions of students have experienced the disruption of their regular routines for learning and physical activity (Roe et al., 2021)). If the demonstrable fact that regular sports and physical exercise not only affect physical and mental health but that they strongly affect the immune system of those who do physical activities is accepted, then a one-year break from PE in the case of children and adolescents can have serious, as well as far-reaching consequences. If the relationship to sports is not supported in the family (Sekot, 2019), the absence of PE, closed playgrounds, and sports grounds can negatively affect the health of children, youth, and the general population. In this context, the socio-psychological and highly socializing significance of Physical Education, physical exercises and games cannot be underestimated. Joy, relaxation, and healthy competition in friends' company during physical activities lead to positive feelings and moods to stress reduction.

If sport is not part of the family or individual lifestyle, it will be the duty of Physical Education teachers, sports coaches, and all sports activists to try to return children, young people, the general public, and sports grounds and encourage regular diverse sports activities.

COVID-19 continues to represent the single biggest challenge to contemporary community sport globally. Compliance with social distancing policies, strict return-to-play protocols, and COVID-19 specific training has, perhaps, forever changed the way that children and young people engage in organised sport. Within this context, and while many children and families seek to re-engage with community sport, we have an obligation to ask questions about how the pandemic has impacted youth sport, understand the short- and long-term consequences, and explore what (if any) opportunities can be seized to assist and improve future participation and retention. Furthermore, last but not least, search if such an unprecedented situation could reveal new ways, horizons, or methods to motivate children and young people to regular sportive activities and adherence to the sport as an integral part of lifestyle(s).

Everyone in the sports community is feeling the impact of COVID-19. Events and competitive seasons at all sports levels are being cancelled, and training facilities are closing. Athletes, coaches, parents, and sport stakeholders are scrambling to develop contingency plans. With no live events to cover, media sources focus on the Coronavirus pandemic, which could further exacerbate everyone's concerns. Fortunately, mental performance and mental health practitioners and organizations are helping to mitigate the effects of this highly fluid situation through online support. A vital step to search for and find a solution to how parents, peers, coaches, and sports organizations can effectively engage with each other during the crisis and during return to play.

In growing urgency, the educational institutions have to take into account that also for parents, it is recommendable to be a positive role model (Sekot, 2019). No matter how young or old the children are, they will likely look for guidance to help them respond to these circumstances. And in the specific situation of distance learning and perhaps training, guidance from their teachers, coaches and parents in a unique and unrepeatable situation can help the children find productive, favourable, meaningful ways to spend that time, rather than spending hours and hours in front of a screen. Supporting children to stay busy helps them to avoid focusing all of their attention on the negative ramifications of the pandemic, such as event cancellations, school closures, and social isolation. Not being able to compete could be a potential identity crisis for some athletes. Therefore, it is a priority to let children and young people enjoy feelings of intensive physical sportive experiencing. School and parental investment can help ease the pain and confusion they might be feeling, helping children find ways to be productive, physically and mentally active, and take care of themselves physically and mentally in a pandemic situation.

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STUDIA SPORTIVA 2021/2

Match-fixing as a Threat to Sport: Ethical and Legal Perspectives

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Abstract

This article aims to show how match-fixing is a threat to sport, not only from an ethical but also from a legal perspective, and to explain the various challenges of combating match-fixing in sport on the national and international level. To achieve this, the first step of the article is to explain corruption in sport, the values of sport and their endangerment through match-fixing, and then the crucial factor of sport autonomy is explained. Further, the article discusses various national and international legal norms and measures in the fight against match-fixing. On the international level there is discussed the current state of play of the Council of Europe Convention on the Manipulation of Sports Competitions (the so-called Macolin Convention) and the Group of Copenhagen, as the follow-up network of national platforms. Finally, the article makes recommendations regarding the better investigation of match-fixing and concludes with a critical appreciation of findings in the fight against match-fixing.

Key words: *legislation in sport, negative aspect, match-fixing, corruption, integrity*

INTRODUCTION

In the world of sports, there have been many betting scandals spanning over the last two decades. Stakeholders have come to realize that values in sports have changed due to the commercialization and globalization of sport. In the White Paper on Sport, the European Commission mentioned that sport is confronted with new threats and challenges such as commercial pressure, corruption, and money laundering. (European Commission, 2007, 2). Thus, the spread of commercialization in sport has brought a fundamental change in values, and economic interest in sport is now becoming more critical. In particular, the internal ethical values of sport, such as fair play, respect, and self-discipline have now taken a shift towards the external values of the pursuit of power and money. (Trunz, 2016, 10). The economic potential of sport within the sports betting market brought the risk that matches could be influenced by illegal machinations. Numerous senior sports administrators have openly cited match-fixing as the biggest threat to sport, even as far as describing match-fixing as a more significant threat to the integrity of sport than doping. (EUROPOL, 2020, 5)

Sports participants recognize that no-one is immune to this phenomenon, and that anyone may become a victim either directly or indirectly, be they athletes, coaches, referees, administrators, betting companies and their customers, or spectators. Any sport is considered endangered where it is possible to bet; and thus, the whole sports industry is at risk of reputational damage, since intrinsic value has been compromised, affecting the credibility of the sport.

There exists match-fixing with the element of betting as well as match-fixing without the betting element (i.e. with only sporting implications). Match-fixing with the betting element is much more prevalent and significant due to the influence of criminal organizations of all levels. It is estimated that around $US140 billion is laundered every year through sports bets, which

means that organized crime launders more than 10% of its worldwide revenue through sports bets. (ICSS, 2014, 29) This percentage reflects only those manipulated matches of which we are aware, so that the real figures are unknown.

The state can regulate the sports betting market and can prosecute criminal activity only on its territory, whereas match-fixing with the element of betting occurs on an international level. To effectively fight against match-fixing, there is a need for international cooperation and a globally viable approach for combating game and match manipulation in sport.

Corruption in Sport

Corruption in sport is not fundamentally different from corruption in other sectors, except that it happens in sports circles. In sports corruption, individuals or groups are influenced by various factors that make them willing to abandon ethical and moral principles. When identifying them, it is necessary to focus on the modus operandi of individual corruptors, which, in a negative sense, means the characteristics of the implementation of corruption or the actors' means and methods.

Persons involved in individual cases of corruption usually stick together and agree a non-aggression pact, or omerta. Omerta is criminal solidarity and has its origins in an unwritten mafia code, which emphasizes the duty of confidentiality against the police, the authorities and foreigners; non-cooperation with authorities, government, or strangers; and the obligation to intentionally ignore and generally avoid interfering in the illegal activities of others, i.e., not to 'grass' (to inform law enforcement or the authorities when an individual is aware of a crime, witnesses it or is even its victim). Corruption involves ways of working that are typical of organized criminal organizations, in which people with corrupt practices organize themselves to create synergies that give them more power, influence, and money that they would never have accumulated if they acted individually and borrowed money legally and through legitimate channels. Corruption networks use the same structures, methods, and techniques as the mafia network. The problem arises for them when members of the association break this unwritten promise. EUROPOL reports that these criminal networks include investors, facilitators, and runners. At the so-called lower level are corrupted athletes, referees, club officials, player agents, etc. These actors coordinate their activities to manipulate those sports events to obtain a financial gain through betting. (EUROPOL , 2020, 5)

Values of Sport and their Endangerment through Match-fixing

In referring to the values of sport, I will treat legal and moral principles more or less interchangeably, since for my purposes in this essay the differences are unimportant. On the nature of the relation between moral and legal principles I rely on Honoré (2002), who argues that critical morality is the source of law.

According to the European Sports Charter of the Council of Europe, *"Sport means all forms of physical activity which, through casual or organized participation, aim at expressing or improving physical fitness and mental well-being, forming social relationships or obtaining results in competition at all levels.* (Council of Europe, 1992, Art. 2. paragraph i. a)

Sport has some basic principles that derive from the practice of sport itself. Parry outlines and justifies a 6-criteria conceptual analysis, which defines sport. Sport is 'human', 'physical', involves 'skill', 'contest', is 'rule-governed' and 'institutionalized'. If we take just two of them, 'rule-governed' and 'contest', it is obvious that these criteria require adherence to certain internal values of sport, such as equality, fairness, and justice. Without agreement on rule-adherence and the central shared values of the activity, there is no contest and there could be no sport. (Parry, 2020, 140).

From this we can see that the most important principle of sport is the principle of competition. If you do not have an opponent, you cannot compete. The second basic principle of sport is the

principle of fairness or fair play. The meaning of this principle lies in the agreement to compete against the opponent following the rules and fairly during the whole competition. It means that everybody should compete in fair circumstances, start from the same starting line, have the same equipment, and operate under the same rules. This follows another basic principle – the principle of equal opportunities, which presupposes that every sporting competition should take place under the same conditions which are valid for everybody.

When thinking about match-fixing, an important consideration is the feature of sport which has been described the "sweet tension of uncertainty of outcome" of a sporting contest. (Kretchmar, 1974, 26). At the beginning of every sporting competition the outcome of the competition is more or less uncertain, and this is one of the reasons why we are interested in sports, why sport is attractive to us and why sport has such a positive image. (European Commission, 2007, 3). Match-fixing puts this most important feature of sport into question, since it seeks to make outcomes less certain, or even (if it can possibly succeed in doing so) to eliminate uncertainty of outcome.

Trunz divides the threats to the external values of sport by match-fixing into six spheres. First are the increasing internationalization and commercialization of sport; second, the offshore states and non-transparent sports betting market; third, the large unregulated betting market in Asia; fourth, organized crime in the sports betting market; fifth, the addictive potential of bettors; and sixth, the particular danger in amateur and junior games. (Trunz, 2016, 8–18).

Internationalization in sport means that modern sport is no longer national but rather international. International sports organizations are created and influenced by their regional, national and continental sports associations, together with whom they must work and cooperate. Along with internationalization, sport has also been affected by massive commercialization, which has influenced the transition from amateurism to professionalism. Professional clubs gain income from club fees, ticket sales, sponsorship money, and equipment contracts, and also from intellectual property rights such as copyrights, trademarks, and media rights.

The sports betting market has also been developed for an international business community, with more than 8000 sports betting operators in the world. Importantly, around 80% of these operators are established in low tax rate territories or tax havens such as Gibraltar, Isle of Man, Malta, etc. (ICSS, 2014, 12) The internationalization of sports and the sports betting market makes it clear that match-fixing is not a national but an international problem.

Currently, football is the most targeted and manipulated sport by international organized criminal groups (OCGs) due to its worldwide popularity, financial dimension, and large turnover betting market. The money generated globally on football betting is reported to be annual €895 billion, and the estimated annual gross amount of bets in sports amount to €1.69 trillion. (EUROPOL , 2020, 15) Despite the fact that football remains the most targeted sport by international OCGs, tennis is also implicated, with an increase in the detection of match-fixing schemes in tennis (Hutchins, 2014, 52), in which Eurasian OCGs are highly involved. (EUROPOL , 2020, 2)

The second threat to sports values is the offshore states and the non-transparent sports betting market. The taxes collected from the sports betting business are in many countries used to finance sports associations and clubs. On the other hand, if bettors use online-based betting providers or the ones operating from offshore states – such as Malta, Gibraltar, or the Isle of Man, sport is losing these taxes and must search for replacement of these incomes. The income from the gaming industry creates a significant share of GDP. In Malta itself, at the end of December 2019, there were 294 companies licensed by the Malta Gaming Authority, including both online and land-based entities, which together generated €1.6 billion in terms of GVA in 2019, increasing the gaming industry's share in economic activity to 13.3%. (Yogonet Gaming News, 2020)

The third threat to sports values is the large unregulated betting market in Asia. The main difference between betting markets between Europe and Asia lies in the regulations. The markets are more regulated in Europe than Asia, where the betting markets are mostly unregulated and untransparent black markets.

The fourth threat to sports values is that organized crime in the sports betting market is highly active. Criminal organizations are interested in the sports betting market because of its great economic potential and the low risk of detection. Criminal organizations operating in the betting market have hundreds of agents or so-called 'runners' around the world, and this number of people involved makes it difficult to uncover cases. Betting activities in context of match-fixing allows criminal organizations to launder their money in the black market. It is estimated that organized crime launders more than 10% of its worldwide revenue through sports bets. (ICSS, 2014, 29) Organized criminals are engaged in match-fixing because of the low risk and high-reward activity with a view of potentially huge profits from betting markets. The working methods of these groups are mostly bribery, coercion, and blackmail. (Boeri & Battista, 2013, 107) The standard of proof in criminal cases is 'beyond a reasonable doubt', and the evidence from the investigation of match-fixing cases is mostly insufficient to reach this level of standard. For example, consider the case of two Brazilian football referees, Edilson Pereira de Carvalho and Paulo Jose Danelon, who faced criminal charges as being part of the match-fixing mafia, but later their criminal action was suspended due to insufficient evidence. (Godinho & Barbosa, 2013, 229)

The fifth threat to the values of sport is the possible addictive potential of bettors. The runners who usually try to fix a match look for vulnerable players. They might have financial or family problems, or they might be addicted to gaming, drugs, or prostitution. (EUROPOL , 2020, 11) If these addicted bettors are players or referees, it is easier to bribe them.

The sixth threat to the values of sport is the danger in amateur and junior games. A large fraction of match-fixing cases occurs in the amateur and junior sectors, which mostly cannot be detected due to a lack of resources. This lack of resources for the detection of fraud, and lack of surveillance systems of competitions in lower leagues, women's team sports competitions, and junior competitions also leads to the conclusion that the identified cases make up only the 'tip of the iceberg', and the real number of uncovered manipulated cases could be much bigger. (ICSS, 2014, 4)

Sport Autonomy as a Crucial Factor

At their 5th International Conference of Ministers and Senior Officials Responsible for Physical Education and Sport, held in Berlin 28–30 May 2013, the United Nations created a Declaration of Berlin, where there they stated that *"the autonomy of sports organizations is closely linked to their primary responsibility for the integrity of sport and the compliance with the general principles and international standards of good governance."* An organization cannot have autonomy, if it doesn't bear responsibility for its actions and doesn't follow international standards regarding good governance in sport.

The high degree of autonomy of sport is one of the fundamental problems of corruption in sport, since it creates space to circumvent society's rules. However, the responsibility for assessing corruption offences in sport is the responsibility of individual countries; corruption should, therefore, be assessed only based on national laws. The European Parliament also points out in its resolution of 11 June 2013 on organized crime, corruption, and money laundering that *self-regulation as a natural mechanism for tackling corruption in sport and betting on sports competitions has proved ineffective. Sports federations alone are not able to deal with these cases of corruption in their competence, and many cases need to be dealt with by national law enforcement authorities*. (Machová, 2015)

The autonomy of associations is limited by the rules and regulations of the society within which it operates. If associations, which usually take the legal form of civil associations, are not capable of taking responsibility for their actions or non-actions, the role of the state is to enforce the rule of law. Sport and sports associations went through the transformation from amateurism to professionalism. Most sports associations nowadays are in the mode of business companies with receipts and expenditures, but some of them are organisationally stuck in amateurism. This may be due to the fact that many people in the world of sport are working as volunteers but, on the other hand, these institutions should work professionally and are responsible to their members and also taxpayers, because sports associations are often partially subsidized by taxpayers.

Match-fixing

According to the United Nations, the key offence which occurs in match-fixing is bribery with money or another pecuniary benefit paid by the criminal person. The transfer of funds happens mostly through a third party to the direct actor in a match, such as a player or a referee, to manipulate the result of a particular sporting competition. (United Nations, 2016, 77)

It is not surprising that OCGs use sport to launder money acquired from illegal activities. The whole process of money laundering is completed after fixing a match – placing a bet and receiving money back through legitimate channels. This happens through betting operators, but it can also be achieved through buying or investing in clubs and players. (United Nations, 2016, 77)

Sport and sports betting have great economic potential. There is evidence that hundreds of sports competitions are manipulated by players and referees worldwide. (ICSS, 2014, 6) This form of match-fixing is a profit-maximizing form, which requires contacts and financial arrangements between gamblers, criminals, players, team officials and referees, umpires, judges, or other officials.

Players or referees are usually approached by criminal gangs, who are willing to pay them tens of thousands of dollars to control the game according to their instructions while making hundreds of thousands or even millions of dollars by betting on an almost certain result. The money spent on bribing individuals represents a negligible investment for betting gangs, which is within 10% of the potential return. (Perumal, 2014) In the current boom of online betting, where huge amounts of money are being wagered for popular sports matches, especially in Asia, the impact on the outcome of a competition or part of it is potentially huge and fundamentally untraceable. Especially in mega-events such as the World Cup and the Olympics, there are no regular betting patterns because it is mostly regular people, who do not bet regularly, who bet on these matches. This type of corruption can be detected mostly in cases where an unexpectedly large amount of money is placed on a relatively uninteresting match in a lower league – for example, when the usual amount of funds in a second-league football match increases several times. (Hill, 2008, 28) Match-fixing linked with betting activities is therefore a fundamental threat to sports as such.

Since the sports betting market has tremendous financial potential, it is no surprise that it attracts the interest of organized crime. Match manipulation and sports betting is a new way of investment, which is very hard to prosecute because most fixed matches and betting frauds occur on the international level. Match-fixing grew when the betting market went online and became international, while individual states had no jurisdiction beyond their own borders, and had to rely on international cooperation. In addition, the international betting market was very much unregulated, providing considerable opportunities to bet online in anonymous spaces. This provides attractive potential for money laundering, since bets can be placed in cash and without any check on where the money comes from, and this reduces risk. A criminal organization can invest some ten thousand euros in bribing a referee but can make betting gains of hundreds of thousands.

The issue of transnationality requires elaboration. A bettor can place an internet bet on a sports competition in another country, through betting operators from yet another country, whose online betting platform is accessible from almost anywhere globally, whilst based in a country where the betting market is unregulated. In addition, corrupt match-fixing activities occur through intermediaries in different countries, who place a bet on a lower league match. Law enforcement in that country is then confronted with corrupt activity occurring locally, whilst organized from elsewhere, with bets being placed in a third country.

There is also problem with transnational legal standards. A particular behaviour might be prohibited in one country, but not in the country where the betting platform operates. Furthermore, sports federations do not have the same investigatory power as do states, and so they must rely on cooperation and support with government and state authorities. If the state authorities are not interested in match-fixing or not capable of solving the problems of sports manipulation in certain countries, then sports federations have a fundamental problem.

One of the most famous match-fixers, Wilson Raj Perumal, said: "Money is the root of corruption and everyone's concern. Everyone needs money to take the next step in life, and those who do not have it are the most vulnerable. If you face players who have never had a lot of money and offer them a good amount for their troubles, they will rarely reject them." (Perumal, 2014) Active police investigations of affected matches are underway in more than sixty countries, approximately one-third of the world. (Forrest, 2014)

The Legal Basis on the National State Level

Match-fixing or corruption in sport is regulated in various countries according to various codes. Some of them regulate match-fixing with general provisions in Criminal Codes, others through Gambling Acts, when match-fixing involves an element of betting. Many countries have made match-fixing a separate criminal offence in recent years rather than rely on existing general provisions incriminating fraud, bribery, cheating, corruption, or deception. (IOC, 2016, 70)

Finland and Austria have regulated cases of match-fixing under the general crime of fraud. Norway is using general criminal law provisions on fraud and corruption. Sweden is also using general provisions on active and passive corruption. Luxembourg, in cases of sports bribery, uses general provisions on corruption. (Gábriš, 2017, 17)

Separate offences have been created either within the general criminal codes, e.g., in Australia, Bulgaria, France, New Zealand, Spain, or Ukraine. (IOC, 2016, 70–71) Separate offences have been created either within the country's law on sports or gambling, e.g., in Argentina, Brazil, China, Italy, Greece, Korea, Malta, Poland, Portugal, Russia, Switzerland the UK. Northern Ireland is one of those countries which regulate match-fixing under the Gambling Act; specifically, they consider match-fixing as fraud under the law on gambling. In the case of Switzerland, the legal basis on the national level influences not only Switzerland, but is also extended on the international level. Switzerland, which is the seat of more than half the Olympic sports federations, including the IOC, FIFA, and UEFA, is directly impacted if there is corruption in sport. (Bradley, 2014).

It is very difficult to prove the manipulation of sports competition, and so criminal offences and sanctions should seek to deter. Secondly, a special type of offence helps, where the perpetrators can are aware that the crime they are committing is seriously punishable. It is also highly recommended to distinguish between a betting-related offence and a merely sports-related offence.

In many countries there have been changes in legislation to implement a special type of offence such as sports fraud or the crime of match-fixing and stricter penalization of corruption in sport – for example, in Denmark, Montenegro, Malta, Lithuania, Hungary, Ukraine, Turkey, Estonia, Azerbaijan, Latvia, and Italy. (Gábriš, 2017, 17–18)

The Legal Basis on the International State Level

Globalization and technical revolution in the last 20 years has exponentially transformed the world we used to know. The same is valid in sport, in which organized crime operates globally. The only effective answer to these global problems is with global solutions. These solutions require intensive cooperation between the states in terms of common approaches and principles. It is not easy due to different approaches in the regulation of betting markets and criminal prosecution of match-fixing. Due to the international nature of match-fixing, single states are not able to prevent and detect these cases, and so this problem must be dealt with and solved at the international level.

There are some international organizations that have started to be active in the field of match-fixing and sports manipulation on the international level. The most important players are the Council of Europe, the United Nations and the European Union. The most important adopted document is the International Convention on the Manipulation of Sports Competitions, which was open to signatures in September 2014 in Macolin, Switzerland.

The current state of play of the Macolin Convention

The Macolin Convention is open for signature not only for the member states of the Council of Europe but also for other Parties such as members of the European Cultural Convention, the European Union, non-member States or states having observer status with the Council of Europe. In the meantime, 38 states have signed the Convention, among them Australia as the only one non-Member of the Council of Europe. The Convention on the Manipulation of Sports Competitions was ratified by the parliaments of 7 signatory states, namely by the date of ratifying by Norway, Portugal, Ukraine, Republic of Moldova, Switzerland, Italy, and Greece, and entered into force on 1st September 2019. (Council of Europe, 2021)

The Macolin Convention was the first international agreement dealing with the problem of match-fixing on such a scale. It is until now, along with the Group of Copenhagen, the best solution for state authorities, betting authorities, and sports organizations to meet, discuss and adopt effective measures against match-fixing. The advantage of the Convention is the recognition of stakeholders across various sectors, the so-called multi-stakeholder approach, which can adopt global measures to tackle match-fixing. It is at the same time a burden to find a consensus on common measures because different states and even organizations within one state have different interests. States have different state approaches in the field of regulation of the sports betting market and in the criminal prosecution of match-fixing. The Convention does not seek to standardize national legal norms; in any case, this is not possible with so many stakeholders, approaches, regulations, etc. The goal of the Convention is to call on states to review their legal state norms and, in the light of the fight against match-fixing, if it is needed, to adopt new measures. However, some degree of harmonization would be necessary to effectively combat match-fixing. Most likely, it would go in the same direction as the adoption of other conventions that are under the Council of Europe in other areas such as anti-doping or spectator violence and misbehavior at sports events. The follow-up committee will be replaced by a Standing committee, and it would adopt and revise recommendations to implement the Convention.

The actual definition of match-fixing adopted in the Convention is open to criticism, since it fails to make the distinction between match-fixing with and without the element of betting, and the difference in risk of these two types of match-fixing is obvious. To begin with, there is a lack of proportionality. We should not compare an offence of match-fixing of global impact (i.e., a fixed match at the World Cup, where criminal organizations are bribing direct actors in the match and are placing bets around the world along with money-laundering) with a match-fixing case of a club needing to win to avoid relegation to a lower division. There is also a difference in

terms of the of actors involved. Given a case of match-fixing without the betting element (i.e. for sporting purposes only) it is difficult to prove that anything else was corrupted other than the integrity of the match and the spirit of sport. So the impact of these two very different types of match-fixing has something in common, but many other issues are divergent.

Some states of the Council of Europe, particularly Malta, criticized the definition of illegal sports betting, causing an 'institutional deadlock' referred to the Convention. The definition is as follows: *"illegal sports betting means any sports betting activity whose type or operator is not allowed under the applicable law of the jurisdiction where the consumer is located."* But if we take the example of Malta, it is not clear which jurisdiction should be preferred. The primacy of EU law is not explicitly laid down in a TFEU but refers to the case-law of the Court of Justice (CJEU) that is relevant to the question of primacy. The primacy of Union law ensures that Union law may not be revoked or amended by national law, and it takes precedence over national law if the two conflict. Malta states that the definition of illegal sports betting is beyond the scope of the Macolin Convention and, therefore, does not contribute to the fight against match-fixing. We do not know whether Malta was involved in drafting the latest version of the Convention or could comment on it, but neither Malta nor any other country whose domestic market is dependent on the profits of the gaming industry will sign the document in such a version. If betting operators with a base in Malta offer their services for customers from other EU member states, it is absolutely in line with Union law, and therefore, the aforementioned definition of illegal sports betting is incorrectly worded and against the interests of Malta or other states strongly dependent on the gaming industry.

In a relatively new report from the Committee on Culture, Science, Education, and Media, a rapporteur from Switzerland states that Malta imposed on the Convention a years-long deadlock over the definition of illegal sports betting. (Büchel, 2020). Malta argues that *"betting services should benefit from free movement under the Internal Market rules whereby a service licensed in one Member State should be accepted in all others. However, it is perfectly clear from the jurisprudence of the CJEU that the principle of mutual recognition is not applicable in this area."* (ibid.)

Legislators drafting the Macolin Convention can always revise the document in the future or prove that Malta's position is wrong as well as prove that Malta is involved in activities of the illegal betting market, but not according to the definition stated in the Convention, but according to International Law. The definition of the legality of sports betting in Europe, as it is stated in the Convention, and the regulated betting market in Europe, is not the real problem in the fight against match-fixing. It is a fact that most cases of match-fixing take place on the unregulated or black market, mostly in Asia, whose countries would probably not be interested in signing and ratifying the Macolin Convention in any case.

The Convention aims to ensure that the provisions can be applied to all regulatory models of the sports betting market. But illegal sports betting operators would not like to cooperate with the state authorities and with the sports associations. They would like to operate without any control and thus represent a threat in the area of match-fixing. (Council of Europe, 2014, 18, Rn. 110.) However, to prevent match-fixing, it would be helpful to define a minimum standard that would apply to all sports betting operators.

Nevertheless, it is the first document of an international character of the Council of Europe, which has a very ambitious goal, suggesting that the Council of Europe wants to become the international body that will address the problem and attract non-member states in the fight against match-fixing. So far, only Australia, which also cooperated in drafting the Convention, is such a signing party. It is a question for the future whether countries in Asia, where the most unregulated betting companies operate, will also sign the Convention and join the countries that consider match-fixing a threat.

The Group of Copenhagen

Two years after the Macolin Convention was opened for signature by the member states, the Council of Europe established a Group of Copenhagen, which is the Council of Europe's Network of National Platforms. Its role is to promote transnational cooperation in the fight against match-fixing and the exchange of information on national platforms. (Council of Europe, 2020).

The priorities of the Group of Copenhagen are to support other CoE member states to create their national platform, to provide support to existing national platforms, and to identify and share best practices of these national platforms. The Group of Copenhagen has set up its own Alert and Surveillance System to strengthen National Platforms' responsiveness to all forms of manipulation, which identifies different types of manipulation and alerts the responsible actors. (ibid.) Some of the National Platforms are currently only formal and do not work as yet. However, it gives the opportunity for relatively undeveloped national platforms to take a lesson from other well-functioning platforms.

The Council of Europe has started an informal cooperation framework with the Group of Copenhagen, even though legal actions against organized crime cannot be laid down on the basis of informal cooperation. First of all, there has to be a formal legal framework. It is crucial to have effective cooperation in the exchange of information among this group and CoE for effective criminal inquiries and pursuits. Otherwise, there could not be an effective investigation and prosecution of suspected natural and legal persons. (Buchel, 2020).

It is necessary to create national platforms for the fight against match-fixing at the national and international levels. These platforms can present with various forms and structures that can be either formal or informal governmental or non-governmental organizations or even a hotline.

Match-fixing is mostly a form of corruption in the private sector, where private entities are involved. So it is essential for law enforcement authorities to cooperate with sport governing bodies, betting regulators, and betting operators. (United Nations, 2016, 80, Art. 39) The establishment of national platforms that are responsible for the fight against match-fixing should also be the backbone of the global approach. These member networks would fill the database with information on best practices and alerts of potential threats of match-fixing.

Better investigation of match-fixing

One of the main means of effectively fighting against match-fixing is to better investigate all participants involved in fixing a match in order to deter them and others from this kind of breach of the integrity of the sport. The accused person should be investigated and, in the case of any proof, prosecuted. There are many participants called runners who act as agents and third parties between the criminals fixing a match and the actors on the pitch. Not only successfully fixed matches should be investigated and prosecuted, but also any attempts to do so. (United Nations, 2016, 78, Art. 27)

Law enforcement bodies in terms of anti-corruption law, depending on the strength of the evidence of an offence through match-fixing, should initiate an investigation and, depending on the strength of the evidence, prosecute all co-conspirators. (United Nations, 2016, 78, Art. 30) Investigation of these crimes and the actors of match-fixing, direct or indirect, could have a deterrent effect. In the investigation, it is suggested to apply the rule 'follow the money' as with any other form of corruption involving serious organized crime. Cooperation in these proceedings requires that betting operators and financial institutions work together. (United Nations, 2016, 78, Art. 31)

It is crucial to provide witnesses with the utmost protection when they decide to cooperate and testify against those convicted of the offence of match-fixing, especially if organized crime is involved, whose regular practice is to intimidate witnesses. If needed, the court can decide to

accept the testimony of an anonymous witness for the purpose of identity protection. Testimonies of such witnesses are sometimes the only evidence which a prosecutor has in such a case. (United Nations, 2016, 79, Art. 32) Many states have an institute of active repentance, which allows for those involved in match-fixing offences to reduce their sentence if they fully cooperate with law enforcement entities, to which they would provide information or offer testimony in order to help the authorities to investigate higher up the chain of the organized crime group. (United Nations, 2016, 80, Art. 37)

Match-fixing offences where organized crime is involved have a cross-border element. If the offence occurred in two or more states, there should be a question of jurisdictional primacy. (United Nations, 2016, 81, Art. 42) To tackle a global phenomenon such as match-fixing and conduct an investigation, collect evidence and witnesses, international cooperation amongst offended states is of the utmost importance. If necessary, the state should cooperate and extradite the accused criminal to the jurisdiction which is leading the investigation. Mutual legal assistance is therefore important in the process of investigation and gathering evidence, which could be used in a trial. (United Nations, 2016, 84, Art. 46) Joint investigations by two or more states are also appropriate means in taking into account the complexity and transnationality of the investigation of a match-fixing offence. Corruption in sport is not new; however, developments in corruption involving the element of online betting, including transnational organized crime laundering money, is an intersectoral and global problem and thus must be solved with the same methods. As criminals are using the newest techniques, law enforcement authorities in particular states must also apply modern ICTs, if possible. (United Nations, 2016, 84, Art. 48)

Conclusion

Match-fixing is a complex phenomenon. The internationality of this phenomenon shows that it is impossible to tackle it on the national level. The best way to fight against match-fixing is on the global level, where intensive international cooperation is needed. To fight against match-fixing, all stakeholders should adopt a common approach. These include the betting providers, the state authorities, and sports associations with their clubs, athletes, coaches, referees, and officials.

State authorities and sports associations should coordinate their actions together – sports associations through their internal rules and regulations and state through its state law, particularly criminal law. Because rules and regulations of associations are valid for its members, but criminal law for all, it is possible to be sanctioned for the same offence twice. The *ne bis in idem* principle cannot be applied, since the sanction of an association can be understood as merely an administrative measure of an association to its members, whilst the sanction according to the valid penal code from a state is applied in the case of a violation of the law. Another advantage of cooperation between associations and states lies in the evidence. Associations cannot undertake real investigations, interceptions, question witnesses, etc. States can do this. After or even during state criminal proceedings, associations can get this evidence to start or continue their disciplinary proceedings.

Some countries where the fight against match-fixing is not a priority might ask: why not build a national platform and contribute to the global platform? One solution might be to join this anti-match-fixing platform under the national anti-doping agencies' activities, which deal with integrity in sport but from the medical point of view. The shining example is the national anti-match-fixing platform of Denmark, whose secretariat is operated by the Danish NADO. It is sometimes the easiest and fastest way of establishing a national platform. National anti-doping agencies already have a functioning organization, and they are active in the fields of education, awareness, testing, etc.

International cooperation against match-fixing takes place from the legal aspect, as well as from the law enforcement aspect. The legal and legislative aspect calls for the adoption of state measures on the national as well as international level. The international legislative body, which started these measures of legislative activities on the international level, was the Council of Europe with its Convention on the Manipulation of Sports Competitions.

The Council of Europe, with the adoption of the Convention on the Manipulation of Sports Competitions, would like to be the supranational governmental organization in the fight against match-fixing. But the standpoint on definitions, from one point weak in terms of minimum standards and stubborn in terms of explanations regarding illegal sports betting, does not help. The problem of match-fixing is a global phenomenon, and the harmonization and coordination of the various measures with the help of all stakeholders are essential.

Cooperation, including the exchange of information and intelligence among national law enforcement authorities, is crucial for the success of investigations of cross-border crimes. To better fight against match-fixing and so investigate and prosecute criminals, it is crucial that the collection, analysis, and exchange of information and intelligence on match-fixing operates on the national and international level. The exchange of information should be safe and secure, otherwise, stakeholders will not share information. Safety and security of information is the most crucial step in collecting information; otherwise, members of a platform would not share information.

Match-fixing is a global cross-border crime that is exceedingly difficult to investigate as the many different countries employ a wide variety of methods, and some lack specific laws. Therefore, to apply a minimum standard by countries that want to tackle this phenomenon of match-fixing would be absolutely instrumental. These minimum standards could be applied and adopted by particular states; currently, the best option would be under the guidance of the Council of Europe within the cooperation of the Group of Copenhagen.

Competing interests

The author declares that there are no competing interests for any commercial associations or financial interests held by the author.

Acknowledgments

This paper was written with institutional support from Charles University, Prague, Czech Republic (SVV – Specifický vysokoškolský výzkum).

Language proofreading

Mravec is an ESL author. The text has been thoroughly revised by a native speaker.

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STUDENT SECTION

Editors:
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The Relative Age Effect in Czech U14 Male and Female Tennis Players in 2007–2016

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ABSTRACT

The issue of the Relative Age Effect (RAE) has been long researched, discussed and published both in the academic and coaching community and the number of studies on it in various sports has significantly grown in recent years. The aim of this study was to verify the existence of RAE among Czech male (n = 6552) and female (n = 4131) junior tennis players and to identify possible differences in birthdate effect between male and female players. The research was carried out in players registered in the years 2007–2016 in the U14 age category in Czech Tennis Association (CTA) database; the athletes were divided into three subgroups ('Ranked', 'Top 100', 'Top 10'). Research data were analysed by the methods of descriptive and inferential statistics: relative and absolute frequency, chi-square goodness of fit test (χ^2_G) and chi-square test of independence (χ^2_I) with the use of effect size (ES index w). A declining tendency of frequencies from Q1 to Q4 between male and female junior players was proven in all three subgroups. In the whole period of 2007–2016, a significant and strong RAE was demonstrated only in the 'Top 10' male subgroup (RAE was significant and ES was small or trivial in the other two subgroups). Among the female players, RAE was significant in all three subgroups (ES was small or trivial). Gender differences in RAE in favour of male players were significant in 'Top 100' and 'Ranked' (ES was small or trivial in all three subgroups). In the short and long term, RAE can have significant implications for the sport development of athletes; both coaches and the professional public can therefore be recommended to pay attention to this issue. The impact of RAE in sport, i.e. the uneven distribution of athletes' birthdates, is more pronounced especially among junior athletes and often significantly affects their sports development and career.

Keywords: *birthdate, chronological age, racquet sports, talent identification, youth sport*

INTRODUCTION

As early as at the beginning of the last century, the first researches focused on the relationship between success in education and dates of birth started to appear indicating that children born earlier in the year have better learning results (Pintner & Forlano, 1934). The term Relative Age Effect (RAE), first used by Barnsley, Thompson and Barnsley (1985), has been mostly used for this phenomenon in recent years. Ontogenetic development occurs frequently at different speed in junior age, which may bring a temporary advantage to earlier in the year born athletes; however, this does not mean that these athletes will be successful in adulthood (Malina, 1994). Especially during the last decade, the RAE has received a great deal of attention in sports sciences as athletes born at the beginning of the year often achieve, because of this temporal biological advantage linked with a higher level of anthropometric and fitness characteristics, better athletic performances. These individuals are often referred to as athletically talented, they are more often chosen for elite junior selections, resp. training programmes, which allows them to gain better conditions for personal development, experience, contacts, motivation and better

training facilities. A number of authors (e.g. Andronikos, Elumaro, Westbury, & Martindale, 2016; Cobley, Baker, Wattie, & McKenna, 2009; Fumarco, Gibbs, Jarvis, & Rossi, 2017; Gómez-López, Granero-Gallegos, Molina, & Ríos, 2017) state that athletes born at the beginning of a calendar year are more often selected for training programmes for talented individuals. Thus, truly talented athletes can be left out, which can have a discriminatory effect on later born players. In sports, the effect of birthdate was first researched in ice hockey (Barnsley et al., 1985), subsequently also in other sports, for instance in soccer (Barnsley, Thompson, & Legault, 1992), baseball (Thompson, Barnsley, & Stebelsky, 1991), gymnastics, soccer, swimming and tennis (Baxter-Jones, 1995). During the last decade, there has been a large increase in studies dealing with the RAE effect in basketball (Ibáñez, Mazo, Nascimento, & García-Rubio, 2018), in soccer (Gil, Bidaurrazaga-Letona, Martin-Garetxana, Lekue, & Larruskain, 2019), in handball (Rubia et al., 2020), in ice hockey (Nykodým, Bozděch, Agricola, & Zháněl, 2020), in volleyball (Parma & Penna, 2018), judo (Albuquerque, Franchini, Lage, Da Costa, Costa, & Malloy-Diniz, 2015) and other sports. Most of the above-mentioned authors found a significantly higher number of athletes born in the first (Q1) and second (Q2) quartiles, i.e. in the first (S1) semester. The effect of RAE was recorded to a larger extent namely in junior categories, while, with the increasing level of competitions, the RAE influence grows stronger, while in senior categories it rather weakens. A larger RAE influence manifests itself in males; Cobley et al. (2009) in their extensive Meta-Analytical Review already registered this phenomenon in the whole spectrum of sports across all the age groups at various levels of competitions (from recreational to elite athletes). Only in a few sports, the RAE influence has not been proven, which for instance Hammer (2020) explains – in elite ski jumpers – by high technical demand on skills and the advantage of jumpers with lower weight. In most sports, athletes are classified into age categories according to their chronological age, specifically to eliminate uneven conditions between the individuals at various levels of ontogenetic development. However, even in these age-homogenous groups, there are significant differences in the mental and physical maturity of individuals, especially with regard to the RAE, as the differences between individuals can be as much as 12 months (Baker, Schorer, & Cobley, 2010).

From the point of view of the interpretation of results of some older studies, it is rather problematic that the agreement between expected and observed data frequencies was assessed in them only with the help of null hypothesis significance testing ($p \leq 0.05$) using Pearson's chi-squared test (goodness of fit test), without using effect size (Cumming, 2013). This causes, especially in case of large files, that even small differences are statistically significant, even if effect size is only trivial or small. Therefore, we present the results of the studies in the original version in this part; for the sake of discussion, the effect size was calculated from the published data (if possible).

Many studies are devoted to the issue of RAE in tennis; both Cobley et al. (2009) and Bozděch, Nykodým, Agricola, and Zháněl (2017) state that in terms of frequency of publications, tennis takes third place after soccer and ice hockey.

It was already Baxter-Jones (1995), resp. Dudink (1994), who showed that up to 85 percent of elite British junior players were born in the first half of the year (S1); respectively almost half of 60 elite Dutch junior tennis players aged 12–16 were born in Q1. Studies by other authors also confirmed significant differences between the first and second 6 months of the calendar year, resp. between individual quartiles Q1–Q4. Filipčič (2001) observed no RAE among Slovenian male and female junior tennis players (12–18 let), while a significantly higher representation in Q1 was found in male players in U12–U16 categories, while in female players only in U12–U14 categories. The author explains the stronger influence of RAE in categories of boys by the earlier completion of biological development in girls and the consequent faster maturation. Edgar and O'Donoghue (2005) demonstrated significant RAE both among elite senior female and male

players and among elite female and male junior players. In a follow-up study, O'Donoghue (2009) also found significant RAE both in female and in male elite junior players. In an interesting study related to our research, Loffing, Schorer, and Cobley, 2010 dealt with the issue of RAE in relation to handedness in a large group of senior professional tennis players (n = 1027; Top 500 of the ATP). The authors showed a significant influence in right-handers (RH), but no influence in left-handers (LH) which they explain by a smaller number of left-handers.

The results of recent studies have also shown a RAE influence especially in junior categories, both in boys and girls. Ribeiro Júnior, et al. (2013) demonstrated more than a half of athletes born in S1 among Brazil female and male junior tennis players (U14 and U18) – also among professional players – while in the U16 category, their number reached about 50 percent. Pacharoni, Aoki, Costa, Moreira, and Massa (2014) found that, in all age categories (U12–U18), more than a half of male junior tennis players (65.2%) were born in S1. Ulbricht, Fernandez-Fernandez, Mendez-Villanueva, and Ferrauti, (2015) found in German male junior tennis players that, with increasing level of performance, also the number of players born in the first semester (S1) had grown. Agricola, Zháněl, and Bozděch (2017) observed significant RAE both in male and female junior players (U14, World Junior Tennis Finals 2007–2011), similarly to Moreira, Lopes, Faria, & Albuquerque (2017) in junior male tennis players (U14). Romann, Rössler, Javet, and Faude (2018) also found in Swiss talent development programme participants (U14, STDP, 25 largest sports) that more of them – both among female and among male junior tennis players – were born in S1. The authors also proved that the highest representation in S1 in 25 largest sports had been found among junior female athletes in badminton and among junior male athletes in soccer/football. Söğüt et al. (2019) dealt with the effects of age and maturity on various anthropometric and fitness characteristics in young female tennis players (U12–U14) and demonstrated a significant difference in test results in favour of players born in S1 compared to those born in S2.

Some authors point out the fact that RAE may lead – in later born, i.e. relatively younger players – to a loss of motivation, lack of interest in tennis as well as to a premature termination of sports career (so called dropout). Potential benefits of earlier born players must be perceived in the context of the necessity and importance of providing equal conditions and opportunities for each athlete regardless the date of birth (Edgar & O'Donoghue, 2005; Myburgh, Cumming, Coelho e Silva, Cooke, & Malina, 2016; O'Donoghue, 2014; Romann et al., 2018). It is clear from the above given synthesis of the findings that the influence of RAE is demonstrable and indispensable especially in junior tennis.

The aim of the study was to verify RAE existence among Czech male and female junior tennis players in 2007–2016 and identify possible sex differences in three subgroups ('Ranked', 'Top 100', 'Top 10').

MATERIAL AND METHOD

Participants

The research sample consisted of Czech male and female junior tennis players, who were – during 2007–2016 – registered in the U14 age category in the official rankings (ttp://www.cztenis.cz/mladsi-zactvo/zebricky) of the Czech Tennis Association (CTA), with full respect to the legal requirements for the protection of personal data (data were anonymized). Three subgroups were subsequently formed from the sample: the first subgroup, defined as 'Ranked' players (male: n_M = 6552; female: n_F = 4131); the two other subgroups were defined as 'Top 100' (n_M = 933; n_F = 837) and 'Top 10' (n_M = 100; n_F = 99); the existence of RAE is generally determined by testing the statistical significance of the difference between the observed distribution of birth dates (sample)

and the expected theoretical distribution (population), (Delorme, & Champely, 2015). Players' birthdates were distributed to four quartiles according to the month of birth as follows: Q1 (January to March), Q2 (April to June), Q3 (July to September) and Q4 (October to December). The expected frequency of the birthdate of Czech same age population was obtained from the publicly available sources (https://www.czso.cz); theoretical (expected) frequency distribution was: Q_1 = 25%, Q_2 = 27%, Q_3 = 25%, Q_4 = 23%.

Data analysis

The chi-square goodness of fit test (χ^2_G; df=3) was used to test the significance of differences between the observed and expected frequencies of birthdate; to determine the association between the samples of male and female players (in groups 'Ranked', 'Top 100', 'Top 10'), we used the chi-square test of independence (χ^2_I). Cumming (2013), Hopkins (2016), Sullivan, and Feinn, (2012) and other authors consider estimation based on the effect size (ES) to be a much better method than mere testing significance of null hypothesis. In case of a conflict between the conclusions gained by both methods, we therefore lean towards the results of ES, also due to the deliberate selection of research sample. The evaluation of ES index w was interpreted as small (w = 0.10), medium (w = 0.30) or large (w = 0.50) based on Cohen (1988) with the use of later Hopkins' (2016) more detailed division: trivial (w = .0), small (w = .10), moderate (w = .30), large (w = .50), very large (w = .70), nearly perfect (w = .90), perfect (w = 1.0). Calculations were performed with the IBM SPSS Statistics software (version 25.0, SPSS INC., Chicago, IL USA) and Microsoft Excel (the level of significance was set at $p \leq 0.05$).

RESULTS

Figure 1 presents the distribution of relative frequencies of male junior players' birthdates (U14) in individual groups ('Ranked', 'Top 100', 'Top 10') in 2007–2016. In all three groups of male players, there is an obvious markedly declining tendency of frequency distribution from Q1 to Q4, but only in Q1, with a decreasing level of performance (from 'Top 10' to 'Ranked'), the influence of RAE also decreases.

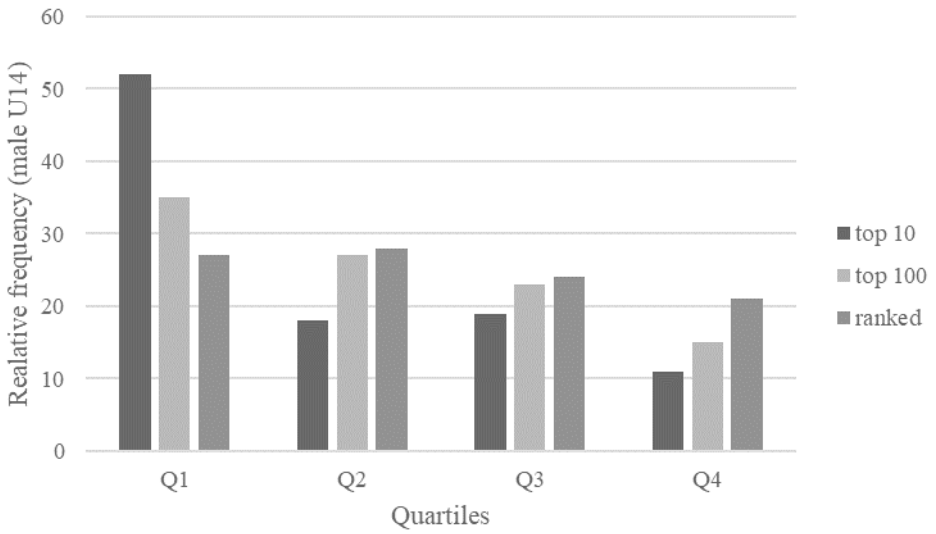

Figure 1. Distribution of relative frequencies (%) male junior players (U14) in 2007–2016

Table 1 summarizes the results of the statistical assessment of RAE in male junior players (U14) in individual years as well as during the whole period of 2007–2016. Among the 'Ranked' male players, mostly no significant RAE was observed (ES was small, resp. trivial each year); among 'Top 100', there exists a significant and medium RAE in 50% of years, in the other half of the years, no RAE was observed. No significant RAE was observed in 'Top 10'; ES was large or medium, in six cases it was impossible to perform a statistical evaluation because of zero frequency in some quartiles. In the whole monitored period of 2007–2016, a significant and strong RAE was observed in 'Top 10'; in the other two subgroups ('Ranked', 'Top 100'), a significant RAE was observed; ES was small, resp. trivial. During the observed period in the individual subgroups, 55% athletes born in the 1st semester (S1) were among the 'Ranked', 62% among the 'Top 100' and 70% among 'Top 10' male players, which indicates increasing impact of RAE with growing athletic performance.

Table 1. Birth distribution of Czech male junior tennis players

Years	Status	Q1	%	Q2	%	Q3	%	Q4	%	n	χ^2_G	p	wG	ES
2007	top 10	4	40	1	10	5	50	0	0	10	–*	–*	–*	–*
	top 100	33	36	24	26	24	26	11	12	92	9.30	0.03	0.32	medium
	ranked	196	29	174	26	172	26	125	19	667	10.76	0.01	0.13	small
2008	top 10	5	50	1	10	2	20	2	20	10	3.71	0.30	0.61	large
	top 100	37	40	23	25	15	16	18	19	93	11.77	0.01	0.36	medium
	ranked	191	28	203	29	164	24	135	19	693	7.39	0.06	0.10	small
2009	top 10	6	60	3	30	0	0	1	10	10	–*	–*	–*	–*
	top 100	36	38	28	30	14	15	16	17	94	12.22	0.01	0.36	medium
	ranked	182	28	184	28	155	24	132	20	653	5.11	0.16	0.09	trivial
2010	top 10	8	80	0	0	2	20	0	0	10	–*	–*	–*	–*
	top 100	33	35	23	24	22	23	16	17	94	5.62	0.13	0.25	small
	ranked	173	28	175	29	140	23	120	20	608	7.38	0.06	0.11	small
2011	top 10	6	60	2	20	1	10	1	10	10	6.72	0.08	0.82	very large
	top 100	33	35	31	33	19	20	12	13	95	10.11	0.02	0.33	medium
	ranked	159	27	179	30	130	22	119	20	587	7.49	0.06	0.11	small
2012	top 10	5	50	3	30	2	20	0	0	10	–*	–*	–*	–*
	top 100	35	37	27	29	23	24	9	10	94	13.11	0.00	0.37	medium
	ranked	176	28	175	27	153	24	135	21	639	2.95	0.40	0.07	trivial
2013	top 10	5	50	2	20	3	30	0	0	10	–	–*	–*	–*
	top 100	27	29	23	24	24	26	20	21	94	0.88	0.83	0.10	small
	ranked	174	25	184	27	192	28	144	21	694	3.56	0.31	0.07	trivial
2014	top 10	5	50	2	20	1	10	2	20	10	3.62	0.31	0.60	large
	top 100	29	32	27	29	22	24	14	15	92	4.22	0.24	0.21	small
	ranked	178	26	194	29	155	23	145	22	672	3.06	0.38	0.07	trivial
2015	top 10	5	50	3	30	0	0	2	20	10	–*	–*	–*	–*
	top 100	32	35	29	32	19	21	12	13	92	8.88	0.03	0.31	medium
	ranked	172	26	208	31	149	22	139	21	668	7.72	0.05	0.11	small
2016	top 10	3	30	1	10	3	30	3	30	10	1.48	0.69	0.39	medium
	top 100	29	31	21	23	28	30	15	16	93	4.97	0.17	0.23	small
	ranked	167	25	187	28	171	25	146	22	671	0.70	0.87	0.03	trivial
2007–2016	top 10	52	52	18	18	19	19	11	11	100	39.86	0.00	0.63	large
	top 100	324	35	256	27	210	23	143	15	933	61.58	0.00	0.26	small
	ranked	1768	27	1863	28	1581	24	1340	21	6552	35.79	0.00	0.07	trivial

Note: * = insufficient group size, Q_i = quartile, χ^2_G = chi-square test (goodness of fit), p = level of significance, w_G = effect size index, ES = effect size, n = number of players in Top 100 (*The number is lower in some cases due to the fact that also the players from the category of U12 took place in rankings and were not therefore included in*

the analysis.)

Figure 2 shows the distribution of the relative frequencies of female junior players' birthdates (U14) in individual subgroups during 2007–2016, giving a significant downward trend of distribution of frequencies from Q1 to Q4; however, only in Q1 also the impact of RAE decreases together with a dropping level of performance (from 'Top 10' to 'Ranked').

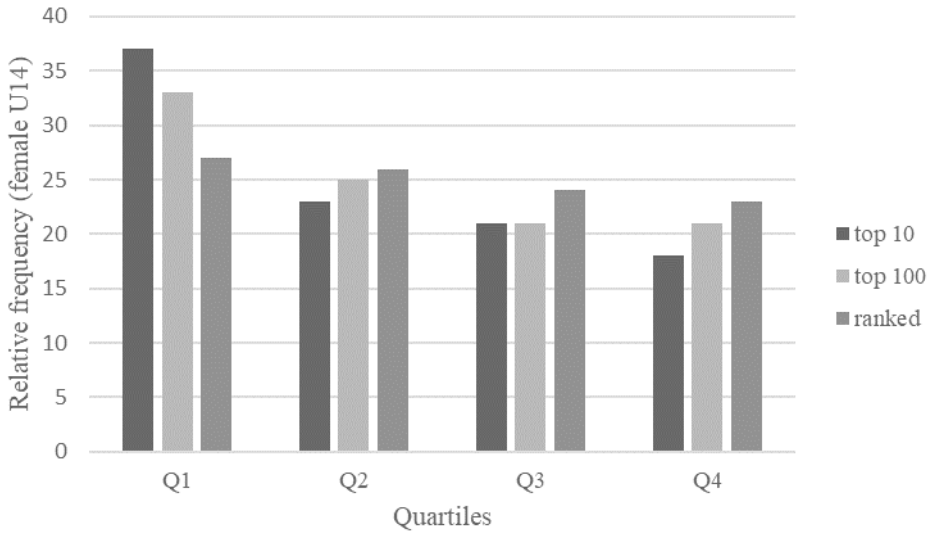

Figure 2. Distribution of relative frequencies (%) female junior players (U14) in 2007–2016

Table 2 presents the result of statistical assessment of RAE in a sample of female junior players (U14) in the individual years as well as in the whole period of 2007–2016. Among the 'Ranked' players, a significant RAE was observed only in 2011 (ES was medium) and 2013 (ES was small). Among the 'Top 100' players, a significant RAE was observed only in 2008 and 2011 (ES was medium). In the 'Top 10' subgroups, no significant RAE was observed all years, but ES was very large (2 players), large (4 players) or medium (3 players). In the whole period of 2007–2016, a significant RAE was found in all subgroups (which is, however, rather the consequence of a large size of files), but ES was small, resp. trivial. During the observed period in the individual subgroups, 53% athletes were born among 'Ranked', 58% among 'Top 100' and 60% among 'Top 10' female players in the first semester (S1), which indicates an increasing impact of RAE with growing sports performance (however, percentage values are lower than among the male players).

Table 2. Birth distribution of Czech female junior tennis players

Years	Status	Q_1	%	Q_2	%	Q_3	%	Q_4	%	*n*	χ^2_G	*p*	w_G	ES
2007	top 10	6	60	1	10	2	20	1	10	10	6.81	0.08	0.83	very large
	top 100	32	37	20	23	18	25	16	19	86	6.87	0.08	0.28	small
	ranked	123	29	99	23	108	25	96	23	426	4.85	0.18	0.11	small
2008	top 10	3	30	1	10	2	20	4	40	10	2.53	0.47	0.50	large
	top 100	29	37	14	18	14	18	22	28	79	9.33	0.03	0.34	medium
	ranked	117	28	97	23	96	23	104	25	414	5.07	0.17	0.11	small
2009	top 10	3	30	1	10	2	20	4	40	10	2.53	0.47	0.50	large
	top 100	24	29	16	20	20	24	22	27	82	2.84	0.42	0.19	small
	ranked	97	25	117	30	100	26	77	20	391	3.15	0.37	0.09	trivial
2010	top 10	4	40	3	30	2	20	1	10	10	1.77	0.62	0.42	medium
	top 100	29	36	21	25	18	22	15	18	83	4.61	0.20	0.24	small
	ranked	110	27	101	25	115	28	86	10	412	3.63	0.31	0.09	trivial
2011	top 10	3	30	4	40	2	20	1	10	10	1.56	0.67	0.40	medium
	top 100	34	40	25	29	14	16	13	15	86	12.34	0.01	0.38	medium
	ranked	110	30	70	19	104	29	78	22	362	37.39	0.00	0.32	medium
2012	top 10	2	22	4	44	2	22	1	11	9	1.62	0.65	0.43	medium
	top 100	26	33	22	28	11	14	20	25	79	6.06	0.11	0.28	small
	ranked	105	28	102	27	73	20	91	25	371	6.23	0.10	0.13	small
2013	top 10	4	40	5	50	0	0	1	10	10	–*	–*	–*	–*
	top 100	28	35	20	25	14	17	19	23	81	5.06	0.17	0.25	small
	ranked	102	26	122	31	66	17	100	26	390	14.22	0.00	0.19	small
2014	top 10	5	50	2	20	1	10	2	20	10	3.62	0.31	0.60	large
	top 100	27	32	24	28	18	21	16	19	85	2.75	0.43	0.18	small
	ranked	114	26	125	29	104	24	94	22	437	1.30	0.73	0.05	trivial
2015	top 10	5	50	1	10	2	20	2	20	10	3.71	0.30	0.61	large
	top 100	18	22	28	34	25	30	11	13	82	6.12	0.11	0.27	small
	ranked	111	23	134	28	126	27	103	22	474	1.57	0.67	0.06	trivial
2016	top 10	2	20	1	10	6	60	1	10	10	6.81	0.08	0.83	very large
	top 100	29	31	18	19	27	29	20	21	94	4.08	0.25	0.21	small
	ranked	122	27	111	24	111	24	110	24	454	2.08	0.56	0.07	trivial
2007–2016	top 10	37	37	23	23	21	21	18	18	99	8.15	0.04	0.29	small
	top 100	276	33	208	25	179	21	174	21	837	28.88	0.00	0.19	small
	ranked	1111	27	1078	26	1003	24	939	23	4131	8.17	0.04	0.04	trivial

Note: –* = insufficient group size, Qi = quartile, χ^2_G = chi-square test (goodness of fit), p = level of significance, w_G = effect size index, ES = effect size, n = number of players in Top 100 *(The number is lower in some cases due to the fact that also the players from the category of U12 took place in rankings and were not therefore included in the analysis.)*

Table 3 shows the results of the assessment of sex-differences of RAE between the male and female samples ('Ranked', 'Top 100', 'Top 10'). Although in case of 'Top 100' and 'Ranked' sub-groups, the sex-differences in favour of male players are significant (again, rather due to the large size of the files); they are trivial in terms of ES.

Table 3. Comparison of RAE in male and female tennis players in 2007–2016

Gender	Status	Q_1	%	Q_2	%	Q_3	%	Q_4	%	n	χ^2_G	p	w_G	χ^2_I	p	w_I	ES
male	top 10	52	52	18	18	19	19	11	11	100	39.86	0.00	0.63	4.92	0.18	0.16	small
female	top 10	37	37	23	23	21	21	18	18	99	8.15	0.04	0.29				
male	top 100	324	35	256	27	210	23	143	15	933	61.58	0.00	0.26	9.13	0.03	0.07	trivial
female	top 100	276	33	208	25	179	21	174	21	837	28.88	0.00	0.19				
male	ranked	1768	27	1863	28	1581	24	1340	21	6552	35.79	0.00	0.07	11.23	0.01	0.03	trivial
female	ranked	1111	27	1078	26	1003	24	939	23	4131	8.17	0.04	0.04				

Note: χ^2_I= chi-square test (independence), w_I w_I= effect size index (independence)

DISCUSSION

Comparison of the results of our study with the results of other authors was possible only in a relatively small number of similar studies. The very first studies already showed in elite young British athletes (without statistical verification) that almost half of male and female tennis players was born in the first quartile (Baxter-Jones, 1995); there was also a significant birthdate influence found in U12 and U14 among Slovenian female tennis players (Filipčič, 2001).

Edgar and O'Donoghue (2005) showed a significant RAE existence among elite female and male junior tennis players; the effect size was medium. Significant, but small RAE was also found by O'Donoghue (2009a) among elite female and male junior players' world rankings (with the exception of 2005) and also in a similar study (2009b) among the ITF ranked (end 2003, resp. 2008) female and male junior players. Recent studies have proven significant and medium RAE in the World Junior Tennis Finals (WJTF, 2007–11) for all female junior players and semi-finalists (Agricola, Zháněl, & Bozděch, 2017); similarly, Bozděch et al. (2017) have found significant and large RAE among all male tennis players and semi-finalists in the WJTF 2012–16. In the study which was the main inspiration for this research, Gerdin, Hedberg and Hageskog (2018) demonstrated a significant, but small RAE among junior tennis players in Sweden (13–16 years old, subgroups 'Ranked', 'Top 50' and 'Top 10') among 'Ranked' and 'Top 50' female players; while no significant and medium RAE was demonstrated among 'Top 10' female players. There was no significant and small RAE found among the male players in all 3 subgroups. While Gerdin et al. (2018) demonstrated no significant and medium RAE only among 'Top 10' female players, significant and strong RAE in 'Top 10' male players during the WJTF was proven in our study. The authors further noted – in correspondence with similar studies in soccer (Vincent, & Glamser, 2006) and swimming (Costa et al., 2013) – a stronger effect of the RAE in favour of female tennis players (although ES was only small, resp. trivial); this study presented by us found a stronger effect of RAE among male players (ES also small, resp. trivial). Romann et al. (2018) observed significant RAE among junior female tennis players in the Swiss talent development programme (ES was medium).

A number of other studies have also been published aimed at RAE among juniors in various sports. Delorme, along with various co-authors, found in three studies that a significant RAE had been observed among U14 female basketball players (Delorme, & Raspaud, 2009; Delorme, Chalabaev, & Raspaud, 2011) and in U14 female soccer players (Delorme, Boiché, & Raspaud (2010); ES was small or trivial. Hancock (2017) also found a significant RAE among female and male ice hockey players aged 13–14 (ES was small); similarly, as Gorski, Rosser, Hoppeler and Vogt (2016) among 13- and 14-year-old female and male Swiss Alpine skiers (significant RAE, ES small). Only Gómez-López et al. (2017) did not prove existence of any significant RAE

(Spanish Championship: ES was medium; Spanish Cup: ES small) among 16-year-old female and male handball players. Krahenbühl and Leonardo (2020) considered the fact that relatively older female junior handball players (born in S1) had played almost twice as much time in matches than younger players (born in S2) a consequence of RAE existence as coaches had considered them better players.

The results of RAE research among senior elite athletes have often been varied; Savassifigueiredo et al. (2020) showed a significant RAE (ES was trivial) for both sexes among elite beach handball athletes, Edgar and O'Donoghue (2005) in female and male elite senior tennis players (ES was small), Nykodým et al. (2020) in elite senior ice hockey players (ES was small)), Bozděch et al. (2020) in elite tennis players – Top 100 ATP 2016–2018 (ES was small).In contrast, no significant RAE (ES was medium) was found among professional Spanish footballers/soccer players (Gil et al., 2019) and also among male and female elite ski jumpers (ES was trivial) between the first and second semester (Hammer, 2020). Parma and Penna (2018) did not prove any RAE among women's elite volleyball players in Brazil (ES trivial), but they proved it among male athletes (ES medium); thus, similarly as in our study, a stronger impact of RAE was demonstrated in men.

As a result of RAE, the earlier born athletes are often, especially in junior age, favoured over their peers due to earlier maturation of their physical, physiological and mental condition. Relatively younger players, who may have a great potential for athletic success, but they are not given enough attention, may – for this reason – prematurely terminate their athletic career (drop-out). Therefore, a necessary precondition for optimal development of all athletes is the provision of equal opportunities both in training and in communication with coaches (Cobley et al., 2009; Fraser-Thomas, Coté, & Deakin, 2008; Musch & Grondin, 2001).

CONCLUSION

The study was focused on assessing whether there exists any RAE among Czech junior male and female tennis players in the U14 age category. The results of the study showed variety in the incidence of RAE in various performance subgroups ('Ranked', 'Top 100', 'Top 10'). A significant RAE was detected among all the male subgroups, but only among the 'Top 10' players it was strong in terms of effect size. Among female players, RAE was significant in all three subgroups, but only weak in terms of effect size. Gender differences in RAE were significant in 'Top 100' and 'Ranked' in favour of male players, but in all three subgroups they were negligible as to effect size. The impact of RAE was therefore more pronounced in male players. Comparison of the results of this study with the conclusions of other authors suggests that RAE is more pronounced in physically demanding sports in contrast with sports where performance depends on technical and motor skills. This leads us to the consideration whether the identification of talents and the selection of junior tennis players based mainly on physical, anthropometric and performance factors is, with regard to possible RAE influence, a suitable method for predicting future development of athletes. The results of this study can help increase the awareness of tennis coaches as well as parents about the impact of RAE and thus contribute to reducing the possible occurrence of dropout in junior tennis. With regard to the fact that, during the identification of talent and implementation of training process, RAE can have – both in short and long term – a great impact on athletic development of an individual, it is really important to recommend coaches as well as the professional public to give their full attention to this issue.

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STUDIA SPORTIVA 2021/2

The Organisation of Formal Education of Fencing Coaches in Hungary, Great Britain and the Czech Republic

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Abstract

The paper deals with formal educational programmes for fencing coaches in Hungary, Great Britain and the Czech Republic. Based on a content analysis of mainly curricular documents, we were able to identify and describe similarities and differences in approaches to coach education. They were apparent primarily on the legislative, organisational and content levels. The research shows that the road to coaching excellence takes a different length of time in different countries. It is even in sharp contrast to formal licence education of some fencing federations when it comes to a bachelor study programme. Differences were also found in the approach towards the organisation of practical training. The more traditionally designed education of coaches in Hungary and the Czech Republic differed from the education in Great Britain from a philosophical and content point of view, specifically in topics such as the application of soft skills and setting, planning and assessment of goals in coaches' practice.

Keywords: *coach education, fencing, fencing coach, coaching school, coaching projects*

INTRODUCTION

Coach education is a term currently relevant to many sports, including fencing. Individual fencing federations develop and implement educational programmes for their coaches, often in collaboration with universities. They are aware of the fact that the main prerequisite of professional development is systematic and continuing education realised on formal, non-formal and informal levels (Dieffenbach & Thompson, 2020; Trudel & Gilbert, 2006; Marinková & Stretti, 2009). It remains unclear what the ideal ratio between the individual forms is and which of them has the greatest effect on the increasing level of coach's skills (Reade, 2009; Mallett, Trudel, Lyle, & Rynne, 2009). Some authors (e.g. Lyle, 2016) perceive the process as an intertwined system of formal and non-formal education. The road to becoming a coach, especially on the elite level, is a complex process that does not follow a stable and precise pattern (Janíková, Jůva, & Cacek, 2019). For this reason, there are many ways of describing and clarifying the phenomenon.

Many authors decided to focus on research of coaching elites in which they give examples of best practices based on results. These empirical studies reflect the trends to conduct research on examples of successful coaches or athletes (how they train or trained in the past) and coaching education programmes they completed (Avard, 1995). Other authors decided to focus on the evaluation of specialised knowledge of coaches which they used to design educational models (Côté, Salmela, Trudel, Baria, & Russel, 1995). There is a growing criticism of classical approaches based on levels of education in the model novice – expert where coaches can not focus on a specific part central to their research interest (Trudel & Gilbert, 2006). The effort to theoretically define and describe the process that would be approved by experts when designing formal coach education was greatly assisted by a non-profit organisation *International Council for Coaching Excellence – ICCE*[1], currently considered to be the leader in this research field. It is, in particular,

[1] *ICCE* – https://www.icce.ws/

the documents *The International Sport Coaching Bachelor Degree Standards of the International Council for Coaching Excellence* (Lara-Bercial et al., 2016) and *The International Sport Coaching Framework, Version 1.2.* (ICCE, ASOIF, & LBU, 2013) that substantially contribute to the design of new functional systems of education. In the USA, the system *QCF – Quality Coaching Framework* (United States Olympic Committee, 2017) was developed. These documents provide valuable information on the principles of the development of systems of coach education. Specific information on what, how and when to teach is stated in a study by Hedlund, Fletcher, Pack and Dahlin (2018).

Another problem transcending the boundaries of specialisation faced by universities, sports federations and organisers of formal coach education is the national legislative and accreditation conditions that define, to a great extent, the content, form, and length of formal educational programmes. The particular issue of coach education in fencing is dealt by, e.g. Kirby (2014), Kundera (2019a, 2019b) and Roček (2020a). In the wider practical and theoretical context as well as in the approach to education in individual sports disciplines, there is a growing interest in this topic in the Czech Republic (Gállová & Jůva, 2019; Taušová, 2012; Tomešová, 2020; Janíková, Jůva & Cacek, 2019; Kovář, 2011).

The aim of the present paper is to describe and compare formal educational programmes for fencing coaches in Great Britain, the Czech Republic and Hungary mainly with respect to the aspects of legislation, content, time allocation and organisation. In addition, attention will be paid to the conception of practical training and support in terms of study and teaching materials.

RESEARCH METHODOLOGY

The countries whose formal systems of coach education were compared were not chosen at random. Historically, Hungary belongs to the three most successful countries in the sport. Great Britain went through several functional changes of its educational system between 2007 and 2017 and recorded a general increase in the performance of its fencers (Randall, 2009; Jones, 2017). The main aim of the study was to compare the selected systems of formal education, identify and describe the similarities and differences in the approaches to coach education by means of content analysis (Hendl, 2005; Gavora 2010). After completing the heuristic stage of the research (Bartoš, 1992; Hroch, 1985), we designed a system of categories focusing on specific partial goals related to the description of:

1- the legislation associated with the process of formal education of fencing coaches in the selected countries;
2- organisations providing fencing coach education;
3- organisational and content matter of courses and study programmes;
4- time allocation for individual levels of education;
5- practical training;
6- study materials provided for course attendees.

We used both quantitative and qualitative approach in content analysis (Macnamara, 2018; Berelson, 1952) of official documents of the studied institutions, educational programmes and their respective curricular documents and literature. This method was also used because it allows the application of descriptive functions (Švec, 2009). The information sources were mainly electronic and were consulted by correspondence and verified by experts on the studied area.

To compare the studied systems, we used a model based on description → interpretation → juxtaposition → and the actual comparison according to Bereday's model (Bereday, 1964). The model is typically used in curricular analyses, mainly in the area of educational science (Maňák

& Švec, 2005). Based on the information gained in the heuristic stage of the preparation, we were able to create a system of categories that were subsequently compared.

RESULTS

The system of fencing coach education in the Czech Republic

The education of fencing coaches in the Czech Republic is based on a 4-tier educational system described in a document *Regulations and Criteria of Coaching Licences* (https://www.czechfencing.cz/uploads/documents/119.pdf). It is a model of gradually increasing levels: fencing practitioner, C licence coach, B licence coach, A licence coach. A specific feature of the system is a degree for coaches with *meritorious service*, which is independent of the formal education of fencing coaches and is awarded for successful long-term work, especially on the occasion of the awarded coaches' anniversaries.

In the past, the education of fencing coaches was provided by the central organs of the Czech Union of Sport and after its disintegration in 1990, the individual unions (federations) were given freedom to design the system of education for their coaches. Over time, Czech fencing achieved a number of international successes. However, it became obvious that the conservative system of education could no longer reflect the current trends in the training of coaches and subsequently athletes, especially when it came to practical training (Kundera, 2019a). In 2020 the *Educational and Methodological Committee* (EMC) was established, aiming to innovate the system of education of fencing coaches. One of the first policies introduced by the committee was conducting of a survey (n = 101) whose aim was to help instructors modify the current education of fencing coaches in the Czech Republic (for more, see Roček, 2020b).

Table 1. Overview of Czech fencing coach education provided by the Czech Fencing Federation and the Coaching School of the Faculty of Physical Education and Sport (FPES) Charles University

	Practitioner	C licence coach	B licence coach	A licence coach
Time allocation	12 hours	30 hours	150 hours	500 hours
Age limit	> 16 years of age	> 17 years of age	> 18 years of age	> 18 years of age
Qualification prerequisites / fencing experience		Practitioner, coaching practice of min. 1 year or 4 years of competition activity	C licence coach, coaching practice of min. 2 years or min. 6 years of competition activity, min. 4times participation at World Cup	B licence coach, coaching practice of min. 6 years or min. 8 years of competition activity – participation at World championships (adults)
Education			Completed secondary education including the school-leaving exam or over 50 hours of the general education programme at the Training School FPES	Completed secondary education including the school-leaving exam at min.

A licence coach

The highest qualification in fencing in the Czech Republic is *A licence coach*. It is provided in collaboration between the Faculty of Physical Education and Sport (FPES) at Charles University and the Czech Fencing Federation (CFF). The FPES provides the teaching of theoretical subjects based on accreditation of the Ministry of Education, Youth and Sports Czech Republic from 12th–13th May 1993 and the re-accreditation 14 756/2009 – 30/1 (https://ftvs.cuni.cz/FTVS-2198-version1-organizacni_studijni_a_zkusebni_rad_ts.pdf). The second stage of the process of coach education, the specialisation[2] is provided by the CFF. The study at the Coaching School at FPES is conceived as a form of lifelong learning (professional education, obtaining the qualification of a professional in education as stated in the law No 563/2004 Sb., § 10 – § 21).

To be admitted for studies, the applicants must be over 18 years of age and must supply a valid certificate of completed vocational or general secondary education, or higher education (min. the school-leaving exam). They also need to be admitted by the respective sport federation which will provide the specialised courses.

The study programme at the coaching school (CS) is divided into 2 years (4 semesters), typically there are 9 consultations every school year on Fridays or Saturdays. The time allocation for the complete study is 500 lessons, out of which, in the new programme design, 220 lessons are devoted to the fencing specialisation (73 lessons of theory, 147 lessons of practice). Although the courses are run by the university, the graduates of the courses do not receive a bachelor degree (BSc). Upon request, however, this education allows them to obtain a trade licence. After completing all their study duties (credits and exams) and passing the final examination in front of a committee, the students receive a certificate of graduation from the CS. The students receive study materials in the form of PowerPoint presentations from individual instructors, comprehensive learning materials (Jansa & Dovalil, 2007) or a textbook on physiology for the CS (Kohlíková 2004).

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[2] The content of the study for A licence was designed within the project "Trenéři do lavic" (*Coaches Going Back to School)* commenced from the academic year 2020/2021 by Fridrich Földes, a renowned fencing coach, formerly also the national team coach of the Czechoslovak and Czech Republic, since 1999 the head coach of the national pentathlon team of Great Britain. His students were participants and medallists at world, European championships and the Olympics.

The specialisation content:

1st year – 1st semester, the basic module: history of fencing (2 lessons of theory/0 practice); nomenclature and terminology (2/0); educational-psychological aspects of the coach's / instructor's work (2/0); rules of fencing (4/2); forms of work, organisation of training (2/0); methods of providing information (1/0); structure of the sports performance of fencers (3/0); basics of sports training (3/0); fencing and movement skills (4/4); fitness training of fencers (2/6).

2nd semester, technical module characteristics of fencing technique, composition and structure (1/2); preparation exercises for technique training (2/4); technique and training of positions (1/3); technique and training of fencing guard, weapon holding (1/2); single and compound footwork – description and training of technique (1/5); footwork training (1/3); types of distances in fencing, training of distance (1/3); blade work, preparation movements (1/3); body thrusts , cuts, types of thrusts and cuts (1/4); actions without the blade, direct thrusts and cuts, disengage (1/4); types of feints (1/2); blade actions –beats, engagement, transfer (1/4); first intention attacks (1/3); second intention attacks (1/4). Defensive actions: types of defence (2/3); hand and blade positions, parries (1/4); defensive systems (1/4).

2nd year – 3rd semester, tactical module: the notion of tactics, tactical thinking (2/4); introduction to tactics (2/6); training of tactical variants within technical preparation (3/12); **Module of guiding an athlete in a competition and analytical work of the coach:** guiding an athlete through a competition (2/4); the writing of fencing (2/0); long-term monitoring of an athlete and opponents (2/0).

4th semester, specialisation: specifics of fencing training: distance, types of trusts and cuts (1/4); individual lessons 1 (3/12); individual lessons 2 (3/12); forms of technical preparation: pairs exercises, dummy exercises (2/6); analysis and correction of errors (2/10).

The final examination at the CS consists of an oral exam from the specialisation and theory. Another part of the final examination is the defence of the thesis on an assigned or chosen topic (min. 30 pages according to the given parameters: https://is.cuni.cz/studium/ekczv/index.php?do=detail&cid=6482; https://ftvs.cuni.cz/FTVS-2198.html). The practical part of the examination is held in a fencing hall. The fees charged for the study at the CS A licence (the theoretical part) are 11 thousand CZK for 2020/2021 or 13 thousand CZK for 2nd year students (https://ftvs.cuni.cz/FTVS-2198.html).

B licence coach

The second highest level of formal education in the qualification process of the CFF is the B licence. Similarly to the A licence, education is provided in collaboration with the Coaching School FPES and CFF. The general part of the training course, the so-called *Scientific Basis of Sports Training* is provided by the FPES CU, the specialisation traditionally by the CFF. The Coaching School runs the programme as a part of lifelong learning – vocational training as specified in the Czech legislation. The study programme is divided into the general and specialised part, in this case theory and practice. There are 50 lessons of the "scientific basis" at the FPES and 100 lessons of specialisation provided by the respective sport federations. For applicants who have not completed secondary education, including the school-leaving exam, there is an obligation to complete 50 lessons of the basic general programme. The theoretical lessons are held during 2 weekend consultations (from Friday – Sunday). The registration procedure is similar to the A licence. The applicant needs to supply a certificate of the highest education received and the CFF then sends the form to the Lifelong Learning Centre of the FPES CU.

The final examination at the Coaching School for B licence coaches consists of a written test on the subject matter covered in the *Scientific Basis of Sports Training* and taught during the weekend consultations. The final written dissertation has min. 15 standardised pages and there are theoretical and practical examinations from the specialisation. At the enrollment, students receive study materials, however, these have not always been a regular part of the study support (Perič, 2016). In terms of content, the text focuses on topics taught in the lessons of the CS: anatomy, kinesiology, physiology, physiology of training load, sports psychology, educational science (including Fair play), sports training (including sports training in children), compensation exercise, nutrition, first aid, management and basics of doping prevention.

C licence Coach

The education of C licence coaches is provided solely by the CFF and its staff who are the Education and Methodology Committee (EMC) instructors for individual specialisations (weapons). In total, there are 30 theoretical and practical classes. Study materials are provided to the course attendees electronically as PDF documents or PowerPoint presentations and are usually designed by the instructors. The materials also include videos supplementing the lectures dealing with theory and practice of fencing, however, these are currently accessible only to the course participants. The theoretical block of sessions consists of 13.5 classes.[3] The process of innovation of C licence coaches' training started before 2020 in the specialisation of foil. The training was provided by the club of sport fencing TJ Sokol Bystřice nad Pernštejnem since 2017 with their

[3] In the theoretical part, the lessons include topics concerning the basics of anatomy and physiology of training (1 lesson of theory / 0 practice); physiology of loading (1/0); theory of sports training (1/0); hygienics and load compensation (1/0); pedagogical basics of training (1/0); sport preparation of children (1/0); definition of the term coach and using soft skills in their practice (1/0). From the specialisation part, the students of the course are partly introduced to the following topics: fencing history (1/0); fencing – sports performance structure (1/0); fencing – basics of technique (1/0); overview of types of fencing actions (1/0); positions and fencing footwork (1/0); basics of the technical training of fencers (1/0); history of fencing rules (0,5/0).

successful and experienced coaches. Since 2020, the foil specialisation is linked to the unified system of coach education under the patronage of the *EMC*.

The final examination for C licence coaches consists of a written test covering the subject matter of the theoretical lectures and specialisation. A practical examination from the chosen specialisation (foil, sabre, épée) is also a part of the assessment. The course run by the CFF is free of charge.

Instructor

The instructor is the lowest introductory degree in the process of formal coach education of the CFF. It comprises 12 practical and theoretical lessons. There is also the lowest entrance age level (upon turning 16). The only course completion requirement is attendance or a final test. Similarly to the other levels, the course attendees receive study materials such as presentations and video materials. The training run by the CFF is free of charge.

The system of training and in-service workshops by the CFF

Apart from the continuing formal education of coaches, the CFF also runs training and weekend workshops on chosen topics or invites guests from within and outside the institution. In the course of the Olympic cycle, the federation holds a specialised workshop under the supervision of a foreign expert for all the specialisations. In addition, the CFF organises workshops for in-service coaches in collaboration with the EMC. These are a compulsory part of the upgrade of a valid licence in a 5-year cycle.

It is the duty of coaches and instructors to complete at least two of the given options specified in Table 2. After that, the licence is automatically renewed. If they fail to do so, their license can be revoked. These partial tasks primarily entail continuous practice and participation in seminars. By means of these measures, the CFF aims to ensure the continuing and systematic education of its coaches (https://www.czechfencing.cz/uploads/documents/119.pdf).

Table 2. The system of in-service workshops for coaches provided by the CFF

Instructor	C licence coach	B licence coach	A licence coach
2 in-service seminars in the course of 5 years	2 in-service seminars in the course of 5 years	2 in-service seminars in the course of 5 years	1 in-service seminar in the course of 5 years
Active as an instructor	Active as a coach	Active as a coach	Active as a coach
		Must participate in the training of new instructors or coaches	Must participate in the training of new instructors or coaches
		Must participate in an international seminar	Must participate in an international seminar
			Preparation or realisation of training – in-service training of lower-licence coaches

The system of fencing coach education in Great Britain

Britain founded its own national fencing federation in 1902 under the name *Amateur Fencing Association – AFA* with Alfred Hutton, the author of a famous textbook on fencing (Hutton, 1889) as its head. *AFA* was renamed in 1996 the *British Fencing Association – BFA* and has been using

the name with *British Fencing – BF* ever since. The *BF*[4] is responsible not only for the traditional agenda of the federation but also for fencing coach education and it is the technical guarantor. Apart from the above given BF as an umbrella organisation on the international fencing scene, fencing training is managed and organised based on the administrative division: England, Wales, Scotland and Northern Ireland. Each of the countries has its own fencing federation which organises its own regional competitions and championships and takes part in British championships under the patronage of the BF. Every four years the national teams also take part in the Commonwealth Games (Kirby, 2014).

The system of fencing coach education in Great Britain reflects regional interests and partly the pursuit of independence presents an issue. A typical example is Scotland where they developed their own 5-level system of coach education which is completely independent of the BF programme of fencing coach education as represented by the *British Fencing Coaching Framework – BFCF*[5] . *Welsh Fencing – WF* has a partly independent system close to the BFCF. The only exception in the Welsh Federation is the foundation training of the coaches of the lowest levels, specifically the programmes *Introduction to Coaching Fencing* (*L1*) a *Coaching Fencing* (*L2*), provided by the WF itself (https://www.welshfencing.org/index.php/component/content/article/10-coaching/650-coaching-system?Itemid=101). The courses for coaches are run on regional level using various locations and sports facilities to allow the access for applicants from all over Wales. Like other BF institutions, WF also hires external collaborators to enhance the quality of teaching in areas such as fitness training of fencers, sports psychology, nutrition, etc.

The British Academy of Fencing – BAF was formed as a professional alternative to the existing AFA (today's BF). Since its foundation in 1948 (with the separation period between 1998 and 2018), it has played a role in the systematic education of masters, coaches and instructors of modern sports fencing. The BAF system of education includes five levels: Level 1, Level 2, Level 3 (Moniteur), conceived as introductory levels and the so-called advanced degree Level 4 (Prevot) and the highest level – Level 5 (Diploma). The graduates of BAF programmes are recognised abroad thanks to the organisation's links to *Academie d'Armes Internationale* – http://www.aai.world/. It is important to note that the organisation together with the *Academie d'Armes Internationale* does not set the trends any more in modern fencing coach education. There was an ideological split in 1998 between BAF and BF. However, since 2018, there has been a shift in the perception of BAF and after improved standards in teaching, its graduates are once again recognised by the BF[6] (British Academy of Fencing, 2020). In Great Britain, the British Fencing is the main organisation educating fencing coaches with significant international achievements although paradoxically, the British Academy of Fencing remains the only organisation operating nation-wide (Kirby, 2014, p. 4).

British Fencing has also struggled with results in the past. Those were achieved mainly thanks to "imported experts" – coaches. The efforts to improve the quality of fencing coach education led to the implementation of *Coach Development Project* in 2007. The project was introduced into the BF structures as a pilot programme designed on the basis of research. It assessed the current situation and gave clear recommendations as to in which direction the development of fencing in Britain should go. This project was seen as ground-breaking and because of its scope belongs to the outstanding events of the BF (Randall, 2009). During the design, questions addressing coach education in fencing specialisation as well as other issues were addressed.

[4] For the sake of simplicity in the text we refer to it as *BF – British Fencing*

[5] https://www.britishfencing.com/members/coaching-zone/the-bf-coaching-framework/

[6] https://baf-fencing.com/the-baf-and-british-fencing/

Fencing coach education in England, Northern Ireland, and Wales

In terms of coach education, the fencing federations of England, Northern Ireland, and Wales are currently following the strategic document *British Fencing Coaching Framework* (British Fencing Coaching Development Framework, 2017, p. 20–21) which outlines the organisational, curricular and ideological framework of the process of improving the coaching competences of the BF members. This framework was designed to improve the coaching skills of every applicant and puts an emphasis on the modern approach in catering for specific needs of coaches (Trudel & Gilbert, 2006). This is reflected in areas such as providing support on the community level, teachers' work at school to integrate fencing into their syllabi, improving the managerial and communication skills but also in performance and elite sport.

The system does not specify only the levels of coach education but also its philosophy which includes four main points: 1/ the Culture of Learning – the striving for permanent development of competences of the coaching community; 2/ the approach of Continuous Improvement based on the reflection of coaching practice; 3/ the option of Flexible Modules in coach education; 4/ appreciation and recognition of coaches' work not only on elite but on all levels (Coaches are valued) [7].

Another approach, not very common in sport, is emphasising the understanding of the process of professional growth in the system of *Why? How? and What?* to do. We commonly encounter the paradigm "*show and copy*", which is represented by the adverbs *"why"* and *"how"*, however, the part that would refer to the philosophical essence of individual elements and their integration into the subject matter is often missing.

Those interested in systematic coaching education are guided by the information and links on the website in the section Coaching zone to individual options that the system enables (https://www.britishfencing.com/members/coaching-zone/).

Among the duties of coaches, assistants and other staff in sports organisations, there is the completion of a course *Safeguarding & Protecting Children*[8], training of first aid and the submission of a criminal record check. In the area of children protection, there are mandatory re-trainings to be taken every three years at minimum. This specific course aims to maximise the protection of athletes, prevent abuse and provide a safe environment for training. It also attempts to minimise the risks of potential lawsuits. The course covers issues that are important in the Czech context, however, so far not as much attention has been paid to them as in the Anglo-Saxon world (the issues of sexual abuse, equal opportunities, racial discrimination, etc.).

Similar measures are applied also in sport in the USA where the issues are dealt with by the organisation the *U.S. Center for SafeSport*.[9]

The system of coach education is conceived on several levels and is described as the *Coach's Journey* (https://www.britishfencing.com/members/coaching-zone/the-bf-coaching-framework/my-coachs-journey/). The name itself refers to the dynamics in the conception of professional development of assistants and coaches of fencing based on the philosophy of the BF system. The long-term continuous development – similarly to the generally accepted professional development model *beginner → expert* of the Dreyfus brothers (Dreyfus & Dreyfus, 1980).

[7] https://www.britishfencing.com/members/coaching-zone/the-bf-coaching-framework/

[8] ttps://www.britishfencing.com/bf-online-renewal-safeguarding-protecting-children-course-fencing-specific/

[9] https://uscenterforsafesport.org/

Core Coach[10]

The introductory course *Core Coach* is aimed at those applicants who do not necessarily have direct experience of fencing, however, they wish to participate in the training sessions and fencing competitions as well as other events associated with fencing. Teaching is aimed at the mastering of the most basic skills of beginners or presentation of fencing[11]. Depending on the level of experience of the attendees, the time allocation varies between 1–2 days or 6–12 topics. If the applicants have had no previous experience with the organisation of sports events or have not completed any other formal education in sport, they participate in the longer variant of the training.

The prerequisite for enrolling on the course is the min. age limit of 18 years and a valid certificate of the *Safeguarding & Protecting Children* as well as a First Aid course. Furthermore, the applicant must submit a criminal record check. The fee for the course is 20 GBP.

Introduction to Coaching Fencing (L1)[12]

The course L1 is aimed at applicants with previous experience with fencing who wish to participate in the training process as assistant coaches or coaches or at those who wish to work in the fencing community without the ambition of becoming a coach. The taught actions are focused on the mastery of designing training for a specific training group and the development of coaching skills in fencing.[13] On the "how?" level, the syllabus of the course focuses on the usage of voice and coaching signals in fencing training. The process skills such as instructions, demonstration, observation and feedback in coach's work, *KLPs – Key Learning Points* are trained.

The syllabus of the course also aims to introduce the importance of self-reflection on one's coaching practice and methods employed. From the specialisation the significance of distance, timing and presentation of the coach's blade in weapon training is highlighted. A newly introduced topic as compared to the *Core Coach* course is the issue of guiding the athletes, types of coaching style and the focus on the knowledge and interpretation of the rules of fencing. In comparison, the knowledge of the rules of fencing features in the CFF coach education in the syllabi of higher levels (A Licence 4 lessons of theory / 2 lessons of practice). Other than that there are self-standing trainings for fencing referees under the patronage of the CFF. The conditions for getting accepted are the same as for the introductory course of the BF, that is a valid *Safeguarding & Protecting Children* certification, a First Aid training and a criminal record check. Furthermore, the applicant must provide evidence of personal active experience of fencing of min. one year. The min. age limit is16 provided there are positive references. A valid membership in the BF is essential as well. The time allocation is 20 theoretical and practical lessons. There are study materials for the course, however, they are not freely available.

[10] https://www.britishfencing.com/members/coaching-zone/the-bf-coaching-framework/my-coachs-journey/core-coach-offer/core-coach-course-overview/

[11] Organisation of a training group: planning; voice technique; coaching signals. Rhythm, strength, speed – their training and instruction in fencing. Conducting a training session and teaching by means of process skills: instruction, demonstration, observation and feedback. The technique of *KLPs* (*Key Learning Points*). The ability to recognise and correct mistakes in the basic fencing technique (guard, lunge, etc.). Ethics of fencing, holding and manipulation of weapon, step forward – step backward, rules of weapons (foil and sabre). Introduction to the social environment in fencing training. From the attack actions the teaching includes a combination of actions: lunge attack, defence – parry and riposte, counter riposte.

[12] https://www.britishfencing.com/members/coaching-zone/the-bf-coaching-framework/my-coachs-journey/introduction-to-coaching-fencing/

[13] The development of basic fencing skills (weapon holding, on guard position, armed arm position, touches, parries, footwork technique- step forward, step back, lunge, step-lunge, recovery); attack; defence; 1st counter riposte; preparations of fencing actions; movement skills facilitating the development of fencing actions; basic rules of fencing; understanding the essence of fencing.

Coaching Fencing Course (L2)[14]

Another level of formal coach education at the BF is the L2 course focused on the professional development of coaches working in clubs with fencers who take part in domestic tournaments. In terms of the content, the attendees develop their knowledge of issues dealing with setting and planning goals. Next, the subject matter expands from the original topic of group sessions to individual work, in particular it deals with the topic of the design and composition of individual lessons. The specialised study focuses only on one weapon. Other coaching competences are developed, namely the process, technical and tactical skills of coaches. The topics of the previous course are expanded in the sense that the new topics touch upon the teaching of compound actions, stop hits, renewals, preparations of attacks, etc.[15] The conditions for being accepted are similar to those on the lower level as shown in table 3. The course includes theoretical and practical classes amounting to the total of 35 lessons (a 4-day course). The course has study materials which are not freely available.

The *Weapon Specific Courses L3 a L4*[16]

The *Weapon Specific Courses L3* and *L4* are programmes aimed at coaches and head coaches of clubs whose athletes regularly participate in official international competitions (*European Cadet Circuit*, *JWC*). The coaching course focuses on teaching and the acquisition of processes associated with effective coaching of group and individual session in the broader tactical and technical context[17]. From the épée specialisation, the focus is e.g. on the methodology of the leg and foot hits. In the L3 degree, the course focuses on the development and guidance in the attendees' coaching philosophy and improvement of their analytical abilities by means of a tool called *Training Needs Analysis* which helps identify and improve the set goals. Also, the emphasis is on self-reflection on the coaching practice. On L4 level, the attendees have to submit training session plans, a presentation on the technical aspects of a chosen weapon and design a training plan for the present season. The course is focused on the design and implementation of individual lessons. All these partial tasks stress the analytical and planning aspect in coach's work and its importance for achieving a higher sports level.

[14] https://www.britishfencing.com/members/coaching-zone/the-bf-coaching-framework/my-coachs-journey/coaching-fencing-course-l2/

[15] The planning of individual sessions and specifically targeted group sessions (focused on a certain topic); conducting training sessions using advanced process skills: instruction, explanation, demonstration, using observation and feedback in the process of motor learning and training; blade presentation, perception refinement and using specific means to train distance, timing and rhythm.

[16] https://www.britishfencing.com/members/coaching-zone/the-bf-coaching-framework/my-coachs-journey/weapon-specific-course-l3/; https://www.britishfencing.com/members/coaching-zone/the-bf-coaching-framework/my-coachs-journey/weapon-specific-course-l4/

[17] Opposition offensive actions angulated offensive actions, point in a line, prise defers, opposition parries, compound counter-attacks and counter riposte, close quarters, flicks in foil and épée, all footwork preparations, all blade presentations. Next, it is renewals, compound attacks, simultaneous attacks and the above-mentioned flicks at the opponent's leg in épée.

Table 3. BF course structure

	Core Coach	Introduction to Coaching Fencing (L1)	Coaching Fencing (L2)	Weapon Specific (L3)	Weapon Specific (L4)
Time allocation	Depending on the level of experience 1–2 day (6–12 modules).	2 days (16 lessons) of direct teaching +4 lessons of self-study, 20 lessons in total	4 days of training (32) lessons of direct teaching +3 lessons of self-study, 35 lessons in total	5 days (35 lessons) of direct teaching + 5 lessons of self-study, 40 lessons in total	2 days (16 lessons)
Age limit	>18 years	>18 years (exceptions granted based on a reference to >16 let)	>18 years	>18 years	>18 years
Qualification prerequisites (fencing experience)	Safeguarding & Protecting Children, first aid training, criminal record check	Safeguarding & Protecting Children, first aid training, criminal record check Fencing experience > 1 year, valid membership in the BF	Safeguarding & Protecting Children, first aid training, criminal record check A holder of the *Introduction to Coaching Fencing (L1)* or older version (*BF L2* before 2016), valid membership in the BF	Safeguarding & Protecting Children, first aid training, criminal record check. A holder of *Coaching Fencing (L2)* ort he older version *(BF L3* before 2016), valid membership in the BF	Safeguarding & Protecting Children, first aid training, criminal record check. Holder of *Weapon Specific (L3)* o ran older version *(BF L4* before 2016), valid membership in the BF
Education	not stated	not stated	not stated	not stated	not stated

The time allocation in L3 is 5 days (35 lessons) of direct teaching for the L3 + 5 lessons of self-study while in the L4 programme there are 2 days (16 lessons). The prerequisites for participation are similar to the two previous courses (see Tab. 3), in addition, there is an obligation to submit the given assignments.

Education of fencing coaches in Scotland

The education of coaches in Scotland is provided by an independent system which is, nevertheless, valid for the fencing coaching practice all around Great Britain and vice versa. The formation of an autonomous organisational entity of Scottish fencing began in 1923 with the establishment of the *Scottish Amateur Fencing Union – SAFU*. The current *Scottish Fencing – SF (http://www.scottish-fencing.co.uk/)* is an autonomous organisation in terms of internal affairs, it is, however, represented by the umbrella organ of British Fencing, the BF on international level. The beginnings of coach education in Scotland are closely linked to the name Bert Bracewell who was in the '60s of the last century appointed the national fencing coach and started to build a system of coach education provided by means of the National Coaching Scheme. Later, the *Scottish Coaches Association* (1969) was founded. Gradually, two levels of fencing coaching education were developed, namely the *Basic Coaching Certificate* (1967) and also the *Intermediate Coaching Certificate* in 1970 (Beaumont, 1966; Gray & Cohen, 1984). At the moment, the education of fencing coaches is provided by the *Scottish Fencing Coach Programme* (https://www.sfcoach.co.uk/), which developed and implements a five-level system of coach education.

L.1 Volunteer Coach[18]

The starting level of formal fencing coach education in Scotland is the *L1 – Volunteer Coach*, composed primarily of modules dealing with creating a safe space for training – *Safe*. Another important topic is setting the code of conduct for training sessions and for the sports community in general. Course attendees are also acquainted with the *Scottish Fencing Code of Conduct for Safeguarding Children in Sport*.[19] It includes examples of good practice (sport as fun, the promotion of fair play, constructive feedback, relationships built on trust) as well as situations that coaches should avoid or are completely unacceptable (favouritism, excessive amount of time spent with a child alone, unauthorised entry into the trainees' rooms, sexual innuendoes, mental abuse, sharing a room with a trainee at a sports event, etc.).

The second module is *Teach the Game* in which the principles of *Teaching games for understanding – TGfU* (Werner, Thorpe, & Bunker, 1996) are applied to teach fencing skills such as attack and defence. The module *Well Run* deals with providing information and practical skills in training planning, the use of entertaining aids and creating a positive and inspiring environment for training. The last module is *Inclusive*, aimed at planning activities and procedures that help cater for the needs of the trainees, coach's integrity, the ways to avoid and prevent abuse including the completion of the *Safeguarding Course*[20].

The final requirements include the planning and implementation of six fencing lessons. The courses provide freely accessible study materials and references to individual study areas. [21] Some of the materials were provided by the umbrella organisation of Scottish sport – *Sportscotland*, an equivalent of the Czech National Sports Agency – NSA.

L.2 Community Coach[22]

The second SF course is called the Community Coach. It focuses on specific aspects of fencing such as the perception of distance, timing and fencing tactic. To improve these skills, the models REFLECT and EQ are used, where emotional intelligence is applied to optimise decision making in a fencing fight by means of connecting thinking and feeling (Gobinder, 2014). The models are used to improve the quality of control over maintaining the distance and timing of the actions of fencers. Both these skills are key to success in fencing. Another topic of the course is the conception of fencing bouts by limiting the tactical and technical possibilities of fencers – *Constraint-led*. The constraint or the inverse setting of options available to a fencer strengthens the focus on specific aspects of movement stereotypes and their effective transfer to competition scenarios. A Czechoslovak author dealing with the phenomenon was e.g. Bořivoj Bidlo (1975).

[18] https://cd8cee83-81ef-442d-b657-0b93af851eba.filesusr.com/ugd/830e40_06e16bb0b8db4fe4a632a04af9e3f800.pdf

[19] http://www.scottish-fencing.co.uk/sites/default/files/SF%20CodeofConduct_0.doc. Scottish Fencing Code of Conduct for Safeguarding Children in Sport. The students are also acquainted with the protection policy of the *BF*.

[20] The study and subsequent completion of the e-learning course *Child Wellbeing and Protection in Sport* (https://sportscotland.info/childwellbeing/v4/index.html)

[21] https://www.sfcoach.co.uk/level-3

[22] https://cd8cee83-81ef-442d-b657-0b93af851eba.filesusr.com/ugd/830e40_3013212cc85346a7b5a6c7ef4f885eb1.pdf

L.3 Club Coach[23]

The programme *Club Coach* focuses on the mastery of processes dealing with competitiveness in sport – *Coaching competitiveness*. The training therefore aims at procedures that make training more effective and help fencers achieve their best possible performance. Coaches learn techniques such as *observation* thanks to which they are able to use self-reflection more effectively, listen to other people and focus their observation on important phenomena. Another topic is *analysis* where the course attendees learn to use tools such as the SWOT analysis and also become acquainted with the *SFCP programme – Solution Focused Coaching Programme.* [24] Tactical awareness, information analysis (video analysis) and problem solution are a part of the section called *Identify*.

The specialisation module of training – *Train* provides information and methodology of training tactical sessions. Based on the description of typical examples of the coaching practice of the students (how they prepare for a training session, what information sources they use in the preparation and where they see their limits) the instructors give feedback and correction. The students then have to apply the newly acquired knowledge on three of their trainees and thus optimise the physical, mental and fencing preparation for a competition. Online material for the course is available on the web *OpenLearn* (https://www.open.edu/openlearn/) – *Exploring sport coaching and psychology.* [25]

L.4 Talent Coach[26]

The fourth level focuses on the development of the club and team spirit. An integral part of the content on this level is the module *Mindset Skills* – the training of mental skills such as mental resilience, motivation, self-control, commitment and problem solving. The course also includes information on the strategies for team psychoanalysis and the design of a plan of individual mental training and its monitoring for 12–18 months (our source, however, gave the information it was 6 months rather than the official figure). In other words, the course aims at one of the most important components of the fencing performance, i.e. the mental readiness for combat or in combat. It is claimed that the mental part constitutes up to 40.7% of the performance (Kogler, 2005, p. 266).

In the area of tactical skills, the students learn how fencing fights are won and how to monitor the tactical development of the trainees. The course deals with the issue of planning – *Planning Skills*, which concerns the strategic planning and development of a club as well as a competition plan of individual athletes and its evaluation. The course applicants also take part in four weekends of the course SFCP, which develops the skills acquired in L3 course where the covered subject matter is demonstrated in practical conditions, and lessons designed by the applicants are demonstrated. This should give feedback as to what the students have learnt during the course and in case of ambiguity or inaccuracy, the educators provide them with correction. The course also includes the online course of the platform *OpenLearn* dealing with eating habits of athletes – *Eating to Win*. [27]

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[23] https://cd8cee83-81ef-442d-b657-0b93af851eba.filesusr.com/ugd/830e40_a54cbef4f94a4209920ef184f34f9232.pdf

[24] SFCP Coaching Process (Teach Game → Coach distance and timing → Facilitate competitive scenarios → Talent Development → High Performance).

[25] https://www.open.edu/openlearn/health-sports-psychology/exploring-sport-coaching-and-psychology/content-section-overview?active-tab=description-tab

[26] https://cd8cee83-81ef-442d-b657-0b93af851eba.filesusr.com/ugd/830e40_b56433d4764b4d6b94986be46a13d935.pdf

[27] https://www.open.edu/openlearn/health-sports-psychology/sport-fitness/eating-win-activity-diet-and-weight-control/content-section-0?active-tab=description-tab

L.5 Performance Coach[28]

The ultimate level in the system of fencing coach education in Scotland is the course *L5 – Performance Coach*. The aim of the course is to provide the students with support on elite technical and tactical level. The syllabi of the courses state that the coach's level is as high as to make it possible for the trainees to achieve the ranking among the 32 best competitors in the official *FIE* and *EFC* tournaments. The coaches develop their own coaching philosophy, inspire and provide mentoring to other coaches. The attendees are required to successfully complete the online course *Motivation and factors affecting motivation.* [29]

Next, they learn to use specific tools for goal setting and problem solving, e.g. the active application of the *GROW* model[30] (Whitmore, 2009), both on themselves and their trainees. Another tool the attendees learn to apply in the area of assessment and personal and process goal setting is the popular *SMART* tool. The distance learning platform *OpenLearn* is further used in the area of training management – specifically with regard to the topic of recovery after training load. [31]

To conclude the section on the Scottish system of fencing coach education, let us add that the time allocation of courses is not strictly given. It is stated only approximately and can be adjusted depending on the knowledge, understanding and grasp of the covered subject matter. Generally speaking, the SF courses run mostly at weekends on Saturdays and Sundays during two teaching blocks – morning and afternoon one with an hour lunch break. There are 7 lessons daily. The legal conditions that Scottish coaches need to comply with are the same as the ones for courses run by the BF. L1 course is open to applicants older than 16 whereas the other courses are for applicants over 18.

The allotted time is one weekend if the attendees have previous experience. In other instances the length of the course can be extended up to 3 weekends depending on the experience and current competences of the students. This open format applies also to L2 courses (2–4 weekends) and L3, where the length varies between 3–6 weekends. L4 and L5 are very specific both in terms of content and time allocation.

The applicant on L4 level has to complete the set assignments for min. 6 months (the syllabi of the course give 12–18 months) while working with their trainees. The situation is similar in the highest L5 level, however, the time allocation is not specified[32]. The price of coaching courses varies from 60 GBP for the L1 course to 120 and 180 GBP for L2 and L3 respectively (http://www.scottish-fencing.co.uk/calendar/2019/01/19/coach-education-l1-l2-l3-and-plastic).

[28] https://cd8cee83-81ef-442d-b657-0b93af851eba.filesusr.com/ugd/830e40_00dc59d1c5ff4cec89d00ece5b0b5a4e.pdf

[29] ttps://www.open.edu/openlearn/health-sports-psychology/motivation-and-factors-affecting-motivation/content-section-0?intro=1

[30] The method of goal setting and problem solving (G – Goal, R – Reality, O – Obstacle and Options, W – Way Forward).

[31] Recovery strategies in sport and exercise (https://www.open.edu/openlearn/health-sports-psychology/recovery-strategies-sport-and-exercise/content-section-0?active-tab=description-tab)

[32] The additional information was provided by a Scottish informant, among others a graduate of *ICC* and *FIE Coaching Academy* (foil specialization).

Table 4. SF course structure

	L. 1	L. 2	L. 3	L. 4	L. 5
Time allocation	1–3 weekends depending on the level of experience (14–42 lessons)	2–4 weekends depending on the level of experience (28–56 lessons)	3–6 weekends depending on the level of experience (42–84 lessons)	6 months coaching a performance-focused group, consults, plans and teaches the content of the course	≥ 6 months of coaching a performance-focused group
Age limit	> 16 years	>18 years	>18 years	>18 years	>18 years
Qualification prerequisites (fencing experience)	Criminal record check. Other duties fulfilled within the course → Child Wellbeing and Protection in Sport, First aid training	Safeguarding & Protecting Children or its equivalent, First aid training, criminal record check	Safeguarding & Protecting Children or its equivalent, First aid training, criminal record check	Completing L3 course. Coaching one's own group of performance-focused fencers + duties determined by legislation	Completing L4 course. Coaching one's own group + individuals ECC, SP (up to 32nd) + duties determined by legislation
Education	not stated	not stated	not stated	not stated	not stated

The Hungarian system of coach education in fencing

An important role in the system of fencing coach education in Hungary as well as on international level is played by the University of Physical Education in Budapest *Testnevelési Egyetem – TE* (https://tf.hu/), which teaches combat sports since its foundation in 1952. The teaching of fencing coaches is currently provided by the Budapest sports university to three strategic partners. 1/ It provides training for domestic fencing coaches via the *Hungarian Fencing Federation* (*Magyar Vívó Szövetség – MVSz*). 2/ The second subject collaborating on fencing coach training in Hungary is the *International Coaching Course – ICC*. 3/ The last key partner is the FIE and its *Budapest Coaching Academy*.

The education of fencing coaches provided by Hungarian institutions is also aimed at foreign fencers, primarily by projects of FIE Budapest Coaching Academy and the International Coaching Course (ICC). In this paper we solely discuss the programmes of formal education aimed at Hungarian coaches of fencing.

University study of fencing – bachelor programme

The highest form of studying coaching of fencing in Hungary is a bachelor study programme at TE in Budapest, namely the field of study *BA Edző* (*BA Coach*).[33] The study is a part of the combined study programme and is not offered annually (the course will run e.g. in 2021/2022; https://hunfencing.hu/hir/vivoedz-kepzes-a-te-n-4206). The standard length of the study is 3 years (6 semesters) and throughout the study, the student needs to obtain 180 credits in total. The graduates of the programme can successfully plan and independently implement the training process of athletes with regard to their physical and mental well-being. They can coach athletes of different performance levels and develop their personality as well as sports performance. The

[33] Apart from BA programmes the university also provides bachelor programmes BSc – Rekreáció és életmód (Recreation and Lifestyle) and BSc – Sportszervezés (Sports organisations).

graduate is also able to organise and realise integrated sports and leisure activities, courses, training, events and competitions. [34]

The applicants for the field of study coaching of fencing have to pass the entrance exams consisting of a written test on biology, then the written and oral exam from the theory of sports training. The highest score, however, is obtained for the part of the test that deals with the sports or coaching practice and tests the practical level of the respective sports discipline. Applicants with significant sports or coaching achievements in their practice so far are exempted from the entrance exams[35] (ttps://tf.hu/felvetelizok-kepzeseink/ba-bsc-szakok/ba-edzo). During their studies, students also need to serve their internships (practice) ranging from 200 to 400 hours. The internships are organised in collaboration with the *Hungarian Olympic Committee (Magyar Olimpiai Bizottság*) and the *Hungarian Fencing Federation (Magyar Vívó Szövetség)*.

The requirements for completing the programme are as follows: the final state exam from the theory and practice and submitting an assignment on a chosen or assigned topic including its defence (the topics of bachelor theses are posted on the web of the university: https://tf.hu/intezetek-es-tanszekek/sportagi-intezet/kuzdosportok-tanszek/szakdolgozat-temak).

It is possible to study fencing at the TE also within a one-semester subject called Vívás (fencing) run by the Department of Martial Arts – *Küzdősportok Tanszék* (tf.hu/kuzdo). Students can enrol on the course after completing the prerequisite subject *Küzdősportok alapja*i (basics of martial arts). The lessons of fencing are taught by renowned fencers – Ákos Patócs, faculty member, the author of an internationally acclaimed and widely well received publication on the methodology of sabre training (Patócs, 2016). In the past, lessons were taught also by Dr. László Szepesi, PhD., world-class coach, educator and author of dozens of articles and publications. He shares his lifelong coaching experience in a publication dealing with group training of fencing (Szepesi, 2009).

The university provides the students with study materials in the form of electronic version of learning materials of all subjects posted on an e-learning portal of the TE (ttps://e-learning.tf.hu/). The content related to the fencing specialisation is also included in documents for subjects of the field of study *BA Edző – Sportági elmélet és gyakorlat* (*Sports theory and practice I. – VI.*).

Coaching courses of OKJ organised by the Sports University TE

Similarly to the Coaching School in Prague, the Sports University in Budapest organises the education of coaches based on valid legislation. The training of fencing coaches and other sports specialisations is provided in terms of organisation by *Továbbképző Központ* (*Further Education Centre*), an equivalent of the Centre of Lifelong Learning of Charles University. The education of coaches in fencing takes place on two levels. The highest formal type of non-university study is *Sportedző tanfolyam (Sports Coach).* The lowest level of coach education at university is the degree *Sportoktató tanfolyam* (*Sports Instructor*).

Sportedző tanfolyam (Sports Coach)

The course on the highest level of coach education (except for the university bachelor or master programme at the TE university) is the Sports Coach. The study is conceived as a combined programme of 1.5 years. The total time allocation is 400 hours, out of that 40% is theory and 60% is practice. Before enrolling on the programme, the applicants can have 400 hours of specialised

[34] Annotation to the study programme *BA Edző*

[35] The applicants (athletes or coaches) who came 1st to 3rd at the Olympics, world championships or European championships in their sport are exempted from the entrance exams. The system is similar for athletes or coaches coming 4th to 6th. Athletes or coaches who won at a national championship in their sport in the category of adults are exempted from the sport practice exam.

qualification recognised. The total time allocation thus increases to 800 lessons (https://www.perfekt.hu/sportedzo-kepzes).

It is a three-semester study programme whose total time allocation is one semester shorter than the Coaching School A licence at Charles University in Prague. The lessons are organised with the help of an application in which the trainees can opt for either regular attendance of weekly lectures in a Wednesday group (17:00–20:15) or attend classes every second Saturday (8:00 – 14:40). The classes include theoretical teaching modules such as: the basics of educational science, psychology and communication; health and first aid; the theory of training and gymnastics; the basics of entrepreneurship and organisation and the subject called employability I and II dealing with the graduates' opportunities in the labour market.

The second block of lessons – Sports training is focused on theory and practice and includes subjects such as *The basics of sport and coaching skills*.[36] Students in this block already take part in practice realised mainly in the university sports facilities.[37] This part of the programme lasts 12–15 days and can be organised as continuous or intermittent practice (e.g. 4 times 3–4 days). Practical classes are taught on weekdays. The theoretical part includes the technical and tactical classes, history and other aspects of the given sports discipline (for more detail see footnote 36). The conditions for enrollment include completed secondary education with the school-leaving exam – the applicant has to submit a copy of the exam certificate; health certificate as confirmed by their general practitioner (the applicant does not have to undergo a special sports check-up); contact details (e-mail address) and a certificate from the respective sports federation declaring the competitive history of the applicant. One difference from the Coaching School in Prague is that in this case, there is no prerequisite of a lower coach education. However, if they have it, they obtain a discount of 20% (50% for students of the TE). The course fee is 400.000 HUF.

The course attendees can be given assignments such as presentations or attendance of certain sports events. The unpenalized absence is 20% for theoretical consultations and 10% for the practical part. The course attendees do not have a status of a student as defined by the Hungarian legislation, and to pass exams and individual modules, there is one regular and two re-sit exam dates. The organisational regulations also allow a temporary leave. All these components are similar to those at the Coaching School in Prague.

Upon completion of all eight modules (over 51% min. success rate), the attendees can sign up for the final exam OKJ which consists of a theoretical and practical part in front of a committee. Unlike at the Coaching School in Prague, there is no obligation to submit a final written dissertation. Students are provided with full study support in the form an ensured an access to the university library and access to electronic learning materials posted on an e-learning portal of the TE (ttps://e-learning.tf.hu/). The course opens for the specific discipline only if there is a sufficient number of applicants. Successful graduates receive a state-recognised certificate of sports coach of fencing and also the Europass certificate for the recognition of qualification in the EU member states and other partners.

[36] The organisation and planning of training, development of the sports performance, the development of specific sports skills and abilities such as: identify and correct mistakes in the execution of movement techniques; judge and assess abilities and endurance of athletes; plan and manage sports preparation and competition of one's athletes taking into account their age and individual talents; assess sports performance of athletes; apply modern principles and methods of talent management; design training plans, manage the activities of coach assistants; organise sports events, tournaments, sports camps; conduct the organisational, financial, administrative and marketing tasks related to coach's work; organise and conduct leisure-time activities in one's sport; identify and prevent any damage potentially related to the work; if necessary provide special assistance and first aid; collaborate with other experts on physical education and paramedics.

[37] The classes of fencing are conducted in a fencing hall located in the university campus, building D, 2nd floor.

Sportoktató tanfolyam (Sports instructor)

The lower degree of coach education is the level of the Sports instructor. The course is run by the TE and conceived as a one-year combined programme with the time allocation of 200 lessons. Upon graduation, the fencing instructor is prepared to teach basic technical and tactical elements of fencing and knows the rules of the sports discipline. His / Her trainees are ready to proceed to the performance level in performance sport and gradually improve their sports performance and lead a healthy lifestyle. The instructors are able to organise and run sports courses, they take part in the organisation of competitions, they can work in leisure-time centres and sports clubs. The conditions to participate are defined as follows: min. 18 years of age, completed elementary education, a medical check-up, personal details provided, a reference from the national sports federation. In the introductory sessions of the course, the knowledge of the participants can be assessed with a test (practical or oral). The total fee for the course is 280.000 HUF, the students of TE and OKJ graduates are entitled to a discount of 50 and 20% respectively. The specialised courses open only if there is a sufficient number of applicants.

Just as with the above mentioned three-semester course, the lessons are organised through an application in which the attendees can select regular weekly lectures on Wednesdays (17:00–20:15) or Saturday classes (8:00–14:40) every other week. The teaching of theoretical subjects includes teaching modules such as the course *Sports coach*, the difference being that the modules *Employability I and II* are missing. The second block of classes – *Sports training* includes only the subject *Basics of sport.* This section of classes is allotted 8–10 days and can be organised as a continuous or intermittent practice (e.g. 4 times 2–3 days). The ratio between the theoretical and practical part is 40% of theory and 60% of practice (https://szakkepesites.hu/okj/tanfolyamok/sportoktato-a-sportag-megjelolesevel). The practical classes can be held also on weekdays. The topics of practical classes are the result of negotiation and consensus between the national federation and TF university. Having completed all five modules (success rate over 51%), the attendees can sign up for the final OKJ exam which consists of a theoretical and practical part in front of a committee. Successful graduates receive a certificate recognised by the state of fencing sport instructor and a certification *Europass* for the recognition of qualifications in the EU member states and other partners.

The education of fencing coach is also supported by *Budapesti Vívó Szövetség* – the Budapest Fencing Association (http://budapestivivoszovetseg.hu/) which takes advantage of an opportunity for formal education of its coaches in collaboration with *Budapesti Sportszövetségek Uniója – the Union of Sports Associations in Budapest* (http://bsu.hu/). Through a system of references from the Union, the Fencing Association can autonomously apply for and issue references for course enrolment in OKJ courses of the Budapest Sports University TE.

Table 5. The overview of coach education in fencing in Hungary provided by TE

	Fencing bachelor study programme BA Edző	**Coaching course at the Sports university Sportedző tanfolyam (Sports coach)**	**Coaching course at the Sports University Sportoktató tanfolyam (Sports instructor)**
Time allocation	3 years – 6 semesters + 200 – 400 lessons of practice.	1,5 year – 3 semesters (including 12–15 days of practice), in total 400 lessons of study at *TE* + 400 lessons of certified out-of-school practice	1 year – 2 semesters (including 8–10 days), in total 200 lessons
Age limit	>18 years of age	>18 years of age	>18 years of age
Qualification prerequisites (fencing experience)	Passed entrance exams: written test, oral exam and practical exam. Acceptance possible also based on exceptional sport and coaching achievements (Olympics, world championships, European championships)	A medical certificate, contact details (e-mail address), a certificate issued by the respective sports federation stating the sports history of the athlete	A medical certificate, contact details (e-mail address), a certificate issued by the respective sports federation
Education	Graduated from a secondary school (at min.) including the school-leaving exam	Graduated from a secondary school (at min.) including the school-leaving exam	Completed basic education

DISCUSSION

The education of fencing coaches receives close attention in all of the observed countries. It is either internal committees functioning as a part of national federations who deal with it or it is dealt with by tertiary educational institutions or the combination of both models. The organisational and content components in these countries differ, with the major difference lying in the system and style of conveying information future coaches are to acquire. Other significant differences were identified in the legislative component. Coach education in the Czech Republic and Hungary is closely linked to the valid legislation specifying training for a pursuit of a profession or it can be perceived as a form of retraining. In the Hungarian system, coaching of fencing can be studied in a bachelor study programme *BY – Coach (BA Edző*). We can find other differences in the length of the programmes (time allocation) of the individual levels of formal education of fencing coaches in the observed countries and in the conception of practical training.

In all three observed countries, the education of fencing coaches is significantly regulated by the respective sports federations or associations. It is especially notable in the case of coach education in Great Britain. The umbrella organisation representing British fencing on international level is the BF. This institution is also in charge of the *British Fencing Coaching Framework* (British Fencing Coaching Development Framework, 2017, p. 20–21), followed by the *EF*, *WF* and *NIF*. *The Scottish Fencing Federation (Scottish Fencing)* has its own education system. A characteristic feature of the education of fencing coaches in Britain is legislative autonomy. It is applied only in the obligation to complete the *Safeguarding & Protecting Children Course,* the first aid training and the criminal record check. Instruction is provided by BF or SF instructors, external instructors or institutions are engaged only in some cases.

Completing the first aid course is not compulsory in the Czech Republic or Hungary, however, it is included in the syllabi of the lower levels of education. In the case of B and A licence, it is

a part of the syllabus of the Coaching School and it is taught by FPES experts. The situation is similar in OKJ courses and BA-coach study in Hungary. The Safeguarding & Protecting Children Course is specific to the Anglo-Saxon context, there is no equivalent in the Czech or Hungarian environment. In the Czech Republic, coach training is realised on lower levels – instructor and C licence coach are run by the CFF whereby the fencing federation itself determines the content both in terms of teaching theory and practice. Nevertheless, it is not randomly done, the four-level system follows principles set by *The International Sport Coaching Framework* (ICCE, ASOIF & LBU, 2013).

The education of the A and B licence coaches is provided by the CFF in collaboration with the Fencing School of FPES Charles University, which is in charge of theoretical subjects, namely the Scientific basis of sports training. The specialised practical lessons are provided by the CFF. Within practical teaching in Hungary, students have placements in selected fencing clubs and the specialised lessons are also provided by university experts. In the case of programmes organised for the ICC or FIE Coaching Academy, the situation is similar with the following exception – the FIE arranges practical specialised lessons taught by their own experts.

With regard to legislation, there are several fundamental differences in providing coach education. The Czech system of A and B licence training builds on the association with the Coaching School at FPES, which provides the teaching of theoretical subjects unrelated to the specialisation. The Coaching School provides lessons within the lifelong learning programme and according to the accreditation of the fields of study of the Ministry of Education, Youth and Sport of the CR. The C licence training and the level *instructor* is provided solely by the CFF mostly by their internal instructors. In Hungary, the fields of study *Sportedző tanfolyam* registered under No. 54 813 02 *(Sports coach with the sport specialised) a Sportoktató tanfolyam* registered under No. 31 813 01 *(Sports instructor with the sport specialised)* are regulated on a legislative level by rules strictly defining the content of the programmes and are registered in the national register of training – *Országos Képzési Jegyzék (OKJ)*. [38] Similarly, the bachelor study programme for coaching of fencing is registered at the TE. In Great Britain, however, it is the sports federations (*WF*, *BF*, *NIF*, *SF*) that are completely in charge of fencing coach education, and this education is independent of government bodies and legislation. The mandatory legislative procedures concern only the completion of first aid courses, *Safeguarding & Protecting Children* course and a criminal record check. There is no equivalent to these duties neither in the Czech Republic nor in Hungary.

The systems of coach education in the Czech Republic and Hungary show signs of traditional education of educators in the sports domain. Their advantage is an association with solid educational institutions such as *Charles University* in Prague or the *Testnevelési Egyetem* (University of Physical Education) in Budapest. This can, however, significantly affect the approach to the latest trends in education and the needs of coaches as these traditional systems suffer from a certain inertia. The British system is to a certain extent independent. This allows the system to reflect current trends and respond to the ever changing conditions. A disadvantage, on the other hand, is the speed with which the programmes are altered as reported by our informant, a BF member and coach. The current educational system of BF coach education allows the students to choose the direction in which they wish to go and develop, be it the perfection of their technical and tactical level in individual weapons – specialisations or community work in fencing, etc.

Another striking difference is the greater emphasis that the BF and SF place on soft skills in everyday coaching procedures and the application of tools for goal assessment and learning process streamlining. The tools to achieve this are primarily *GROW, SMART and SFCP*

[38] https://www.nive.hu/

– *Solution Focused Coaching Programme.* The partnership with the *OpenLearn* platform is another innovation in distance teaching. What I consider a disadvantage is the existence of three educational systems (including the British Academy of Fencing – BAF) although membership in the BF enables the participation in education and recognition of the individual qualification degrees.

The comparison of time allocation (Table 6) in the individual educational systems (leaving out the bachelor study programme at the university in Budapest) shows a distinct disproportion mainly on the higher educational levels of the BF and the Czech and Hungarian systems. The differences are even more striking when comparing the total values, as previously pointed out by Kirby (2014, p. 55). As regards the university degree BA – Coach, the standard training of fencing masters[39] takes 3 years.

Table 6. Overview of the total time allocation for individual educational systems

Czech Republic (instructor → A licence coach)	∑ 692 lessons
Hungary (instructor → coach). University programme *BA Edző (BA – Coach)* not included	∑ 1.000 lessons 600 + (400 lessons of recognised practice)
British Fencing*: EF, WF and NIF (Core coach → L4)*	∑ 123 lessons
Scottish Fencing (L1 → L5)	∑ cannot be specified

As far as the numbers of coaches in the observed countries are concerned, we only have data from Great Britain and their *BF Coach Register* (https://publish.smartsheet.com/7f681af8be664f46985fa2b238366765), which (as of December 2020) gives a record about 511 active coaches who have met all the requirements for BF membership (in total, however, the register includes 677 people, some of whom are not active or have not fulfilled the BF membership conditions). Most represented in the system are educational levels 2 and 3 (in foil it is 234 out of 423 people; in sabre it is 124 out of 249 and in épée 154 coaches out of 291). A study on fencing coaches conducted by Kirby (2014) revealed the fact that it is namely the most represented educational levels 2 and 3 that the research participants considered to be essential for the development of their coaching competences (Kirby, 2014, p. 55). The given time allocation of formal courses are only the foundation of the education. We need to take into account other forms of coach education (formal and informal) and their everyday practice. The sports history of the given person plays a certain role as well, however, this link (elite athlete → expert coach) has not been proven yet (Gilbert, Côté, & Malle, 2006, p. 74).

The coach register also provides information on other competitive systems of coach education in Great Britain. E.g. for the specialisation of foil out of the total 423 current coaches with a valid licence 18 took advantage of the opportunity to obtain education with the *British Academy of Fencing* (4,26 %). Other 25 (5,91 %) obtained a formal education recognised by the BF e.g. by taking a course with the *ICC*, *FIE Coaching Academy* or by successful participation in international programmes run by the French or Italian fencing federation (https://publish.smartsheet.com/7f681af8be664f46985fa2b238366765). Overall, the percentage of people obtaining alternative education for foil is 10.17% of registered British coaches. The number of active fencing coaches

[39] A custom in the community to address highly acknowledged experts by the expression *master, maître d'armes* or *maestro di scherma.* In certain cases, these expressions are a sign of the highest possible formal education of the given system (e.g. in France and Italy).

in the Czech Republic is not known, however, the database is being developed and will serve among others as a basis for records on mandatory in-service training and participation in the CFF courses. Nevertheless, it is estimated that the number of assistants and coaches is around 250.

The Scottish educational system has its specific characteristics and it is not simple to determine the exact time allocation as it responds to the current needs and also reflects the individual abilities of the participating coaches. In its highest programmes of L4 and L5 though it lasts at least half a year.

The practical teaching in Hungary is run under the supervision of university experts[40] as well as in the sports clubs where the students do their placements for practice. Right on the premises of the university, there is a fencing hall. An indisputable advantage of the practical training in Hungary is a high level of local fencers and the tradition of a successful sport. It is safe to say that there are many Olympic medalists and world champions of various age categories in Hungarian clubs. This competitive environment and continual high success rate make it possible to draw on experience, absorb it and transform into coaching knowledge and skills that develop in time. Although fencing is not a major sport in Hungary in terms of numbers, it is the most successful one. In the history of the modern Olympics, Hungarian fencers won 37 gold, 23 silver and 27 bronze medals (https://en.wikipedia.org/wiki/Hungary_at_the_Olympics).

In the Czech Republic, experts from the CFF provide the formal education of coaches. Only one expert has ever been engaged to teach all three fencing specialisations. In association with the EMC provision from 2020, the teaching of individual specialisations is delegated on specialists in épée, foil and sabre. Lessons are run in a group of students, there have also been a few intensive camps in the past to hold the practical part. In the informal education of coaches, the CFF often drew on foreign elite coaching experts. However, as pointed out by Kundera (2019a), despite these events, the experience was not passed and shared in the long term in a systematic way, and thus the potential of these events was not fully exploited. The practical training of fencing in Great Britain is provided by local or invited foreign experts.

All the observed levels and educational systems offer study material for their students. Some of them are designed by the instructors themselves and used as PowerPoint presentations in the lectures; some are referred to as the recommended literature for the course, some are provided by the university partner in the process of coach education. In this context, we would like to point out to the TE university e-learning portal (ttps://e-learning.tf.hu/) with study materials for all subjects taught in the bachelor programme *BA Edző* (*BA – Coach*) and the course *Sports Coach*. Students thus have complete study materials. Furthermore, the website of the *Department of Combat sports – Küzdősportok Tanszék* (tf.hu/kuzdo) contains teaching aids in the form of 20 accessible publications.[41] Moreover, since the second half of the 20th till the present, renowned Hungarian coaches have published a number of acclaimed textbooks and texts that have been translated into a number of world languages and are used worldwide as essential literature on fencing (Lukovich, 1986, 1997, 2013; Szepesi, 2009; Szepesi, 2005; Vass, 1976; Beke & Pologár, 1963; Patócs, 2016; Szabo, 1998).

[40] Sabre: Dr. László Szepesi, PhD. (French national team coach, Olympic winner and eight times world champion; won several Hungarian championships and European championship leagues with the VASAS club teams). Ákos Patócs: graduated from the Physical Education University, assistant at TF, former assistant in a coaching course FIE in Budapest (before the FIE Coaching Academy was founded), manager of training camps for Irish and British fencers, the head of the fencing club at the Physical Education University in Budapest, the coach of the national team fencing champions (sabre) to 20 years of age. Foil: István Lukovich, mainly known as the author of professional books on fencing. Kun Csaba – European champion from 1991. Épée: Béla Kopetka: the coach of Imre Géza, the world and European champion and a bronze medalist form the Olympics in Atlanta 1996 (https://fie.org/development/courses/21).

[41] https://tf.hu/intezetek-es-tanszekek/sportagi-intezet/kuzdosportok-tanszek/oktatasi-segedanyagok

In the Czech Republic, the tradition of Methodology newsletters published in the 70s and 80s of the last century under the patronage of the Czech Union of Sport has been broken. For this reason, Czech coaches, with only rare exceptions (Čivrný, 2018), are forced to study foreign literature or older Czech sources. The topics that resonate most in fencing are history (e.g. Křížek, 2014; Angelo, 2018; Čapek, 2012; Habermann, 2014). There are also scholarly studies, e.g. by Štefan Balkó, dealing with the analysis of movement structures and reaction time in fencers (Balkó, 2014; 2016a; 2016b; 2017). The fencing school of FPES provides study materials in the form of comprehensive study texts for theoretical subjects taught in consultations (Jansa & Dovalil, 2007; Kohlíková, 2004; Perič, 2016).

The British coach education system (BF, SF and BAF) also provides study materials for their students. The portal of accessible materials of the SF has the most elaborate content structure as it also refers to videos documenting examples from coaching practice (https://www.sfcoach.co.uk/level-3; https://www.sfcoach.co.uk/level-2; https://www.sfcoach.co.uk/video). In the case of the BAF, the materials can be purchased for the final exam revision.

CONCLUSION

The present study of formal educational programmes designed for fencing coaches has confirmed that the observed federations approach coach education differently. The Czech Fencing Federation has stagnated in this respect despite excellent results on the European and world level. In 2020, however, the EMC was founded and introduced new procedural rules regarding coach education. Based on the obtained information, the committee is currently taking measures to optimise the process. The regulations also include a provision related to mentoring and continuous education by means of compulsory in-service seminars and training.

Thus, a systematic approach towards fencing coach education in the Czech Republic has been laid again. Another turning point in the history of coach education at the CFF is delegating instructors for specific weapons while in the past, the practical lessons in formal courses for all three specialisations were taught by a single instructor.

In Hungary, the legacy of generations of successful fencers, the opportunity to collaborate with renowned domestic coaches of fencing affiliated with the structure of university education allows great professional development of Hungarian coaches of fencing. Also, thanks to these circumstances, Hungarian fencers are the third most successful nation in the world in fencing. Compared to other fencing superpowers with multiple times many more members, the quality and stability of their results are remarkable.

The British system associated with the *British Fencing Coaching Framework* as well as coach education in Scotland approaches the issue of coach education with a slightly different philosophy compared to the traditional systems of the Czech Republic and Hungary. The application of modern educational methods *(SFCP)*, e-learning courses and the collaboration with widely acclaimed experts brought about a wide-scale increase in the performance level of British fencing. The strong economy and the possibilities to employ foreign coaches also contribute to the success.

The work that has begun on the revival of systematic coach education in the Czech Republic has been strongly encouraged and supported by the CFF. Another significant factor is active participation in the process of the development of fencing coaches represented by Fridrich Földes, a widely acclaimed coach with rich experience in pentathlon and expert knowledge who can become a patron of this process.

Dedication: This study was conducted at Masaryk University as a part of a project "Comparison of formal education systems for fencing coaches in Hungary, Great Britain and the Czech Republic" No MUNI/A/1232/2019 supported from the targeted funds for specific research provided by the Ministry of Education, Youth and Sports in 2020.

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STUDIA SPORTIVA 2021/2

Breathing as One of the Components of Biathlon Shooting in Youth Biathletes

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ABSTRACT

PURPOSE: *This study is aimed at identifying the length of breath holding in youth biathletes before shooting in both the prone and the standing position, and determining potential dependence between breath holding and the shooting performance at rest and after physical load during the training period.*
METHODS*: Twenty-one national youth biathletes, women (n = 10; 16.7 ± 0.7 years) and men (n = 11; 16.5 ± 0.6 years), participated in the study. All participants completed two series of measuring of breath holding after 3 months period during shooting at rest and after roller skiing in a race load, in the prone as well as the standing position. They shot using their own biathlon rifles with a fixed accelerometer and respiration belts on the thorax.*
RESULTS: *The average length of breath holding when successfully hitting the target in the prone position was 0.65 seconds in average both at rest and in the racing load, with some significant differences both men and women. When shooting in the standing position, the average values were approximately same as in the prone position 0.65 seconds both at rest and in racing load, again with some observable differences both men and women. There were several significant differences between the pre-test and post-test in the length of breath holding in both groups ($p < 0.05$).*
CONCLUSIONS: *The study evaluate the length of breath holding and determine dependence of breath holding on the shooting performance at rest and after physical load during the training period in youth biathletes. The comparison of the acquired information with the shooting methodology taught by the coaches brought beneficial results. The study showed that is appropriate to hold breath for an average of 0.55–0.7 seconds in both shooting positions for both men and women in this age category.*

Keywords: *biathlon training; breath holding; physical load; shooting performance; training period.*

INTRODUCTION

Biathlon is a sport that connects two seemingly different disciplines: cross-country skiing and shooting. Both disciplines have their specifics. Cross-country skiing makes high demands on the cardio-respiratory system and movement preconditions of the athletes which, along with many other factors, affect the shooting performance. Considering the shooting technique, we define the internal factors of the biathlete and other components of shooting such as the shooting position, postural stability, physical load, aiming, breathing, triggering and many more (Žák et al., 2020). Numerous authors deal with the influence of these factors on the success of shooting. However, a minimal number of studies focuses exclusively on breathing in biathlon shooting.

The respiratory rate (RR) is one of factors that can affect the shooting performance. RR depends mainly on the level of physical activity. Pelin et al. (2020) wrote that anaerobic stress affects both the disciplines, cross-country skiing and shooting, due to increased respiratory activity and heart rate (HR), while also having a negative effect on postural regulation. The authors agreed that physical stress, i.e. high HR and RR, in biathletes adversely affects the accuracy, shooting time,

postural control and stability of the rifle, with a greater impact on the standing position than on the prone position (Ihalainen et al., 2018; Laaksonen et al., 2018; Pelin et al., 2020; Sattlecker et al., 2017). Ihalainen et al. (2018) stated that biathletes usually hold their breath during the aiming and triggering phases, which means that the observed decrease in postural balance during intense exercise is likely caused by other mechanisms, such as higher cardiovascular load, than the increased breathing activity. Pelin et al. (2018) mentions the quality of the breathing technique, which is determined by the uniformity of the interval between shots, a balanced rhythm (a continuous succession of inspiration, expiration and apnea) and by appropriate coordination with other elements of the technique. Furthermore, Pelin et al. (2019) focused on adjusting HR before entering the shooting range in young biathletes. They achieved efficiency and progress in shooting from both prone and standing positions. Høydal and Nord (2017) also emphasized the importance of HR monitoring during young biathletes' training as one of the predictors of successful shooting.

Another important factor which is associated with the length of breath holding during shooting is aiming. Vonheim (2012) investigated the effect of dynamic and isometric aiming at rest and after physical load. The resulting claim states that there are various factors which make it difficult to compare the holding still and the following the line approaches. The differences were reported not to be substantial enough to determine without doubt if the subjects perform better utilizing dynamic precision (following the line) rather than the isometric precision (holding still), or if the isometric precision is more affected by the intensity of the physical load than the dynamic precision. Moreover, he found that increased HR appeared to cause more difficulties for the subjects to hold their breath and aim controllably. Therefore, the subjects performed their shooting faster to avoid hypoxia or breathing during aiming (Vonheim, 2012).

Higginson's research into breathing during shooting (2002) was also very beneficial to our study. He stated that RR is substantially elevated upon entering the range during a biathlon race due to the increased physiological demand placed on the human body at high levels of physical activity. The most apparent implication related to a high RR is the movement of the rifle during inspiration and expiration, resulting in a lower stability of hold. The reasoning behind this phenomenon is that biathletes time their shots according to their breathing pattern, usually taking one breath per shot. Moreover, respiration also plays an indirect role in the stability of hold. Many studies reported by Higginson (2002) have shown that respiration is the primary determinant of HR. These studies indicated that rapid shallow breathing decreases HR and heart rate variability (HRV), whereas slow deep breathing increases HR and HRV.

The above-mentioned articles deal mainly with the body's response to physical activity and examine HR and respiration before and during shooting. However, no research has focused purely on the duration of breath holding during shooting. This is a very individual matter related to local shooting methodologies. The length of breath holding usually correlates with the length of aiming at the target. In the prone position it should be longer than in the standing position. This study aims to discover the specific length of breath holding in young biathletes. Couches in the Czech Republic teach young biathletes to hold their breath for 0.5 to 1 second before triggering in the prone position and for 0.2 to 1 second in the standing position. Our objective was to verify and evaluate this fact by studying the dependence between the length of breath holding and the shooting success. The following research question was asked: RQ1: What is the difference between the length of breath holding at rest and after physical load? RQ2: How will the length of breath holding at rest and after physical activity change after a 3-month intervention? RQ3: What is the difference in the length of breath holding between hit and missed target?

MATERIAL AND METHODS

Participants

Twenty-one national youth biathletes (ten women, eleven men) participated in the study. Participants were members of the Biathlon youth sports center in the Czech Republic. They represented the highest national level in the selected category. The mean and standard deviation of age, height, and weight were 16.7 ± 0.7 years, 166.1 ± 4.9 cm, 58.8 ± 5.7 kg for women and 16.5 ± 0.6 years, 177.7 ± 4.8 cm, 67.1 ± 5.4 kg for men. The study was conducted in accordance with the Declaration of Helsinki and followed the ethical standards of the Masaryk University. Before the study, all participants were informed about the aim of the study, the nature, and potential risks of the study and that the data will be processed anonymously. Each of the participants (or their legal representative in the case of under-age athletes) signed an informed consent in which they voluntarily agreed to take part in the research.

Test design

All tests were conducted at the Vysočina Arena in Nové Město na Moravě, Czech Republic (600 m above sea level), which is a certified outdoor biathlon stadium. Two testing measurements were obtained after 3 months in July 2020 (pre-test) and in October 2020 (post-test), in both cases between 1 p.m. and 4 p.m. The weather conditions were as follows: average temperature 21 °C; sunny / partly cloudy; calm / light air. Participants shot with their own rifles and were instructed to shoot in their individual firing rhythms and speeds. Before the test, they calibrated the rifles in both prone and standing positions (15–20 shots per athlete). The test had the following form (Figure 1). Each participant shot 1 series of 5 shots in both prone and standing positions at rest → warmed up for 15 min at a gradually increasing speed on roller skies → completed 3 min ride in race load (RL; 95 % of HR_{max}) → shot 5 shots in prone in RL → completed 2 min ride in RL → shot 5 shots in prone in RL → completed 2 min ride in RL → shot 5 shots in standing position in RL → completed 2 min ride in RL → shot 5 shots in standing position in RL. Finally, there was a cooling phase in the form of roller skiing. The researchers monitored the participants' HR during roller skiing and shooting using a Polar sport tester (model Polar M600). The participants fired at metal targets in the test (4.5 cm in diameter for the prone position; 11.5 cm in diameter for the standing position; 50 m distance). The participants were not provided any feedback about the results during the whole period of the experiment.

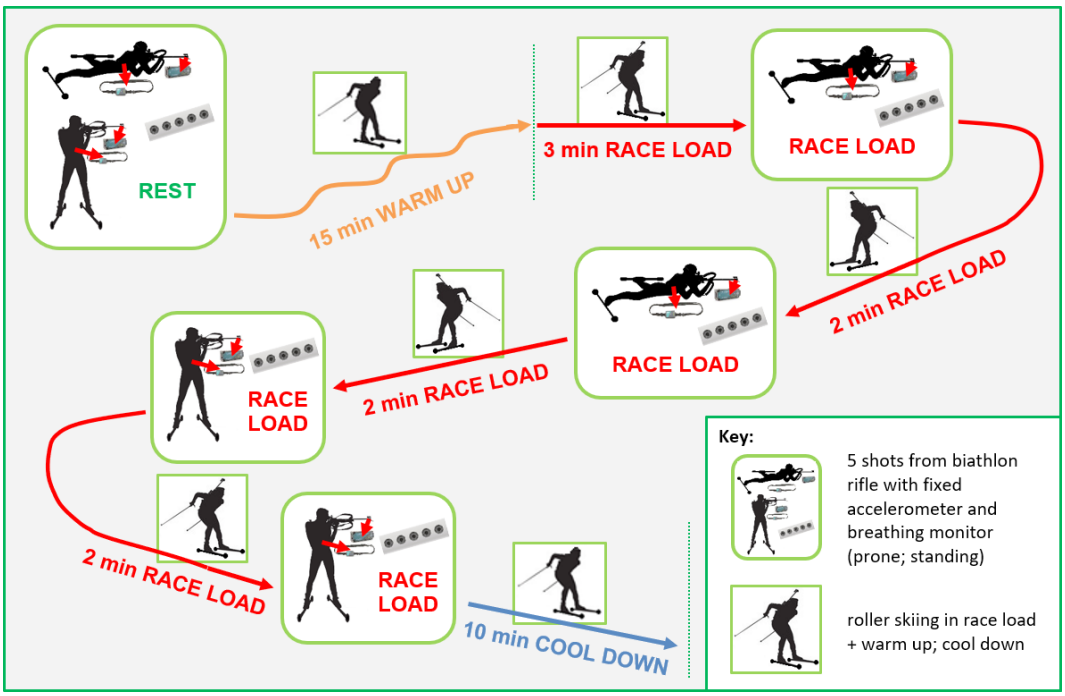

Figure 1. Graphical form of the test design

Measurement of breathing during shooting

Breathing during shooting was monitored and recorded using a Go Direct® Respiration Belt, Go Direct® Acceleration Sensor and Vernier Graphical Analysis software (Vernier Software & Technology). The Go Direct® Respiration Belt was placed on the participant's' thorax (in the prone position) or abdomen (in the standing position). The 3-axis accelerometer Go Direct® Acceleration Sensor was fixed (Figure 2) on the top of the barrel of the biathlon rifle (ANSCHÜTZ, model 1827 F). The data were sampled at 100 Hz. All information was graphically displayed in the researcher's computer using the Vernier Graphical Analysis software (Figure 3). For evaluating the results, the use of an accelerometer helped to accurately determine the moment of the shot during breathing or holding the breath, respectively. The essential information was the length of breath holding in relation to the success of the shooting. The indication of the moment the shooter stopped breathing required manual marking on the timeline. Subsequently, the time difference between stopping the breathing and shooting was calculated.

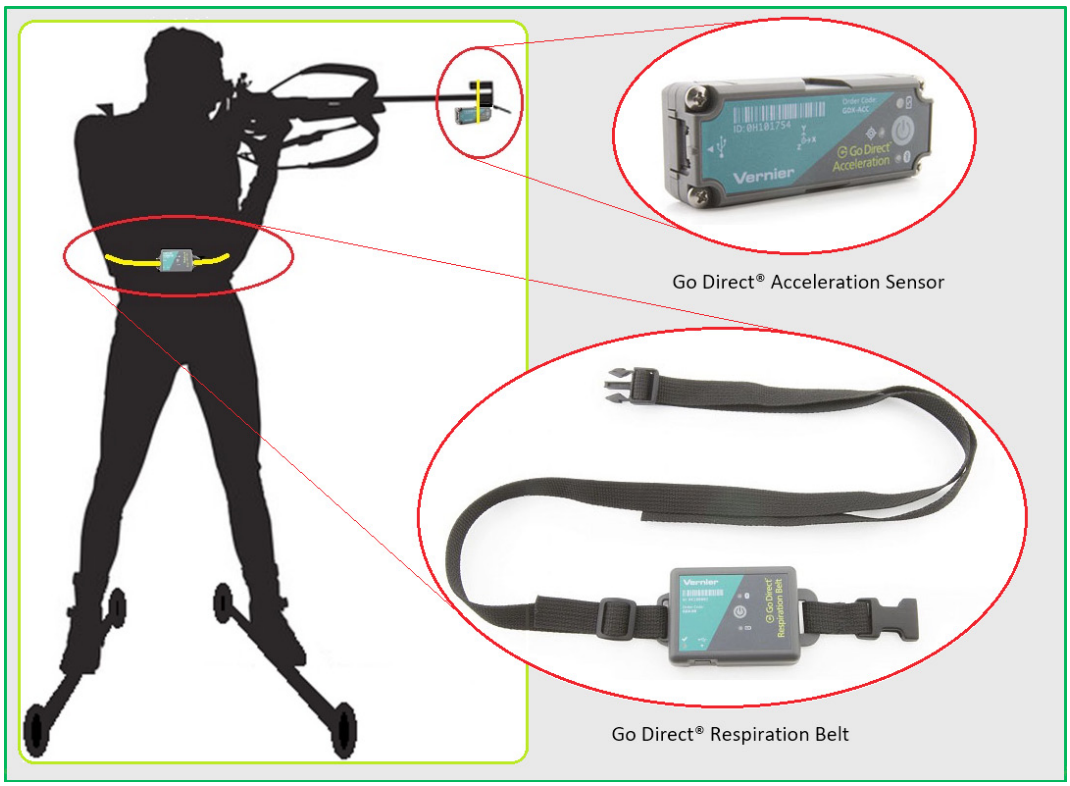

Figure 2. Location of sensors measurement

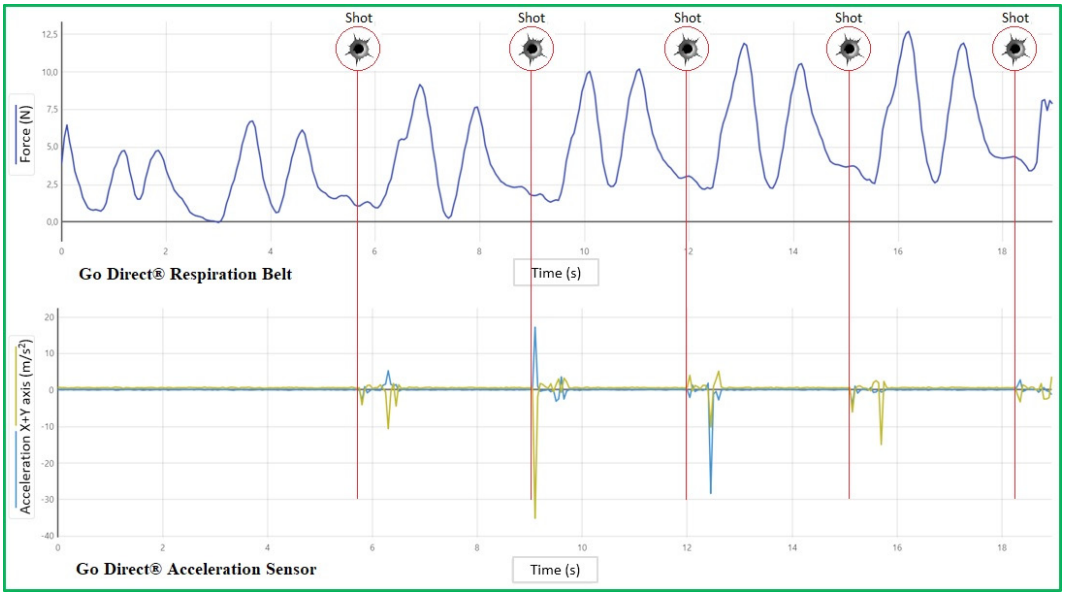

Figure 3. Working with data in Vernier Graphical Analysis software

Statistical analysis

The statistical analyses were conducted using the STATISTICA software (Statsoft Inc, Tulsa, Oklahoma, USA; version 12). Descriptive data were summarized as mean ± standard deviation

(SD). Shapiro-Wilk's test was used to test the normality of the data. For the statistical analysis, unpaired sample *t*-tests were compared in both the men and the women groups for both the prone and the standing positions: breath holding at rest vs. in race load (RL) (pre-test; hit), breath holding at rest vs. in RL (post-test; hit), breath holding at rest in pre-test vs. post-test (hit), breath holding in RL in pre-test vs. post-test (hit), breath holding at rest in hit vs. missed targets in pre-tests vs. post-tests, breath holding in RL in hit vs. miss ed targets in pre-tests vs. post-tests. The level of significance (α) was set at $p < 0.05$. It was also calculated the statistical significance of the effect size (ES) to determine the effect of the differences between given indicators (effect size index Cohen's *d*). According to Cohen (1988), the effect size was interpreted as *small* ($d = 0.20$), *medium* ($d = 0.50$) or *large* ($d = 0.80$). Values less than *small* were marked as trivial.

RESULTS

All obtained data are presented in Tables 1–6 below. The columns show the values of the length of breath holding (in seconds) for women in the prone position (Women_P) and the standing position (Women_S), as well as for men in the prone position (Men_P) and the standing position (Men_S). The rows indicate individual parameters such as load intensity (REST, racing load (RL)), measurement period (pre-test, post-test), number of shots fired in given indicators (n_s), successfully hit targets (hit) and missed targets (miss). Furthermore, a statistical significance between each two parameters (*p*-value) and effect size (Cohen's *d*) is given. Statistical methods describe equality of mean values of these variables.

If the biathlete is well trained, the apnea pause should be as long at rest and after physical load. The first two tables (Table 1, Table 2) show the differences in the length of breath holding between rest and race load in successfully hit targets in pre-test and post-test. The results answered to RQ1: What is the difference between the length of breath holding at rest and after physical load? No statistically significant dependence was found among most of the monitored indicators. In the case of standing shooting in a pre-test in July in women was statistical significance found ($p < 0.05$), when the women held their breath longer after the race load. Cohen's *d* calculation showed a medium effect size in this one case ($d = 0.53$), in other cases were values of Cohen's *d* trivial or small.

Table 1. Comparison of breath holding (second) at REST (**pre-test**; hit) vs. in RL (**pre-test**; hit)

	Women_P	n_s	**Men_P**	n_s	**Women_S**	n_s	**Men_S**	n_s
REST_ pre-test_hit	0.53 ± 0.32	44	0.58 ± 0.36	44	0.42 ± 0.36	42	0.61 ± 0.43	44
RL_ pre-test_hit	0.61 ± 0.36	68	0.75 ± 0.63	78	0.63 ± 0.43	75	0.62 ± 0.57	81
***p*-value**	NS (.190)		NS (.099)		*.009		NS (.921)	
Cohen's *d*	0.26		0.32		**0.53		0.02	

Data are presented as mean ± SD; NS: not statistically significant; *$p < .05$; **$d \geq .50$; *** $d \geq .80$

Table 2. Comparison of breath holding (second) at REST (**post-test**; hit) vs. in RL (**post-test**; hit)

	Women_P	n_s	**Men_P**	n_s	**Women_S**	n_s	**Men_S**	n_s
REST_ post-test_hit	0.62 ± 0.31	41	0.72 ± 0.56	46	0.66 ± 0.50	36	0.57 ± 0.46	39
RL_ post-test_hit	0.69 ± 0.37	68	0.59 ± 0.46	90	0.64 ± 0.45	70	0.57 ± 0.35	57
***p*-value**	**NS (.356)**		NS (.136)		NS (.836)		NS (.948)	
Cohen's *d*	0.19		0.26		0.04		0.01	

Data are presented as mean ± SD; NS: not statistically significant; *$p < .05$; **$d \geq .50$; *** $d \geq .80$

Next two tables (Table 3, Table 4) answered to RQ2: How will the length of breath holding at rest and after physical load change after a 3-month intervention? These results present the values in the length of breath holding between pre-test and post-test in successfully hit targets at rest and in race load. As in the previous case, no statistically significant dependence was found among most of the monitored results. In the case of standing shooting between the pre-test and post-test in women was statistical significance found ($p < 0.05$), the average length of breath holding (0.42 ± 0.36) in the pre-test in women's standing shooting is one of the shortest monitored indicators ever. Therefore, it is positive that there was an increase in the duration of apnea after a 3-month intervention period. Cohen's *d* calculation showed a medium effect size in this case again ($d = 0.54$), just as in other cases were values of Cohen's *d* trivial or small.

Table 3. Comparison of breath holding (second) at REST (**pre-test**; hit) vs. at REST (**post-test**; hit)

	Women_P	n_s	**Men_P**	n_s	**Women_S**	n_s	**Men_S**	n_s
REST_ pre-test_hit	0.53 ± 0.32	44	0.58 ± 0.36	44	0.42 ± 0.36	42	0.61 ± 0.43	44
REST_ post-test_hit	0.62 ± 0.31	45	0.72 ± 0.58	46	0.66 ± 0.50	41	0.57 ± 0.46	39
***p*-value**	NS (.164)		NS (.153)		*.018		NS (.676)	
Cohen's *d*	0.31		0.31		**0.54		0.09	

Data are presented as mean ± SD; NS: not statistically significant; *$p < .05$; **$d \geq .50$; *** $d \geq .80$

Table 4. Comparison of breath holding (second) in RL (**pre-test**; hit) vs. in RL (**post-test**; hit)

	Women_P	n_s	**Men_P**	n_s	**Women_S**	n_s	**Men_S**	n_s
RL_ pre-test_hit	0.61 ± 0.36	68	0.75 ± 0.63	78	0.63 ± 0.43	75	0.62 ± 0.57	81
RL_ post-test_hit	0.69 ± 0.37	68	0.59 ± 0.46	90	0.64 ± 0.45	70	0.57 ± 0.35	77
***p*-value**	NS (.247)		NS (.055)		NS (.925)		NS (.516)	
Cohen's *d*	0.20		0.30		0.02		0.20	

Data are presented as mean ± SD; NS: not statistically significant; *$p < .05$; **$d \geq .50$; *** $d \geq .80$

Last two tables (Table 5, Table 6) are related to RQ3. What is the difference in the length of breath holding between hit and missed target? The tables illustrate the length of breath holding between hit and missed targets compared pre-test and post-test at rest and in race load. The results of statistical significance ($p < 0.05$) and large effect size ($d = 1.04$; $d = 0.89$) in Table 5 may be distorted by the low number of missed targets. Therefore, let's take the results of the post-test of women and men in the prone position in missed targets with a certain detachment. On the other hand, in the case of women goes on a long-held shots. On the contrary, men fired shots prematurely. Cohen's *d* points out to large effect size in women and men breath holding in the prone position ($d = 1.04$; $d = 0.89$), which is related to the significantly different length of apnea. In the case of statistical significance ($p < 0.05$) in men standing shooting position, it was a long-held shots in average, but it is necessary to emphasize the size of the standard deviation, which indicates both long-held and prematurely fired shots. Cohen's *d* calculation showed a medium effect size in women and men standing position ($d = 0.53$; $d = 0.61$), indicating relatively large differences in the length of apnea.

Table 5. Comparison of breath holding (second) at REST (**hit**; pre-test, post-test) vs. at REST (**miss**; pre-test, post-test)

	Women_P	n_s	Men_P	n_s	Women_S	n_s	Men_S	n_s
REST_ pre-test_hit	0.53 ± 0.32	44	0.58 ± 0.36	44	0.42 ± 0.36	42	0.61 ± 0.43	44
REST_ pre-test_miss	0.74 ± 0.67	6	0.67 ± 0.58	11	0.66 ± 0.55	8	1.05 ± 0.90	11
***p*-value**	NS (.192)		NS (.495)		NS (.115)		*.023	
Cohen's *d*	0.41		0.20		**0.53		**0.61	
REST_ post-test_hit	0.62 ± 0.31	45	0.72 ± 0.56	50	0.66 ± 0.50	41	0.57 ± 0.46	43
REST_ post-test_miss	1.07 ± 0.52	5	0.25 ± 0.16	5	0.68 ± 0.58	9	0.49 ± 0.40	12
***p*-value**	*.008		NS (.102)		NS (.890)		NS (.571)	
Cohen's *d*	***1.04		***0.89		0.05		0.20	

Data are presented as mean ± SD; NS: not statistically significant; *$p < .05$; **$d \geq .50$; *** $d \geq .80$

Table 6 indicates one statistical significance ($p < 0.05$) in men standing shooting in the pre-test. It shows, that it may not be appropriate to hold breath for more than 0.6 seconds on average in this age category. All of Cohen's *d* calculation showed a trivial or small effect size, including the above-mentioned standing shooting in men.

Table 6. Comparison of breath holding (second) in RL (**hit**; pre-test, post-test) vs. in RL (**miss**; pre-test, post-test)

	Women_P	n_s	Men_P	n_s	Women_S	n_s	Men_S	n_s
RL_ pre-test_hit	0.61 ± 0.36	68	0.75 ± 0.63	78	0.63 ± 0.43	75	0.62 ± 0.57	81
RL_ pre-test_miss	0.49 ± 0.30	32	0.56 ± 0.73	32	0.52 ± 0.47	25	0.89 ± 0.70	29
***p*-value**	NS (.083)		NS (.183)		NS (.287)		*.049	
Cohen's *d*	0.39		0.27		0.24		0.41	
RL_ post-test_hit	0.69 ± 0.37	76	0.59 ± 0.46	90	0.64 ± 0.45	78	0.57 ± 0.35	77
RL_ post-test_miss	0.60 ± 0.41	24	0.58 ± 0.44	20	0.83 ± 0.62	22	0.58 ± 0.40	33
***p*-value**	NS (.330)		NS (.939)		NS (.132)		NS (.847)	
Cohen's *d*	0.23		0.02		0.35		0.04	

Data are presented as mean ± SD; NS: not statistically significant; *$p < .05$; **$d \geq .50$; *** $d \geq .80$

DISCUSSION

In general, based on the results, it can be stated that to achieve the best possible shooting success, it is appropriate to hold breath for an average of 0.55 – 0.7 seconds in both shooting positions for both men and women in this age category.

Focusing on successfully hitting the targets, the length of breath holding should ideally be similar at rest and after exercise, in both the prone and the standing position. We came to this conclusion after analyzing the results of the testing in pre-test and in post-test (Table 1, Table 2). The only statistically significant difference appeared in the women's group in pre-test in the standing position (Table 1). The lower volume of training at the higher load intensity that was

typical for this training period is suspected to be the reason. In short, women were not able to hold individual shots longer due to poorer position stability at higher HR and RR.

There were no significant differences in the breath holding and the success of shooting between pre-test and post-test (Table 3, Table 4). It was expected that the length of breath holding in October would be longer than in July because of a period of intensive shooting training between the two measurement cycles. However, the relatively short duration of the period between the tests proved not to be significant. A more substantial change is presumed to occur in the next few years when the biathletes should gain greater postural stability, as showed by the studies of Sattlecker et al. (2014, 2017). The only statistically significant difference in the shooting success between the time periods was found in women in the standing position (Table 3). The supposed reason is a lower postural stability combined with racing load as explained above.

According to the aforementioned results, it cannot be concluded that the length of breath holding has a significant effect on shooting success in physical load, although in some cases a statistical significance has been demonstrated (Table 6). Based on studies by several authors (Coote, 2010; Higginson, 2002; Konttinen et al., 2003; Laaksonen et al., 2018; Pelin et al., 2019; Sattlecker et al., 2014, 2017) it is known that shooting success involves many more factors, such as HR and RR, postural stability, rifle stability and triggering.

In most cases of shooting at rest and in race load, the result between the hit and miss has been statistically insignificant (Table 5, Table 6), but they showed large effect size in two cases, as described above in the results. In men's standing position, a statistically significant difference was found in shooting at rest and after physical load in pre-test. Similarly to the case of women, this may be associated with the training period, lower position stability, and higher HR and RR in association to Coote (2010). Due to previously described reasons, a portion of the missed targets may have been caused by various other factors. As mentioned in the introduction to the results, if the biathlete is well trained, the apnea pause should be as long at rest and after physical load.

Our research team is currently conducting a study of breath parameters of elite adult biathletes racing in IBU World Cup based on video analysis. The preliminary results show that the length of breath holding is significantly longer in comparison to youth biathletes' performance. The average difference is up to 1 second in both shooting positions. However, the final conclusions of this study are yet to be published.

CONCLUSION

The aim of the study was to analyze and determine the average length of breath holding in young biathletes and its relation to the success of shooting during 3-months intervention training period. We obtained the necessary data using the Go Direct® Respiration Belt in conjunction with Go Direct® Acceleration Sensor. The comparison of the acquired information with the shooting methodology taught by the coaches brought beneficial results. The length of breath holding corresponded to the recommendations of the coaches in the Czech Republic – namely of 0.5 to 1 second in the prone and 0.2 to 1 second in the standing position. We can clarify this statement, as the study shows that is appropriate to hold breath for an average of 0.55–0.7 seconds in both shooting positions for both men and women in this age category.

The findings should help biathlon coaches and the biathletes themselves. Breathing technique is one of the basics of shooting performance, so it should be widely represented in the shooting training of young athletes. With increasing postural and rifle stability, the length of breath holding should keep extending over several years. At the transition from the junior to the senior category,

the biathlete should be able to hold their breath before the shot for approximately 1 second in both prone and standing position. However, this is an individual matter as stated before.

Finally, it is necessary to mention the limiting factors of our study. We consider the schedule of the measurements to be one of the major ones. The research had to be conducted in summer and autumn in concord with the schedule of the Specific University Research Grant. For comparison, it would be beneficial to add data from the following winter. Furthermore, we did not report the results of the length of breath holding of elite biathletes. As mentioned above, this is the subject of a different study.

Based on the results, we affirm that an adequate length of breath holding should precede each shot. As indicated by the results of the standard deviation of missed targets, very short or unnecessary long breath holding can lead to worse shooting performance.

ACKNOWLEDGEMENTS

This article was written at the Masaryk University as a part of the project "Evaluation of shooting performance based on selected aspects of physical load II." number MUNI/A/1271/2019 with the support of the Specific University Research Grant, as provided by the Ministry of Education, Youth and Sports of the Czech Republic in the year 2020.

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Published by Faculty of Sports Studies of Masaryk University
Press: Palacký University publishing house in Olomouc
MK ČR E 17728
ISSN 2570-8783 (On-line)

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