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The Effect of 8 Weeks of Complex Training Methods on the Countermovement Jump Performance

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Abstract

PURPOSE: *The purpose of this study was to find out whether a more specific stimulus, such as training which stimulates the production of power above 90% of P_{max} (P_{max} = maximal average concentric power output), is effective in enhancing the countermovement jump (CMJ) performance using the method of complex pairs or separate execution of the exercises in the complex pair (separate complex pair).*

METHODS: *Thirty male students of the Faculty of Sports Studies were divided into 2 experimental (EX1, EX2) and 1 control group (CNTR). The experimental groups trained for 8 weeks using the complex training (CT) method twice a week with the same amount of repetitions for each exercise. The complex pair consisted of half-squat jumps with the intensity of over 90% of P_{max} and plyometric depth-jumps. EX1 trained using the complex pair method with the intracomplex rest interval of up to 15 seconds. EX2 trained all sets of the half-squat jumps first and then all sets of the plyometric exercise. We used non-parametric statistics and linear regression analysis to evaluate the effect on increasing the CMJ performance after the intervention program.*

RESULTS: *There were no significant differences between the pre-test and post-test in any of the experimental groups ($p > 0.05$), although there were significant differences between the weeks in EX1 and EX2 ($p < 0.05$). The CMJ performance increased insignificantly ($p > 0.05$) each week by 0.14 cm in EX1 and by 0.07 cm in EX2.*

CONCLUSION: *These results did not clearly show the application of the CT methods to be useful in enhancing the CMJ. In practice, we recommend using complex pairs to save training time and increase training intensity. However, an additional longer-term intervention experiment with a bigger sample size and groups randomized only by the CMJ parameter (not by P_{max} and CMJ performance together) is needed.*

Keywords: *power output; Pmax; PAP; half-squat jumps; depth jumps, complex pairs*

INTRODUCTION

Strength and power training is widely used by recreational and elite athletes in their training. Strength training and one of its forms, resistance training, is generally known as a method to promote many benefits such as improving physical strength and body posture (Molina-Garcia, Plaza-Florido, Mora-Gonzalez, Torres-Lopez, Vanrenterghem, & Ortega, 2020), improving body composition (Zeng, Peng, Zhao, & Chen, 2020). Furthermore, resistance training helps against insulin resistance (Niemann, Tucker, Bailey, & Davidson, 2020) and also brings positive psychological impact on future lifestyle habits and thus reduces the risk of chronic diseases (Faigenbaum, Kraemer, Blimkie, Jeffreys, Micheli, Nitka, & Rowland, 2009; Rowland, 2007). In the field of elite sports training, coaches and scientists work together to develop new training methods to improve and support their athletes to achieve better results effectively in a short time using resistance training with other forms of strength and power training.

One of the commonly used effective methods is the shock method, also known as the plyometric method (Ozen, Atar, & Koc, 2020). The plyometric exercises include jumping, throwing, bounding. Resistance training and plyometric training have been incorporated into weekly programs separately for several years. However, with the development of postactivation potentiation (PAP) and thus muscle toning enhancement which proved to be a good method for preparing the muscles for more power production (Robbins, 2005), the coaches put resistance and plyometric exercises together. One of the definitions of PAP is an increase in muscle twitch and low-frequency tetanic force after a contractile activity (Sale, 2002). The current studies mostly focus on an immediate effect of PAP, and to a very limited extent on possible chronic adaptation to PAP. When including more sets of a heavy resistance exercise together with a plyometric exercise, it is possible to talk about complex training that uses increased muscle activation as a tool to increase the training intensity of the exercise. With its regular inclusion in the training program, we can focus on chronic adaptation. Doing a heavy resistance exercise before a plyometric exercise which is biomechanically similar is called the complex training method (Hodgson, Docherty, & Robbins, 2005). Heavy resistance exercises associated with the application of complex training are in most recommendations defined as a load of at least over 80% of 1RM (repetition maximum) (Docherty, Robbins, & Hodgson, 2004; Ebben, 2002). There are many recommendations and options for applying the complex training method. From the basic recommendation by Bompa (1983) to become a more versatile athlete to Chu (1998) and his recommendations to do heavy resistance exercises (like squats) and plyometrics (like a triple jump) in the same training session to today's view of the complex training.

Today's view is divided into two main approaches to and interpretations of complex pairs. The first one is doing heavy resistance exercises (all the sets) and then doing all the sets of the plyometric ones while maintaining biomechanical similarity of the exercises. The second interpretation, partly similar to the methodological approach of contrast training, is to perform the first set of a heavy resistance exercise and then immediately, or after a rest interval, do one set of a plyometric exercise while maintaining biomechanical similarity of the exercises as well. However, every recommendation included the load of the first heavy load exercise based only on the % of the 1 RM value or RM value in repetitions. We did not find a study that would include % of power production and heavy power output exercises instead of heavy load (above 80% of 1 RM) exercises when investigating the effect of complex training. This is the reason why we tried to find out whether a more specific stimulus, training which stimulates the production of power above 90% of P_{max} (P_{max} = maximal average concentric power output), will be effective in enhancing the countermovement jump (CMJ) performance using the method of complex pairs or separate execution of the exercises in the complex pair (separate complex pair).

METHODS

Experimental Approach to the Problem

This study was designed to investigate the effect of an 8-week training program using complex pairs on the CMJ performance each week. Two different approaches to the complex training methods were used. One method implemented complex pairs (with the interval between exercises of up to 15 s) and the second method consisted of performing all the sets of power-strength exercises first and then all the sets of plyometric exercises in the same training session (separate pair exercises). We also focused on bringing the conditions as close to real training as possible. Therefore, the load was regulated precisely, so that the athletes always trained above the value of

90% of their current P_{max}. This means that the load was tested at the beginning of the first workout of the week during the first set of half-squats jumps.

The 8-week experimental study consisted of 16 training sessions. The participants trained twice per week (minimum of 48 hours apart) for the duration of this study. The complex pair group (EX1) completed 8 complex pairs per session. One complex pair consisted of 4 repetitions of half-squat jumps with a load corresponding to a minimum of 90% of P_{max} measured during the pre-test, immediately followed (within up to 15 s) by four repetitions of drop jumps. The rest interval between the complex pairs was 4 minutes. The second experimental group (EX2) completed 8 sets of 4 repetitions of half-squat jumps with a load corresponding to a minimum of 90% of P_{max} measured during the pre-test, with 2-3 minutes rest interval between sets. After 8 sets of half-squat jumps, the EX2 subsequently executed 8 sets of 4 repetitions of drop jumps, with a 1-minute rest interval between the sets. Groups EX1 and EX2 conducted an identical total number of repetitions of each exercise.

Subjects

Thirty male students of the Faculty of Sports Studies were divided into 2 experimental (EX1, n=8, age = 21.4 ± 1.8 years, height = 179.3 ± 5.2 cm, weight = 77.4 ± 8.4 kg; and EX2, n=10, age = 21.8 ± 2.6 years, height = 178.9 ± 4.0 cm, weight = 75.6 ± 8.9 kg) and 1 control groups (CNTR, n=12, age = 21.7 ± 2.2 years, height = 180.5 ± 7.0 cm, weight = 75.9 ± 9.4 kg) by the parameter P_{max} and also there were no statistical differences between these three groups in the CMJ performance. The original number of 32 people was divided into experimental groups of 10 people, and the 2 remaining people were assigned to the control group rather than to the experimental ones, to prevent potential non-completion of the research. Two people dropped out of the first group (one due to school duties and one due to research unrelated injuries). The control group was asked not to participate in any non-school strength sports activities that they did not have in common with the members of the experimental groups. All participants were informed of the training and testing protocols, the experimental risks, and signed an informed consent form before the research. The consent forms were consistent with the ethical standards and approved by the Ethics Committee of Masaryk University, Brno, Czech Republic.

Measurements

Two weeks before the intervention started, we informed the subjects about the benefits and risks of this research and the training schedule. There were also training sessions to teach the proper squat technique (as well as the half-squat jump technique), depth jump, and vertical CMJ technique. One week before the training began, the performance in CMJ, maximal power output during loaded half squats and the optimal drop height for drop jumps was tested. The participants completed each test after a minimum of 48 hours of rest. The subjects performed the same warm-up protocol before each training session and testing. The protocol included 5 minutes of low-intensity running and dynamic stretching exercises focused on the whole body (3 exercises) and the lower body (5 exercises).

CMJ testing was conducted before the first training session of the week. They performed two warm-up jumps under the same conditions as in testing (with the rest period of 30-60 seconds). For the test, each subject performed 3 jumps and the best maximum in terms of height was taken for further analysis. The rest period between the jumps was always between 30-60 seconds. Each subject's CMJ height was evaluated using the Myotest accelerometric system (Myotest SA, Sion, Switzerland). The Myotest system is a valid and reliable method to assess vertical jump height (Casartelli, Müller, & Maffiuletti, 2010; Nuzzo, Anning, & Scharfenberg, 2011). The CMJ was performed from an upright position with hands kept on the hips for the whole duration of the jump

to negate the effect of an arm swing. The subjects flexed their knees and hips into a squat position to touch a bench (the height was set individually to 90° at the knee joint) and then extended their knees and hips into an upward – vertical jump immediately after the touch, without any delay. Each subject was given external encouragement throughout all the tests. The verbal instructions were to jump as high as they could explosively after they had touched the edge of the bench.

To establish the intensity for the loaded half squats (the bottom position at 90° at the knee joint) a diagnostics series measured by Fitro Dyne Premium (FiTRO Dyne Premium; FiTRONiC Diagnostic and Training Systems Ltd., Bratislava, Slovakia) was used, as it is suitable for measuring muscle power with high reliability (Jennings, Viljoen, Durandt, & Lambert, 2005). The subjects performed a loaded half-squat jump with a barbell held on the shoulders. The test started with a load of 20 kg and increased by 10 kg increments until the average power during the repetition no longer surpassed the previous value. The maximum jump squat power in this study was defined from the highest measured average concentric power. The squat depth before the jump was individually controlled using foam cubes at the bench, where they touched them with their hamstrings and glutes at the 90° knee angle. The rest interval between each load was 2–3 min. One attempt at each load was given until they no longer outperformed the previous best result in the average concentric power. In the case of not outperforming, they had one more attempt at the same load. When they succeeded, they could continue the testing. If they failed twice with the same weight and did not exceed the previous best result, the testing ended. The average concentric power was determined using a FiTRO Dyne diagnostic device (FiTRO Dyne Premium; FiTRONiC Diagnostic and Training Systems Ltd., Bratislava, Slovakia) attached to the barbell grip to measure displacement. The system's sensor unit is connected to a personal computer and the accompanying software (FiTRO Premium; FiTRONiC Diagnostic and Training Systems Ltd.) gives instantaneous feedback regarding force, velocity, and power (Vanderka, Krčmár, Longová, & Walker, 2016).

The optimal drop height for depth jumps, the second exercise in the complex pair, was tested before the experiment started. The optimal drop height was identified by testing maximal jump height, which is the recommended method for establishing drop height by Byrne, Moran, Rankin, & Kinsella (2010).

Statistical Analyses

The data were analyzed to validate the differences between the pre-test and post-test in the EX1, EX2, and CNTR group through the non-parametric Wilcoxon Signed-Rank Test. To find the differences between weeks and groups the Mann-Whitney U test, Kruskal-Wallis H test (independent group), and Friedman's test (paired group) were used. In addition to statistical significance (W, U, H, χ^2), we also calculated the statistical significance of the effect size (ES) to determine the effect of the differences between two groups (effect size index *d*), more independent groups (partial eta-squared, η_p^2), paired groups (Kendall's W test), and the association between two variables (r). According to Cohen (1988), the effect can be interpreted as *small* ($\eta_p^2 = 0.01$, $d = 0.20$, r = 0.10, W = 0.1), *medium* ($\eta_p^2 = 0.06$, $d = 0.50$, r = 0.30, W = 0.30), or *large* ($\eta_p^2 = 0.14$, $d = 0.80$, r = 0.50, W = 0.50). Values less than *small* were marked as trivial. Using linear regression analysis, we could further predict the height of the CMJ (dependent variable) with a week of training (independent variable). The statistical significance level (α) was set to 0.05. All statistical calculations were performed on IBM SPSS Statistics licensed software (version 25).

RESULTS

The main purpose of the study was to compare which training method of complex training leads to better improvements in the performance in the CMJ in 8 weeks. Table 1 contains an overview of the CMJ values divided into three groups (EX1, EX2, CNTR). The results show that there are no statistically significant differences between the groups (EX1, EX2, CNTR) in the pre-test ($p > 0.05$), but in the post-test, there were statistically significant differences between the CNTR group and the EX2 group ($p < 0.05$). According to the ES, there was a small effect of the differences between the EX1, EX2, and CNTR group for the pre-test ($\eta_p^2 = 0.03$, CI = 0.00–0.16) and a large effect of the differences between the EX1, EX2, and control group for the post-test ($\eta_p^2 = 0.30$, CI = 0.03–0.49). To evaluate the differences between the pre-test and post-test in the groups (EX1, EX2, CNTR) we used the Wilcoxon signed-rank test. The results show that EX1 and EX2 lead to a statistically significant improvement after 8 weeks of training ($p > 0.05$) with a small ES. The CNTR group also shows a significant improvement, but according to the trivial effect as a result of the Effect size index *d* (Cohen's *d*) of the difference between pre-test and post-test for a control group, it is classified as an insignificant improvement. Furthermore, Table 1 shows the percentage difference for the differences between the average values of the pre-test and post-test together with statistical (Wilcoxon Singed-Rank Test, Kruskal-Wallis H test) and the effect size (Eta-Square test, Effect size index d, 95% Confidence Interval) evaluation.

Table 1 CMJ values for experimental and control groups in the pre-test and the post-test

Groups	*n*	Countermovement jump (CMJ)		% diff	*Z*	*p*	*d* (95% CI)
		Pre-test (cm)	Post-test (cm)				
EX1	8	40.49±5.04	42.03±3.41	8.96	-1.55	.12	0.36 (-0.63; 1.35)
EX2	10	42.48±4.00	44.29±3.80[b]	4.17	-1.90	.06	0.46 (-0.42; 1.35)
CNTR	12	39.51±3.82	39.18±2.49[a]	0.84	-0.65	.51	0.10 (-0.70; 0.90)
H		2.68	10.00				
p		.26	.01				
η_p^2 (95% CI)		0.03 (0.00; 0.16)	0.30 (0.03; 0.49)				

Note: Z = z-score for Wilcoxon Signed-Rank Test, *p* = p-value, *d* = effect size index *d* (Cohen's *d*), CI = confidence interval, H = Kruskal-Wallis H test, η_p^2 = partial eta-square, [a] = significant difference with EX2, [b] = significant difference with CNTR

The second purpose of this study was to compare the changes in performance measured every week before the first training session of the week. In Figure 1, the differences between the groups are recorded. The changes have a wave-like character. In Figure 1 we can observe that after the first week of the intervention the muscle demands on the probands were very high, therefore the performance in the second week is lower than in the pre-test. Subsequently, the load on the probands was increased by continuous testing of the ability to train the half-squat jumps, always above 90% of the current Pmax. However, in the 3rd and 4th weeks, after the first neuromuscular adaptation, the increase was very high and lead to high muscle damage. That is probably the reason for the fluctuation in performance for the CMJ in the 4th and 5th week. The same situation was repeated after week 7. It can be seen graphically in the 9th week when the post-testing was done during and at the end of the week, the probands were able to perform at their best.

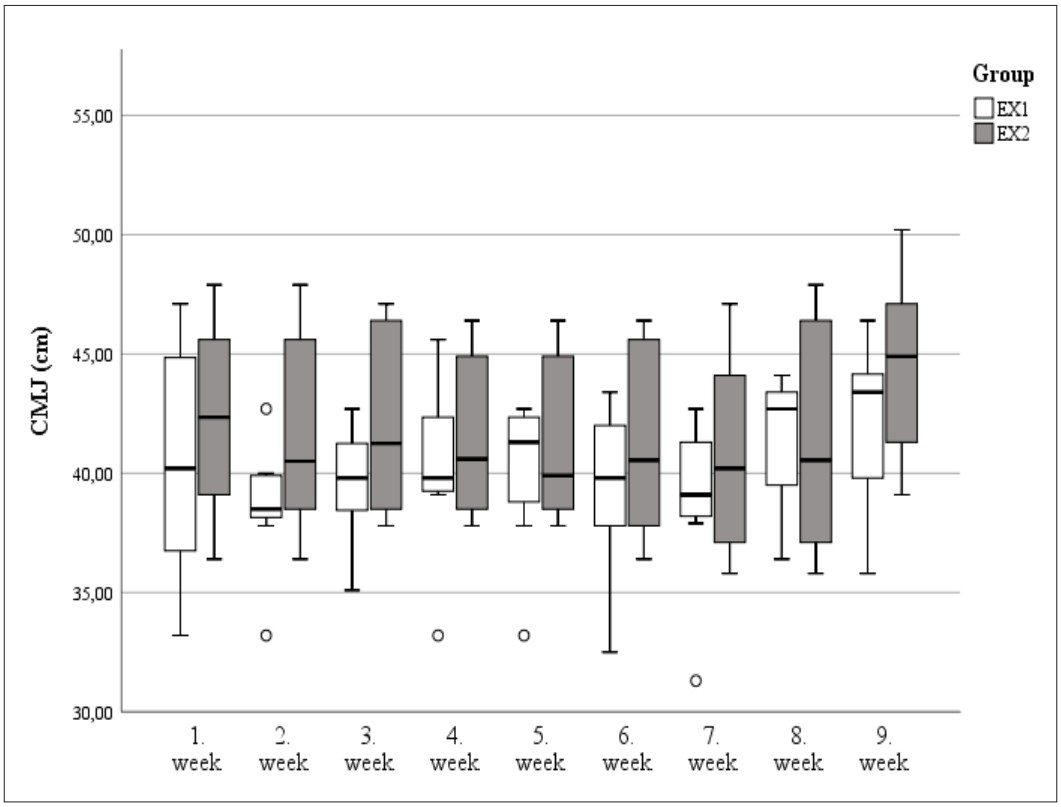

Figure 1 Overview of CMJ performance changes in experimental groups

Table 2 shows the differences between the experimental groups EX1 and EX2 each week. The hypothesis was tested by Friedman's test, Mann-Whitney U test, and Effect size by Kendall's W test, Cohen's *d*, 95% confidence interval. We reject the null hypothesis for the difference between the values for the CMJ by week according to EX1 and EX2 training program, because there was a statistically significant difference between the value of CMJ (cm) each week for EX1 ($\chi^2(8) = 17.9$, $p = 0.02$, ES = small effect; EX2 ($\chi^2(8) = 21.2$, $p = 0.01$, ES = small effect). According to the Mann-Whitney U test we also cannot reject the null hypothesis, because the CMJ (cm) wasn't greater for EX1 ($Med_{max} = 43.05$, $Med_{min} = 39.15$) than for EX2 ($Med_{max} = 44.90$, $Med_{min} = 39.90$), $U_{1-9\ week} = 39.5–53.5$, $p > 0.05$. The results show that there are significant differences in performance in the CMJ over the weeks between EX1 and EX2 ($p < 0.05$). But there were no significant differences between the experimental groups (EX1, EX2).

Table 2 Differences between the values of CMJ by week according to EX1 and EX2 training program

No. of week	Experimental group		*U*	*p*	*d* (95% CI)
	EX1	EX2			
1.	40.5 (5.0)	42.5 (4.0)	50.00	.41	0.5 (-0.5; 1.4)
2.	39.5 (3.6)	41.6 (4.2)	51.5	.31	0.5 (-0.4; 1.5)
3.	40.1 (2.8)	42.1 (3.8)	50.0	.41	0.6 (-0.3; 1.6)
4.	40.5 (3.6)	41.6 (3.6)	41.5	.90	0.3 (-0.6; 1.3)
5.	40.4 (3.4)	41.4 (3.7)	44.5	.70	0.3 (-0.6; 1.2)
6.	39.5 (3.6)	41.2 (3.9)	47.0	.57	0.5 (-0.5; 1.4)
7.	39.0 (8.0)	40.8 (4.0)	47.5	.52	0.3 (-0.6; 1.2)
8.	41.3 (2.7)	41.5 (4.7)	39.0	.97	0.1 (-0.8; 1.0)
9.	42.0 (3.4)	44.3 (3.8)	53.5	.24	0.7 (-0.3; 1.6)
n	8	10			
χ^2	17.9	21.2			
p	.02	.01			
W	0.28	0.27			

Note: U = Mann-Whitney U test, *p* = p-value, *d* = effect size index *d* (Cohen's *d*), CI = confidence interval, χ^2 = Friedman's test, W = Kendall's W test

The third purpose of this study was to find out what prediction model results from the performances in the CMJ of EX1 and EX2 which varied from week to week. The regression analyses (Table 3) show that there is a small association (r = 0.104, r^2 = 1.08 %) between the performance in the CMJ and the week of the training program in EX1, and a trivial (r = 0.043, r^2 = 0.18 %) association between the performance in the CMJ and the week of the training program in EX2. We could consider, that in the EX1 the CMJ performance is increased by 0.14 cm (CI = -0.18–0.46) each week, and for EX2 by 0.07 cm (CI = -0.25–0.38) each week. However, both models are statistically insignificant (EX1: t = 0.87, p = 0.39; EX2: t = 0.41, p = 0.69). It is important to note that none of the simple linear regression models was statistically insignificant (p> 05).

Table 3 Results of regression analyses between experimental groups (EX1, EX2) and number of weeks

	Model	Unstandardized Coefficients		Standardized Coefficients	*t*	*p*	95% CI for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant_EX1)	39.60	0.90		44.03	.00	37.81	41.39
	week	0.14	0.16	0.104	0.87	.39	-0.18	0.46
2	(Constant_EX2)	41.58	0.90		46.09	.00	39.78	43.37
	week	0.07	0.16	0.043	0.41	.69	-0.25	0.38

Note: dependent variable: CMJ (cm, continuous), independent variable: No. of the week (1-9, discrete)

DISCUSSION

The study aimed to compare the effects of two different methods of the complex training application. The current recommendations for implementing complex training are focused on the intra-complex rest interval (ICRI), which is the time between the heavy resisted and the light resisted exercises (Jensen & Ebben, 2003). In acute effect studies, however, minimal rest such as 10 and 15 seconds seems to decrease a subsequent power output (Bevan, Owen, Cunningham, Kingsley, & Kilduff, 2009), but there is no mention of the effect on chronic adaptation. The examined range of time between the complex pair exercises is from 10 seconds to 24 minutes (Jensen & Ebben, 2003), and the practical advice for coaches is to apply 2 minutes of the ICRI if focusing on strength, and 1 minute of the ICRI if focusing on power (Carter & Greenwood, 2014). In our study, we tried to verify whether the low ICRI values in the regular complex training method using complex pairs lead to a better adaptation or stimulation of the body to produce more power output. Contrary to expectations, we did not find any significant increases after 8 weeks of intervention. In any case, it should be noted that the results of the comparison of the groups after the intervention indicate significant differences ($p < 0.05$) between the control group and the EX2 group (training complex pairs separately). Interestingly, the studies do not describe in detail the effects of training, which is designed as training performed by EX2, where subjects perform several sets of the first exercise from the complex pair and then several sets of the second exercise from the complex pair in one training unit. Studies (Ebben, Jensen, & Blackard, 2000; Stasinaki, Gloumis, Spengos, Blazevich, Zaras, Georgiadis, ... & Terzis, 2015) describing the complex training method state that heavy resistance exercises and plyometric training are performed within one training unit, but this almost always means utilizing complex pairs (heavy resistance exercise first, then plyometric exercise with adequate ICRI using PAP).

If we compare the usefulness of complex training methods in training, we must also take into account the possible different lengths of training with different methods of implementing complex training. The research of Santos & Janeira (2008) states time efficiency as one of the main benefits of this method. In our study, we compared the time-effectiveness of a method using complex pairs (EX1) and a mixed concept of a training unit, which includes both complex pair exercises done separately to increase muscle strength and power, and plyometric exercises. Therefore, we calculated rest intervals during training and compared them between the groups, assuming that the time required to perform the same exercise was the same. EX1 had 8 sets (rest interval after the set was 4 minutes), each consisting of 4 half-squat jumps and 4 depth jumps with a rest interval of up to 15 seconds. The total time of the rest intervals is 23 minutes in the EX1 group. EX2 had 8 sets of 4 half-squat jumps with a rest interval of 2-3 min after each set, and then 8 sets of 4 depth jumps with a rest interval of 1 minute after each set. The total time of rest intervals is from 23 to 31 minutes depending on the rest interval between the half-squat jumps in the EX2 group. Thus, the complex pair method saves from 0 to 8 minutes. When using multiple complex pairs during the training, the time saved should be considerable and useful.

Another possible view of the results is the use of suitable statistical methods and interpretation of the results. For athletes who are experienced in strength or explosive training, we cannot expect performance gains as high as we would expect from untrained individuals. For elite athletes, even very small improvements play a role, as long as there are no big differences in the results between the top athletes of the sport. Thus, the observed, although statistically insignificant ($p > 0.05$), average performance increases in CMJ over 8 weeks were 0.14 cm (CI = -0.18–0.46) each week for EX1, and 0.07 cm (CI = -0.25–0.38) each week for EX2, which could play a key role at the elite level.

This study had several limitations that must be considered when extrapolating conclusions based on the results. First, the participants were divided into the groups by the parameter of P_{max} and not primarily by their CMJ performance, although the CMJ performance in the pre-test did not differ statistically significantly among all groups. Second, the participants had experience with resistance training, but we did not take into account the differences in years of experience, experience with different forms of training, or their history of training and skill levels for half-squat and depth jumps. Third, an effort to ensure that the training intensity was maintained above 90% P_{max} could lead to some individuals being able to train above and below the level in the last series of squat-jump exercises. These high intensities may be the cause of the unconvincing results at the end of this study when in the last two weeks we probably no longer had to regulate the intensity of the squat-jump load. Fourth, a heavy resistance exercise to elicit PAP is not generally defined as exceeding 90% of P_{max}.

CONCLUSION

Due to the limited number of participants and ambiguous results, we cannot generalize the results of the study. However, the results suggest that when using complex pairs, it is necessary to consider and use a longer time interval between the exercises in a complex pair (more than 15 seconds). The analysis indicated the possible effectiveness of the training of the EX2 group (separate pairs of complex training), which differed statistically significantly from the control group in the post-test ($p < 0.05$). Subsequently, we wanted to create a prediction model, but we failed because our results were not statistically significant. Our practice recommendations are that when using complex pairs, the trainer can save training time and increase training intensity, and the training will be similarly effective as when complex training is applied in the form of separate exercises of complex pairs in the same training session. However, an additional longer-term intervention experiment is needed to determine the effect of performing exercises of complex pairs separately in one training session.

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STUDIA SPORTIVA 2020 / 2

The Effect of Respiratory and Physical Intervention on Selected Parameters of Heart Rate Variability in Hematooncological Patients after Treatment

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Abstract

The aim of this research was determined the effect of respiratory intervention for twelve weeks and physical intervention for twelve weeks on selected parameters of heart rate variability in hematooncological patients after treatment. Spectral analysis of heart rate variability was measured by DiANS PF8 machine with Medical DiANS PC software. Evaluated were complex indices – Total score and Sympathovagal balance (S-V balance). The intervention programme was composed of three months of respiratory training and then three months of physical training. The experimental group, which absolved this combination of respiratory and physical intervention, was assessed at free time points: firstly, before the respiratory intervention, secondly between the respiratory and the physical intervention and thirdly after the physical intervention. The control group (without intervention) was measured twice between six months. 30 hematooncological patients (16 women and 14 men) were participated in this research, ranging in age 53,74±14,76 years from Internal Hematology and Oncology Clinic of The University Hospital Brno. Results of selected parameters of heart rate variability showed positive increase in sympatovagal balance after respiratory training, but without statistically significant effect of intervention programme.

Keywords: *Oncological patients, lymphoma, respiration exercise, physical exercise, autonomic nervous system, heart rate variability*

INTRODUCTION

Oncologic diseases are on second place in reasons why people dying in the Czech Republic and in the World too. According to the National Cancer Registry were in year 2016 diagnosed 779 causes of neoplasm of non-Hodgkin lymphoma and 152 causes of neoplasm of Hodgkin lymphoma. In year 2016 died in the Czech Republic 565 patients with non-Hodgkin lymphoma and 46 patients with Hodgkin lymphoma. (1) Physical activity can be very beneficial for patients with oncological disease. Positive effect has on quality of life. (3) With oncological diseases is connect fatigue too. On fatigue can have physical activity positive influence too. (4,5,6) Physical activity should have place in oncologic treatment. (7) Physical activity has influence on heart rate variability. Moderate aerobic endurance activity improves autonomic heart regulation. (9) Connection has fatigue and activity of autonomic nervous system too. (10)

METHODS

Participants

For the research were intentionally chosen patients from Internal Haematology and Oncology Clinic of The University Hospital Brno in remission after oncological treatment of Hodgkin's or Non-Hodgkin's lymphoma. In this research group specifically were 9 patients with Hodgkin's lymphoma diagnosis and 21 patients with Non-Hodgkin's lymphoma diagnosis. Except one case was used chemotherapy treatment, the most was used chemotherapy regiment BEACOPP (bleomycin, etoposide, adriamycin, cyclophosphamide, vincristine, procarbazine, prednisone), secondly regiment R-CHOP (rituximab + cyclophosphamide, doxorubicin vincristine, prednisone). Chemotherapeutic treatment was applied independently or combinated with radiotherapeutic or biologic treatment. In two cases was used autologous transplant after chemotherapeutic treatment.

The research group were composed of 16 women and 14 men ranging in age 53,74±14,76 years (age at the time of the first measurement). The reconditioning programme completed 17 patients and in the control group was included 13 patients.

The reconditioning programme included only patients in remission (within 2 months after the end of oncological treatment) and without any contraindication regarding the performance test. The randomisation was geographic (patients from vicinity with a possibility to commute regularly for the exercise lessons).

Measures

The participants, who were included in the experimental group were assessed at three times – firstly before the respiratory intervention, secondly between the respiratory and the physical intervention and thirdly after the physical intervention. The participants in the control group were tested at two times within 6 months.

The study instruments included measure of heart rate variability (DiANS PF8), body composition (Inbody230), strength of upper limbs (handgrip), cardio-respiratory fitness (spiroergometric: Lode Excalibur + Cortex Metalyzer®), inspiratory and expiratory mouth pressures (Micro RPM), anamnestic examination, psychologic examination of quality of life (SEIQoL – Schedule for the Evaluation of Individual Quality of Life) and examination of nutritional habits (FFQ – Food Frequency Questionnaire).

In this part of the research was main procedure measure of heart rate variability. Heart rate variability was measured on DiANS PF 8 machine and analysed by Medical DiANS PC software. Test was composed from three 300 R-R intervals and based on orthostatic reaction. Evaluated were complex indices of spectral analysis Sympathovagal balance and Total score.

Interventions Programme

The intervention programme was composed of respiratory intervention for twelve weeks and physical intervention for twelve weeks.

Respiratory intervention

Before the intervention were participants educated by physiotherapeutic for right technique of the exercise. The respiratory intervention was applicated every day for twelve weeks at home with breath machine Threshold® IMT (Inspiratory Muscle Trainer) and Threshold® PEP (Positive Expiratory Pressure). Resistance was individual set on 30% of maximal inspiratory/expiratory pressure. These parameters were measured and set by physiotherapeutic on the first testing of participants before respiratory intervention.

Physical intervention

The physical intervention was going three times of week for twelve weeks. Physical training had 60 minutes and started with warm-up on cardio machines. Main parts of lessons were composed of cardio training (used were spinning bicycles, cross trainers, steppers, treadmills and rowing machines). All the exercise lessons were closed with stretching and relaxation. During the exercise lesson was controlled individual level of set intensity based on heart rate (it was used chest belt ST Polar RS 100, RS 300X) and subjective level of intensity on the Borg chart (in 5 minutes intervals). The optimal individual level of intensity was set on 60-80% of maximal heart rate, which was measured on the first testing of participants on spiroergometric.

Statistical Analysis

Statistical analysis was performed with software Statistica 12. The normality of distribution was verified with Shapiro-Wilk test, Kolmogorov-Smirnov test and Lilliefors test. Based on the results of these tests was determined that data were nonparametric, and number of participants was small. Therefore, was chosen nonparametric Wilcoxon t-test. A p value of less than 0.05 was considered statistically significant. Results were verified with Cohen *d.* A Cohen *d* value 0.2 indicates small effect size, 0.5 represents medium effect size and 0,8 considers large effect size. Values of S-V balance and Total score were compared in experimental group before the respiratory intervention, after the respiratory intervention and after the physical intervention. In the control group were studied differences of these values, which was measured at two times within 6 months.

RESULTS

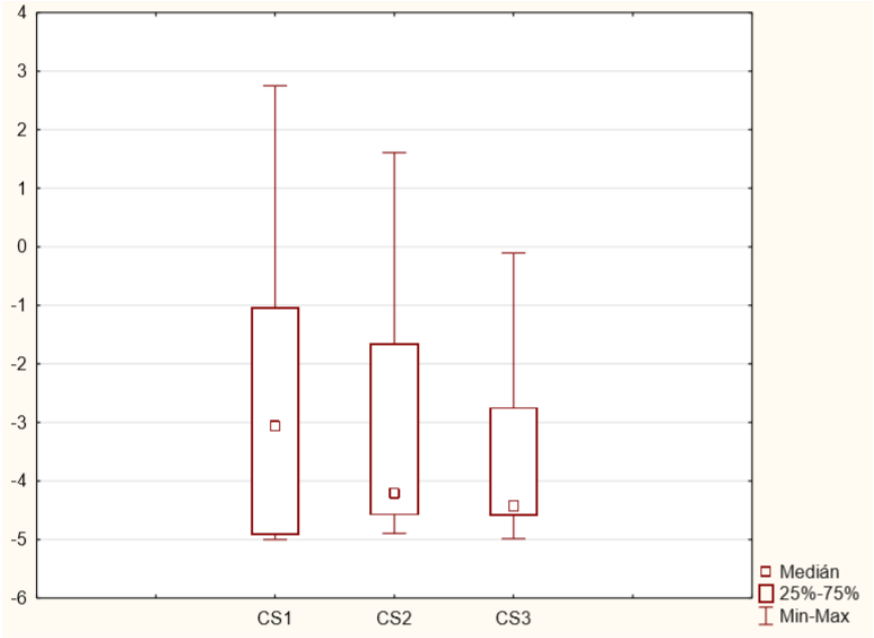
Median of total score value at first testing of experimental group (before respiratory intervention) was -3,0627. Minimal value was -5,0 and maximal 2,75. Median of S-V balance value at first testing of experimental (before respiratory intervention) group was -1,78235. Minimal value was -4,55 and maximal 2,73. Median of total score value at second testing of experimental (between respiratory and physical intervention) was -4,|2076. Minimal value was -4,90 and maximal 1,61. Median of S-V balance value at second testing of experimental (between respiratory and physical intervention) was -0,1088. Minimal value was -4,96 and maximal 2,68. Median of total score value at thirdly testing of experimental group (after physical intervention) was -4,42880. Minimal value was -4,99 and maximal -0,11. Median of S-V balance value at thirdly testing of experimental group (after physical intervention) was -0,0907. Minimal value was -3,82 and maximal was 1,17.

Median of total score value at first testing of control group was -3,2174. Minimal value was -4,99 and maximal 1,69. Median of S-V balance value at first testing of control group was -0,5748. Minimal value was -4,99 and maximal 2,56. Median of total score value at second testing of control group was -3,29305. Minimal value was -4,91 and maximal 1,18. Median of S-V balance value at second testing of control group was -0,06845. Minimal value was -3,88 and maximal was 2,13.

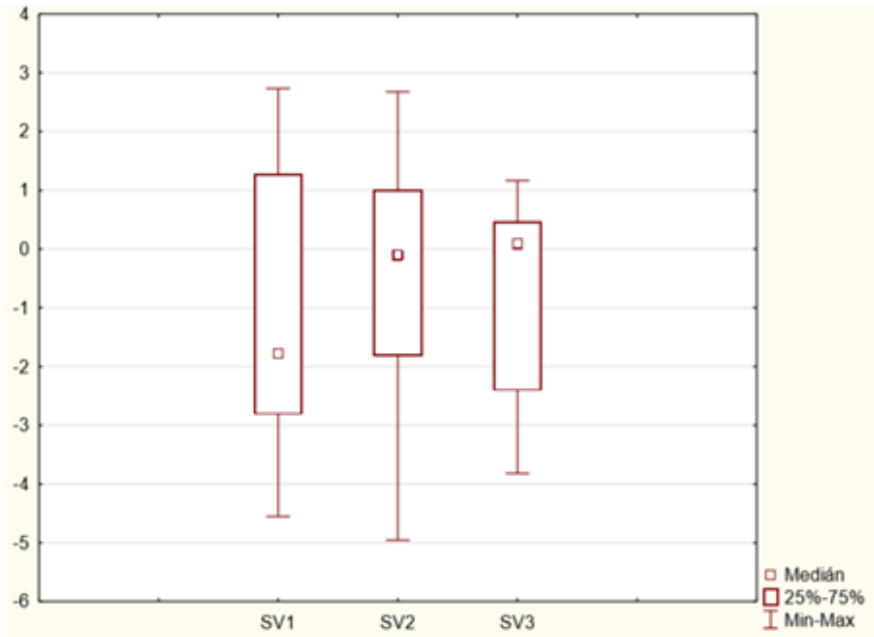
A statistically significant p value was set $p < 0.05$. *P* value of Total scores between measurements before (CS1) and after respiratory intervention (CS2) was 0,64 (Cohen *d* 0.11). *P* value of Total scores between measurements before respiratory (CS1) and after physical intervention (CS3) was 0,64 (Cohen *d* 0.03). *P* value of Total scores between measurements after respiratory (CS2) and after physical intervention (CS3) was 0,55 (Cohen *d* 0.15). *P* value of S-V balance between measurements before (SV1) and after respiratory intervention (SV2) was 0,13 (Cohen *d* 0.03). *P* value of Total scores before respiratory (SV1) and after physical intervention (SV3) was 0,24 (Cohen *d* 0.01). *P* value of Total scores between measurement after respiratory (SV2) and after physical intervention (SV3) was 0,55 (Cohen *d* 0.03).

P value of Total scores between measurement of control group (CS1 and CS3) was 0,48 (Cohen *d* 0.01). *P* value of S-V balance between measurement of control group (SV1 and SV3) was 0,89 (Cohen *d* 0.02).

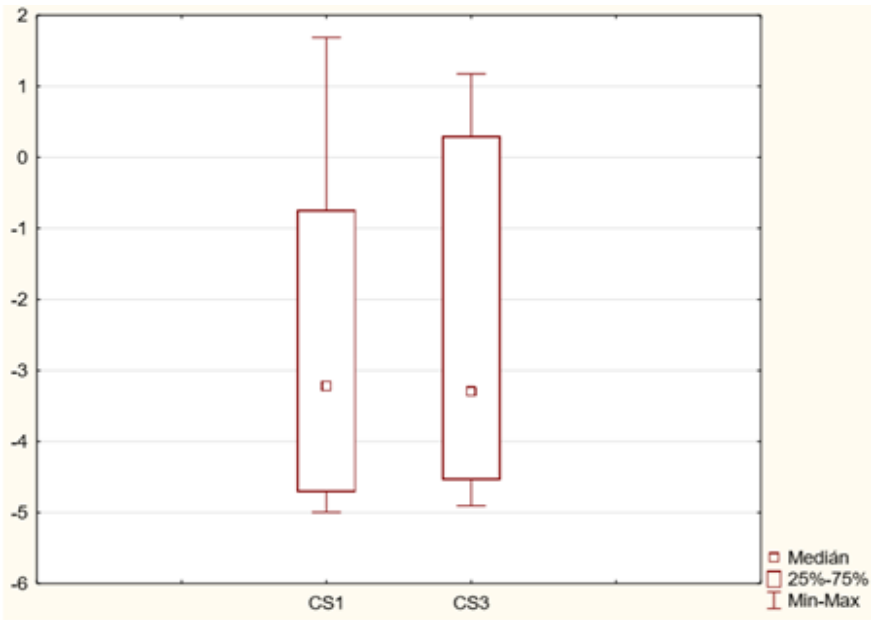
We didn't reject null hypotheses of equality of mean values – effect is not statistically significant.



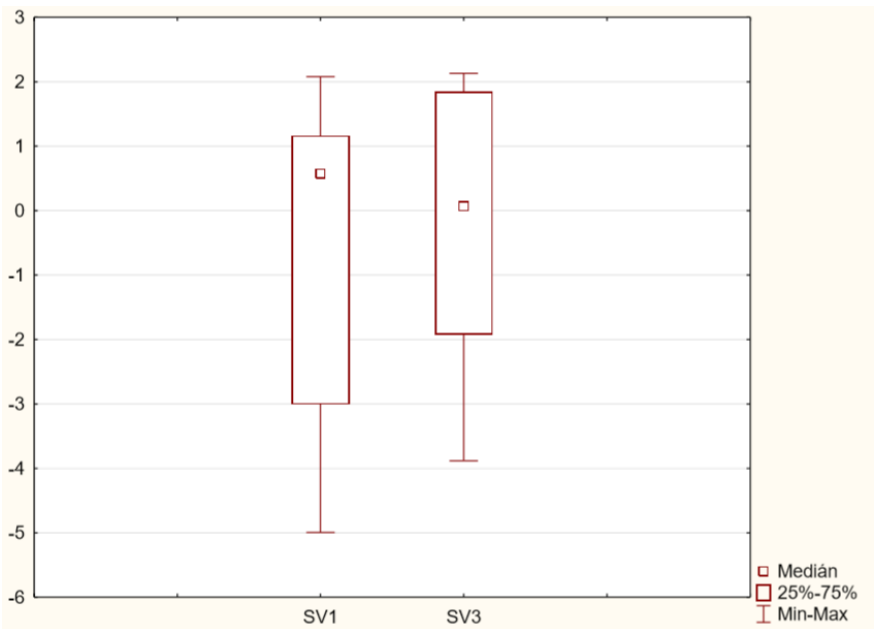
Box-plot n. 1 – Total score EG (author)



Box-plot n. 2 – S-V balance EG (author)



Box-plot n. 3 - Total score CG (author)



Box-plot n. 4 – S-V balance CG (author)

Box-plot n.1 – Total score EG: Values of Total score in the experimental group. CS1 – Total score before the respiratory intervention, CS2 – Total score between the respiratory and the physical intervention, CS3 – Total score after the physical intervention

Box-plot n.2 – S-V balance EG: Values of S-V balance in the experimental group. SV1 – S-V balance before the respiratory intervention, SV2 – S-V balance between the respiratory and the physical intervention, SV3 – S-V balance after the physical intervention

Box-plot n.3 – Total score CG: Values of Total score in the control group. CS1 – Total score at the first testing, CS3 – Total score at the second testing

Box-plot n.2 – S-V balance CG: Values of S-V balance in the control group. SV1 – S-V balance at the first testing, SV3 – S-V balance at the second testing

DISCUSSION

In years 2017 and 2018 were connected 30 participants (16 women and 14 men) ranging in age 53,74±14,76 years from Internal Hematology and Oncology Clinic of The University Hospital Brno. From all participants were 21 with non-Hodgkin lymphoma and 9 with Hodgkin lymphoma. In experimental group were included 17 participants and 13 were included in control group. Respiration programme finished 17 participants, but whole interventional programme completed only 13 participants. 3 participants did not finish physical programme because of time or health complications, 1 participant weren't measured after interventional programme because he was on holiday in this time. In control group were measured 13 participants at the first time, but second testing absolved only 8 participants. Reasons were for example relapse of disease, move out of Brno or lose interest in research.

Results did not show statistically significant effect of intervention in experimental group and no statistically significant difference between measurements in control group. For verification will be preferable larger file of participants. The biggest problem in physical training was in attendance, which was influence by in two cases by long-term illness, in one case by departure to a health resort or complexly by irregular participation of physical training. These gaps between trainings could cause why didn't be statistically significant effect of intervention. Reason would be big age variance of group or very difference values of selected parameters before interventional programme too. Another reason could be fact, that physical intervention was only 12 weeks, for better answer of training would be preferable longer time. At the end I think that better would be measurement of heart rate variability more often, for example continual every day at home too. Single measurement can be influence by actual condition of organism and stress.

However, in absolute result was improvement in S-V balance parameter in the experimental group.

Compared with other authors we can see that physical activity can have positive influence on heart rate variability in cancer patients. For example, the study from Niederer et all (2013) which showed significantly difference between non-intervention and intervention post treatment in heart rate variability parameter Total Power follow-up score (2.0 ± 0.5 vs. 2.6 ± 0.5 $logms^2$) (9)

CONCLUSION

The aim of this research was determined the effect of respiratory intervention for twelve weeks and physical intervention for twelve weeks on selected parameters of heart rate variability in hematooncological patients after treatment. Respiration training and physical activity can be very beneficial for patients with oncological disease and physical activity should have place in oncologic treatment. In this research was showed improvement in complex indices of heart rate variability S-V balance parameter, but it wasn't statistically significant effect of intervention.

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SOCIAL SCIENCES

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Strengthening Pupils' Physical Activity through Outdoor Education

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Abstract:

The time pupils spend at school provides a very small benefit to pupils' movement activity. At a time when many school-age children lack physical activity, it is necessary to think about how to integrate more movement into the period that the child spends at school. The paper is based on the assumption that outdoor education can contribute to the development of movement activity of pupils, and the paper aims to determine to what extent. For model pupils, the calorie count and metabolic discharge, including sedentary analysis, were recorded through an ActiGraph accelerometer during 4-hour lessons of different types of education days. The result is that outdoor education can serve as an appropriate complement to learning that contributes to the development of pupils' knowledge and skills while working in a real environment but also acts as a mean of increasing the possibilities for movement for pupils during their schooling.

Keywords: *outdoor education; elementary school; physical activity assessment; health promotion; accelerometry*

INTRODUCTION

Movement (physical activity) is an integral part of human life and, at the same time, one of the important needs of each child (pupil/student). Neumann (2000, p. 24) states that "we live at a time when the physical fitness of the population is on the downgrade and movement activity is often replaced by passive ways of entertainment" (e.g., playing on the PC, watching TV, etc.). An international study Health Behaviour in School-Aged Children compared the movement activities of schoolchildren ages 11, 13, and 15 of 48 countries in Europe and North America including Central Europe (Czechia, Slovakia, Poland, Hungary, and Ukraine) also shows that more and more European students are lacking in physical activity (Madarasová Gecková et al., 2016). Similarly, there is evidence of the increased prevalence of childhood obesity in the UK (Lobstein, James, & Cole, 2003) or the USA (Lobstein & Jackson-Leach, 2007; Lee, Stodden, & Gao, 2016). Since a hypo-kinetic lifestyle prevails among children today (as well as among adult population), teachers could do more to promote the healthy development of pupils supported by movement activity (Mužík & Krejčí, 1997). The movement inadequacy, or hypokinesia, occurs in children and adults and its manifestations are not only physical but also psychological (Krejčí, 2011). As the current lifestyle of many children and adults is not good, a positive attitude towards movement and a healthy lifestyle should be built up already in school-aged children.

Mužík and Krejčí (1997) recommend 30 minutes of a lower intensity movement activity (light to moderate) a day, to which 30 minutes of medium intensity movement (moderate to vigorous) should be added at least three times a week. As compared to Mužík and Krejčí, the demands of Sigmund and Sigmundová (2011) for the daily movement activity of early school-age children are significantly higher. In their opinion, the medium intensity daily movement activity of children should be three times longer, i.e., 90 minutes. Strong et al. (2005) recommend at least 60 minutes per day of moderate to vigorous intensity of physical activity.

There are several strategies on how to raise the intensity of physical activity. Steele et al. (2010) speak about promoting physical activity during weekdays after school and weekends. We focus on increasing physical activity during school-time, because this time can take up more than 1/3 of the pupil's total daily time without the required time for sleeping. Wareham, van Sluijs and Ekelund (2005) claim that when examining the most effective school-based interventions, it appears that such interventions are indeed limited to structured activity through predominantly physical education classes. However, movement can be largely incorporated into the teaching of most subjects at elementary school. If we disregard the actual physical education, which is a compulsory subject, then the movement can be incorporated mainly by means of outdoor education, which is an integral part of the natural sciences (geography, biology). It can also be applied to most social science subjects. Outdoor education is inherently associated with movement activities. Still, the movement itself is not a necessary priority for such form of education and that pupils sometimes may not even realize its importance. In the outdoors, pupils move on foot to various places during the collection of primary data for later processing. We see one of the most significant values of outdoor education in the fact that it combines elements of physical education with the transfer of subject-oriented schoolwork in natural science subjects and the humanities to the pupils.

The compatibility of physical education and outdoor education has already been described in Bunting (1989), who compared physical education and outdoor education objectives. Both physical and outdoor education directly or indirectly develop skills, social domains, physical fitness, and the process of learning. Moreover, outdoor education emphasizes environmental interdependency (Martin & McCullagh, 2011). In some countries, the outdoor education is considered to be so important that it has its own curriculum (Australia – Gray & Martin, 2012; New Zealand – Boyes, 2000; Denmark – Bentsen, Mygind, & Randrup, 2009).

In Czechia, the benefits of outdoor education have been described in general based on the view of teachers (Svobodová, Mísařová, & Hofmann, 2016), while in foreign literature the numerous benefits of outdoor education have been deeply analysed in various studies (Meredith, Fortner, & Mullins, 1997; Neill & Richards, 1998; Knapp, 2000; Rickinson et al., 2004; Fuller, Edmondson, France, Higgitt, & Ratinen, 2006; Shin, 2007; Mygind, 2007, 2009; Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2010; Cooper et al., 2010; Karppinen, 2012). The specific benefit of outdoor education on the development of natural movement activity has been investigated only partially in the context of Czech schooling (Korvas, 2005; Hofmann & Korvas, 2008). These researches, however, consisted of a measurement of the number of steps in different activities which are typical for integrated outdoor education. Later, the step count and MET rate has been gauged by Trávníček, Svobodová, and Durna (2018) on school aged children during different types of learning lessons.

However, outdoor education is also connected with the need to overcome a wide range of organizational, safety, as well as methodological obstacles (Waite 2009; Yang, Wang, Xu, & Deng, 2014). Therefore, it is not surprising that it remains the domain of only the most daring educators in the Czechia (Smrtová, Zadabal, & Kovaříková, 2012). It is necessary to add that the study courses for outdoor educators, as are usual in more developed countries (Thorburn & Allison, 2010; Lugg & Martin, 2001), are missing in Czechia.

The facts described above bring us to the aims of this paper. The influence of outdoor education on the Czech pupils' knowledge and skills were described in another authors' paper (Svododová, Mísařová, Durna, & Hofmann, 2019). The influence of outdoor education on the pupils' movement activity needs to be more investigated (among Czech pupils) as compared to learning in a classroom. The absence of repeated sophisticated measurement of pupils' movement activity and its comparison in different educational units implies the aim of this paper. The aim

of our study is to find out how can outdoor education contribute to the physical activeness of the pupils during school-time. Our research question is following: Is the pupil's physical activity during the day of outdoor education comparable or lower/higher to their physical activity during sedentary classroom education with/without the PE lesson?

To reach this aim, we compared the data gained from the physical activity measurement during the following forms of education: 1) all day classroom education, 2) classroom education with the incorporation of a physical education lesson, 3) outdoor education.

ANCHORING MOVEMENT AND OUTDOOR EDUCATION IN THE CZECH CURRICULUM

The educational objectives and content of the Czech curricula are defined in the Framework Education Programs (FEPs), which represent the national level of educational content. These centrally drafted curricular programs are binding for all elementary and secondary schools. The FEPs provide a foundation for the School Education Programs (SEPs) that are set at the school level to help teachers refine and customize the objectives and content of the subjects they teach (Vlček et al., 2016).

The FEPs specify (1) the level of key competencies that pupils should acquire by the end of specific education grade, (2) define an obligatory content of education (expected outcomes and curriculum), and (3) integrates cross-curricular topics as an obligatory part of education.

The educational content is divided into nine educational areas. Movement activities can be explicitly found only in the part of FEP called Man and Health educational area (incorporated in all nine grades of Czech elementary schools and it includes both Physical Education and Health Education – the given minimum of two hours per week in all grades).

In other educational areas, movement can be incorporated, for example, in the following ways, whereupon Jacobs (1989) speaks about complementary units in this context:

(1) A minute for health – pupils should break up long periods of sitting down with a minute of physical activity, during which they perform some movement exercises.
(2) Class lessons – teachers can prepare simple physical/sports activities in the course of regular lessons in the classroom (traditional dances in geography or music lesson).
(3) Outdoor education. As outdoor education is the key term for our paper, we add our own definition according to Hofmann (2003) and later adjusted by Svobodová, Mísařová and Hofmann (2016).

> "Outdoor education is an 'umbrella' concept for multiple forms of education, with the common feature of being undertaken outdoors, outside of school buildings. Outdoor education can take on a variety of organizational forms, from didactic walks, excursions, and field exercises to field research. If an outdoor education should have any benefits for students, they must be actively performing activities such as collecting and processing information from primary and secondary sources, using the research methods and aids of individual scientific disciplines".

The definition of OEA (2010, n. p.) adds that "outdoor education provides unique opportunities to develop a positive relationship with the environment (or experiential knowledge as is said in VCAA, 2005, p. 7), others and ourselves through interaction with the natural world."

One of the priorities of the Framework Educational Program is the consistent use of inter-subject links and the integration of the educational content of various subjects. Outdoor education, which can be an integral part of many subjects (especially the natural sciences), is an appropriate form of teaching to meet these inter-subject links, leading to the cooperation of teachers in various educational areas. From the above- mentioned possibilities for incorporating movement into learning, outdoor education can be considered in terms of its benefits on the development of movement activity and the development of key competencies as the most complex form of education.

In relation to outdoor education, it is only up to the teachers themselves how they will transfer all of the activities into the School Educational Program and subsequently to educational units. There are sufficient prerequisites for the application of outdoor education in the Czech curriculum, but its realization in practice often fails (Svobodová, Mísařová, & Hofmann, 2016). It is mainly because the benefits of outdoor education not only for physical activity are not yet widely appreciated among Czech teachers as no institution provides them appropriate education in the field of outdoor education.

From the point of view of didactics, outdoor education in the Czech education system is often included on the basis of the "traditional" concept of teaching. The methods of its implementation at many Czech schools nowadays are considered as ways that have already been overcome abroad. This means that outdoor education is rather associated with excursions, school trips, and other activities where pupils are merely observers and passive recipients of information – not active researchers, as exemplified in Oost, De Vries and van der Schee (2011). The different forms of outdoor education units contribute differently to the development of natural movement activity.

METHODS

Participants

Measurements of physical activity were taken in May 2017 for pupils of the 5th grade (age 9–11, i.e., K–5) and 8th grade (age 13–14, i.e., K–8) of the elementary school, where all day long outdoor education is used regularly in each of those grades (5th and 8th). So, this was the main reason why we conducted research on pupils in described age groups. We also wanted to avoid the research distortion where possible. Therefore, all lessons were conducted under the guidance of the teacher, to whom the pupils were accustomed. The present researcher only assured the correct setting and deployment of physical activity sensors. The sample for pupil measurement was limited by the number of ActiGraph monitoring devices to 10 pupils per grade that mean 20 pupils in total (ten for 5th grade and ten for the 8th grade). These ten devices were distributed among pupils using a stratified selection. In the 5th grade group, boys and girls were equally represented (five male and five female pupils). In the 8th grade group, there was only one male pupil, and the rest of the group represent nine female pupils. The reason for this sex disproportion was caused by the deficiency of boys in 8th grade (and the actual health condition of the other male pupil prevent him from participation in the research). So the sex ratio (F : M) of the sample (n = 20) was 2.3 : 1. More detailed information about each participant (BMI, BMI percentile, age) is shown in Table 1. Due to sample size we consider this research as the pilot study. Nevertheless, we believe that the data and methods presented here can be used by other fellow researchers, who are interested in research of children's physical activity during their schooling.

Table 1. BMI percentile and weight status of 5th and 8th grade probands according to the 6th NAS methodology.

5th grade						8th grade					
P5	AGE	SEX	BMI	BMI P	WS	P8	AGE	SEX	BMI	BMI P	**WS**
1	9	M	14,7	10–25	slim	1	13	F	18,0	25–50	prop.
2	10	M	15,8	25	prop.	2	13	F	18,8	25–50	prop.
3	9	M	16,4	50	prop.	3	13	F	17,3	25–50	prop.
4	9	M	15,2	25	prop.	4	13	F	16,5	10–25	slim
5	9	M	21,3	97	overweight	5	13	F	20,8	75	at risk
6	10	F	16,9	25–50	prop.	6	14	F	19,5	50	prop.
7	9	F	21,4	97–99	obese	7	14	M	24,1	90–97	overweight
8	10	F	16,6	25–50	prop.	8	14	F	19,5	50	prop.
9	9	F	18,1	75	prop. / at risk	9	13	F	22,6	90	at risk
10	11	F	19,5	75–90	at risk	10	13	F	18,4	25–50	prop.

Legend: P5, P8 – proband of 5th and 8th grade; BMI P – BMI percentile (specific to the age of probands); WS – weight status (according to the 6th NAS); prop. – proportional. Probands are labelled by the number of worn ActiGraph device (first column of the table). Column BMI percentile (BMI P) contain information if BMI value of proband lies directly on the edge of interval (single number) or if the value lies in the interval of value range.

Instrumentation

The physical load of the pupils was monitored by the ActiGraph wGT3X-BT accelerometers. Twenty participants were instructed to wear the monitoring device on the right hip during the education units. Activity data were recorded at 10-second intervals. Data processing and evaluation were done with hourly averages of the measured data. Every measured education unit lasted 4 hours.

We focused on the values of the energy consumed in kcal and the metabolic output in MET (metabolic equivalent of task). One MET is defined as the resting metabolic rate, represented by the amount of oxygen consumed at rest (sitting quietly), approximately 3.5 ml O_2/kg/min (or 1.2 kcal/min for a 70-kg person; Jetté, Sidney, & Blümchen, 1990). For example, the energy cost of playing rugby is 8.3 METS, which means the use 8.3 times more energy than sitting quietly and rest (M.E.T.S., 2016).

For each pupil, the value of kcals was recorded for the same time interval that is for four hours over three days, with a different form of learning represented on each day. For regular lessons lasting 45 minutes, the break time (3×10 and 1×20 minutes) is also included.

The ActiGraph accelerometer is also able to process the sedentary analysis. We focused on the total length of sedentary bouts, i.e., the total sedentary time in minutes detected during four hours of different types of learning. So, we can also compare the time spent (by the probands) on sitting for each educational unit.

Procedure

Given that we are aware of certain research limitations, which include the different levels of movement activity during different learning units and different types of outdoor education, we have carried out first measurements with 5th grade pupils and later a control measurements with pupils of the 8th grade at the same school. The conditions were similar for both grades – pupils completed four hours of classroom lessons without PE, four hours of indoor lessons including two lessons of PE (i.e., 2 times as much as the grade 5), and four hours of outdoor education.

The representation of girls (9) and boys (1) in the evaluated sample was uneven, as there were only 2 boys in the class.

Data Analysis

Before the physical activity measurement, the height and weight of probands were recorded, and the body mass index (BMI) was calculated for each of them. We are aware that simple value of BMI is not very useful for assessment of weight status of children and youth, so we adapted the method of BMI percentile which is more suitable for children and adolescents due to fluctuations in height, weight, and body composition that occur in the growth stages. BMI percentile tends to be a more sensitive tool to the change in the weight status of growing children and adolescents (Hoelscher, Kirk, Ritchie, & Cunningham-Sabo, 2013; Price, Cohen, Pribis, & Cerami, 2017).

For Czech children, weight status is determined using BMI age and sex norm-referenced values derived from the national wide survey. In Table 1 there is the BMI percentile and the weight status of all probands. Using the 6th National wide Anthropological Survey (Kobzová, Vignerová, Bláha, Krejčovský, & Riedlová, 2006 – 6th NAS) growth charts, *obesity* is defined as a BMI $\geq$ 97th percentile and *overweight* is BMI $\geq$ 90th and < 97th percentile and the zone *at risk of overweight* is defined as a BMI > 75th and < 90th percentile. The *proportional* zone (regular weight in specific age) lies between the $\geq$ 25th and $\leq$ 75th percentile, and *slim* is defined as a < 25th percentile. Values below the 3rd percentile indicate the very severe *underweight*. Authors are aware that BMI percentile limit values may differ among the other authors, so we use these values only in the Czech anthropo-socio-cultural context. We use the above-described method to inform about the weight status (WS) of probands (see Table 1).

To interpret the measured data, we used three kinds of analysis provided by the ActiLife (actigraphy data analysis software platform). Firstly, the Energy Expenditure (analysis of the calories burned) of each proband during three different types of learning was carried out. Secondly, we considered the MET rates values reached by the probands. Finally, the Sedentary Bouts (analysis of low activity describing the proband's sedentary behavior) were calculated in the ActiLife software.

To interpret the data coming from the analysis described above, we adopted the methods of descriptive statistic (average value) and data significance level. We combined all the data described above in an attempt to discuss one of the potential benefits of outdoor education – the increased physical activity during this type of education.

RESULTS

Energy Expenditure

The results of ActiGraph measuring of the calories burned by the 5th grade pupils (Table 2) show that the average energy expenditure among the probands was 23.8 kcal per a regular learning day without PE (exactly four hours of learning). On a learning day wherein PE is incorporated, the average energy expenditure was 57.2 kcal. For outdoor education day, the average energy expenditure was 189.3 kcal, i.e., three times more than on a learning day with PE and eight times more than on the learning day without PE. This result suggest that outdoor education may contribute significantly to the daily energy expenditure.

The results of 8th grade pupils' movement activity (Table 2) show a higher energy expenditure than in the group of the 5th grade pupils in all cases. Differences between classes can be explained, in particular, due to different pupil activities during the individual types of learning as well as the different individual biometric characteristics of pupils in grades 5 and 8.

On a regular learning day without PE, the average energy consumed value was 53.4 kcal. For a learning day where PE was incorporated, the average energy consumed value was 110.6 kcal. During outdoor education of the same time range as learning at school, the average energy consumed value was 277.7 kcal, i.e., 2.5 times more than during the learning day with PE and five times more than during the school day without PE.

Table 2. Energy expenditure (kcal) of the 5th & 8th grade pupils during 4 hours of different types of education

5th grade pupils				
Pupil (sex)	**Weight status** (see table 1)	**Classroom education without PE**	**Classroom education with PE**	**Outdoor education**
pupil 1 (M)	slim	27,117	41,711	157,456
pupil 2 (M)	proportional	22,965	84,447	266,275
pupil 3 (M)	proportional	21,045	32,856	136,660
pupil 4 (M)*	proportional	11,286	23,270	41,431
pupil 5 (M)	overweight	33,074	70,778	235,441
pupil 6 (F)	proportional	18,550	40,640	151,332
pupil 7 (F)	obese	11,100	74,025	199,620
pupil 8 (F)	proportional	41,116	82,842	199,511
pupil 9 (F)	prop./ at risk	20,676	38,221	134,540
pupil 10 (F)	at risk	31,127	83,475	371,074
Average – male	-	23,097	50,612	167,453
Average – female	-	24,514	63,841	211,215
Average	-	23,806	57,227	***189,334***

8th grade pupils				
Pupil (sex)	**Weight status** (see table 1)	**Classroom education without PE**	**Classroom education with PE**	**Outdoor education**
pupil 1 (F)	proportional	47,940	130,320	403,870
pupil 2 (F)	proportional	70,971	71,878	241,360
pupil 3 (F)	proportional	30,303	49,188	205,811
pupil 4 (F)	slim	38,882	95,946	191,747
pupil 5 (F)	at risk	54,337	176,880	302,487
pupil 6 (F)	proportional	44,347	61,424	291,894
pupil 7 (M)	overweight	77,686	205,830	362,866
pupil 8 (F)	proportional	53,025	95,306	233,740
pupil 9 (F)	at risk	57,785	89,396	319,096
pupil 10 (F)	proportional	58,389	129,710	223,820
Average – male	-	77,686	205,830	362,866
Average – female	-	50,664	100,005	268,203
Average	-	53,367	110,588	277,669

Source: own ActiGraph measurements, own calculations

* The lower measured values for pupil 4 can be explained by the partially incorrect measurement of the ActiGraph – see the limitations of the research for further detail.

Metabolic Equivalent of Task

The value of the Metabolic equivalent of task (MET) per individual per time provides information about how intensive is the executed physical activity of proband compared to sitting still (MET =

1). We compared the average MET rate achieved during the three types of learning (Table 3) and all values strongly differ from 1 (basal metabolic rate). This is interesting, especially in case of learning in the classroom, but it can be probably explained by the fact that pupils do not sit still during the lessons all the time (they move on the chair, sometimes walk around the room, they move during the breaks, etc.). MET rates achieved during learning in the classroom including the PE lesson was in the case of 5th grade 1.3 times higher (on average) compared to classroom learning without PE and similarly 1.2 times higher in the case of 8th grade (similarly the Energy Expenditure was higher in all cases). If we compare the MET rate achieved by probands during the outdoor education to MET rate achieved in the classroom, the outdoor shows the 2.6 times higher values (on average) in case of 5th grade and 1.9 times higher values in case of 8th grade pupils. The ratio of the difference of MET rate and energy expenditure among the 5th and 8th grades is the same (close to the value 1.4×).

Table 3. MET rates of the 5th & 8th grade pupils during 4 hours of different types of education

5th grade pupils				
Pupil (sex)	**Weight status** (see table 1)	**Classroom education without PE**	**Classroom education with PE**	**Outdoor education**
pupil 1 (M)	slim	1,55	1,89	4,06
pupil 2 (M)	proportional	1,38	1,98	3,97
pupil 3 (M)	proportional	1,42	1,70	3,64
pupil 4 (M)*	proportional	1,28	1,52	3,52
pupil 5 (M)	overweight	1,41	1,72	3,30
pupil 6 (F)	proportional	1,29	1,52	3,30
pupil 7 (F)	obese	1,15	1,75	3,52
pupil 8 (F)	proportional	1,57	1,91	3,37
pupil 9 (F)	prop./ at risk	1,37	1,75	3,75
pupil 10 (F)	at risk	1,32	1,66	3,74
Average – male	-	1,41	1,76	3,70
Average – female	-	1,34	1,72	3,54
Average	-	***1,37***	***1,74***	***3,62***

8th grade pupils				
Pupil (sex)	**Weight status** (see table 1)	**Classroom education without PE**	**Classroom education with PE**	**Outdoor education**
pupil 1 (F)	proportional	1,28	1,74	3,07
pupil 2 (F)	proportional	1,59	1,59	2,63
pupil 3 (F)	proportional	1,28	1,43	2,53
pupil 4 (F)	slim	1,34	1,81	2,52
pupil 5 (F)	at risk	1,32	1,97	2,57
pupil 6 (F)	proportional	1,27	1,38	2,54
pupil 7 (M)	overweight	1,42	1,93	2,40
pupil 8 (F)	proportional	1,44	1,72	2,57
pupil 9 (F)	at risk	1,33	1,75	2,59
pupil 10 (F)	proportional	1,48	1,69	2,75
Average – male	-	1,42	1,93	2,40
Average – female	-	1,37	1,67	2,64
Average	-	1,40	1,80	2,52

Source: own ActiGraph measurements, own calculations

Sedentary Analysis

The learning day without the PE lesson(s) or outdoor education was mainly (more than 80 % of the time spent by pupils) in a sedentary way – see Figures 1 and 2. Pupils spended about 20 % of the time in light or moderate movement, which roughly corresponds to the period of time of a break when pupils can move freely (a total of 40 minutes of the 240 minutes measured). During a learning day with the inclusion of PE, there was a higher proportion of time when pupils engage in moderate movement – approx. 15–20 %. The representation of light movement was similar to a day without PE, i.e., approx. 10 %. As opposed to a learning day without PE, the vigorous movement type prevails here at a higher rate (approx. 3–5 %).

The different representation of movement activity was also apparent in different outdoor education days. Although the sedentary type prevailed in 8th grade group (because there was a task insisting a lot of writing), it was not the same case in the 5th grade group where the moderate movement type prevailed. Nevertheless, the vigorous movement type was represented by about 15 % in both assessed groups.

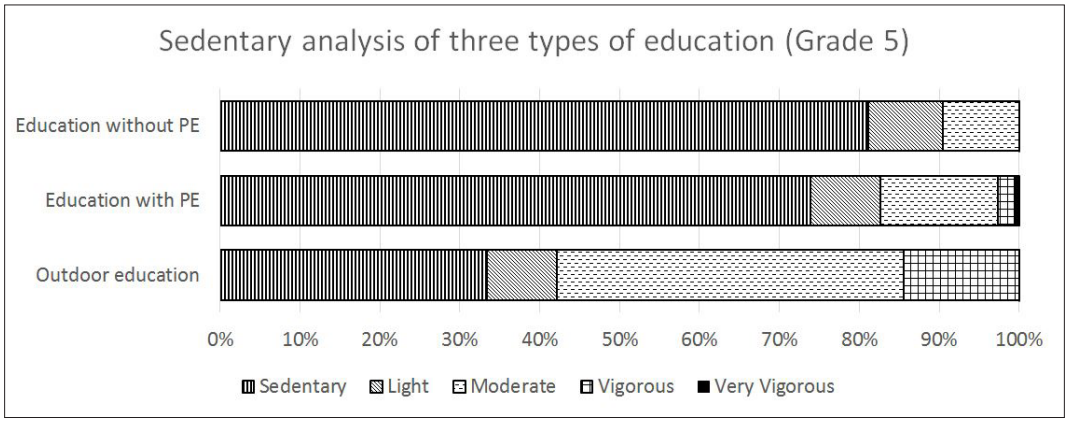

Figure 1: Sedentary analysis results (5th grade pupils).

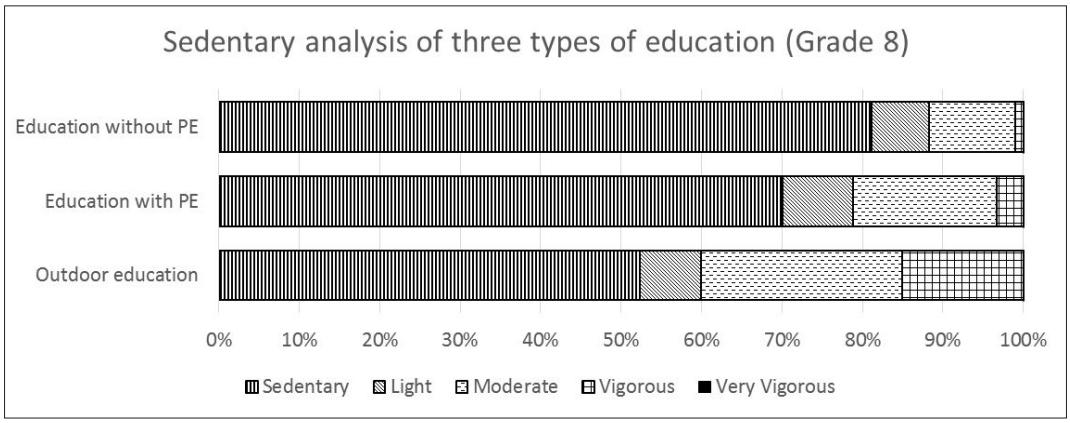

Figure 2: Sedentary analysis results (8th grade pupils).

Overall, the benefit of outdoor education, both in terms of the contribution to the daily calorie consumption and in terms of sedentary analysis, can be more positively evaluated than "common" education. If we compared 1 hour of outdoor education and 1 hour of PE, then the

8th grade pupils consumed an average of 48.2 kcal during one hour of PE and 107.3 kcal during one hour of outdoor education, while 5th grade pupils consumed 30.8 kcal during one hour of PE and 39.1 kcal during one hour of outdoor education. From these data, it can be concluded that in specific cases even an hour of outdoor education may have a slightly larger benefit on pupils' movement activity than an hour of PE. This can be caused by specific conditions during particular lessons. In both cases of outdoor education, pupils had to be active (physically) during the whole session of the measured period because they have to walk, observe, measure etc., all the time. Although during the PE lesson in the 8th grade pupils played volleyball (and ran at the beginning of lesson to warm-up the body), there were some *blind spots* where the physical activity was lower (e.g., when some active child was performing an excellent play, while the less active one was nearly standing still and waiting). Of course, this can vary depending on given sport and children attitude to sports activity.

DISCUSSION

Before we approach to the discussion of possible implication for the school practice, we would like to describe the limitations of this pilot study that we found out during the research. We believe it is correct to do so before formulation of the finishing statements as it can help to replicate the research without these obstacles.

Limitations

The authors of the paper are aware of several limitations of the presented research. Data collection was limited by the technological burden of the used device. The chest strap with the heart rate detector is primarily designed for an adult body. For children, the length of the chest strap had to be adjusted. Although we try to fix the strap on the children's chest, sometimes the detector was not recording the data for all of the 10-seconds intervals (in cases of very slim body type). The percentage of the measured data averages over 75 % for all pupils; the data significance level p has been calculated for the measured data sets, which is in all cases $p > 0.20$, meaning that the differences between the measured data are not significant and can be used for further analysis. Another limitation is the quite small sample, so we cannot allow generalizing the results on the population. Though the limitations of the obtained results, but we believe this can be a valuable tool for the larger-scale measurements and deeper statistical analysis of physical activity achieved during school activities of Czech pupils.

Implications for School Practice

At a time when the physical fitness of youth is decreasing (Madarasová Gecková et al., 2016; Lobstein, James, & Cole, 2003; Lobstein & Jackson-Leach, 2007; Lee, Stodden, & Gao, 2016) already from an early age compared to previous years, the schools should seek different ways to contribute to the development of pupils in this field. One of the ways how elementary schools can contribute to the development of movement activity to a certain extent is through the more frequent incorporation of outdoor education, both in short-term (1–2 learning hours) and medium-term forms (usually one day), as well as long-term forms (two and more days outside the school building). During well thought-out outdoor learning sessions, pupils are given a chance to be engaged in natural unstructured movement (walking, running, cycling) and, at the same time, to develop their knowledge and skills while not missing out on their schoolwork.

The results of pilot study suggest that the movement activity performed by pupils during outdoor education could be comparable to the activity that pupils perform during some physical

education lessons. Nonetheless, there are limited hours for PE during a school week. However, outdoor education can be cross-sectionally incorporated into almost all subjects and, inter alia, develop inter-subject links – naturally between physical education and other subjects. It is also an advantage not only for the natural sciences that pupils learn in a real environment, which corresponds to current trends in education (Vlček et al., 2016; Adkins & Simmons, 2002).

However, the principles of incorporating outdoor education into school education are not elaborated in great detail in the Czech education system. Many teachers still incorporate outdoor education in poorly designed ways (e.g. without links to the schoolwork discussed in class, with little pupil's own activity). Therefore, further research steps consist of: 1) the extension of the sample of measured pupils in different types of learning to make results of measurements more relevant, and 2) the preparation of the methodology of outdoor education, including the deepening of inter-subject cooperation. The teachers could be helpful partners in both – the cooperation in measurement of physical activity and preparation of school conception with clearly defined objectives how to strengthen the role of outdoor education at their school.

CONCLUSION

In the approach to the measurements, the researchers have been inspired in particular by researchers (Steele et al., 2009) who used the ActiGraph device for investigations of patterns of children sedentary and vigorous physical activity throughout the week. In another research (Fairclough, Beighle, Erwin, & Ridgers, 2012) authors measured the patterns of physical activity of differently active pupils during a school-day.

The results of the research on the movement activity of school-age pupils suggest that the outdoor education can contribute to its increasing (just simple walking during the outdoor education seems to be a great booster of MET rate and daily energy expenditure). Based on the results, it can be concluded that outdoor education can contribute to the development of the natural movement activity of pupils. It seems to be valuable to look deeper on the outdoor education from the point of the physical activity and thus it can be interesting for school authorities.

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Implementation of the CSR Principles in the Czech Football Environment

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Abstract:

The goal of this article is especially to provide information about the current situation as it pertains to the application of CSR principles within the Czech football environment, both on the part of the executive bodies in Czech football (the Football Association of the Czech Republic – FACR and the League Football Association – LFA) and all the clubs participating in the top football competition in the Czech Republic. This article combines the conclusions from secondary data analysis, content analysis of websites (top managing bodies of Czech football and all participating clubs of the highest Czech football league) and the author's own empirical investigation based on a series of semi-structured interviews.

Keywords: *Social responsibility in sport, football, the Football Association of the Czech Republic, the League Football Association, UEFA*

INTRODUCTION

In recent years, more and more attention has been paid to the social responsibility of sport, both by the academic sphere and by the actors on the sports scene themselves. According to many experts (e.g. Babiak & Kihl, 2018; Hildebrandt, 2019; Ratten, 2011), professional sports clubs, like many other business entities, should strive to make corporate social responsibility (CSR) an integral part of their management processes and proactively develop their activities in this area.

The ever-increasing commercialisation, media coverage and globalisation of the professional sport, as well as the intensification of demands from stakeholders, have greatly influenced the behaviour of many sports entities (Valeri, 2019). In particular, sports clubs of the highest level are subject to intense interest and control by the mass media and the general public, the latter of which is constantly informed by the former about almost everything related to the activities of the clubs (Riggin et al., 2019). In everyday management, it is a matter of solving many related problems, presented for example by the increased attention towards the clubs' possible unethical practices or the growing interest of their fans in non-sporting aspects of the clubs' operation. Professional sports organisations that want to gain the long-term commitment of their key stakeholders and achieve success beyond the field of sports now need to focus on these issues much more closely. For their management, this also means that they have to take a multidimensional approach to creating their strategies. In other words, besides focusing on sporting success and economic sustainability, they also need to focus on the social and environmental aspects of their activities (Babiak, 2010).

Nowadays, sport is being more and more recognised as an effective tool that can help bring about positive change in society, be it internationally or at a national, regional or local level (Giulianotti, 2015). The positive impact of sport in global humanitarian, development and peace efforts is at the centre of the praise (Waardenburg & Nagel, 2019). For these reasons, a number of important top international organizations (e.g. the UN or the EU) have included sport in their agendas (Kunz, 2018). Also, many expert studies show that there are a lot of reasons to use sport as a suitable instrument of CSR. In their acclaimed 2007 scientific article, Smith and Westerbeek

even identified a number of unique features of sport in terms of its use as a suitable CSR tool, including the mass media interest, the attractiveness of sport for young people, the positive health effects of sport and its ability to improve cultural understanding and integration.

It is also pointed out that the application of the CSR principles in the daily management practice of professional sports organisations can bring them many benefits, such as (Baena, 2018; Levermore & Moore, 2015; Trendafilova et al., 2017):

- becoming more attractive for existing and potential partners;
- improving the positive image of sports organisations;
- improving relationships with key stakeholders; or
- contributing to a healthier organisational culture of sports organisations.

CSR is increasingly supported and widely developed in the sport environment. For example, in America, majority of the local clubs from the most famous professional league competitions (e.g. NBA, NHL, or MLB) have been involved in a wide range of CSR activities for decades (Barett et al., 2019). CSR has also gradually become an important part of the agenda of many sports governing bodies, including those with an international reach (e.g. the International Olympic Committee). Equally, the fame and worldwide viewership of major international sporting events is increasingly being used in conjunction with various CSR initiatives (Knott et al., 2017). CSR initiatives are also being more often developed in the football environment, both by international governing bodies (e.g. FIFA or UEFA) and by some football league competitions (e.g. Premier League or Bundesliga) and their clubs (Blumrodt et al., 2013).

The German football environment in particular has long been considered one of the most active and inspirational European sports environments when it comes to the implementation of and support for CSR. Moreover, the majority of the top league clubs have begun to approach their CSR activities much more strategically in the new millennium, so that they include the systemic evaluation of CSR activities or CSR reporting. Many clubs have also established their own charitable foundations, which mainly focus on working with children and young people, in the interests of making their CSR activities even more systemic. They mainly support educational and school projects where the clubs cooperate with various types of schools or other extracurricular projects that support physical activities for children (Hildebrandt, 2019).

While the social CSR activities of the Bundesliga teams are most commonly realised at the initiative of the individual clubs, a number of environmental measures have often also been influenced and initiated in the past by the German government. The Bundesliga clubs were especially influenced by the government's Green Goal environmental program for the football world championships held in Germany in 2006 and 2011, when Germany endeavoured to utilise its position as the host nation for these significant sporting events to reinforce its image as an environmentally friendly country. Another of the highly inspiring environmental acts in German professional club football involves support for the public transportation of fans. Thanks to this, they can use their match tickets on public transport on the day of the match. This is a relatively traditional device that has been used by the majority of the Bundesliga clubs since the 1990s (Reiche, 2014).

The area of social responsibility has become an integral part of the management of the majority of Bundesliga clubs, which has also been projected into their organisational structures. Werder Bremen became the very first German football club to create a separate CSR department in 2002. In recent years, Bundesliga clubs have begun to be comprehensively involved in CSR reporting, while the first club to ever publish a CSR report was Hamburger SV in 2009. The fact that German clubs have been increasingly involved in CSR activities in recent years is also borne out by the fact that they dedicated an average of three full-time employees to the area of social responsibility in the 2017/18 season (Hildebrandt, 2019).

The supreme executive bodies of German football have also gradually adopted many diverse CSR activities, with which they are trying to further expand the overall CSR involvement in German football. The German Football League (Deutsche Fußball Liga – DFL) has also endeavoured to expand CSR involvement in the German football environment since the beginning of its existence. The establishment of the Bundesliga Foundation (DFL Stiftung) in 2008 was a significant act in this area on the part of the DFL. The German Football Association (Deutscher Fußball-Bund – DFB) has also established several foundations in support of CSR projects, the most significant of which is the DFB Sepp Herberger Foundation. Moreover, the DFB also created a Committee for Sustainability in 2010 and at the same time it also published its first joint CSR strategy with the DFL entitled the Path to Sustainability (Reiche, 2014).

A lot of varying activities in the area of CSR were also realised in English club football in the 1990s. The fundamentally significant initiative which was intended to connect football clubs with their local communities was the government's Football in the Community program. CSR activities are not only pursued in English football through this program by both the top football bodies and the larger Premier League clubs. The high degree of involvement in English club football has also been confirmed by the latest scientific research. For example, Rosca (2011) dealt with an analysis of the English Premier League clubs' CSR activities in the 2010/2011 season in his relatively comprehensive expert study (Rosca, 2011). The research has unequivocally confirmed the involvement of English clubs in this area, in that the Premier League clubs realised a total of 355 CSR programs in the given season (Rosca, 2011). The top five clubs with the greatest numbers of CSR programs included four from London (Chelsea 44 programs, Arsenal 34, Tottenham 31 and Fulham 24).

Like, the Football Association, the English Premier has long initiated many different CSR programs (for example, Premier League Kicks or Premier League Primary Stars) that concentrate, for example, on supporting the physical fitness of students and their personal and social development. Increasing numbers of club fans are becoming involved in supporting CSR. For example, Manchester City has enabled its fans throughout the world to vote for one of six community football projects via its Citizens Giving CSR campaign since 2014 (Francois et al., 2019).

In addition to German and English football, the area of CSR is also supported in a number of other Western European football leagues, no matter whether this involves the Spanish La Liga, the Italian Serie A or the French Ligue 1. On the other hand, the individual clubs in the Eastern European football environment are mostly only starting to gradually develop their CSR activities, albeit that here too it is possible to find some inspiring examples in this area. For example, the leading Polish football club Legia Warsaw has been actively involved in CSR for a number of years, including via its Fundacja Legii club foundation. Its activities are mainly oriented towards education and leisure time activities for children and young people. The club foundation helps to provide primary school pupils aged 7 – 14, who mainly come from socially excluded families, with courses in Polish, English or mathematics, usually in a fun form that is somehow combined with football. The "Bez Barier" program enables Legia fans with severe handicaps to request free entry to Legia home games. Special radio broadcasts have been prepared for blind fans (Chanvat et al., 2017).

In the Czech football environment, more attention has been paid to the field of CSR only in recent years, including the support of the governing bodies of Czech football (Czech Football Association, League Football Association). A number of clubs in the Czech top football competition have gradually developed various activities in the field of social responsibility. However, there are considerable differences in the degree of application of CSR principles in the management practices of individual clubs. Compared to most other football league competitions, not only from Western Europe, the involvement in all major areas of CSR is still lower. This is also evidenced

by the evaluation of the Czech football league in the prestigious Responsiball ranking, which has been annually evaluating the CSR in selected top professional league competitions since 2011 (Responsiball, 2020). Table 1 summarises all of the positions of the Czech football league to date in the Responsiball rankings.

Table no. 1: The evaluation of the top Czech football league in the Responsiball ranking (Responsiball, 2020)

Year	Number of evaluated football leagues	Czech league ranking	Total score (%)	Club management (%)	Community work (%)	The environment (%)
2011/12	16	14	9.85	18.00	11.00	0.00
2012/13	16	15	7.26	20.22	1.56	0.00
2013/14	16	15	6.46	11.00	9.00	0.00
2016/17	25	23	13.00	13.00	16.00	0.00

The top Czech football competition was last evaluated in the 2016/17 season when it ranked 23rd in the Responsiball ranking with a total evaluation of 9.95% (the maximum achievable evaluation was 100%). Only the Greek and Indian football leagues finished behind the domestic league in the total of twenty-five evaluated football league competitions (Responsiball, 2020).

It is clear from the table that Czech first-league football clubs are lagging behind, especially in the environmental area of CSR.

METHODS

The author combines the conclusions of secondary data analysis, web content analysis and empirical research based on a series of semi-structured interviews. In order to determine the situation in the field of CSR in the Czech football environment, both the web pages of the governing bodies of Czech football ((the Football Association of the Czech Republic – FACR and the League Football Association – LFA) and of all participants of the highest domestic football competition were analysed.

The examination of CSR at two levels allowed for a more comprehensive view of the issue, i.e. it not only facilitated the identification of the main areas of CSR focus of domestic football clubs, but it also allowed for a more detailed insight into the CSR support by the highest governing bodies in the Czech football environment (FACR, LFA).

The research deals with a number of areas in the application of CSR in the Czech football environment, aiming in particular to:

- Identify the main focus of CSR activities in the Czech football environment, including the identification of the main target groups they are focused on (including analysis of the scope of activities, themes, messages, etc.)
- Uncover other deeper contexts – e.g. major differences in terms of strategic approach to CSR and systematic implementation, etc.
- Analyse communication of CSR activities in the Czech football environment – in terms of utilising the online environment.
- Determining the degree of involvement of the governing bodies in the Czech football environment, or its impact on the development of CSR in Czech football.

In the fourth quarter of 2019, own research empirical survey was conducted. In a series of individual semi-structured interviews, CSR and its application in their own management

practice was commented on by:

- Managers of fifteen first league clubs and one leading second league club (Dukla Praha) – these were mostly marketing managers. However, other persons were involved in the research, such as the club's CSR manager, a manager of community projects or a club's business director. Almost one half of the addressed club representatives have been working in their clubs for more than a year, more than one third of them have been working in their respective clubs for one to five years.
- Selected representatives of the top governing bodies of Czech football – manager of social projects of the Football Association of the Czech Republic (FACR) and director of communication and public relations of the League Football Association (LFA).

RESULTS

The clubs' CSR programs are most frequently oriented towards the neighbouring community, whereby this very often involves children and young people. With regard to the focus of the CSR programs, Czech first-league clubs are mainly involved in charity projects, which can be ascribed to the fact that this constitutes one of the simplest methods of CSR engagement for them. The clubs often support such projects with charity auctions of football jerseys and other club artefacts. These projects are usually focused on helping selected ill or handicapped individuals or specific organisations. The clubs cooperate with a range of non-profit organisations ranging from children's homes (for example, FK Teplice, Viktoria Plzeň and FK Jablonec), organisations which help handicapped individuals (for example, SK Slavia and AC Sparta Prague work with the Jedlička Institute Foundation, FK Teplice works with Konto Bariéry and SK Č. Budějovice works with the Bazalka Centre) or senior citizens' organisations (FC Plzeň cooperates with the Peaceful Aging Home and AC Sparta works with the Sue Rider Retirement Home).

The clubs also often cooperate with kindergartens and primary schools (stadium tours or meetings with the players – for example, the "Viktorka in Schools" project operated by FC Viktoria Plzeň), while only a few of them have established cooperation with secondary schools or universities (for example, the cooperation between FK Teplice and J. E. Purkyně University). A number of clubs have also endeavoured to realise CSR sports programs (for example the "Whoever is playing has no time for mischief" CSR project operated by SK Č. Budějovice) which range from football tournaments for the pupils of kindergartens and primary schools to other sports activities, during which the clubs endeavour to make use of their own resources and abilities with regard to both sports facilities and qualified coaches. Moreover, the sports programs focused on children also provide the clubs with the opportunity to acquire new talented footballers into their youth teams. In addition to this, the clubs also prepare a number of other programs for children and young people, in which the clubs not only endeavour to help them have fun in their free time (for example, Sparta's Kite Day or the Children's Day at Letná), but also to bring them, for example, to conscious fandom (for example, the "Polite Supporters" project operated by AC Sparta Prague). Moreover, a number of clubs also keep entire families with children in mind, not only by offering them entertainment programs at matches, but also, for example, through the construction of so-called family stands (for example, SK Č. Budějovice or AC Sparta Prague). Only two Czech first-league clubs (Mladá Boleslav and SK České Budějovice) have publicly joined the program against racism (FARE).

Some league football clubs have also become involved in CSR programs aimed at supporting health and a healthy lifestyle, such as the cooperation of Viktoria Plzeň with the National Register of Bone Marrow Donors or support for blood donation (for example, FK Teplice). Cultural in-

tegration programs focused on the integration of citizens of different nationalities have yet to be realised within the Czech football environment. Similarly, none of the Czech clubs has yet joined any social integration programs which could simplify, for example, the provision of assistance to individuals who have difficulty in the job market or the integration of some groups of individuals who have been excluded from society (homeless people, recidivists or drug addicts). Unlike Western European football clubs, which have mostly created independent foundations to support their CSR activities, only AC Sparta Prague has created an independent club foundation in the Czech Republic to date. It was established in 2013 with the objective of supporting former club players who had found themselves in medical or social need. Environmental CSR has been relatively rare among Czech football clubs to date and it is usually related to either securing the operations of the clubs, in which case this mainly involves measures aimed at saving energy and searching for more ecological solutions, such as the use of so-called "green energy" (for example, FK Teplice) or the acquisition of a fleet of thirty hybrid vehicles at FC Ostrava. In addition, FK Jablonec, for example, supported the "Let's Clean the Jizera Mountains" environmental project with the active participation of the players from the A-team and their families.

The analysis of the clubs' CSR communication through their websites showed that information about their CSR activities is most often concentrated under the "club" tab (e.g. Jablonec, Plzeň, Olomouc, Dukla, Sparta, Plzeň). Only two clubs (Teplice and Zlín) have a separate main section on their website dedicated to their CSR activities. Furthermore, the websites some clubs (Sigma Olomouc, Zlín and FK Teplice) also list the charities with which the club cooperates. Regarding the comparison of club websites in terms of communication of their CSR activities, it is especially FK Teplice that can be praised in this area. On its website, there is a separate main CSR section, which is called "More than football" and it is the most comprehensive presentation of a club's activities in this area in the Czech Republic. Furthermore, it also presents CSR initiatives of international football associations FIFA and UEFA. An integral part of it are the club's CSR strategy or ethical codes (player, coach and parents); it also comprehensively introduces the organisations with which the club cooperates on CSR projects. There are also subsections called "write us" and "whom you can currently help", which seek to involve the club's stakeholders and the general public in supporting CSR activities in the region.

The results of a research survey among representatives of first-league football clubs and one leading second league club (Dukla Praha) showed that the addressed representatives of clubs perceive the socially responsible behaviour of their clubs to be, above all, represented by the impact of their activities in areas not related to sport. At the same time, they are aware of their considerable influence on the surrounding society, especially on the young generation. Some representatives of clubs (e.g. Slavia Praha) emphasised that socially responsible clubs should try to inspire their fans with their behaviour and provide a good example for the society. According to all respondents, socially responsible clubs should, within their means, support public benefit projects that help where they are needed. Representatives of clubs think that in addition to the clubs proactively initiating these charitable projects themselves, they can also support third-party projects, especially by providing their relatively great communication reach. According to some of the addressed representatives, in addition to the publicity of various charitable activities, the clubs should also focus on promoting other necessary social issues, including, for example, promoting a healthy lifestyle or fight against all forms of inequality and violence. The above is also evident from some statements of the addressed clubs' representatives, such as the following:

- "A socially responsible club uses the power of its brand to make positive changes in society, especially in its surrounding community." (Sparta)
- "A CSR club is characterised by a healthy internal culture, condemnation of any signs of corruption and by fair play behaviour both on and off the pitch." (FK Teplice)

- "We perceive the social responsibility of our club mainly in the good work of our coaches with young people." (MFK Karviná)

Almost all respondents perceive their clubs as socially responsible (except for two club representatives who believe that their clubs are not socially responsible). None of the respondents believe that socially responsible activities are completely irrelevant for their clubs, and only one of the clubs considers CSR to be a rather marginal issue. In the area of social responsibility, the clubs focus mainly on the support of handicapped and ill people and on work with children and youth, including cooperation with children's homes. More than half of the club representatives contacted believe that most of the first-league domestic football clubs are actively involved in the field of social responsibility. The addressed representatives perceive AC Sparta Praha, Slavia Praha, Viktoria Plzeň and FK Teplice as the most active first-league football clubs in the area of social responsibility. Likewise, some of the projects of these clubs are considered the most successful CSR projects in the Czech football environment. These are in particular the following: Viktoria Plzeň's project supporting registration in the bone marrow donor register; FK Teplice's Žlutomodrá splněná přání (yellow and blue wishes granted) charity project; and the regular audio descriptive commentary of AC Sparta Praha's matches on its website. In addition, some clubs praised the Green Life CSR project of the League Football Association.

Clubs' representatives are convinced that their involvement in the field of social responsibility brings to their clubs, in particular, an improvement in reputation. The representatives of the clubs are rather sceptical regarding the impact of CSR activities on attracting new fans. In the area of social responsibility, clubs focus their attention on supporting selected organisations rather than specific individuals. The clubs' representatives consider their CSR activities in the social field, especially the charitable projects, to be the most successful socially responsible projects. Some clubs (e.g. Ostrava, Opava) emphasised that they are striving for greater involvement in the environmental part of CSR, be it issues related to efficient waste management plan or energy savings. None of the clubs yet implement a CSR programme dealing with the social inclusion of at-risk groups. The addressed football clubs in the Czech Republic support socially responsible projects mostly by providing their communication power. If partners find any of the socially responsible projects interesting, they participate in its support primarily financially or materially. Representatives of clubs were optimistic about the future role of CSR in Czech football. None of the respondents think that CSR in Czech football will be a rather marginal issue or an area with no interest whatsoever in the future.

The Football Association of the Czech Republic (FACR), which organises the lower football competitions in the Czech Republic, incorporates 3500 registered clubs and over 330,000 players and is also in charge of the Czech national football team or indoor football, has initiated some activities corresponding to the principles of the CSR concept in recent years. The FACR supports the development of amateur football via a so-called grassroots program, whose central tenet is to give everybody the chance to play football regardless of their gender, age, race or lifestyle. The main part of this program involves youth football, but also increasingly popular sports such as indoor football, women's football or beach football. The program has also had a substantial social impact and it supports football for senior citizens and veterans, for players with physical and mental handicaps and for children from children's homes and for homeless people. For example, the 2nd Czech championship in walking football for senior citizens and the 16th year of the tournament for children from children's homes (the Children's Home Cup) were both held in 2019. The FACR was also one of the partners in an international tournament for people with mental handicaps (the 2019 EASI Cup) which was held in Prague in July 2019. The FACR hosts a gala evening for grassroots football every year in Prague, during which the best amateur footballers ranging from youth players to senior citizens receive awards. As far as the FACR's support for

youth football is concerned, it is possible to consider the My First Goal project, which the FACR has organised in this area in recent years, to be a significant and inspiring activity. The European football union (UEFA) even named the "My First Goal" project the best grassroots project of 2015 from all of its member countries. This project focuses on young boys and girls starting out in football and especially on continual support for the recruitment activities of football clubs and the footballing youth in the Czech Republic.

The League Football Association (LFA), which is an interest association of professional football clubs in the Czech Republic, also implements three key projects within the Czech highest football competition, which reflect the principles social responsibility concept. The first of them is a CSR program called Green Life which has been in operation since 2013. The programme focuses not only on informing about the socially responsible activities of the participants of the highest football competition in the Czech Republic, but it also tries to combine some activities of clubs in this area and to generate funds that are subsequently used for a good cause. Therefore, the LFA has created a separate Green Life Endowment Fund, the aim of which is to support children, youth and disabled people, especially by providing for their social, medical, sports and cultural needs. The support from the Green Life Endowment Fund is mainly intended for young footballers aged 5-15 who are growing up in difficult economic and social conditions. An allowance of up to ten thousand CZK per year can be used, for example, to buy sports equipment, pay for membership fees or to participate in training camps. The Governing Board of the Foundation decides on the granting of support based on an application basis. A round of the Czech football league has been regularly dedicated to the Green Life programme in every league season since 2013, it is called a Green Round and the players wear green colours in order to draw attention to selected social issues; they also financially support a certain selected project to help the people in need. Since 2015, the LFA has also organised another CSR project in the top Czech football competition called Fathers' Weekend, under which one league round in autumn and one in the spring part of the season is dedicated to fathers and their children. This not only involves discounted ticket prices, but also various entertainment programs and competitions or autograph sessions with the footballers, for example. The last significant CSR project undertaken by the LFA to date, which began in the 2018/19 season in cooperation with the general partner of the top football competition in the Czech Republic, the Fortuna company, is the Fortuna Fair:Play initiative. As part of this project, the representatives of the top football competition in cooperation with the wider public endeavour to recognise clients or individuals from the environment of professional football who honour the rules of fair play and in doing so spread the idea of fair play throughout the game.

The answers of the addressed representatives of the governing bodies of Czech football (FAČR, LFA) also showed that they consider involvement in the field of CSR to be important. This is also evident from the statement of the FACR CSR project manager: "The Football Association of the Czech Republic, within the framework of its social responsibility, provides everyone with the opportunity to play football, regardless of age, race, gender or any handicap, whether health-related or social. In practice, this means that the FACR supports large social projects where football can be played by the blind, the deaf, the mentally handicapped, but also by children from children's homes, homeless people and people with other disabilities. In the same way, we also strive to make football a sport for all stages of life, i.e. from the smallest children to the elderly".

Representatives of the governing bodies of Czech football consider the LFA's Green Life charity project to be one of the most successful CSR initiatives in the Czech football environment. According to the FACR representative, most clubs in the Czech Republic are involved in CSR and when compared to other European countries, the Czech football environment is the more active in this field (this is also based on feedback from UEFA). The LFA representative consid-

ers FC Viktoria Plzeň, FK Teplice and AC Sparta Prague to be the most active clubs in the field of CSR in the Czech Republic. According to the respondents, greater involvement in the field of social responsibility in Czech football can bring, in particular, an improvement of its image and improved relations with existing sponsors. They believe that CSR projects should continue to focus on a wide range of target groups from children and the disabled to the elderly, ex-athletes in need of assistance and the socially disadvantaged. The governing bodies of Czech football strive to support CSR initiatives mainly financially and at the same time by providing their communication power. The addressed representatives stated that so far only a minority of their main partners are involved in the socially responsible projects implemented by them and that their support is mainly financial or material (e.g. sports equipment). According to the respondents, important football events should also be used for socially responsible campaigns, be it international football events (e.g. European Championships, friendly matches of the Czech national team) or domestic football events (e.g. MOL Cup final, Fortuna League superstructure, etc.). According to the opinions of both representatives of the governing bodies of Czech football, CSR in Czech football will be a rather important area in five to ten years.

DISCUSSION

In recent years, a number of clubs in the Czech top football competition have gradually developed various activities in the field of social responsibility. It is quite clear that overall, compared to most other football league competitions, not only from Western Europe, the involvement in all major areas of CSR is still lower. There are considerable differences in the degree of application of CSR principles in the management practices of individual clubs. While some Czech football clubs show that CSR has become a strategic part of their club management (e.g. AC Sparta Praha, FK Teplice or Viktorie Plzeň), most Czech football clubs are still implementing only partial CSR activities mainly in the charity field, without much connection with the key management systems of the respective clubs.

The clubs' CSR programs are most frequently oriented towards the neighbouring community, whereby this very often involves children and young people. Most CSR activities of Czech clubs are developed mainly in the social field and the clubs are still mostly involved in charity projects. This finding can be attributed to the fact that this type of CSR programmes represents one of the simplest ways for clubs to help their surrounding communities financially or materially (without higher demands on the necessary human resources and competencies for this area). Clubs often provide their support via charity auctions of jerseys or other club merchandise.

Activities to support handicapped fans are being gradually developed. In addition to barrier-free entrances to football stadiums, other activities in this area are starting to emerge, such as steward services for the disabled or activities for blind fans, which have been common in the top league competitions in Western Europe for many years.

Unlike Western European football clubs, which in most cases already have independent foundations to support their CSRs, in the Czech Republic it is so far only AC Sparta Praha that has created a separate club endowment fund that seeks to support former club players who find themselves in need of health-related or social assistance.

The representatives and governing bodies of Czech football are aware of football's considerable potential for influencing the surrounding society and especially the young generation, which stems from its media attention. The addressed representatives of the governing football bodies would also like to use important football events for socially responsible campaigns in the future, including, for example, matches of the Czech national football team or the MOL Cup final. Most

of the addressed representatives of football clubs in the Czech Republic are convinced that their clubs should, within their capabilities, support public benefit projects. They perceive their social responsibility relatively intensively also in connection with the quality and comprehensive education of young people in their clubs, including the systematic incorporation of the principles of fair play into the value system of young people. Representatives of Czech football clubs are convinced that their involvement in the field of social responsibility brings to them, in particular, an improvement in reputation and a partial improvement of relations with existing sponsors or municipalities.

CONCLUSION

While it has been possible to find a series of expert studies (e.g. Blumrodt et al., 2013; Reiche, 2014; Rosca, 2011) dedicated to CSR in the football of a number of Western European countries, including the situation in their leading clubs, in recent years, this area has not been examined more deeply in the majority of Eastern European countries. The same is also true for the Czech Republic. This article is the very first in the Czech Republic to concern itself with the current state of the application of the CSR concept in the management of domestic premier league football clubs.

The achieved findings may constitute a valuable reflection on the further targeting of CSR initiatives, not only on the part of the managers of clubs which are active in the top domestic football league, but also on the part of the representatives of the football governing bodies in the Czech Republic (the Football Association of the Czech Republic and the League Football Association).

The further development of CSR involvement in the Czech football environment requires the top bodies of Czech football to develop their own comprehensive strategic approach to this area that will simultaneously help the majority of Czech first league football clubs to become involved in a wide variety of CSR activities. They can take inspiration, for example, from the top management in German football which has not only created strategic documents and structures for sustainability (for example, the DFB has created a Committee for Sustainability, as well as the "Path to Sustainability" CSR strategy with the DFL). The English Premier League and the majority of its clubs can also inspire the Czech football environment from the point of view of the different types of CSR projects that have long been developed there, no matter whether this involves educational projects or projects in support of integration into society.

Some other CSR activities that have been developed in the domestic ice hockey environment may also be inspiring for Czech professional football clubs as well as for the top management of Czech football. It is possible to state the joint CSR projects developed by the management of Czech ice hockey in conjunction with the main partner of the Czech Extraliga (for example, the 50:50 charity tombola, the proceeds of which are used to support the CSR projects of the majority of the ice hockey clubs in the Czech Extraliga).

Increased CSR involvement in the Czech football environment has also been confirmed by tens of activities in support of the needy as part of the COVID 19 program against the coronavirus, which has not only been realised by the majority of Czech first league clubs, but also by the League Football Association.

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STUDENT SECTION

Editor:
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Effect of the Different Ski Length on the Level of Anxiety at Novice Skiers

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Abstract

Efficient teaching of alpine skiing at the beginning of the teaching process should be the main goal of every ski instructor. In our research, we investigated the influence of different ski length on the efficiency of the alpine skiing teaching process, as well as on the level of state anxiety during alpine skiing of ski novices. The research was conducted on 34 participants (19 men, 15 women). The experimental group had skis of 130cm in length with a 7m radius from the brand Lusti. These skis are specialized for very short and aggressive turning including fun carving. The mean height of the participants from the experimental group was 178.07cm (±10.89). The control group had skis of the standard length according to the person´s height. The mean height of the participants from the control group was 177.33cm (±6.87). The mean length of the skis was 158.6cm with a 1.,05m radius. For our research, the following data were collected: pre-test, continuous test and post-test state and trait anxiety. In this paper, the main intention was to determine the effect of different ski length on the state anxiety level of novice skiers. The data were acquired from the questionnaire STAI, which shows the level of anxiety (Künzell, S. & Müler, J., 2008; Koca, 2015). Based on the results we can say that teaching alpine skiing with the usage of short skis might be less stressful for novice skiers than with the usage of standard length skis.

Keywords: *state-trait anxiety inventory, anxiety level, alpine skiing, education, short ski, snowplough, novice skiers*

INTRODUCTION

The efficient teaching of alpine skiing at the beginning of the teaching process should be the main goal of every ski instructor. The efficiency of ski tuition is a frequently discussed topic all over the world. In their research Cigrovski et al. (2010) investigated whether novice skiers can accelerate their process of learning alpine skiing by omitting one of the basic elements of the alpine skiing methodological procedure – the snowplough. Their results show that omitting the snow plough is not an efficient way to teach alpine skiing. Similar research was also done by Joksimović et al. (2012). They also concluded that the snow plough is an important element for skiers to be able to learn the new and mainly advanced elements of alpine skiing.

On the other hand, there are ski instructors and scientists, who claim the exact opposite. One of the leading personality who promotes the so-called direct method is Ken Lawer. In 1996 he wrote a methodical guide for ski instructors where he described a direct method to learn parallel skiing with the omission of the snowplough. Besides omitting the snowplough he also suggested the use of shorter skis. Král (2012) conducted research, where he applied this method. The results demonstrated that short skis without the snowplough were superior to classic skis and the snowplough.

Another study with a similar goal was conducted by Künzell, S. & Müler, J. (2008). They studied the level of anxiety during the learning process of novice skiers and how the anxiety was affected by the length of the skis. In their study, they compared the state anxiety of novice

skiers using either standard skis with a length according to their height or short skis – so-called Bigfoots. The novice skiers with Bigfoots had a lower level of state anxiety than novice skiers using standard skis. Similar research led by Koca (2015) also focused on state anxiety during alpine skiing. He did not discover a significant difference in anxiety levels in ski novices either before or after a ski course.

In our research, we investigated the influence of different ski length on the efficiency of the alpine skiing teaching process, as well as on the level of state anxiety during the alpine skiing of ski novices. In this paper, we present the results from our measurements of state anxiety.

METHODS

Subjects

The research was conducted on 34 participants (19 men, 15 women). The mean age of the participants was 21.67 ± 3.94 years. All participants were novice skiers with no or minimal alpine skiing experience. The participants were intentionally divided into two homogenous groups. The distribution was based on the results from a general questionnaire, results from the Iowa – Brace test and results from the State-Trait Anxiety Inventory (STAI) questionnaire. In the general questionnaire, there were questions regarding the current level of experience with skiing, inline skating (Božić et al., 2017; Roman et al., 2007; Takahashi, M. & Yoneyama, T., 2001), ice skating and cross – country skiing. The Iowa – Brace test is usually used to determine motor skills as well as coordination (Havel, Z., & Kynštová, H., 2013; Vobr, R., & Heřmánek, R., 2018). To determine trait anxiety we used the standardized questionnaire STAI. In particular the STAI – X2 which is focused on the general level of anxiety. Based on the results from the STAI – X2 we were able to divide the participants into two homogenous groups with similar levels of trait anxiety.

The experimental group had skis of 130cm length and a 7m radius from the brand Lusti. These skis are specialized for very short and aggressive turning including fun carving. The experimental group consisted of 16 participants (8 men, 8 women). The mean height of the participants from the experimental group was 178.07cm (±10,89). The control group had skis of the standard length according to a person´s height. The mean length of the skis was 158.6cm with a 14.05m radius. The control group consisted of 18 participants (11 men, 7 women). The mean height of the participants from the control group was 177.33cm (±6.87).

Research procedure

The teaching process was carried out according to the methodological manual for alpine skiing called *Snowsport Manual – Blue Book for Alpine Skiing* (Mical et al., 2017) which was developed in cooperation with the Association of Professional Ski Instructors (APUL). APUL is the leading organization in the Czech Republic in the field of ski instructor education. As mentioned in the introduction, there is not one united approach to alpine skiing education for novice skiers. In general, we can choose the classic approach which includes the snow plough element (Cigrovski et al., 2010; Joksimović et al. 2012; Mical et al., 2017) or the direct method, which omits the snow plough element. Omitting the snow plough is usually followed by the usage of smaller skis (Lawler, 1996; Král, 2012; Künzell, S. & Müler, J.,2008). While the snow plough is considered to be a useful tool for learning the basic and advanced ski elements (Cigrovski et al., 2010) we decided to combine those two approaches. We used short skis in the experimental group while preserving the classical approach which includes the snow plough element.

In total four ski courses took place during our experiment. 9 participants attended the first and second courses and 8 participants who attended the third and fourth courses. Each course

had the same ski instructor and similar conditions for skiing including the quality of the snow, weather, slope maintenance etc. All courses took place at the Piancavallo ski resort in Italy. Each course consisted of four days of training and one day of demonstration of the four ski elements (snowplough turn, wedge turn, parallel turn and carving turn). All participants had the skis with the standard length for the first 90 minutes of training on the first day. After 90 minutes the experimental group was given short skis. From that moment till the end of the third day of training, the experimental group trained on short skis. The teaching program was the same for both the experimental and the control groups in each course. At the beginning of the fourth day, the experimental group were given back their standard length skis. They had one day to transfer skills from short skis to standard skis. On the last and fifth day of the course, the participants demonstrated the four elements of alpine skiing.

Data Collection

For this paper, the data was acquired from the STAI questionnaire, which shows the level of anxiety (Künzell, S. & Müler, J., 2008; Koca, 2015). From the STAI we can get information about the general level of trait anxiety (STAI – X2 form) or the level of actual state anxiety (STAI – X1 form). In the questionnaires, participants use the Likert scale from 1 to 4. Each form of the questionnaire consists of 20 questions and the final score is from 20 – 80 points. The higher the score is, the higher the level of anxiety is. Participants completed the STAI – X2 questionnaire form before the course. Based on the results from the STAI – X2 we could divide the participants into two homogenous groups with a similar level of general trait anxiety. At the end of the second day of the course, participants completed the STAI – X1 questionnaire, which gives information about actual state anxiety. By that time, the experimental group had spent one and a half days on short skis. The same questionnaire was completed at the end of the fourth day of the course. The fourth day was also the first day when the experimental group had their standard length skis returned to them.

Statistical Analysis

The results were processed in the software Statistica 13.2. Based on the Shapiro – Wilk test the data had a normal distribution. We used a parametric t-test to find out if there was a statistically significant difference between the results of each group. We also determined the effect size by calculating the Cohen d.

RESULTS

The mean result from the STAI – X2 for the experimental group was 36.66 ± 9.15 and for the control group 36.81 ± 9.82. We did not find any significant difference in levels of general trait anxiety between groups at the significance level $p < 0,05$. The mean result from the STAI – X1 at the end of the second day for the experimental group was 34.83 ± 8.3 and for the control group 40.87 ± 11.59. We did not find any statistically significant difference between groups ($p = 0.08$). Based on calculating the Cohen d we found a moderate effect size between the groups ($d = 0.59$). The mean result from the STAI – X1 at the end of the fourth day for the experimental group was 38.05 ± 13.03 and for the control group 37. 37 ± 9. 54. We did not find either statistical significance nor an effect size between the groups ($p = 0,86$; $d = 0,05$).

DISCUSSION

The results from the STAI – X2 were very similar between both groups. We can say that there was no difference between the general trait anxiety levels of each group. The results from the STAI – X1 at the end of the second day of skiing were different between groups. Even though we did not find any statistically significant difference, we found a medium effect size (d = 0.59). Based on this result we can say that the experimental group had a lower level of state anxiety after two days of skiing on short skis. The results from the STAI – X1 at the end of the fourth day of skiing were similar between groups. We did not find either statistical significance or an effect size between the groups (p = 0.86; d = 0.05), although we can see the difference between the second and the fourth day of skiing. The results from the STAI – X1 in the experimental group were 34.83 ± 8.3 at the end of the second day and 38.05 ± 13.03 at the end of the fourth day. Here we can see a small increase in the state anxiety. This might be due to only having one day for the transition on to standard length skis. The results from the STAI – X1 in the control group were 40.87 ± 11.59 at the end of the second day and 37. 37 ± 9.54 at the end of the fourth day. Here we can see a small decrease in the state anxiety. The control group had a higher score after the first two days of skiing but as they used the same skis for the entire course they might have got used to them and consequentially reduced their level of anxiety.

CONCLUSION

In our presented paper, the main intention was to determine the effect of different ski length on state anxiety level in novice skiers. Previous studies have shown the importance of the snowplough turn in the teaching process of alpine skiing (Cigrovski et al., 2010; Joksimović et al. 2012) and also the possible effect of short skis on the level of anxiety in novice skiers (Künzell, S. & Müler, J.,2008; Koca, 2015). Based on the results presented in this paper we can say that teaching alpine skiing with the usage of short skis might be less stressful for novice skiers than with the usage of standard length skis. The crucial part is the transition between short and standard skis. Even though the experimental group had a lower level of state anxiety after two days of skiing, after the transition to standard skis with only one day of training before the final demonstration of four alpine skiing elements, their level of state anxiety increased. On the other hand, the control group, which showed higher levels of state anxiety among its participants after two days of skiing, slightly improved during the rest of the course and after four days of skiing had a lower level of state anxiety than the experimental group.

Unfortunately, the research was limited by time. Each course had only five days. The usage of short skis seems to be helpful to novice skiers but only one day to transition to standard skis is not enough. There are few alternatives for future study. The experimental group could use short skis for only two days and another two days would be used for transition to standard skis. Another alternative is to use short skis for the entire time including the final demonstration of the ski elements. But the idea of using short skis as a tool to improve rather than proper skiing equipment seems to have no use. Ideally, the skiing course would have more than just five days. We could also include more participants for more valid data.

In this paper, we have presented only the data from the measurement of the state anxiety during the process of teaching novice skiers alpine skiing. The whole research was also focused on the efficiency of using short skis and how they affect learning new alpine skiing skills.

The conclusion about the usage of short skis can be done after processing the remaining data from the entire research. In the next paper, we will evaluate the efficiency of usage of short skis in terms of learning new ski elements.

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STUDIA SPORTIVA 2020 / 2

The Effect of Age and Anthropometric and Somatic Variables on Agility Performance in Adolescent Ice Hockey Players

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Abstract

Agility, one of the components that affect performance, is beneficial in invasion sports, such as ice hockey. This study aimed to assess the relationship between agility and pubescence in adolescent male ice hockey players. Agility and anthropometric and somatic data were evaluated in 60 male participants (age, 12.98 ± 1.44 years). Participants were divided into 5 groups according to age from 11 to 15 years (11y to 15y). Anthropometric and somatic variables were observed using a bioelectrical impedance device. Agility performance level was evaluated by T-Test and Edgren Side Step Test (EDGREN). Significance level was set at $p \leq 0.05$. One-way analysis of variance was used to investigate mean differences. A significant effect of age was found for height, body weight, and skeletal muscle mass percentage. Tukey's (HSD) post hoc test revealed significant differences in height and body weight between all age groups. The T-Test revealed significant differences between all groups, except between groups 11y and 12y, 12y and 13y, and 14y and 15y. EDGREN showed differences only between groups 11y and 13y and 11y and 15y. Significant Pearson correlations were found between all monitored variables and both agility tasks. Agility improves with age in adolescent male ice hockey players. In ice hockey, EDGREN is suitable for testing agility skills in children from the end of middle childhood to early adolescence because it is less influenced by anthropometric and somatic variables. The T-Test should be used in testing agility in late adolescent and adult hockey players when maturation is completed.

Keywords: *maturation, body composition, Edgren Side Step Test, T-Test, youth*

INTRODUCTION

Ice hockey is a complex sport that requires the contribution of many different physical and psychological components for success at the elite level (Burr et al., 2008). Agility, one of the components that affect performance, is beneficial in invasion sports, such as ice hockey. A high level of agility performance is advantageous to attackers to evade their opponent's tackles and to defenders to reduce space on the field to limit attacking movements or achieve a turnover (W. B. Young, Dawson, & Henry, 2015). During skating, on-ice agility is a major component of ice hockey (Bracko, Fellingham, Hall, Fisher, & Cryer, 1998). Skating in ice hockey is a complex skill involving the contributions of many diverse components. The ability to generate power during a stride will provide a more meaningful contribution to skating speed if the player exerts the force while being well balanced and stable (Behm, Wahl, Button, Power, & Anderson, 2005).

Agility is considered as a key part of performance in team sports (Paul, Gabbett, & Nassis, 2016). Chelladurai defined the forms of agility performance as simple, temporal, spatial and universal (Chelladurai, 1976). This division provide a unique framework for the understanding of the demands of many sports (Sheppard & Young, 2006). Nowadays, although the common definition of agility is inconsistent (Sheppard, Dawes, Jeffreys, Spiteri, & Nimphius, 2014) the term agility is broadly defined by Sheppard and Young (Sheppard & Young, 2006) as "a rapid whole-body

movement with change of velocity or direction in response to a stimulus" (p. 922). According to the authors (Sheppard & Young, 2006) this definition "respects the cognitive components of visual scanning and decision making that contribute to agility performance in sport" (p. 922). The definition was adopted by other authors (Jeffreys, 2011; Scanlon, Humphries, Tucker, & Dalbo, 2014; W. Young & Rogers, 2014). However, the new deterministic model of agility (W. B. Young et al., 2015) indicates the main factors (i.e. cognitive, physical and technical), that determine agility in invasion sports such as ice hockey, basketball etc., differs from the previous one (W. B. Young, James, & Montgomery, 2002), by excluding change of direction speed (CODS). The stimulus to change velocity or direction is typically the actions of opponents, in terms of that, change of direction speed is not a component of agility, but a different skill (W. B. Young et al., 2015).

The time of agility performance decreases during pubescence in childhood up to maturity with the highest decrease from 7 to 10 years (27.1%) and from 10 to 14 years (26.5%) of age and with the lowest decrease from 14 to 18 years of age (16.5%) (Zemková & Hamar, 2012). However, agility skills may be influenced by participation in organized sports in childhood and adolescence (Zemková & Hamar, 2014). Considering ice hockey, the on-ice training is more effective in the development of agility performance, however training off-ice agility provides a sufficient motor transfer to on-ice agility performance (Novák, Lipinska, Roczniok, Spieszny, & Stastny, 2019). The level of motor development, influenced also by agility skills level, is determined by somatic traits, such as body height and subcutaneous fat tissue, in childhood and adolescence. These determinants primarily affect speed and strength abilities of children aged 8–years 12 than their older counterparts aged 13–16 years (Puciato, Mynarski, Rozpara, Borysiuk, & Szyguła, 2011). Overweight and obesity in children aged 13–18.5 years is associated with lower performance in speed-agility tasks compared to subjects with normal weight (Artero et al., 2010).

To reach the elite level in ice hockey, it is also necessary to meet the current basic physical parameters such as body height and weight. These values indicate the current level of optimal development of basic physical parameters that predict a possible success, taking into account various game positions (Sigmund, Kohn, & Sigmundova, 2016). High-level Canadian players aged 13.1 ± 0.6 years were characterized by higher values of height and weight compared to the reference population with the same age (Allisse, Sercia, Comtois, & Leone, 2017). Moreover, young Russian hockey players aged 13–16 years tend to have higher body weight compared to inactive peers (Surina-Marysheva, Erlikh, Korableva, Kantyukov, & Ermolaeva, 2018). With respect to physiological profile, there are some differences among various positions, and the physiological profile of elite players has changed over the past decades (Quinney et al., 2008).

Although agility is an important factor in ice hockey, the association between off-ice agility testing and anthropometric and somatic variables, such as height, weight, skeletal muscle mass (SMM), fat-free mass (FFM), and body fat, in adolescent male ice hockey players remains unresolved in current literature. The aim of this study was to assess the relationship between agility and age in adolescent male ice hockey players.

METHODS

Every year, youth hockey players participate in a battery of hockey-related tests designed to assess players fitness and performance level. However, because of morphological and physiological changes during pubescence, not all the tests are considered as suitable performance predictors. Thus, the analyses of anthropometric and somatic profiles were conducted to assess the differences between male youth hockey players of different age groups. The agility performance was evaluated to indicate the differences between the age groups. Then, correlations were calculated

to examine association between anthropometric and somatic variables and both off-ice agility tasks. These results showed influence of age and anthropometrical and somatic variables on agility performance in adolescent male ice hockey players.

PARTICIPANTS

A total of 60 young male hockey players (12.98 years, 162.62 ± 11.84 cm, 54.85 ± 14 kg) were recruited from the same professional hockey 2nd division team. Participants were divided into 5 groups according to age (11–15 years [11y, 12y, 13y, 14y, and 15y]).

All hockey players participated in the regular training sessions and scheduled matches of the competition in the whole season. The exclusion criteria were chronic ankle instability and any lower extremity musculoskeletal injuries in the previous 6 months. Parents of the participants signed a written informed consent before the start of the study. The study was approved by the Ethics Committee (no. 4/2018) of the Faculty of Physical Culture, Palacký University Olomouc, Czech Republic in accordance with the ethical standards of the Declaration of Helsinki.

PROCEDURES

Data collection was conducted at a local hockey stadium after the end of the regular ice hockey season. First, the body height of each participant, while being barefoot, was obtained. Further, body composition was measured using a bioelectrical impedance device. Second, each participant performed two trials of both agility tasks (i.e., T-Test and EDGREN). There was a 60-s rest period between each trial and 2-min rest period between each agility task. Participants were provided 10-min dynamic warm-up, including jogging and stretching, and practice trials on both tasks before the start of actual testing. Each participant performed EDGREN first, followed by the T-Test.

MEASURES

Body height was measured using a stadiometer (Leicester High Measure MK II, Leicester, Great Britain). Total body weight, FFM, SMM, and body fat percentage (BF%) were measured by the InBody230 bioelectrical impedance device (Biospace, Seoul, Korea) in the morning after overnight fasting and emptying the bladder. Measurements were obtained with all participants wearing light underwear. Then, agility performance level was evaluated by T-test (Pauole, Madole, Garhammer, Lacourse. & Rozenek, 2000) and Edgren Side Step Test (EDGREN) (Farlinger, Kruisselbrink & Fowles, 2007), both with good validity and reliability (Pauole et al., 2000; Raya et al., 2013).

STATISTICAL ANALYSIS

Data from this investigation were analysed using STATISTICA (version 13; TIBCO Software, CA, USA). Data were normally distributed, as evaluated by the Kolmogorov-Smirnov test. One-way analysis of variance was used to investigate mean differences and partial eta-squared (η^2) for the assessment of effect size. The effect was considered as small ($\eta^2 = 0.01 – 0.05$), medium ($\eta^2 = 0.06–0.13$), and large ($\eta^2 \geq 0.14$) (Miles & Shevlin, 2001). Tukey's (HSD) post hoc test

was used to investigate mean differences between groups. Significance level was set at $\alpha = 0.05$. Pearson correlation coefficients were used to examine the relationship between agility tests and anthropometric variables as follows: small effect $r_p = 0.10–0.29$, medium effect $r_p = 0.30 – 0.49$, and large effect $r_p \geq 0.5$ (Dishman & Buckworth, 1996). Further, for the selected variables (Height, Weight, SMM%, FFM% and BF%), there was calculated an expression of % of the total variance ($r_p^2 * 100$) that explains the effect of the factor on the observed effect.

RESULTS

Considering all hockey players, we found significant differences between groups with various ages in all variables, except FFM% and BF% (Table 1). There were significant differences in SMM% only between groups 11y and 14y ($p = 0.01$) and 11y and 15y ($p = 0.01$).

Table 1. Description of anthropometric, somatic, and agility variables for each group. Differences in selected variables among all groups

Parameter	11y (n = 13)		12y (n = 11)		13y (n = 13)		14y (n = 10)		15y (n = 13)		All groups (n = 60)	
	Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD		*P-value*	η^2
Height	149.00	4.85	158.65	9.71	160.89	8.21	173.13	7.39	173.25	6.74	< 0.001	0.63
Weight	40.46	7.47	48.87	6.96	52.62	8.92	64.88	12.75	68.82	10.38	< 0.001	0.58
SMM%	42.83	2.82	44.09	4.06	44.91	2.18	47.63	2.26	46.80	2.98	<0.001	0.28
FFM%	80.71	5.71	81.24	6.93	81.65	3.07	85.01	3.51	83.21	4.95	0.269	0.09
BF%	19.29	5.71	18.80	6.93	18.33	3.05	14.99	3.51	16.80	4.96	0.267	0.09
EDGREN	25.46	0.78	27.00	3.85	28.85	3.91	28.30	2.21	28.92	2.33	0.015	0.20
T-Test	14.38	0.90	13.86	0.99	13.26	0.97	11.92	0.73	11.54	0.95	< 0.001	0.61

Height in cm; Weight in kg; SMM%, skeletal muscle mass percentage; FFM%, fat-free mass percentage; BF%, body fat percentage, EDGREN, number of crossed cones; T-Test, duration of the test in seconds.

Agility testing, particularly in T-Test, revealed significant differences in all groups, except groups 11y and 12y ($p = 0.64$), 12y and 13y ($p = 0.51$), 14y and 15y ($p = 0.86$). Significant differences were found in EDGREN only between groups 11y and 13y ($p = 0.03$) and 11y and 15y ($p = 0.02$).

Pearson correlations between agility tests and anthropometric and somatic variables are shown in Table 2. The largest correlations were found between T-test and height ($r_p = -0.68$), T-test and weight ($r_p = -0.63$), and T-test and SMM% ($r_p = -0.61$).

Table 2. Correlations (r_p) between agility tests and monitored variables and expression of percentage of the total variance

	EDGREN		T-Test	
N = 60	r_p	%	r_p	%
Height	0.4	16.11	-0.68	45.72
Weight	0.38	14.3	-0.63	40.3
SMM%	0.42	17.67	-0.61	37.14
FFM%	0.29	8.28	-0.4	15.89
BF%	-0.29	8.19	0.4	15.71

%, expression of % of the total variance that explains the effect of the factor on the observed effect; SMM%, skeletal muscle mass percentage; FFM%, fat-free mass percentage; BF%, body fat percentage

DISCUSSION

In our study, we evaluated the influence of age and anthropometrical and somatic variables on agility performance in adolescent male ice hockey players. Moreover, we assessed the relationship between anthropometric and somatic variables (i.e., height, weight, SMM%, FFM%, and BF%) and agility performance (T-Test and EDGREN).

Generally, it was shown that agility skills improved with age from childhood to adolescence and maturity (Zemková & Hamar, 2012). We reported similar findings in adolescent male ice hockey players. Results showed differences in agility skills as older individuals had better results in both specific agility tasks than their younger peers. The highest differences were noted between players aged 14–15 years compared to younger ones, similarly as in the study evaluating the physical development of young Russian ice hockey players (Surina-Marysheva et al., 2018). Development of agility during childhood may lead to improvement in motor skills and object control skills in general. These specific skills have a strong influence on subsequent fitness in adolescence (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2008).

Results of the somatic variables revealed that SMM%, FFM%, and BF% differ the most in players aged 13 to 14 years, where it is based on chronological age of the players, co there could be some differences in comparison of biological age. Similar findings were shown in a study describing the evolution of selected parameters (i.e., morphological, physiological) of high-level Canadian ice hockey players (aged 13.1 ± 0.6 years) in three sessions over 1 year (Allisse et al., 2017). The period between childhood and adolescence is an important lifetime period in which healthy weight gain can be promoted and fat gain can be reduced (Barbour-Tuck, Erlandson, Muhajarine, Foulds, & Baxter-Jones, 2018). In this period, physical activity is a modifiable lifestyle factor capable of alleviating fat gain (Barbour-Tuck et al., 2018; Thompson, Karpe, Lafontan, & Frayn, 2012). During physical maturity, men gain greater amounts of FFM and SMM (Loomba-Albrecht & Styne, 2009). This factor is important especially in competitive sport disciplines. Early physical maturation of young hockey players increases their chance of being selected for the elite level of ice hockey in adolescence and adulthood (Roczniok et al., 2016; Sherar, Baxter-Jones, Faulkner, & Russell, 2007).

Thus, the T-Test results showed that there were significant differences between all groups in favour of participants at least 2 years older, except for differences between groups 13y and 14y. EDGREN revealed significant differences only between groups 11y and 13y and 11y and 15y. These results may be influenced by the differences in body composition and specificity of both tasks (Jones & Lorenzo, 2013; Spasic, Uljevic, Coh, Dzelalija, & Sekulic, 2013). The results obtained from agility tasks (Table 2) showed that, in young hockey players, T-Test is more related to anthropometric (Height, 45.72%; Weight, 40.30%) and somatic variables (SMM%, 37.14%; FFM%, 15.89%, BF%, 15.71%) than EDGREN (Height, 16.11%; Weight, 14.30%; SMM%, 17.67%; FFM%, 8.28%, BF%, 8.19%).

With respect to the results of our study, there is a correlation between anthropometric measures and specific change in direction speed (CODS) task performance. SMM% seems to be the predictor of performance in specific CODS task in young and adolescent hockey players. Furthermore, comparing two players with equal anthropometric parameters but different SMM%, the athlete with higher BF% will have less lean mass to contribute to the speed requirements of agility performance (Sheppard et al., 2014). Lower SMM% and higher BF% would require greater force to produce a required change in velocity or direction (Enoka, 2002). Considering the body height, shorter athletes are capable of lowering the centre of mass to gain greater stability and perform quick and fast lateral cutting manoeuvres from sliding (Shimokochi, Ide, Kokubu, & Nakaoji, 2013), which are essential in ice hockey. Lowering the body's centre of mass requires

a specific technique and sufficient lower extremity muscle extensor power output capabilities, strength, and endurance (Shimokochi et al., 2013). Although performance in both agility tasks, where high-velocity lateral CODS is required, was better in taller athletes, this result is rather a confirmation that the decisive factor is the SMM and body fat mass of the athlete.

Considering the ice hockey, we recommend using the EDGREN to test children, in the age range from 11 years to early adolescence, as it is less related to body height, weight, and muscle growth, which is natural in this period of growth spurt (Philippaerts et al., 2006). T-Test, as it is related to body height, weight, and muscle growth, seems to be a better tool for testing agility in late adolescent and adult ice hockey players, where physical growth and maturation have been completed (Chulani and Gordon, 2014).

CONCLUSION

Therefore, the present results revealed that agility skills improve with age in adolescent male ice hockey players. Anthropometric variables differ the most between players aged 13 to 14 years. EDGREN was less related to body height, weight, and muscle growth and seems to be a better tool for testing agility skills in children from the end of the middle childhood to early adolescence. T-Test, as it is related to body height, weight, and muscle growth, should be used for testing agility in late adolescent and adult hockey players.

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