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Relationship Between the Length of an Active Wrestling Career with Selected Attitudes and Behavior Caused by the Covid-19 Virus Pandemic

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ABSTRACT

The main aim of this paper is manifested in the hypothesis that there is a statistically significant correlation between the length of an active wrestling career and selected attitudes and behaviours caused by the COVID-19 virus pandemic. The sample of respondents (N=131) consists of international wrestlers (average age 22.32±5.08 years) from all competition categories (seniors, senior juniors U23, juniors and cadets). The collected survey data were systematized based on obtained answers and numerical values and according to the instructions for interpretation of answers analysed with part frequencies and descriptive statistics. Correlation analysis proved statistically significant negative association (r = - 0,19) between the length of an active wrestling career and the behaviour of wearing a protective mask during the COVID-19 virus pandemic. Observing all age groups, attitudes indicate concern about the infection of acquaintances, and the behaviour of wrestlers emphasizes the importance of washing hands, wearing masks, and using disinfectants. Wrestlers are also aware of the dangers of the virus for their careers and are informed and follow the instructions of experts.

Keywords: combat sport; sport and COVID-19; pandemic influence

INTRODUCTION

The coronavirus disease (COVID-19) has affected all sectors of the global economy, but some have been affected more than others. The sports sector was particularly affected by the COVID-19 crisis in a way that has not been seen before (Ratten, 2020) and had a great impact on the training and competition process for athletes, especially in contact sports such as wrestling (Gentile et al., 2021). According to the latest data from the World Health Organization (WHO), the disease caused almost six and a half million deaths (WHO, 2022). The number is certainly not small and

insignificant and affects both everyday life and athletes. A large number of people become infected and later successfully overcome the virus, but there is also a large number of people who later have health problems after overcoming the disease. This is especially evident in fatigue, insomnia, decreased endurance, poorer appetite (as evidenced by loss of taste and smell) and other side effects of the disease, which have a great impact on athletes (Parm, Aluoja, Tomingas and Tamm et al., 2021). Also, participating in competitions during the pandemic is more stressful for athletes in combat sports (Gentile et al., 2021) due to the knowledge related to the transmission of the virus through close mutual contact at a distance of up to one and a half meters or two. Wrestling is a sport dominated by a close fight between two competitors or training partners and certainly belongs to the risky COVID-19 sports, especially when you look at the fact that the sport takes place indoor, and the contact between the wrestlers is extremely close. It is also a very important fact that in a wrestling match, due to the nature of the sport, it is not possible to use any protective equipment. Researchers who dealt with the impact of the COVID-19 pandemic on the way of training under the conditions prescribed by individual governments tried to see if it is possible to train in wrestling under these specific conditions without losing too much of the wrestler's form and physical condition. Thus, Sung et al. (2021) observed the possibility of using electrical muscle stimulation (EMS) equipment in the training of wrestlers in order to improve efficiency in training that had to adapt to the conditions of the COVID pandemic, and Herrera-Valenzuela et al. (2020) developed a HIIT (high intensity interval training) program that martial arts athletes of sports can be used for training at home, because such trainings were only possible at the time of the first lock-down, in order to preserve muscle mass and physical condition.

The main aim of this paper is to test whether there is a correlation between the length of an active wrestling career and selected attitudes and behaviours caused by the COVID-19 virus pandemic.

MATERIALS AND METHODS

Respondents sample

The sample of respondents (N=131) consists of international wrestling national team' members (average age 22.32 ± 5.08 years) from all age categories: seniors, senior juniors (U23), juniors and cadets. The respondents are participants of the international preparatory camp in Poreč in 2021, they come from 19 countries from Europe and five countries outside of Europe.

Measuring instruments and variables

Each respondent voluntarily filled out a survey questionnaire that contained basic information about the respondent, as well as specific questions that consisted of the length of an active wrestling career and questions about the current COVID-19 pandemic.

The first question is directly related to infection with the virus, i.e. whether the respondent recovered from COVID-19 and if so, what were the symptoms of the disease (possible answers: NO, I did not recover; YES, I recovered; YES, asymptomatic COVID-19; YES, mild symptoms; YES, severe symptoms).

The second question is related to the vaccine with the question *Have you received the vaccine against COVID-19?* with possible answers: YES, I have received it; NO and I do not plan to get vaccinated in the near future; NO, but I plan to get vaccinated in the near future.

The next set of questions were taken from the already standardized questionnaire The COVID-19 Anxiety Scale (Jokić, Korajlija and Mikac, 2020) and related to the self-assessment of anxiety caused by COVID-19, and the second set of questions were taken from the already standardized questionnaire Swine Flu Anxiety Items scale (Wheaton et al., 2020). The questionnaire is validated and reliable and as such can be used for related research purposes. The COVID-19 anxiety scale consists of 5 items with the questions: *How worried are you about COVID-19?; How likely is it that you could get infected with COVID-19?; How likely is it that someone you know could contract COVID-19?; If you get infected with the coronavirus, how worried are you that the disease could be serious? and How much, in your opinion, is this virus more dangerous than the flu virus?* Respondents chose answers scored according to a scale from zero to four (0 – does not apply to me at all; 1 – does not apply to me to some extent; 2 – neither applies nor does it apply to me; 3 – somewhat applies to me; 4 – completely applies to me).

After this set of questions, respondents filled in new items from the COVID-19 Safety Behaviour Checklist (CSBC) (Jokić, Korajlija and Mikac, 2020), which consists of seven questions related to the behaviour of respondents directly related to COVID-19. A set of questions that were related to behaviours related to COVID-19: *I wash my hands more often and more thoroughly than usual; I avoid places with a lot of people; I follow news related to the spread of COVID-19 more often; I wear a protective mask; I use hand sanitizers; I avoid shaking hands with other people; I avoid people who look sick*. Respondents chose answers scored according to a scale from zero to four (0 – no at all; 1 – most likely no; 2 – neither yes, nor no; 3 – most likely yes; 4 – definitely yes.

Data analysis

The collected survey data were systematized on the basis of the received answers and numerical values and, according to the instructions for the interpretation of the answers, analysed with questions frequencies, descriptive statistics and correlation analysis (The Statistica v.13.05.0.17 – TIBCO software Inc). Indicators in descriptive statistics are arithmetic mean, standard deviation, frequency and percentage. Correlation analysis was performed and interpreted with Pearson's correlation coefficient.

RESULTS

For each question, frequencies, percentages, arithmetic mean and standard deviation (Table 1) will be presented. Also presented are the results of the correlation analysis observing the length of the active wrestling career variable (Table 2).

Table 1. Descriptive indicators and frequencies of attitudes towards the COVID-19 virus

QUESTION	ANSWER	N	%	$\bar{x}$	SD
How worried are you about COVID-19?	It doesn't apply to me at all	47	35.9	1.05	0.93
	Somehow it doesn't apply to me	36	27.5		
	It neither applies nor does it apply to me	42	32.0		
	It applies to me somewhat	6	4.6		
	It totally applies to me	0	0		
	Total	**131**	**100**		
How likely is it that you could get infected with Covid-19?	It doesn't apply to me at all	23	17.6	1.76	1.17
	Somehow it doesn't apply to me	29	22.1		
	It neither applies nor does it apply to me	45	34.4		
	It applies to me somewhat	24	18.3		
	It totally applies to me	10	7.6		
	Total	**131**	**100.0**		
How likely is it that someone you know could contract COVID-19?	It doesn't apply to me at all	13	9.9	2.23	1.32
	Somehow it doesn't apply to me	31	23.7		
	It neither applies nor does it apply to me	31	23.7		
	It applies to me somewhat	25	19.1		
	It totally applies to me	31	23.7		
	Total	**131**	**100.0**		
If you get infected with the coronavirus, how worried are you that the disease could be serious?	It doesn't apply to me at all	33	25.2	1.37	1.04
	Somehow it doesn't apply to me	36	27.5		
	It neither applies nor does it apply to me	46	35.1		
	It applies to me somewhat	13	9.9		
	It totally applies to me	3	2.3		
	Total	**131**	**100.0**		

In your opinion, how much more dangerous is this virus than the flu virus?	It doesn't apply to me at all	26	19.85		
	Somehow it doesn't apply to me	48	36.6		
	It neither applies nor does it apply to me	33	25.2	1.45	1.07
	It applies to me somewhat	20	15.3		
	It totally applies to me	4	3.1		
	Total	**131**	**100.0**		
I wash my hands more often and more thoroughly than usual	Not at all	10	7.6		
	Most likely not	18	13.7		
	Neither yes nor no	29	22.1	2.61	1.29
	Most likely yes	30	22.9		
	Certainly yes	44	33.6		
	Total	**131**	**100**		
I avoid places with a lot of people	Not at all	33	25.2		
	Most likely not	34	26.0		
	Neither yes nor no	33	25.2	1.53	1.22
	Most likely yes	23	17.6		
	Certainly yes	8	6.1		
	Total	**131**	**100**		
I follow news related to the spread of COVID-19 more often	Not at all	45	34.4		
	Most likely not	20	15.3		
	Neither yes nor no	40	30.5	1.46	1.32
	Most likely yes	13	9.9		
	Certainly yes	13	9.9		
	Total	**131**	**100**		

I'm wearing a protective mask	Not at all	11	8.4	2.61	1.30
	Most likely not	17	13.0		
	Neither yes nor no	28	21.4		
	Most likely yes	31	23.7		
	Certainly yes	44	33.6		
	Total	**131**	**100**		
I use hand sanitizers	Not at all	20	15.3	2.26	1.40
	Most likely not	20	15.3		
	Neither yes nor no	31	23.7		
	Most likely yes	26	19.8		
	Certainly yes	34	26.0		
	Total	**131**	**100**		
I avoid shaking hands with other people	Not at all	50	38.2	1.11	1.15
	Most likely not	39	29.8		
	Neither yes nor no	27	20.6		
	Most likely yes	8	6.1		
	Certainly yes	7	5.3		
	Total	**131**	**100**		
I avoid people who look sick	Not at all	17	13.0	2.29	1.32
	Most likely not	21	16.0		
	Neither yes nor no	28	21.4		
	Most likely yes	37	28.2		
	Certainly yes	28	21.4		
	Total	**131**	**100.0**		

Legend: N - number of subjects; $\bar{x}$ - mean value; SD - standard deviation

Table 2. Correlation analysis of indicators and frequencies of behavior according to the COVID-19 virus

QUESTION	**Wrestling career length**
How worried are you about COVID-19?	0.08
How likely is it that you could get infected with Covid-19?	0.09
How likely is it that someone you know could contract COVID-19?	-0.02
If you get infected with the coronavirus, how worried are you that the disease could be serious?	-0.1
In your opinion, how much more dangerous is this virus than the flu virus?	0.07
I wash my hands more often and more thoroughly than usual	-0.02
I avoid places with a lot of people	0
I follow news related to the spread of COVID-19 more often	-0.16
I'm wearing a protective mask	**-0.19***
I use hand sanitizers	-0.02
I avoid shaking hands with other people	0.03
I avoid people who look sick	0.1

DISCUSSION

The main goal of this work is manifested in the hypothesis that there is a statistically significant connection between the length of an active wrestling career and the chosen attitudes and behaviours caused by the pandemic of the COVID-19 virus. The highest value of the arithmetic means in the answers of the wrestling national team members related to the attitudes towards the virus COVID-19 was recorded in the question *How likely is it that someone you know could be infected with COVID-19*, where the arithmetic mean is 2.23±1.32. These answers indicate the awareness of the wrestlers and the seriousness of the pandemic and the possibility of contracting the virus and other people the athletes know. The highest value of the arithmetic means for the behaviour caused by the virus COVID-19 is identical to 2.61 (standard deviations 1.29 and 1.30) for two questions: *I wash my hands more often and more thoroughly than usual* and *I wear a protective mask*. In addition to being an indicator of the self-awareness and responsibility of wrestlers, it is also an indicator that the instructions issued by the WHO (2022) as well as the national and local instructions of professional services have reached the top wrestlers, and they adhere to them. Since pandemic in most countries protective masks must be used whenever there is potentially close contact (Cirrincione et al., 2020), especially during training and close contacts between athletes, to reduce the spread of viruses in the environment. Handwashing according to WHO handwashing guidelines during a pandemic

has a large impact on respondents. Also, the higher arithmetic mean in the question about wearing a mask indicates, apart from the awareness of wrestlers that the possibility of infection is reduced by wearing a mask, also the decisions of national headquarters about wearing masks in indoor spaces where wrestling competitions and trainings are held. Wrestlers are listening to higher national institutions instructions although it is recommended that athletes and coaches should be aware of the impact of masks. This reflects especially on sports performance and such as high-intensity aerobic exercise, where capacity or volume of training was significantly reduced when exercising without a mask (Kwon et al., 2023). Higher values of arithmetic averages were also recorded for the question *How likely is it that you could get infected with Covid-19?* (1.76±1.17) related to attitudes towards the virus, while high behaviour values were obtained for the question, *I use hand sanitizers* (2.26±1.40). The results of the correlation analysis indicate a negative correlation (r= -0.19) between the length of an active wrestling career and the behaviour related to the question *I wear a protective mask*. Although correlation is not very high it is significant, and the obtained results may be a consequence of taking one's own attitude in older age groups and refusing to wear a protective mask or wearing it only when absolutely necessary. Other questions are not statistically significantly related to the length of an active wrestling career.

CONCLUSION

Correlation analysis revealed a statistically significant negative relationship between the length of an active wrestling career and behaviour while wearing a protective mask during the COVID-19 virus pandemic. Observing all age groups, the respondents indicate concern about the infection of acquaintances, and the importance of washing hands, wearing masks and using disinfectants is emphasized in the behaviour of wrestlers. Wrestlers are also aware of the danger posed by the virus to their careers and are informed and follow the instructions of experts.

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Does the Amount of Injuries Affect the Final Ranking at The End of the Competitive Season in Football?

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ABSTRACT

The aim of this research is to determine whether a larger number of injuries in the team affects the final competitive achievement of clubs in the 1st Croatian Football League. Data on injuries in training and matches were collected using UEFA's Injury Study Questionnaire. 340 players (in all 10 clubs) participated in the research. The Chi-square test was used for non-parametric tests while logistic regression analysis was used to correlate the independent and dependent variables. The hypothesis that clubs with lower rankings will have statistically significant more injuries has not been confirmed ($p<0.05$), but this difference (although not statistically confirmed) still exists between clubs that finished the championship at the top five compared to the low five clubs.

Keywords: injury prevention; football injuries; injury occurrence; injury type; specific training

INTRODUCTION

Daily high-intensity training, frequent travel, playing domestic and European leagues with the imperative of achieving results puts football players in a situation of high risk of injury. The possibility of injury to players increases exponentially as contact between players is an important feature in football (Andersen et al., 2003; Andersen et al., 2004; Kucera et al., 2005; Peterson et al., 2000)Methods: Football incident analysis (FIA. An injury in sports carries with it far-reaching consequences, both for the player and for the club, but also for society. For example, when a player is injured, the key question for the coach is when the same player can return to a full training load. The information is important for the club and the coach if it is an injury to an important player. In UEFA Champions League, the unavailability of players to participate in matches due to injuries averages 14%, with range between 5% and 20%, and lower placed teams injury rates are associated

with success in national and international competitions (Ekstrand, 2013). In addition to the huge cost that the injury brings to the club and the footballer, the injury of the player also calls into question the flow of the season, but also increases the risk of another, more serious injury. Injuries that are more serious and require an absence of more than 28 days should be taken with much more caution. One of the reasons is that in more than 50% of cases of such injuries, a repeated injury occurs, that is, an identical injury occurs in the same place. In such cases, apart from the great risk for the club that loses a large amount of money, there is also the risk of jeopardising the player's career (Junge et al., 2000). A footballer who suffered a minor injury will return in less than 7 days to a full training load (Lüthje et al., 1996)two out of three players were injured during the whole season. The injury incidence per 1000 playing hours among injured players and all players during games was higher than during practice, 14.2 vs. 11.3 and 2.3 vs. 1.8, respectively. The lower extremity was involved in 76% of the injuries. Thigh injuries were most frequent (22%. Injuries of a more serious type and that require an absence of more than 28 days should be taken with more caution because in more than 50% of cases of such injuries recurrence occurs, i.e. an identical injury occurs in the same place. Teams with more injuries throughout the season have lower result at the end of the season (Chalmers, 2002) and teams with fewer injuries end up in a better position at the end of the season while in other research opposite results were found (Dauty & Collon, 2011) This refers especially to teams that suffered a minor number of serious injuries (<28 days). Progress in injury prevention can only be achieved by directing research efforts towards understanding the implementation context of injury prevention, as well as expanding the existing evidence base on the efficiency and effectiveness of interventions.

Research aim is to determine whether the clubs in the 1st Croatian football league (1. CFL) that recorded a higher number of injuries in the competition season achieved a lower competition result (according to position in the table) and vice versa. It is hypothesised that football teams with higher incidence of injuries will be statistically significantly correlated with lower competitive result.

METHODS

Ethics committee approval

Prior to conduction of the research, a letter of intent was sent to the Croatian football federation with the tasks and goals of this research briefly explained. The Ethics Committee of the Faculty of Kinesiology, University of Zagreb has approved a study which is in line with ethical principles and requirements of the Declaration of Helsinki (96/2020).

Participants sample

The entity sample is 340 football players in all 10 clubs of the highest rank in football competition in Croatia. The average age of participants was 24.22±3.95, with maximum of 37 and minimum of 18 years. Participants' average weight was 79.54±8.43 kilograms with minimum body mass of 55 and maximum of 96 kilograms. Average height of the participants was 183.31±6.86, with minimum height of 159 and maximum of 203 centimetres.

Protocol

Data collection was carried out prospectively, where the person in charge of each club entered data into the database every two weeks. Data on exposure as well as the incidence of player injuries during training sessions and matches were recorded. In addition to exposure, data were collected on the anthropometric measurements of the participants, as well as on attitudes towards prevention programs and positive and negative factors on their implementation.

The research plan, way of participation of subjects from clubs was presented to leading club staff (directors / sports directors) in the first stage of the research. After management staff, plan of cooperation was agreed also with fitness trainers, medical doctors and physiotherapists in the club, who got familiar with a protocol for recording injuries in the "injury form" for training / matches. The protocol contained all the essential injury definitions so the research would be unified for each club equally. The used injury pattern was UEFA's Injury Study Questionnaire and it has been used in a prospective study for the past 15 years (Ekstrand et al., 2020). The form was already used and evaluated by the English Football Association, FIFA's Medical Assessment and Research Centre (F-MARC) and the Oslo Sports Trauma Research Centre (OSTRC), as well as other institutions. Questionnaire is based on consensus on the definition of injury (time loss), injury recurrence, injury severity and player exposure in training and matches. The form of injuries and the form for the football players' exposure was available on the website, where previously collected data for each team were added every seven days by person responsible for data entry.

Data analysis

After collected data for all the players and clubs, data processing was carried by statistical package software SPSS v.27. The Chi-square test was used for non-parametric tests to check association between top and low five clubs, while logistic regression analysis was used to determine correlation of the independent and dependent variables.

RESULTS

Significance levels of tested variables of Chi-square test (p>0.05) show no difference for clubs in top five and low five according to table placement in all observed variables. Looking at the total days of absence due to injuries between the top five clubs and low five clubs, the difference between them (74.8% vs. 25.2%) favours low five clubs (Table 1).

Table 1. Chi-square results of clubs in variable total days of absence

			Total days of absence		Total	p
			9 and more	1 - 8		
Clubs	Low 5 clubs	N	37	132	169	0.199
		%	82.2%	72.9%	74.8%	
	Top 5 clubs	N	8	49	57	
		%	17.8%	27.1%	25.2%	
Total		N	45	181	226	
		%	100.0%	100.0%	100.0%	

The values of logistic regression analysis (p>0.05) show no statistically significant association according to total number of absence days, i.e. a significant deviation for the observed clubs (Table 2).

Table 2. Logistic regression analysis results of top 5 and low 5 clubs

		Clubs				p
		Low 5 clubs		Top 5 clubs		
		N	%	N	%	
Injured part of the body	Head / Face	20	11.7%	5	8.8%	0,548
	Shoulder / Clavicle	3	1.8%	0	0.0%	
	Upper arm	1	0.6%	0	0.0%	
	Forearm	1	0.6%	1	1.8%	
	Fist / Fingers	4	2.3%	0	0.0%	
	Neck	2	1.2%	0	0.0%	
	Chest / Ribs	3	1.8%	0	0.0%	
	Stomach	7	4.1%	7	12.3%	
	Lower back / Pelvis	9	5.3%	4	7.0%	
	Hip / Groin	18	10.5%	4	7.0%	
	Thigh	28	16.4%	9	15.8%	
	Knee	21	12.3%	8	14.0%	
	Lower leg / Achilles tendon	18	10.5%	7	12.3%	
	Ankle joint	28	16.4%	7	12.3%	
	Foot / Toes	8	4.7%	5	8.8%	
	Total	171	100.0%	57	100.0%	
Injury type	Brain concussion	4	2.4%	0	0.0%	0.692
	Fracture	4	2.4%	1	1.8%	
	Other bone injuries	4	2.4%	3	5.3%	
	Dislocation / Sublocation	5	3.0%	1	1.8%	
	Ligament sprain	22	13.3%	12	21.1%	
	Meniscus / Cartilage lesion	3	1.8%	0	0.0%	
	Muscle rupture / Stress	38	22.9%	14	24.6%	
	Tear	10	6.0%	6	10.5%	
	Tendon injury / Rupture	13	7.8%	5	8.8%	
	Tendinosis / Bursitis	5	3.0%	1	1.8%	
	Haematoma / Contusion	47	27.1%	13	22.8%	
	Cramps	9	5.4%	1	1.8%	
	Abrasion	0	0.0%	0	0.0%	
	Nerve injury	2	1.2%	0	0.0%	
	Dental injury	2	1.2%	0	0.0%	
	Total	171	100.0%	57	100.0%	
Injury occurrence	Training	49	28.7%	21	36.8%	0.232
	Match	122	71.3%	36	63.2%	
	Total	171	100.0%	57	100.0%	

Legend: N – total days of absence

Significance values of the regression coefficient are not statistically significant in the model with the analysed clubs and the total number of absence days (Table 3), therefore there is no correlation between the observed dichotomous variables and the associated independent variables.

Table 3. Logistic regression analysis results for variable total days of absence (1 to 8; 9 and more) of top 5 and low 5 clubs

		B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP (B)	
								Lower	Upper
Step 1[a]	Clubs	0.540	0.424	1.623	1	0.203	1.717	0.747	3.943
	Constant	1.272	0.186	46.750	1	0.000	3.568		

Legend: [a] – Variable(s) entered – clubs; B – Values for logistic regression, coefficients of the prediction variable of the dependent variable by the independent variable; S.E.– Standard errors related to coefficients; Wald – Wald value of the chi-square test; df – Degrees of freedom; Sig. – Significance value of the coefficient; Exp(B) – odds ratio predictor

DISCUSSION

Clubs ranked lower in the 1. CFL have a higher number of injuries during the preparation period and the competition season. From these results it can be concluded that clubs that finished the season lower ranked were more susceptible to injuries during matches but the same did not determine statistical significance ($p>0.05$), with similar conclusions found in other studies (Dauty & Collon, 2011). This means that the hypothesis presented, which refers to clubs that implement fewer prevention programs and at the same time occupy lower positions at the end of the season, has not been confirmed According to this model, it cannot be concluded with certainty that in the next competitive season in the 1. CFL, the team with the most injuries will take the worst position at the end of the competition. Another important difference is where the injury occurred, a larger difference occurred in low five clubs (28.4% in training compared to 71.6% in matches) while in the top five clubs the difference was smaller (36.8% in training and 63.2% in matches). Clubs ranked lower reported concussion injury in 2.4% of cases, meniscus/cartilage lesion in 1.8%, nerve injury in 1.2% and dental injury in 1.2%, while clubs in the top five did not have these types of injury.

Clubs that finished the season lower part of the table do not have statistically significantly more injuries than teams that are at upper part of the table, which is not the case in previously mentioned research. Lower ranked clubs have a higher number of injuries in training and a lower number in matches compared to clubs that rank at the top with the opposite distribution. Thus, results direct the focus to an importance of prevention programs. Previous research has shown that teams that implement prevention programs (FIFA 11+) have significantly fewer injuries several times a week than teams that do not apply them (Bizzini et al., 2013; Clausen et al., 2014; Grooms et al., 2013; Impellizzeri et al., 2013; Owoeye et al., 2014)to understand whether this programme is an appropriate warm-up for football players. Results were compared with the literature using a meta-analytical approach. Twenty amateur male football players [mean age 25.5 (s ± 5.1. A smaller number of injuries was also found in this study for clubs from top five as they probably have a prevention program in some form. Whether this is due to better staff quality or quantity should still be researched in another study, but it helps teams to have better injury-free results than low five teams from research.

With extremely important obtained data, further programming of prevention programs crucial in reducing the number of player injuries, focus on injury problems, time of occurrence and the fact that research of this type has not yet been conducted can be considered as the strength of the study. The limitation of this study could be its duration (less than a year), as well as the time of conducting research during the Covid-19 viral pandemic, where at one point the competition part was interrupted. Without the constancy of the competition and with dominance of training regime, the dispersion of injuries and its number in trainings and matches differs from the European average. Also, for future research, it is necessary to determine the percentage of application of prevention programs in the 1. CFL so the obtained results can be more easily interpreted in relation to the competitive achievement.

CONCLUSION

Although it is not statistically significantly confirmed that clubs with lower rankings have more injuries, difference still exists between clubs that finished in the top five clubs in the championship compared to clubs which were ranked as low five clubs (which have more injuries in the season). Also, low ranked clubs don't have budgets like higher ranked clubs, and their medical staff is not expanded as in higher ranked clubs. Lower ranked clubs should consider expanding their medical and strength and conditioning departments to lower their injuries and consequently to have better results at the end of the season. Also, clubs that are ranked worse should conduct more education among players to raise the awareness of players towards injuries and how to reduce them to the smallest possible number. As this research was conducted on the entire CFL, the recommendation for clubs is to implement prevention programs with minor or major corrections that are needed for each club individually.

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Endurance Test on the Rowing Machine

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ABSTRACT

Several laboratory and field tests are used to assess the endurance level. The aim of the study was to determine the significance of differences between men and women 12-minute Rowing Test (12MRoT) and the relationship between the anthropometric and performance variables for both genders separately. A literature review of aerobic capacity indicators and endurance fitness tests on the C2 rowing machine was prepared. The result of extensive research is the design for a simple test with a set duration, when the tested person should try to cover the greatest possible distance (i.e. maximum effort). A total of 323 students of the University of Defence were males (n = 270; age = 20.9 ± 1.88) and females (n = 53; age = 20.6 ± 1.47) who participated in 12MRoT. The basic anthropometric characteristics were measured (height, weight). The endurance fitness indicators were the distance covered (DC, meters), average power (AP, watts), and average heart rate (HR, beats per minute). Statistical analysis of differences between mean values (t-test, effect size index d) and relationships between variables (Pearson or Spearman correlation coefficient r or rs, effect size index r) demonstrated significant differences between males and females were observed for the indicator DC ($p < .05$; $d = 1.79$) and for the AP ($p < .05$; $d = 1.94$). A small correlation between HR and DC ($p < .05$; ES small), HR and AP ($p < .05$; ES small) was found in males. A medium correlation between DC ($p < .05$; ES medium), AP ($p < .05$; ES medium), and HR was found in females. A statistically significant correlation was demonstrated between height ($p < .05$; ES medium), weight ($p < .05$; ES medium), and DC and also between height ($p < .05$; ES medium), weight ($p < .05$; ES medium) and AP in men. On the other hand, in women, there was no statistically significant correlation between height ($p > .05$; ES small), weight ($p > .05$; ES small), and DC and also between height ($p > .05$; ES small), weight ($p > .05$; ES small) and AP. The results of our study demonstrate the applicability of the 12MRoT on Concept II under the

required conditions. The results of the study provided initial reference values for individual assessment of aerobic fitness. This study should be followed up by further research where it seems appropriate to compare performance on the 12-minute Cooper test and the 12MRoT.

Keywords: diagnostics, fitness test, Cooper´s test, 12-min rowing test, military, Concept2

INTRODUCTION

All students of the University of Defense in Brno must complete physical tests, as one of the conditions for fulfilling the credit from physical training. They have to overcome the high level of endurance they demonstrate by completing Cooper's 12-minute run. At the Physical Training and Sports Centre of the University of Defence, we encountered the following problem: How to test the endurance abilities of people who cannot undertake the running test? Therefore, we will try to define the physiological factors of running endurance and thus facilitate the selection of a substitute test for a 12-minute run.

Indicators of aerobic capacity:

A well-proven physiological indicator of aerobic capacity is the maximum minute oxygen uptake (VO_2max), especially when calculated per 1 kg of human weight (VO_2max.kg-1). An indicator of aerobic capacity is also the so-called anaerobic threshold. It is the load intensity in the transition zone between predominantly aerobic and predominantly anaerobic energy acquisition for muscle work. It is expressed by the highest power at the beginning of the steep onset of the indicators of anaerobic energy acquisition (during the graded load). Ventilatory-respiratory anaerobic thresholds can be established, based on the detection of a sudden increase in ventilation and CO_2 output: "V-slope", balanced ratio of CO_2 output and O_2 uptake (RER=1), the first ventilation threshold (VT1) at the beginning of the increase in the ventilation equivalent for O_2, the second ventilation threshold (VT2) at the beginning of the increase in the ventilation equivalent for CO_2. Another indicator of aerobic capacity is the so-called oxygen half-life. It is the time it takes for VO2 to reach half of its peak value (under constant load). It is not used in common practice. All these indicators can be monitored through spiroergometry, using a respiratory gas analyzer (Kenney et al., 2012; McArdle et al., 2007; Powers et al., 2007). The so-called Conconi's circulatory threshold was determined by the deflection of the minute heart rate (HR) from its linear course (under graded load). The corresponding load intensity was supposed to be an indicator of the level of the so-called anaerobic threshold. However, its validity and reliability have been fundamentally questioned (Bourgois & Vrijens, 1998; Cook, 2011; Ignjatović et al., 2008). In sports coaching practice, lactate thresholds are still used as indicators of the "anaerobic threshold". However, the methodology of their determination and implementation in practice is questionable. Different authors have different approaches to them: The first and second lactate thresholds (LT1 and LT2), the lactate turn-point (LTP), the onset of blood lactate accumulation (OBLA), and balanced lactate steady state (BLSS) are known. Currently, the dynamics of muscle oxygen saturation (SmO2) during muscle

work is starting to be promoted as an indicator of aerobic capacity. The so-called hyposaturation threshold can be determined, i.e. the power, at which the saturation, under graded load, starts to decrease. A significant advantage is that it is a piece of information directly from the muscle. We decided to use the rowing machine test as a suitable alternative to the running test. Finding rowing tests of endurance fitness on the C2 rowing machine will be arranged chronologically.

The first, the Rowing Beep Test with increasing load intensity on the C2 rowing machine – the Incremental Rowing Test (IRT): Metcalfe et al. (2013) conducted a study of 25 males and 16 females aged 21.0 ± 5.1 years. Air resistance was set to level 10 in all participants. The initial stroke rate per minute was 28 in females and 30 in males; every other minute it increased by 1 stroke per minute until exhaustion. The clue was an audio signal that the person tested had in the mobile phone headphones. A treadmill test was performed to compare the aerobic response: with a 1 % slope, the initial speed was 8 km/h and increased by another 1 km/h every next 2 minutes. VO_2max, maximal ventilation, and maximal HR were significantly higher on the treadmill than during the IRT. There was no significant difference between the two tests in the values of the CO_2 and O_2 respiratory exchange ratio (RER) and lactate concentrations. There was a significant correlation between VO_2max on the treadmill and during IRT, similarly in HRmax. The average load time during IRT was 566.3 + 79.3 s. It correlated significantly with VO_2max during IRT, but rather loosely (r=0.32). Equations for constructing nomograms for predicting VO_2max on a rowing ergometer were obtained by regression analysis. An illustrative video and a mobile app are available on the website.

Second, in their research, Mello et al. (2014) used graded load to the maximum. On the C2 ergometer, an initial load of 150 W was increased by an additional 50 W every 30 seconds. They measured cardiorespiratory response (HR, VO_2, etc.) and lactate to determine the lactate threshold.

The third, Haraldsdottir et al. (2018) performed a maximal test on female rowers with the measurement of spiroergometric parameters on the C2 rowing machine, model E: When testing the rowers, they set the initial load to 70 W, then increased it every 3 minutes by another 70 W until exhaustion. It is not stated, how they did this setup.

The fourth, the possibility of gently increasing the load (ramp test) on the C2 rowing machine was developed by Treff et al. (2018). It is a special system, however, not readily available.

The fifth, a C2 rowing machine test with HR and VO_2 measurements was performed by Treff et al. (2022): Healthy, untrained people were supposed to maintain "submaximal" exercise intensity by themselves, lasting for 5 to 10 minutes. They found that uneven rowing is the main reason for C2 distance reading increased inaccuracy. Hence, rowers should row as even as possible and prefer higher stroke rates to minimize underestimation of their performance.

The sixth, was an aerobic fitness test in rowing with a set distance of 2 km on the C2 rowing machine: Sebastia-Amat et al. (2020) investigated the relationship of anthropometric and strength parameters to the power during a rowing test. In their test, they set a distance of 2 km and a "drag factor" to 130 in males and 110 in females. They monitored the total time, power, and stroke frequency.

The seventh, Benson and Connolly (2020) describe their test as follows: The person tested tries to cover a distance of 2 km in the shortest possible time (with maximum effort). The distance of 2 km is associated with a sufficiently long time when the work is carried out in a predominantly

aerobic mode of energy metabolism. The predicted VO_2max can be calculated according to the Hagerman formula, in which data on the weight of the person tested and the time to cover the 2 km distance are entered: VO_2max = (t * 1000) / weight (kg) where t is time t (minutes). (A calculator is available at https://www.concept2.com/indoor-rowers/training/calculators/vo2max-calculator.)

The eighth, Holmes et al. (2020) tested 31 young females on the C2 training machine during two tests with a rest period of 72 hours between them: Tests to overcome distances of 6 km and 2 km, with a resistance adjusted to level "3–4". They found a close relationship of peak oxygen uptake (VO_2peak) to the total time at both 2-km and 6-km loads. There was no significant difference between VO_2peak in these two tests.

The ninth, the possibility of SmO2 monitoring with a rowing load was verified by Klusiewicz et al. (2021). They fixed the sensor in the area of the skin above the vastus lateralis muscle. They proved a decrease in SmO2 with an increasing load. Determining the hyposaturation threshold, however, requires a graded load intensity, which is complicated on this training machine.

Finally, the rowing 6-minute test on the C2 (6MRT) training machine Funch et al. (2021): It is a test of aerobic capacity, which is evaluated according to the distance covered (DC) in 6 minutes. The load is set to the 5th stage of the air brake. During the verification of this test, VO_2max was determined based on the highest VO_2 value in a 30-second interval. The VO_2max/kg values obtained from this 6MRT were not significantly different from the VO_2max/kg from the Cooper 12-minute Run Test (CRT), which was also performed. This proved the comparability of the results of both aerobic tests. The authors demonstrated a statistically close relationship between VO_2max and the DC during the CRT. In the 6MRT on a rowing machine, the researchers found a close relationship between VO_2max and the mean power output (MPO). This study also found a close relationship between the weight of the person tested and the MPO (higher power output at greater weight). The authors recommend the 6MRT as an alternative test of aerobic fitness, with the fact that the weight of the person tested must be taken into account when evaluating the result. The mean and peak heart rates were significantly higher in the CRT than in the 6MRT. A certain weak spot of this study is that these tests evaluated the results of males and females together. According to Jensen et al. (2021), the test on the rowing machine uses a close relationship of VO_2max to dynamometric indicators from two tests - to the average power when covering 2 km (W2k) and to the "maximum power output" (MPO) during the 7x2 minute test with increasing load intensity. With it, the initial load was 40 % W2k, and further load stages increase by another 25 %. On the C2 training machine, the degree of resistance of the air brake (damper) is set on a scale of 1–10. However, this is not the final setting of the load intensity. This is determined only by the strength, speed, and frequency of strokes during the work of the person tested. The so-called drag factor, which is based on measuring the speed of the flywheel deceleration, gives some information about the actual force of the strokes. As for this training machine, it is not possible to simply set the power in advance like on a bicycle ergometer or the speed like on a treadmill. It is not possible to increase the load accurately and reliably over time. Only the power after each stroke is continuously calculated and shown on the display as well as the mean power output (MPO) from the entire time of the work performed (Concept2, 2022). It is possible to set the distance (m) or time (sec) in advance. After the test, the average speed (m/s) can be calculated from the distance and time. The manner

of generating resistance on the C2 training machine is created by air damping which means that the targeted mechanical performance is unstable. The mechanical performance we observe is influenced by the rower's effort. The high variability of power is especially at the beginning of the load during the first strokes. The authors provided a critical summary of findings on the application of C2 for testing physiological abilities for short-term performances. With the number of strokes performed, the flywheel apparently wears out and changes its properties.

The aim of the study was to find out in groups of men and women 1) the significance of differences between endurance characteristics in the 12-minute Rowing Test (12MRoT), 2) the relationship between anthropometric and endurance variables, 3) to compile percentile intervals allowing individual assessment of endurance fitness.

METHODS

Participants

A total of 323 males (n = 270; age = 20.9 ± 1.88 years; height = 181.2 ± 7.25; weight = 79.6 ± 10.48) and females (n = 53; age = 20.6 ± 1.47 years; height = 169.1 ± 5.58; weight = 63.9 ± 7.10) students of the University of Defence took the test. All the tested students were members of the first year of the military college and had passed both the University of Defence and Czech Army entrance physical tests, which are compiled of strength and endurance disciplines. Indisposed subjects were excluded from the study. The empirical part of the study was approved by the Ethic board of the University of Defence and all participants provided written informed consent. We followed the methods of the principles of the Declaration of Helsinki (World Medical Association, 2013).

Protocol

The 12-minute Rowing Test (12MRoT) was executed on Concept2 rowing ergometer model E (Concept2, Inc., 105 Industrial Park Drive, Morrisville, VT 05661, USA). Before the test, participants set the ergometer to fit their individual needs by adjusting the height of the foot stretchers and the height of the monitor. After a 5-minute warm-up on the training machine at any frequency at light resistance, there was a break of 2 minutes followed up by the test rowing for 12 minutes with damper setting 5. Execution of the load by a person tested was to cover the greatest possible distance with maximum effort in 12 minutes. The participants of the test were measured in their height and their weight before testing. Evaluation of the test was the endurance fitness indicators that are the distance covered (DC, meters) and the average power (AP, watts), which are measured by the display on the Concept2 rowing ergometer and were read after the end of the test. The heart rate (HR, beats per minute) was recorded throughout the HR monitor (Polar Sport Tester H7; Kempele, Finland) and read from the Concept2 rowing ergometer also after the end of the test. It was the average figure of all figures of the heart rate during the test.

Movement on the rowing machine, C2 properties:

The person tested rotates the flywheel (braked by an air brake) by repeated strokes using the part of the handle from front to back, over the chain. He has stationary leg support foot stretchers and slides backward using a movable "seat cushion". The basic movements are as follows: the catch-flexion of

the hips, knees, and back, dorsiflexion of the legs and extension of the shoulders and elbows (without the resistance of the training machine); the drive and the finish, in which the back, hip, and knee extension, shoulder and elbow flexion, and foot plantar flexion take place against resistance (Figure 1).

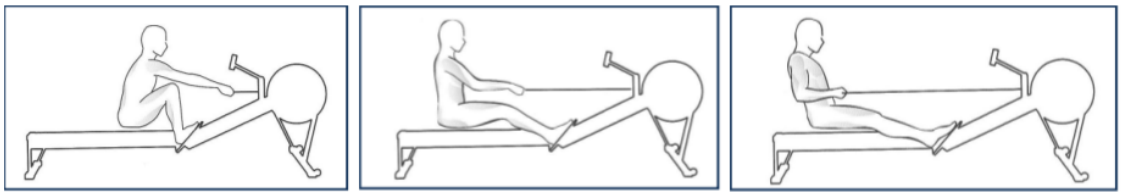

Figure 1. Three stages of work on a rowing machine, from left to right: catch, drive, and finish (Concept2, 2022)

Statistical Analysis

Distribution of values with an assessment of their normality (Shapiro-Wilk test). The basic anthropometric characteristics were measured (height, weight). The other characteristics of the observed parameters distance covered (DC, meters), average power (AP, watts), and heart rate (HR, beats per minute) in males and females were calculated (mean and standard deviations, coefficient of variation). Parametric tests (t-test, Pearson or Spearman correlation coefficient r or r_s) were used to analyze differences and relationships between variables with a normal distribution of values. The level of significance was set at $p < 0.05$. We evaluated the effect size (ES) of the distance covered (DC) and the achieved performance (AP) and average heart rate (HR) between men and women using Cohen's d. The evaluation of ES index d was interpreted as small ($d = .20$), medium ($d = .50$), or large ($d = .80$), and ES index r and r_s was interpreted as small ($d = .10$), medium ($d = .30$), or large ($d = .50$) (Cohen, 1988). The results were processed and statistically evaluated in Statistica 14 (IBM SPSS Statistics software version 14.0, SPSS INC., Chicago, IL USA) and MS Excel.

RESULTS

A study to validate the test

Based on the Shapiro-Wilk test (W), we note that the average power (AP) has a normal distribution in males (AP: $W = 0.99$, $p = 0.89$), however the distance covered (DC) and heart rate (HR) in male does not (DC: $W = 0.91$, $p = 0.00$; HR: $W = 0.86$, $p = 0.00$) it has an asymmetrical distribution. Height ($W = 0.99$, $p = 0.67$) and weight ($W = 0.99$, $p = 0.28$) in men also have a normal distribution. In females, both parameters have a normal distribution (AP: $W = 0.98$, $p = 0.36$; DC: $W = 0.99$, $p = 0.97$). Height ($W = 0.98$, $p = 0.51$) and weight ($W = 0.98$, $p = 0.27$) in women also have a normal distribution, but the average heart rate (HR) ($W = 0.92$, $p = 0.003$) in women has an asymmetrical distribution as well. Table 1 presents the basic statistical characteristics of the results and the comparison of males and females in the 12MRoT. The differences between males and females for DC are significant. We evaluated the effect size (ES) of the DC (m) between men and women using Cohen's $d = 1.79$ (large) and the effect size (ES) of the AP (W) between men and women is Cohen's $d = 1.94$ (large).

Table 1. Basic statistical characteristics of the distances covered and average power comparison of males and females in the test 12MRoT

Sample/ Variables	Distance covered (DC, m)				Average power (AP, W)			
	M ± SD	CV (%)	t-test	ES (*d*)	M ± SD	CV (%)	t-test	ES (*d*)
Males (n = 270)	2869.42 ± 230.91	8.07%	p < 0.0001	1.79	180.61 ± 31.64	17.54%	p < 0.0001	1.94
Female (n = 53)	2492.92 ± 187.32	7.51%			120.92 ± 30.00	24.82%		

Note: DC = distance covered; m = meters; AP = average power; W = watts; M = mean, SD = standard deviation, CV = coefficient of variation; ES = effect size; *d* = Cohen´s coefficient; statistically significant ($p < .05$)

Correlation analysis (Table 2) showed statistically significant correlations between both DC and HR (ES small) and between AP and HR (ES small) in men. Among women, statistically significant correlations were also demonstrated between both DC and HR (ES medium) and between AP and HR (ES medium) Thus, the relationships between variables are stronger than in men.

Table 2. Correlation between the distance covered, average power, and average heart rate (p < .05)

Coefficients of correlation *(r)*	DC vs HR			AP vs HR		
	r_s	*p*	ES	r_s	*p*	ES
Males (n = 270)	0.25	<.05	small	0.29	<.05	small
Females (n = 53)	0.43	<.05	medium	0.41	<.05	medium

Note: DC = distance covered (meters); HR = average heart rate (beats per minute); AP = average power (watts); ES = effect size; *r* = ES index; r_s = Spearman´s correlation coefficient; statistically significant ($p < .05$)

Correlation analysis (Table 3) showed statistically significant correlations between body height, weight, and DC (ES medium) and also between body height, weight, and AP (ES medium). Among women, no statistically significant correlations were found between body height, weight, and DC (ES small) and also between body height, weight, and AP (ES small).

Table 3. Correlation of body height and weight with a distance covered and average power in men, and women (p < .05)

Males (n = 270)	**DC**	***p***	**ES**	**AP**	***P***	**ES**
Height (r_s, r)	0.40	<.05	medium	0.42	<.05	medium
Weight (r_s, *r*)	0.34	<.05	medium	0.39	<.05	medium
Females (n = 53)	DC	*p*	ES	AP	*P*	ES
Height (*r*)	0.17	> .05	small	0.14	> .05	small
Weight (*r*)	0.20	> .05	small	0.16	> .05	small

Note: DC = distance covered (meters); AP = average power (watts); ES = effect size; *r* = ES index; *r* = Pearson´s correlation coefficient; r_s = Spearman´s correlation coefficient; statistically significant ($p < .05$)

Statistical analysis of endurance variables allowed the construction of percentile intervals that provide the possibility of individual assessment of the endurance fitness of each individual. The students' results were divided into five intervals of 20 percentiles each (Table 4).

Table 4. Percentile intervals of the distances covered and average power with a verbal assessment of endurance fitness.

	Percentiles (*p*)	**< 20.**	**21. – 40.**	**41. – 60.**	**61. – 80.**	**> 81**
	Fitness assessment	**very bad**	**bad**	**average**	**good**	**very good**
Males	DC (m)	< 2 720	2 721–2 843	2 844–2 927	2 928–3 040	3 041
	AP (W)	< 153	154–174	175–190	191–211	212
Females	DC (m)	< 2 329	2 330–2 465	2 466–2 544	2 545–2 650	2 651
	AP (W)	< 95	96–112	113–124	125–146	147

DISCUSSION

In the study we present, the differences between men and women are significant. We hereby correct the approach of Funch et al. (2021), who did not respect the differences between males and females in the statistical evaluation. A statistically significant relationship was found between distance covered (DC), average power (AP), and heart rate (HR) in both men (ES always small) and women (ES always medium). The statistical power of detecting an effect is therefore only small in men. Given the individual genetic dispositions of both men and women, it cannot be argued that a higher average heart rate means both higher distance covered and higher average power. In the male cohort, there was a statistically significant relationship between height, weight, and DC ($p < .05$; ES medium) and between height, weight, and AP ($p < .05$; ES medium). In the female cohort, there was no statistically significant relationship between height, weight, and DC ($p > .05$; ES small), as well as between height, weight, and AP ($p > .05$; ES small). The statistical power of detecting an effect is therefore only small in women. This suggests that height and weight have a greater effect on overall performance in males than in females. In men, taller stature with longer limbs may be a definite advantage for this test. Also, greater weight in males may mean a greater amount of muscle and therefore gain a definite advantage. However, it cannot be concluded that the higher the weight the better the performance. For these reasons, it makes no sense to overestimate the influence of height and weight and we recommend that these anthropometric variables be taken only as supplementary indicators. The level of aerobic fitness has a decisive influence on the level of performance in the 12MRoT in both men and women, and the rowing technique also plays a role. Our goal was not to create a maximum test into the exhausting like other authors (Haraldsdottir et al., 2018; Mello et al., 2014; Metcalfe et al., 2013). In contrast, the studies by Treff et al. (2022) and Funch et al. (2021) are more similar to ours in terms of loading. After considering the above-mentioned literary review findings, we used a simple test with a set duration, when the tested person should try to achieve the greatest possible distance (i.e. maximum effort). Such a test was largely validated and published by Funch et al. (2021) as a 6-minute rowing test (6MRT), where the main indicators of endurance fitness are the distance covered and average power, which are correlated with VO_2max. It was prepared by the authors for the Danish Armed Forces. However, the 6MRT does not meet the requirements for the test to be comparable to the Cooper 12-minute Run Test (CRT); therefore, we recommend setting the test length to 12 minutes so that similar energy

coverage and mental load demands for both the CRT and the 12-minute rowing test (12MRoT) may be achieved. To achieve the comparability of the physical and psychological demands of the CRT, a new 12MRoT was created. For the above-mentioned reasons, the new 12MRoT should closely match the CRT. Evaluation of the test was the endurance fitness indicators which are the distance covered (meters) and the average power (watts), which are measured by the display on the Concept2 rowing ergometer. Volianitis et al. (2022) reported that there was relatively limited data on the validity and accuracy of the tests on the C2 training machine. The study that verified the technical accuracy of the C2 training machine functions (Treff, et al., 2022) brought positive findings: The nominal accuracy of the machine depends on the total number of strokes. No significant differences were found in the structure of strokes at frequencies of 22–28 per minute. The participants of the University of Defence achieved a significantly lower average power than the group of people in the study by Funch et al. (2021). We explain it by half-duration of the maximum performance of their people (6 minutes). It also logically corresponds to the fact that the distances they covered (1,507 m) exceeded half the distance of our students. Statistically significant relationships between height, weight, and distance covered (DC) with average power (AP) in men correspond to similar results of the study by Funch et al. (2021). Low correlations between these fitness indicators to body weight and height in females do not support the need to use relative fitness indicators (per kg of weight). The results of the study provided initial reference values for individual assessment of aerobic fitness. Interestingly, the scaling of distance traveled for both men and women roughly matches the scaling at the University of Defense for the 12-minute run. 2.850 m for men (2.450 for women) is an average performance in both running and rowing tests. Those findings suggest that running and rowing 12-minute tests might be legitimately substitutable and even comparable, even though further research is necessary to confirm this statement.

CONCLUSION

The results of the study demonstrated that significant differences in performance variables were found between men and women in the proposed alternative 12-minute Rowing Test (12MRoT), both in terms of statistical significance and level of effect size. This confirms the importance of evaluating the results for each gender separately. The relationships found between performance variables (distance covered and average power) and heart rate were statistically significant between men and women although the level of effect size was small in men and medium in women. Furthermore, statistically significant relationships were demonstrated between anthropometric (height and weight) and performance indicators (distance traveled and average performance) and mean ES level in men, while not in women. The results of our study demonstrate the applicability of the 12MRoT on Concept II under the required conditions. The results of the study provided initial reference values for individual assessment of aerobic fitness. This study should be followed up by further research where it seems appropriate to compare performance on Cooper´s 12-minute run test and the 12MRoT.

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Effects of 4-week Olympic Weightlifting Training on Speed and Power Performance in Recreational Athletes

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ABSTRACT

Olympic weightlifting (OW) is sport with high strength and power demands where athletes need to explosively lift heavy weights. It is consisted of barbell lifting snatch and clean and jerk disciplines. In the strength and conditioning training, OW techniques are often used as a method for speed and power development. The aim of this study was to determine effects of 4-week OW training intervention on speed, agility and power performance among young recreational athletes. The sample of participants consisted of 12 Kinesiology students (average 23 years old). They attended the Olympic Weightlifting course. The training intervention lasted 4 weeks and with 3 training sessions per week in which participants practiced OW training based on learning OW techniques and auxiliary lifts execution. Before and after the intervention, measurement was conducted and included power, speed and agility tests. Squat jump (SJ), countermovement jump (CMJ) and drop jump (DJ) were used to estimated lower body power and medicine ball throw (MBT) for upper body power. Sprinting on 5 meters (S5) and 15 meters (S15) were conducted as power and speed tests, while 20 yards test (20Y) measured nonreactive agility performance. All variables were descriptively analysed and T-test for dependent samples was used to determine possible effects of training intervention. Results showed improvement in jumping capacities, with statistically significant difference noted only for CMJ ($p>0.01$). Upper body power and agility performance did not show any significant changes, while a decline in sprinting performance was found for both S5 ($p>0.01$) and S15 ($p>0.01$). While the results in jumping variables are expected and in accordance with current scientific knowledge, the results in sprint tests are somewhat confusing. Possible explanation for this can be found in the fact that the participants worked for four weeks the tasks that biomechanically are not similar to the structure of sprinting movement. This could suggest that athletes who want to improve their explosive speed capacities should include specific sprint stimuli in their training program in addition to OW training program. In the future, more variables and longer treatment duration need to be applied.

Keywords: weightlifting, intervention, speed, agility, power

INTRODUCTION

Olympic weightlifting (OW) is sport with high strength and power demands where athletes need to explosively lift heavy weights. It is consisted of barbell lifting snatch and clean and jerk disciplines in which athletes need to produce high levels of strength and power (Helland et al., 2017; Santos et al., 2021). In the OW competitions, athletes try to lift highest possible load, in maximum of three attempts, in both techniques.

Besides the sport itself, these lifting techniques gained big popularity as specific training method. In particular, in the strength and conditioning training, OW techniques are often used as a method for speed and power development (Chaouachi et al., 2014; Hackett, Davies, Soomro, & Halaki, 2016a, 2016b; Helland et al., 2017). These two major techniques, along with supplementary exercises like hang clean, hang snatch, power clean, power snatch, high pull and similar, are very popular and useful training modalities for the development of whole spectre of speed-power abilities (Morris, Oliver, Pedley, Haff, & Lloyd, 2022). Speed, power and agility demands are present in most sports, including team sport games, combat sports and many other individual sport and disciplines. They are manifested with jumping, sprinting, change of directions and similar movements and actions (Morris et al., 2022; van der Kruk, Van Der Helm, Veeger, & Schwab, 2018).

Comparing to traditional strength training with heavy lifts, OW training produces less improvement in strength and muscle gains but generates highest possible power outputs (Channell & Barfield, 2008; Hedrick & Anderson, 1996; Semenick & Adams, 1987; Zaras et al., 2020). Studies report that power output during OW is approximately four to five times greater than that during basic strength exercise like the squat or deadlift (Channell & Barfield, 2008). For these reasons, it has been suggested that these kind of training methods should be emphasized in the strength and conditioning programs in the power-based sports (Semenick & Adams, 1987).

This has been confirmed in multiple studies that investigated effects of the OW training and compared it with different training modalities (Arabatzi, Kellis, & De Villarreal, 2010; Chaouachi et al., 2014; Hoffman, Cooper, Wendell, & Kang, 2004; Tricoli, Lamas, Carnevale, & Ugrinowitsch, 2005). Studies regularly confirm positive effect of the OW training on the power of the lower extremities (Arabatzi et al., 2010; Berton, Lixandrão, Pinto e Silva, & Tricoli, 2018; Chaouachi et al., 2014). For example, study on the sample on young male students of physical education showed significant improvement in the vertical jump height after OW intervention (Arabatzi et al., 2010). These improvements were also found in the younger athletes, as the study on the kids from 10 to 12 years showed positive effects on both horizontal and vertical jumping performance (Chaouachi et al., 2014). Similar to this, several studies also studied the effects on sprint performance and confirmed the positive transformations that followed OW training (Chaouachi et al., 2014; Hermassi, Schwesig, Aloui, Shephard, & Chelly, 2019; Hoffman et al., 2004; Tricoli et al., 2005). For instance, Hofmann et al. (2004.) analysed OW effects on collegiate football team and found significantly better results on 40-yard sprint after 15-week intervention (Hoffman et al., 2004).

Considering the importance of the speed and power abilities in sport, the main aim of this study was to determine effects of 4-week OW training intervention on speed, agility and power performance among young recreational athletes. We hypothesized that certain improvement in mentioned abilities would occur.

METHODS

Participants and study design

The sample of participants consisted of 12 male Kinesiology students (average 23 years old, average height 182.4cm, average body mass 81.91kg) that attended the Olympic Weightlifting course in summer semester of academic year 2021/2022. First two weeks of the classes were used for introduction to Olympic weightlifting and familiarization with specific techniques. After that, 4-week intervention was conducted with 3 training sessions per week in which participants practiced OW training based on improving OW techniques and performing supplementary lifting exercises. Every training consisted of four exercises that were performed 3-5 sets of 5-8 repetitions in the first two weeks and 3-5 repetitions in last two weeks. The concept of the trainings is briefly showed in the table 1.

Table 1. OW training

WEEK	TRAINING 1	TRAINING 2	TRAINING 3
1	Snatch	Clean and jerk, press	Basic strength
2	Snatch	Clean and jerk, press	Basic strength
3	Snatch, clean and jerk	Supplementary lifting exercises	Snatch, clean and jerk
4	Snatch, clean and jerk	Basic strength	Snatch, clean and jerk

The study was conducted according ethical guideline and was approved by the Ethical Board of the Faculty of Kinesiology, University of Split (app number. 2181-205-02-05-22-029).

Variables

Before and after the intervention, measurement was conducted and included power, speed and agility tests. Squat jump (SJ), countermovement jump (CMJ) and drop jump (DJ) were used to estimated lower body power and medicine ball throw (MBT) for upper body power. The height and the contact time of the jump were measured by the Optojump system (Microgate, Bolzano, Italy). All jumps were performed three times and the best results was considered as the final score. For all three jumps height was noted while reactive strength index (RSI) was calculated for the CMJ as ratio between jump height and contact time. Sprinting on 5 meters (S5) and 15 meters (S15) were conducted as running power and speed tests, while 20 yards test (20Y) measured nonreactive agility performance. All running test were performed with Powertimers 300 (Newtest Oy, Oulu Finland, Core serial number:08310013). In all three running tests, participants position was behind the photocells and they started with running when they were prepared and ready, without the signal from the measurer. MBT test was performed from sitting position, back placed on the wall and the goal was to throw the 3kg medicine ball with both hands as far as possible. Before both measurements, 15-minute warm up protocol was conducted and included dynamic stretching (3 minutes), jogging (4 minutes) and athletic exercises that consisted of running mechanic drills and innervation (8 minutes).

Statistics

Descriptive statistic parameters were calculated for all measured variables and included arithmetic means and standard deviations. Normality of distribution was checked with Kolmogorov-Smirnoff test.

To determine possible differences between initial and final measurement, T-test for depended samples was used.

All calculations were conducted with Statistica v.13.0 (Dell Inc., Palo Alto, CA, USA) and with p-level of 95%.

RESULTS

Descriptive statistic parameters are presented in the Table 1. Along with the results of the Kolmogorov-Smirnoff test that suggests that all variables are normally distributed.

Table 2. Descriptive statistics

Variable	Initial			Final		
	AM	**SD**	**K-S (p)**	**AS**	**SD**	**K-S (p)**
MBT (m)	5.90	0.55	p > .20	5.78	0.69	p > .20
SJ (cm)	39.36	4.90	p > .20	39.08	4.94	p > .20
CMJ (cm)	38.52	4.25	p > .20	40.44	4.91	p > .20
DJ (cm)	51.31	6.33	p > .20	54.25	7.33	p > .20
RSI (index)	1.54	0.47	p > .20	1.70	0.33	p > .20
5M (s)	0.89	0.05	p > .20	1.10	0.07	p > .20
15M (s)	2.31	0.09	p > .20	2.52	0.10	p > .20
20Y (s)	4.68	0.25	p > .20	4.77	0.21	p > .20

***Legend: MBT** – medicine ball throw, **SJ** – squat jump, **CMJ** – countermovement jump, **DJ** – drop jump, **RSI** – reactive strength index, **5M** – sprint on 5 meters, **15M** – sprint on 15 meters, **20Y** -20-yard shuttle*

Results of the t-test for dependent samples are shown in the table 2. Significant differences between initial and final measurements were found for CMJ (t=-3.11, p=0.01), 5M (t=-11.06, p=0.01) and 15M (t=-10.86, p=0.01).

Table 3. T-test

Variable	t-value	p
MBT (m)	1.45	0.17
SJ (cm)	0.35	0.73
CMJ (cm)	-3.11	0.01*
DJ (cm)	-2.02	0.07
RSI (index)	-1.40	0.19
5M (s)	-11.06	0.01*
15M (s)	-10.86	0.01*
20Y (s)	-1.97	0.07

***Legend: MBT** – medicine ball throw, **SJ** – squat jump, **CMJ** – countermovement jump, **DJ** – drop jump, **RSI** – reactive strength index, **5M** – sprint on 5 meters, **15M** – sprint on 15 meters, **20Y** -20-yard shuttle*

DISCUSSION

This study aimed to evaluate effects of 4-week intervention of Olympic weightlifting training on speed, agility and power performance in young recreational athletes. Results in general showed improvement in jumping capacities, with statistically significant difference noted for CMJ ($p>0.01$). Upper body power and agility performance did not show any significant changes, while surprisingly, a decline in sprinting performance was found for both S5 ($p>0.01$) and S15 ($p>0.01$).

Improvement in power capacities

Progress in the power of the lower extremities was recorded in all types of jumps, regardless of the type of muscle contraction. However, significant differences compared to the initial measurement were observed only in the eccentric-concentric jumping, i.e. in the CMJ. This finding is in line with the results of other studies that repeatedly confirmed the positive impact of OW training on power (Arabatzi et al., 2010; Hackett et al., 2016a; Pichardo et al., 2019; Tricoli et al., 2005). In particular, a review by Hackett et al. (2016) included six studies in order to evaluate the effects of Olympic weightlifting (OW) on vertical jump height and recorded improvement of 7.7% compared to control group (Hackett et al., 2016b). In the study on the sample of male students, authors found that OW training improved power and muscle activation during the concentric phase of the CMJ (Arabatzi et al., 2010). Authors explained this improvement with kinetics and kinematics similarity between jumps and OW exercises (Arabatzi et al., 2010). In line with this study, Tricoli et al. conducted the experiment on similar participants (young male physical education students) and found the positive effect in both concentric (Squat jump) and eccentric-concentric (Countermovement jump) type of jumps (Tricoli et al., 2005). Besides mentioned biomechanical similarities, authors that examined this topic in general concluded that the load imposed in the OW exercises result in the development of a wider spectrum of mechanical parameters and greater motor-unit synchronization which can be transferred to execution of other sport tasks (Arabatzi et al., 2010; Hackett et al., 2016a; Tricoli et al., 2005).

Although the interventions in these studies lasted somewhat longer (specifically from 6 to 15 weeks), it is obvious that even interventions of only 4 weeks like conducted herein, are enough for certain advances in power performance.

Decline in speed performance

And while the jump results are expected, the speed test results are quite surprising. In particular, not only was there no improvement in speed, but there was a significant decline in performance. These results are clearly not in accordance with previous studies which regularly reported positive effect of OW training on speed capacities. For example, study on 20 member of collegiate football team found significant improvement in 40-yard running after 5-week OW training program (Hoffman et al., 2004). However, it is important to note that the sprint and agility training program was incorporated into the intervention and most likely had a significant impact on speed performance (Hoffman et al., 2004). Similar to this, Chaouachi et al. (2014.) noted advancement on 5- and 20-m sprint times in 10 to 12 years old kids after 12-week OW program (Chaouachi et al., 2014). This gains in speed output are primarily consequence of the high rates of force development

and improved contractile properties of muscular-skeletal system (Duchateau & Hainaut, 1984; Häkkukinen, Komi, & Alen, 1985; Hoffman et al., 2004).

Considering the unexpected, and in fact counterintuitive results, we can only hypothetically discuss possible explanations of the findings obtained here. By authors opinion, most probable explanation for this can be found in the fact that the participants worked for four weeks on tasks that biomechanically are not similar to the structure of sprinting movement. In detail, during a period of 4 weeks, the subjects did only OW exercises and did not conducted any speed or running session. This potentially resulted in acute effects in terms of kinetic and kinematic parameters that led to sprint performance decline.

However, we need to emphasize few study limitations that possibly influenced the results. First of all, anthropometric measurements were taken only on the initial testing so there is possibility there was an increase in body mass, which had a somewhat negative effect on sprinting. Also, the sample of participants was relatively small so these results could occur as specificity of the observed participants. Finally, the duration of the experiment was only four weeks which is less than usual experimental studies on this or similar topic so these results should be taken with some caution.

CONCLUSION

The results of this research showed that in young recreational athletes there is an improvement in the power of the lower extremities already after 4 weeks of systematic OW training. Once again was confirmed the positive effect of OW training on athlete's power capacities.

On the other hand, the decline in speed performance is hypothetically explained by different biomechanical demands during the intervention period. This may suggest that in speed-explosive sports, athletes should not only rely on OW method, but should include other training modalities for developing these capacities, specifically athletic speed training.

The major limitations of the study are; small sample, recreational athletes, lack of strain factors control (body mass measurement, other physical activity records, etc), and short intervention period.

Study confirmed positive effect of OW training on power performance in recreational male athletes. Hence, date gathered could be helpful in expanding safe and efficient training modalities with recreational athletes' population.

In the future studies, it is necessary to further expand the sample of the observed variables and especially perform a longer intervention with inclusion of the control or some other experimental group.

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SOCIAL SCIENCES

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Implementation Methodology of People with Disabilities, for Work and Sports/Free-Time Teams

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ABSTRACT

In the last 10 years, the Czech Republic has been struggling with a strong social policy, influenced by the active social policy of post-communist countries. The ever-increasing number of people with disabilities creates space for the creation of a universal method, for the implementation of people with disabilities into the work process, work teams, free-time activities and society as a whole. The aim of the research is to complete an implementation method for the integration of people with disabilities into work, leisure and sports teams. The implementation method brings a universal tool for recognizing the individual needs of people with disabilities and assistance with implementation into a specific team. The research focused on examining people with disabilities in work, free-time and sports teams. Primary research in the form of a questionnaire survey of open, closed and scale questions was solved on a sample of 101 employees and 15 team leaders in 8 companies, another was carried out, another Questionnaire survey at the level of employees/members of interest groups with health disadvantages 303 people from the Czech, Slovak and Hungarian Republics, persons with recognized disability I.III. degree. The secondary research worked with internal data of 8 companies, approximately 14322-15189 (influence of seasonality of employees and interest groups). The result of the conducted investigations is a specific method for the implementation of people with disabilities into the team.

Keywords: implementation, disability, implementation method, work and sport-teams, sport

INTRODUCTION

Employment of people with disabilities is a very broad and constantly addressed topic in society, whether it is a specific country such as the Czech Republic or the European Union as a whole. It is a topic that moves society and represents a big problem for many people, which generally limits or affects society in some way, even though it may not seem so at first glance. However, it is usually difficult for people with disabilities to find a normal job, like any other healthy individual, especially in traditional areas (e. g. restaurants, company cleaning, warehouse work or even more skilled and professional work in international companies, etc.). In agriculture, on the other hand, it is even more difficult, because the work is more demanding, less accessible or in field conditions that do not allow a person with physical disabilities, blind or limited body functionality (or certain parts) to perform. It is the same with their implementation and integration back into the work process or a certain collective, where everyone is healthy in terms of health, etc. In the following paragraphs, we will look at this problem from the perspective of the Czech Republic.

Not only the employment of people with disabilities is specific and due to inequality in the labour market, these people encounter restrictions and solutions to situations based on their specific health disadvantage in their daily contact. According to research, there is a sense of belonging for people with disabilities, as evidenced by the 2013 and 2021 surveys using a questionnaire survey of workers with disabilities in security agency corporations. The sense of belonging is enhanced by collective activities, such as sports. Sport is no longer taboo for people with disabilities or for people with mental disabilities. Proof of openness and variability in the issue of DISABILITY are non-profit organizations focusing on associating people with disadvantages and breaking down established stereotypes. Like employing people with disabilities, their inclusion is important across every spectrum of their lives. It represents the full awareness of the collective about the specification of the disadvantage of the person in the team and in the approach to it. Each disadvantage carries unique features and in combination with the personal aspect of the disadvantaged person's personality, this combination and approach cannot be replicated identically. See the articles Pros and Cons in Employing People with Disabilities in a Company and Pros and Cons in Employing People with Disabilities in a Company already published in IJMAS vol.8, issue 8 (Sedláková, 2022; Sedláková, Pavelková 2022).

LITERATURE REVIEW

Inducted by the employer corporation and the developed method of the implementation People with health disadvantages, so-called "handicapped", have difficulty in finding a new job in the Czech Republic, because their health restrictions often do not allow them to perform any work (mostly physically demanding work). Another reason is that not every society is adapted to provide people with disadvantages with a sufficient environment for their work, mobility in the given environment, etc. This problem usually appears especially in manufacturing companies, where employees stand for hours at the production line, assemble various components, or the production

environment is so narrow and even dirty that it is not for these people with some types of health disadvantages, the so-called "Cold Bandwidth". A handicap, realistic in such an environment often to work at all, let alone move.

Another and related problem with employing people with disabilities is their implementation itself, i. e. integration back into the work process. Every company, organization, society and overall employer providing a job or more jobs to people with disabilities must have a so-called implementation method. It is therefore a step-by-step procedure for introducing a new employee to other employees of the company, how to train him, guide him through the company, etc. However, Schur et al., during their research, found that it is impossible to determine the ideal method for the integration of people with disabilities. Despite the fact that employers and the state have discovered many advantages in employing people with disabilities, they encounter great diversity. The emphasis is on an individual approach to a specific group, as it is not possible to generalise the approach to specific groups, but is useful as a starting model for addressing groups such as people with disabilities (Schur et al., 2005). It is also stressed that benefits must be weighed side by side, which brings efficiency and profitability to all stakeholders. This approach leads to increased productivity, integrity of the company and the company itself in terms of creativity, efficiency, satisfaction, work ethic and increased prestige of the company (Lindsay et al., 2018). Based on Snyder's research, employees with disabilities are highly sensitive to injustice in the work team from their healthy colleagues or management (Snyder et al., 2010). For the company, this means higher inclusion costs and other additional costs to catch up with productivity. In 2001, Collela also identified several models that are based on a psychological approach to people with disabilities, where models serve as initial tools for setting up the right communication and approach to people with disabilities (Colella, 2001).

For the company, employing this group of people has several advantages, such as an income tax credit for each employed person with a disability (PWD) in the amount of CZK 18,000, in the case of a person with a health disadvantage (OZZ) it is already a discount of CZK 60,000 for each such person. Furthermore, there is also the possibility of the employer to pay this person only the minimum wage without the obligation to give more, which saves the employer part of the costs, because he does not have to evaluate the person with a disability with a monthly wage as well as any other and healthy employee in the same position, but can only give him a wage equal to the basic wage in the Czech Republic (pruvodcepodnikanim.cz, 2020). However, in addition to the above-mentioned financial benefits for the company, employing PWD and OZZ also benefits society through the public or corporate culture, because such an act casts a very good name on the company as such, that it cares about its employees and is willing to take care of anyone. However, this is often only the external point of view of the general public from the external environment of the company, and not from the internal environment.

Therefore, when it comes to employing people with disabilities or disabilities, it has never been easier for employers to find this type of people than it is now. Today, there are a number of websites where these people register and register with a demand for a possible job for them, ideally in their home or in the vicinity of their home, so that they are as little dependent as possible on transport and the help of other people and manage, for example, to get to work there and back on their own. Of course, not always and for everyone this is quite possible.

In 2018, there were approximately 1,152,000 people in the Czech Republic with various types of disabilities (smaller, major), of which more than half of these people were seniors over the age of 65 and more often they were women (CZSO, 2020). The specific division of these people in individual age groups from 15 years of age to the age limit of people over 80 years of age according to the assessment of the severity of their disability (only subjective, medical, subjective or only medical) and through gender from 2018 can be seen in the following table, where the values are given both in absolute and percentage terms.

Table 1. Persons with disabilities as assessed, gendered and aged (CZSO, 2020)

disability assessment	total	sex		age groups				
		men	women	15–34	35–49	50–64	65–79	80+
absolute number in thousands								
total	**1151,9**	**510,9**	**641,0**	**64,6**	**136,6**	**313,6**	**415,9**	**221,2**
only subjective	508,0	222,7	285,3	14,2	30,2	79,7	227,0	106,9
both subjective and medical	617,0	275	342,0	47,0	101,1	220,3	135,4	113,2
medical only	27,0	13,2	13,8	3,3	5,3	13,7	3,6	1,1
structure in %								
total	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**
only subjective	44,1	43,6	44,5	22,0	22,1	25,4	66,6	48,3
both subjective and medical	53,6	53,8	53,4	72,8	74,0	70,2	32,6	51,2
medical only	2,3	2,6	2,2	5,1	3,9	3,9	0,9	0,5

Note: Medical assessment – disability pension or care allowance or mobility allowance or disability status or disability card.

It is clear from the table values that a greater number of people with disabilities or disadvantages appear in men according to the medical and medical assessment as well as their subjective assessment, but women dominate the subjective assessment of disability. According to the medical assessment, there is almost no health disadvantage in younger people aged 15-34 years, because they are of working age and therefore also in an age with better immunity, etc. While, in other gradually older age limits can be observed already occurrence of these problems, it may be caused by worse health of people, fatigue from some professions and occupations that are physically more demanding after their long-term-performance, etc. According to the medical assessment, the greatest impact is on people aged 50-64, when people are tired, tired and often count down the days until the nation has enough to retire, see e.g. (Maxwell, 2022).

In 2020, there were already 1.5 million people in the Czech Republic who had some kind of health disability or disability and were thus limited in part or most of the content of their work. (CZSO, 2020). The majority of these people therefore receive either a disability pension or at least contributions from the state to make up for this income difference. However, this contribution does not always cover all necessary expenses and especially the standard in which a person was accustomed to live until then.

Integration of persons with disabilities into society

Integration generally means the integration or joining of several parts into a unified and integral whole, or within the work environment, it can be said that the integration of a new employee into a still functioning and permanent working team among other employees. It can therefore be said that within the framework of people with disabilities or disadvantages, it is their involvement in an intact society and, for example, the involvement of these people in various social activities in the form of physical activities, the creation of recreational or team sports, teambuilding, etc. (Doležel, 2007). Of course, only if their health allows it and it does not limit them even more, mentally or physically.

As part of the implementation of these people back into work or sometimes personal life and their integration into the environment, e. g. at work, two basic factors influence them: personal and environmental factors. Environmental factors can include any physical and social factors, but also the attitudes of other people or the location where people live and thus spend most of their free time. The special basis of each person is then personal factors, which consist of the characteristics of a person beyond his health problems and health status. These are factors such as: age, gender, race, lifestyle or education, etc. (Hnízdová, 2016), (Opatřilová, 2011).

Every person, healthy or disabled, is influenced in some way by these two factors, although it may not seem so at first glance. At school, at home, at work, in public - everywhere, there are other people and different environments, places that can affect us differently than others. The same applies to people with disabilities, as they are also very affected by the environment. Unfortunately, it cannot always have a positive effect on them, whether because of other people (e. g. colleagues in the workplace, superiors or subordinates, etc.), as well as through a personal feeling from the work done or from the feeling atmosphere of the environment.

Organizations involved in the implementation of people with disabilities

In the Czech Republic and the European Union, there are a number of bodies responsible and dealing with the issue of implementation, i. e. the implementation of the European Union. Integration of people with disabilities back into the workforce, to a greater or lesser extent. One of these bodies in the Czech Republic is the Government Committee for Persons with Disabilities (VVOZP), which is a "permanent coordinating, initiative and advisory body of the Government of the Czech Republic for the issue of support for persons with disabilities". This committee was established in 1991 by a resolution of the Government of the Czech Republic and is mainly responsible for problems concerning people with disabilities that cannot be solved by one ministry alone, but it is necessary to involve the cooperation of several ministries (Government of the Czech Republic, 2023).

Another organisation is the United Nations (UN), where the so-called United Nations plays a very important role. UN Convention on the Rights of Persons with Disabilities see MPSV (2020) or UN (2023), as the VVOZP always ensures the preparation of the National Plan for the Support of Equal Opportunities for Persons with Disabilities at certain intervals, with the national plan being "the basic strategic document that determines the direction of the Government Policy of the Czech Republic in the area of creating equal opportunities for persons with disabilities for the following period" (Government of the Czech Republic, 2020). Now it is a support plan for the period 2021-

2025, which was approved by Government Resolution No. 761 of 20 July 2020. By its structure and content, this plan builds on the UN Convention on the Rights of Persons with Disabilities and contributes to its fulfilment, therefore these two organizations or bodies are important bodies in the issue of the implementation of people with disabilities in the work process itself, as the national plan also contains and treats this area.

Disability in sport and free-time area

They represent handicaps not only in work teams, but also in sports teams and free-time activities. Modern technologies and approaches to the implementation of people with disabilities are a huge group of people that need to be included, educated and developed. This situation brings space for the creation of methods, approaches and organizational techniques for effective alignment and a beneficial implementation process for the entire company (Pedersen and Thibault, 2014). Sports management education programs at colleges and universities in the U.S. and around the world have grown over the past twenty years (Zhang, Wang, Min, Chen, & Huang, 2016). There is a visible great effort of the USA for interdisciplinary penetration of the issue of DISABILITY.

This fact is answered by the modern concept of this tendency, namely sports management, which now also counts on athletes with health disadvantages (Pitts, 2001). According to the UN, there are many stereotypes and stigmas about athletes with health or mental disabilities, the originator of this is in the fact that people with disadvantages for a long time were not allowed to play sports or only on an individual basis, and not on a collective basis (UN, 2015). According to the results conducted in 2010, the United States Office for Government Accountability (GAO) investigated that students with disabilities were not allowed to play sports and their interest in sports in high school was almost zero. United States Government Accountability Office, 2010. Three years later, Toppo published research from the university environment and here the participation of students in sports activities was higher among the physically disadvantaged and the interest was higher than among healthy students, taking into account specific conditions in participation according to the type of disadvantage (Toppo, 2013).

In response, the National High School Athletic Association and the National Association of Interscholastic Athletic Administrators have published a document on best practices in customized team sports for state athletic associations across the United States. This intervention was in response to the above research (NFHS, 2015). Sports, recreation, and fitness opportunities for people with disabilities are growing in number and diversity, becoming part of a growing industry in the United States and around the world (Disabled World, 2015, Shapiro and Pitts, 2014).

METHODOLOGY AND USED METHODS

For research in the field of investigation of the implementation method for the integration of people with disabilities into teams, an evaluation strategy using the description of secondary data, analysis of initial collection at the level of companies and free-times activities, sports collectives used. To create a universal implementation method using the analytical-synthetic method and the resulting method represents a certain universal template of individual implementation.

Material and methods

For research in the field of investigation of the implementation method for the integration of people with disabilities into teams, an evaluation strategy using the description of secondary data, analysis of initial collection at the level of companies and free-times activities, sports collectives is used. To create a universal implementation method using the analytical-synthetic method and the resulting method represents a certain universal template of individual implementation. It builds on the results of previous research in the field of disability of the authors of this article.

SOURCE DATA AND COLLECTIONS

Research sample

Three research samples were used for the overall results for the compilation of the implementation method, namely:

- Of 101 workers and 15 team leaders in 8 companies.
- Questionnaire survey at the level of employees/members of interest groups with health disadvantages, 303 people from the Czech, Slovak and Hungarian Republics, people with recognized disability I.III. degree. For primary investigation.
- Secondary research with internal data of 8 companies, approx. 14322-15189 (influence of seasonality of employees and interest groups).

Secondary research

For the application to the Czech environment was the contribution of the state and the determination of mines. From the research point of view, it is research using statistical processing of secondary data. Data from the CZSO, the Ministry of Labour and Social Affairs of the Czech Republic (Ministry of Labour and Social Affairs of the Czech Republic), etc. were used. In the field of sports and leisure activities, the search for secondary data was used and the implementation method was adapted for the team for sports or leisure activities.

Primary research

The research of the implementation method consists of several survey results that connect the issue of disability in the Czech environment from multiple perspectives. The specific implementation method is the result of the collection of raw data in the enterprise and is directly related to the results collected in earlier investigations, namely: A Pearson coefficient was used to confirm the correlation between company profits resulting from hours worked by employees with disabilities and factors that could affect profits, such as state support for workers with disabilities. Data was collected from 2013 to the end of 2019 and until the end of 2022. In-depth interviews were conducted semi-structured on 15 executives of leading teams of 8 corporations with or without active implementation method, questionnaire survey on 303 people with disabilities.

Used Methods

The Statistics program and the SPSS program were used for data analysis The research of the dissertation provides an overview of the issue of disability in the Czech environment in comparison

with Hungary and Slovakia, historically related territorial units, in the issue of employment of persons with disabilities and state support in employment, the research is carried out by an employer corporation and the developed method of the implementation process will be intended directly for corporations with ineffective or unimplemented implementation policies of persons with disabilities. Corporations are anonymized at the Company's request in order to provide complete sensitive data to maintain a competitive advantage. To assess the values, the evaluation was made by the graduation of the SPSS program Cohen d, Glass alpha and Hedg's g, which determine the standard deviation of the examined samples. For groups with a large difference in standard deviations, Glass alpha and use in the control group are significant, for smaller groups Hedg's g and Cohen's d are used, which evaluated the effect between two independent variables. To test the differences between the average values of numerical indicators (value of part-time work, hourly wage, etc.) for individual firms in groups (Disability yes x no), two sample t-tests were used. The assumption of normality was satisfied in the groups, the assumption of homogeneity of scatters in all groups was not. Depending on this, a variant of the test for homogeneous or non-homogeneous variances was used. Tests were evaluated at a 10% significance level, for more significant differences.

Result of the methods used

For the application to the Czech environment was the contribution of the state and the determination of mines. From the research point of view, it is research using statistical processing of secondary data. Data from the CZSO, the Ministry of Labour and Social Affairs of the Czech Republic (Ministry of Labour and Social Affairs of the Czech Republic), etc. were used. In the field of sports and leisure activities, the search for secondary data was used and the implementation method was adapted for the team for sports or leisure activities.

Implementation method

The implementation method was compiled on the basis of in-depth interviews with managers of diversity teams, corporate management and employees of corporations themselves using a questionnaire survey. The sample consisted of 101 employees and 15 team leaders in 8 companies. The method is based on the following subdivisions to adapt integration appropriately to the specific needs of the worker with disabilities. The breakdown by health disadvantage is based on S. Venclíková (Venclík, Venclíková et al., 2016). After minor modifications, this method can be transformed into the implementation of any person with mental and health disadvantages and carried out orally or in writing. Implementation brings not only a sense of interest in the person with a disadvantage, but an understanding of their behaviour, disadvantage and helps to induce a sense of belonging and happiness, which Owen mentioned in the era of pre-classical economics.

RESULTS

The specific result of the work is the implementation method for a worker with a disability in the work team listed below. The method below will help an existing or new worker with a health disadvantage to effectively integrate into the work team, facilitate the understanding of his

disadvantage, adjust his needs, job and work performance and, from the company's point of view, mainly evaluate the effectiveness of the employment of such a worker at a basic level, although the results of previous studies paradoxically show that more than 62% of people with disabilities working full-time are as or more effective than employees without disadvantage (according to hours worked).

DISCUSSION

Based on the results of this survey, the individuality with which people with disabilities must be approached is visible. This created implementation method will serve the company and the employees in many ways. It will be easier to build a suitable environment for a given workplace. Within the free-time activities and sports, this implementation method will help instructors or employees to choose the appropriate level of difficulty for the given activity, to adapt the necessary tools or to choose a suitable environment. This is precisely why understanding the needs of a disadvantaged person plays an important role. Each individual has specific wishes, needs arise from his personality, but above all from his health disadvantage and it is necessary to approach it with regard to him. It is necessary to involve workers in leisure activities to strengthen the collective, but again based on the disadvantage of the worker, e. g. there will be no joint physical activity, e.g., voleyball for a team employing a wheelchair worker. Therefore, it is necessary to understand these people, adapt and use their strong work potential, of course also in terms of human and social level.

Given the social security benefits provided to persons with disabilities, which may undoubtedly be necessary to meet their basic needs, it is best to legislate this item of expenditure so that there is no overall abuse of the benefits provided. Another option is to enact and provide direct benefits for sports and free-time activities to disadvantaged people. In this way, part of the expenses would be shifted to be used for a specific purpose, which would not lead to misuse of funds. Furthermore, this would support the inclusion of disabled people in free-time activities and sports, not only within teams made up of disabled people, but also in combined teams. It will help physically disadvantaged people to be in a group of people/athletes who are in a similar situation. Sports activities allow them to develop mental activity in addition to physical activity. Thanks to this factor, we have a wide representation of athletes at the Paralympic Games, whether winter or summer. Increasing self-confidence and motivation helps to integrate into a team of healthy athletes. Compared to the financial reward for winning a medal that healthy athletes receive, the amount for Paralympics is literally sad.

CONCLUSION

The aim of this research was to complete the implementation method for the integration of people with disabilities into work, leisure and sports teams. The research, therefore focused on the examination of persons with disabilities in work, leisure and sports teams to complete the implementation method and at the same time to verify the fulfilment of the set research objective.

The obtained results show that the implementation method represents a universal method for the implementation of a person with a health/mental handicap in a team, both in a team motivated by motivation and economy for employers, as well as for leisure and sports teams. The problem solved in this research and the obtained results of this investigation can certainly be followed up by the continuation of further research, which would focus its attention, for example, on the very introduction of the implementation methodology in various types of organizations, what difficulties this method has or, conversely, on the verification of the method by applying a specific sample, e.g. 15 athletes with different types of health handicaps in the diversity team. The diversity team and investigation would be implemented in selected secondary schools in the Czech Republic and the Federal Republic of Germany. The aim of the research can be found in the attachment to the article, as the output and ful-fillment of the stated objective of the investigation.

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The Impact of Social Media on People with Disabilities, as Well as a Tool for Effective Communication for the Corporate Implementation Policy of New and Existing Employees

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ABSTRACT

Social media is all around us, talking to us every step of the way and pulling us into the centre of the action. They control the masses of people, change attitudes to life, globalize and internationalize the entire planet. This research answers for following questions: What is the place of a person with disabilities in this huge global group? Is it possible to use social media to connect people with disabilities to the world and bring them closer to other groups of people in society? Can a company reach and effectively integrate people with disabilities through social networks? The primary data was collected based on research conducted through in-depth interviews that addressed 12 respondents from 4 corporations, 2 focused on the provision of security services, and 2 private healthcare facilities. The data has been processed in accordance with the ESOMAR Code of Conduct 2016. The results were complemented by a questionnaire survey with 303 people with disabilities integrated into work and leisure time teams. The results of the survey show a strong influence on social media on all team members with health impairments and are an effective implementation tool for communication.

Keywords: social media, people with disabilities, influence, power of implementation

INTRODUCTION

Social media can be characterized in different ways. Someone understands under this term typical social networks of today (Facebook, YouTube, Instagram, Twitter, etc.), someone on the contrary the term media within the social point of view imagines rather any communication tool in the form of, for example, television, online news, etc. The authors Pospíšil and Závodná (2012) define

social media as "a virtual place – a server where hundreds of thousands of users often meet, whose primary interest is to share personal information. An important aspect is that users want to share personal data and information with other community users using their profiles. " Janouch (2011), on the other hand, considers it a kind of "online media where content is (co-)created and shared by users". According to him, social media is constantly changing as its content changes (more and more are added more and more) and also as new features are added all the time. It could be argued that nowadays that in the Czech Republic, almost every person aged 12 and over has their own mobile phone and a social network in it, which they use to daily supply new information from various surrounding parties. It is therefore undoubtedly clear that social media will always be here and will be used more and more in private life and in work (Janouch, 2011).

As French author Marcellini (2018) states in his study/article, "physical and athletic practices are part of the social history of people with disabilities that has gradually become visible, but still little explored". Specifically, this is a development since the 1980s, when it was the decade for people with disabilities and when sport has also become accessible and possible for people with disabilities. I. e. according to this Claims currently made by people with disabilities or disabilities if they have possibilities and are physically adapted to it through their health limitations (within hearing, sight, musculoskeletal system), then they also spend their time maintaining their fitness through various sports (e. g. swimming, cycling, walking, hiking, etc.).

For example, in cycling, which is a very popular sport for people with disabilities disadvantage, the problem of safety for people without health restrictions is very often solved, let alone for people with disabilities. This is mainly due to the fact that cycling instructors They have limited training and resources for this type of people, so they can't provide them with more time for training, training and possible resources to improve the situation. (Berent et al, 2021)

In an international/global comparison, e. g. in the United Kingdom, persons with health disadvantages of sports or at least participation in public sports centres does not contribute too much. According to the study (Kung, Taylor, 2014), these people make up a really small proportion sports participants in English public sports centres where persons can socially include and share their homes, successes and failures. According to Carroll et al. (2021): "Disabled young people have in a number of areas, including sports activities, lower levels of participation in community life than peers without disabilities, which has profound implications for health, well-being and life opportunities." Therefore, there is a chance to reach people with disabilities into work, social, sports and other teams using social media and to effectively integrate them, thanks to universal communication channels of social networks. Research (Benešová, 2016) or a study (Adamčák, 2016) conducted on comparing the physical requirements of children with different social status in society in the Czech Republic focuses on the range of physical and sports activities of primary school pupils in their free time and the motivation to do them themselves.

METHOD

Research area

The research was applied in two Czech, one Slovak and one Hungarian companies. Company names and survey responses have been anonymised and translated into a single language. The

results of the in-depth investigation were written in a free transcript and evaluated by descriptive statistics. Thanks to the ability to conduct in-depth interviews, there was a 100% return on the investigation and none of the questions were rejected for answers. For the research survey, the possibilities of in-depth interviews with 12 employees with disabilities were used, which were created semi-structured and conducted in 4 corporations from the service sector, namely in two companies providing security services and two private healthcare facilities. One company in the sector has an active inclusion policy and the other does not. These are companies actively employing workers with disabilities of at least 25% of the total number of employees and across corporate positions. The pilot project was carried out on two employees with health disadvantages in a Czech company, who subsequently did not participate in the survey, it was carried out in order to verify the correctness of the questions for a group of people with disabilities.

Primary research

The primary data was collected based on research conducted through in-depth interviews that addressed 12 respondents from 4 corporations, 2 focused on the provision of security services, and 2 private healthcare facilities. In-depth interviews were semi-structured and evaluated using descriptive statistics. It was supplemented by a questionnaire survey at the level of companies, sports and leisure time groups of people with health disadvantages, when 301 respondents with health disadvantages were addressed. The full text of the questions and the deciphered abbreviations are in the annex document of the article and are available on request. Secondary data were used for a literature review on disability processing and social networks, see. List of sources.

Processing of primary research

The data was handled in accordance with the ESOMAR Code of Conduct from 2016. The survey was descriptive and conceptual with demoscopical elements. On the results of this research. In the questionnaire survey, a non-parametric Kruskal Wallis test was used for individual companies to test the differences in answers that were on the ordinary (ordinal) scale and then post-hoc tests to assess which pairs of companies showed statistically significant differences. The tests were evaluated at a 10% significance level, to detect more significant differences). Most of the questions are categorical and have only two options, the independence test in the pivot table was performed after the K-W test. Pearson's chi-squared independence test in a pivot table was used to assess the dependence of individual questions depending on the company. The tests were evaluated at a 10% significance level.

Coding in research

However, the pivot table does not clearly show the order of companies for evaluating the question. Supplemented by graphs from ANOVA below. Deficiencies were found in ANOVY due to discontinuous variables in most questionnaire survey questions, where the questions are scale or binary 1 and 0. To evaluate the questionnaire survey, quantitative signs were assigned to qualitative characteristics and abbreviations were used for possible processing in the statistical program, the list is given in the appendix of the thesis. The concept of femininity was introduced, which determines the degree of femininity of the work/sports/leisure time group at 3 levels, namely female, mixed, masculine. When the highest point is for the highest degree of femininity and that is 3.

RESULTS

From the below table and the assigned subjective values, it follows that we confirm the zero hypothesis. Interesting is the fact that the examined sample almost copies the results of EUROSTAT for 2021. The above results in full will be discussed in more detail in the article application using social media for the relationship between a worker with a disability and an employer firm. For corporate communication, it is effective to recruit and strengthen relationships with employees with disabilities through social media.

Table 1. *Descriptive evaluation of in-depth interviews (subjective evaluation, 1 confirms the suitability of social networks for communication between the employee and the company, 0 does not confirm) own source*

DESCRIPTIVE EVALUATION OF IN-DEPTH INTERVIEWS		
Wording of the question	**Answers**	**VALUES of subjective evaluation**
Are you male/female/neutral? Your age?	8x woman, 4x man median 35, modus 43	1, age group of people fully according to EUSTAT, CSU active on social networks 16–72 years
How long have you had a recognized disability status? From what event, describe?	Modus-5 years Median-3.5 years After injury 4 times, from adulthood5 times, after long-term illness 2 times, consequence of demanding treatment 1 time	Cannot be rated
Did you work before being disabled?	Yes 9x, 3x no-I don't need	
Do you have social networks, or what? How often do you use them, which do you prefer? If not, why don't you have them when more than half of the Czech population does?	Twitter Facebook Instagram Youtube Messenger	1
For what purposes do you have social networks? Private, work, etc.?		1
How do you rate social networks as a job search tool?		

What sites do you use?		
How would you like companies to offer jobs? How did they communicate with new or existing employees? Through social networks or otherwise?	Facebook, twitter, práce.cz, messenger	1
Do job offers pop up on social networks? What?	Yes 8 times, 4 x no Invalidavpraci, miscellaneous, brigade	1
Have you ever found a job offer through social networks and what kind of job offer? What kind of job and how do you evaluate it?	Ne 12x	0
Sum of values (probability level)		***0,714***
I confirm/reject the zero hypothesis		***We confirm***

Employee-level questionnaire survey evaluated using pivot tables and ANOVA test

To test the differences between the average values of numerical indicators (value of part-time work, hourly wage, etc.) for individual firms in groups (Disability yes x no), two sample t-tests were used. The assumption of normality was met in groups, the assumption of homogeneity of scatters in all groups was not satisfied. Depending on this, a variant of the test for homogeneous or non-homogeneous variances was used. Tests were evaluated at a 10% significance level. A ten percent significance level for this group of tests was chosen due to the small sample size.

In the questionnaire survey, a nonparametric Kruskal-Wallis test was used for individual companies to test the differences in answers that were on the ordinary (ordinal) scale and then post-hoc tests to assess which pairs of companies showed statistically significant differences. The tests were evaluated at a 5% significance level.

DISCUSSION

The topic of disability is also a very frequently addressed topic, not only through the sources of funding for these people and issues dealing with possible forms of how to help them via (Edwards & Nash, 2022; Friedman, 2022 etc.) But also, through the fact that within the political and social system this problem does not always need to be solved as it should. Therefore, there are a number of people in the world who deal with this issue through social media, such as Facebook and Facebook groups (Jeanette Purkis, Lisa Cox, Talya Goding, Otway Healt), Twitter or especially and probably the most widespread various blogs (Carly Findlay 2022 or Mayo Health 2022).

Based on the results of the survey, it is clear that these issues could be addressed by society and companies thanks to the connection via social media directly with the actors of events, namely people with disabilities.

The division of social media can be according to different ways, there are already a number of them nowadays. Among the best known and at the same time the best clear division can be ranked, for example, the division according to Urgerman (2014), where social media consists of social networks (e. g. Facebook), various blogs (e. g. Twitter), discussion forums or portals (e. g. Yahoo!), shared multimedia (Youtube) or even possible virtual worlds (socially based game The Sims, etc.). All these types of social media represent a certain tool within the communication channel. Yet, the most used and known various withocial networks, such as: facebook, twitter, instagram, youtube, tiktok and a bunch of other options, currently have (regardless of their preferences, popularity and functionality, style of use) the same essence, and that is the sharing of information between users and to other people possibly to the wider public.

Social media is a cornerstone for today's society, whether it is media used through communication between individuals (messenger, whatsapp, viber, instagram) or communication and information exchange across society. Especially withocial networks, they currently provide a large space for creating a profile not only for individuals (younger or older), but also for companies or various projects, see, for example, a study through the Czech Statistical Office (Burešová, Wiechetová, 2022). The increasing trend of the use of social networks and media in general by citizens in the Czech Republic within the time horizon of the past few years (specifically from 2017 to the current year 2022) can be seen in comparison with the values from 2010.

These figures show that the use of social media is still increasing. On average, this is an increase of 3 percentage points each year. However, comparing 2010 to 2017, this is already an increase of almost 35% overall, especially for people aged 16 to 24. For this age group, it is understandable that in adolescence and placement in the labor market, the media and sharing all their feelings or information with others are also starting to be used more. This fact is confirmed, for example, by the German data company Statista, which it mentions (Spěvák, 2022), because in its findings Statista claims that every person at the age of 16 currently has at least one social network, dominated by Youtube, TikTok or Facebook. However, most people retain this habit or habit of using various media over time and it can be seen that the growing tendency has continued in recent years also in older age groups from the age of 25 and over, where it is also seniors after retirement age. See also (Cieslar, 2022) or (ceskenoviny.cz, 2022).

In addition to the age groups of users of social networks in the Czech Republic, it is also possible to notice the division according to education or economic activity of individual persons, which also includes, in addition to employed people and women in the household, students, seniors and people drawing disability pensions (people with disabilities). Educated people according to the results in the table are apparently more prone to using various social networks than other groups in this category. The reason for this may be the intentional acquisition and sharing of various information to influence others with their experiences, opinions, etc. Or, however, it may also be a consequence of technological development at work, in education – people through progress and modern times must use some information channels through communication in companies (MS Teams, Outloock, zoom and others). However, what is very interesting is the fact that compared to 2010, the percentage of social media use by students and housewives has gradually increased rapidly by 2017. Students are clearly using it to study and they cannot do without social media

nowadays. However, this trend of growth in recent years is not as rapid as it is for housewives, where it is a steadily increasing trend to a greater extent even after 2017. A big jump also appeared in the category of people with some health disadvantage receiving any range of disability pension (I., II. or even III. degree), because for these people social media represent a kind of safety rope (thanks to social networks they can connect with their loved ones, friends or even employer when they cannot reach them through disabilities or walk themselves (MyCareSpace, 2022).

In comparison with other EU countries, the Czech Republic for 2021 with a total share of 62% of persons aged 16-74 was above the EU average, which was only 57%. On the other hand, the highest number of social network users was in Denmark, where 85% of the country's total population used social networks, especially such as Facebook, YouTube, Instagram or Twitter.

Employment of people with disabilities

People with health disadvantages, so-called "handicapped", have difficulty in finding a new job in the Czech Republic, because their health restrictions often do not allow them to perform any work (mostly physically demanding work) or not every company is adapted to provide them with a sufficient environment for their work. This problem usually occurs especially in manufacturing companies where employees stand for hours at the production line, assemble various components, or the production environment is so narrow and even dirty that it is not realistic for these people with disabilities to work in such an environment.

This problem of the placement of people with disabilities has long been addressed by both the Labour Office and the Ministry of Labour and Social Affairs (MoLSA), which is constantly inventing possible ways to change this situation for the better in the Czech Republic. In 2013, for example. The Further Education Fund of the Ministry of Labour and Social Affairs implemented a two-year project "Education of employees with disabilities", which was co-financed from the European Social Fund, in order to increase the possibility of employing this group of people in the labour market. The content of this project were activities aimed at: financial support for the education of employees from the ranks of OZP / OZZ, trained for HR specialists and company management, audits of suitable job positions for PWD / OZZ and consultancy on employment issues or various workshops and breakfasts for employers. The purpose of the project was to show employers, HR workers and companies in general that there is nothing wrong with employing people with disabilities and offering them vacancies. (European Social Fund in the Czech Republic, 2015)

For the company, employing this group of people has several advantages, such as an income tax credit of CZK 18,000 for each employed person with a disability, in the case of OZZ, it is already a discount of CZK 60,000 for each person. Furthermore, the possibility of the employer paying this person only the minimum wage without the obligation to give more. However, in addition to the above-mentioned financial benefits for the company, employing PWD and OZZ also benefits society through the public or corporate culture. (pruvodcepodnikanim.cz, 2020). It has never been easier for employers to find this type of people than at present, as there are already a number of websites where these people register and register with a job demand in their home or near their home. For example, these are pages: www.pracovnitrziste.cz, www.ozpprace.cz, www.prace.cz/nabidky/ozp and others.

In 2018, there were approximately 1,152,000 people in the Czech Republic with various disabilities, of which more than half were seniors over the age of 65 and more often were women. (CZSO, 2018)

In 2020, there were already 1.5 million people in the Czech Republic who had some kind of health disability or disability and were thus limited in part or most of the content of their work. The majority of these people therefore receive either a disability pension or at least contributions from the state to make up for this income difference. However, some more severely handicapped individuals will not be able to do their life without the help of someone else, and in such cases, it is unrealistic that the individual will ever be able to work or do the work alone.

In cases where handicapped people and their relatives no longer have financial reserves because they have already exhausted them or did not even have them, do not and do not receive contributions from the state in a sufficient amount to cover all the necessary costs with care, etc. of their disabled family member, then various non-profit organizations helping these people, for example, play a big role here. One of the well-known non-profit organizations is the worldwide helping humanitarian and development organization ADRA (2023), which already operates in more than 100 countries around the world. This non-profit organization was founded in 1992 and its goal is to help not only during various natural disasters (flood, tsunami, tornado, ...), but also to help people in difficult life situations in various ways and generally improve the living conditions of people living in poverty. Volunteer centers are deployed all over the world and in every country to connect volunteers (i. e. people willing to help others) with those who need help for the elderly, the disabled, the abused, etc.

CONCLUSION

Social media and their influence are still growing in popularity, both through communication between people of different types with each other, and also in terms of contact, for example, between companies and their customers. Companies use social networks in order to keep their customers, not to lose them, and at the same time to get more awareness of them or to attract more new customers (promotion of the company). Social media is already a tool that moves the world today, so it's an ideal vehicle for companies to get the word out. Some companies use different types of social media, or specifically social networks, to find out what is more important to customers, what they want, what the business should improve or stop producing or start, etc.

Demonstrating a high level of use of social networks thanks to the survey and its importance in a wide spectrum of use for the target group across gender and age policy brings further scope for reaching a large group of people with disabilities not only in leisure activities, but also in sports groups and work teams. As this study shows, it is a universal tool across age groups, regardless of team gender composition and disadvantage. In addition, it is evident from the obtained results that it is possible to use social networks to connect different types of people, i. e. people with disabilities, to the surrounding world and to bring it closer to other groups of people in society, as social networks today bring everyone together and connect everyone and everything with everyone. I. e. even organizations and companies of different types can reach their potential customers through social networks or even integrate them effectively.

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Mapping of Literature on Sport and Religion Research: Scientometric Review

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ABSTRACT

Throughout history, many sports evolved from rituals performed at religious festivities. In light of this fact, it is apparent that religion and sports are symbolic systems or emblematic structures with shared values and goals. This study aims to provide a comprehensive overview of the descriptive parameters of publications by visualising citation patterns, extracting authors' keywords, and determining the influence and performance of research on religion and sports. The current study examined 1,408 publications concerning sports and religion in the Scopus and WoS databases, spanning 1899 to 2022. The results revealed a notable rise in publications regarding sport and religion following 2015, with a more substantial increase in Scopus publications than WoS. The United States accounts for about 457 of the total worldwide publications. In addition, the title of the scientific source, "Games and Economic Behaviour", is the most active, with 19 documents. With 170 documents, the keyword "physical activity" appears most frequently in this analysis. The trending topic with the most considerable absolute growth is "physical activity". The trending topic with the most significant relative growth is "osteoarthritis". In general, the research in this field is still changing as new techniques and avenues for conveying significant findings about values, appropriate cultural behaviour, and the extent of health emerge. This investigation helps generate novel ideas in the diverse study of the connection between sports and religion. The significance of spiritual values in physical activity, athlete injuries, and athletes' psychological growth is an area that warrants additional exploration.

Keywords: Sports, religion, physical activity, osteoarthritis, scientometric

INTRODUCTION

Despite variations in laws and practices, religions encourage their followers to participate in sports for various reasons, such as improving health, entertainment, and disease prevention. Sports and religion are inextricably linked and cannot be considered separate entities. Sofyan et al. (2022) liken sport to a narcotic or an opiate, allowing individuals to fulfil various social, economic, entertainment, and health-related desires. According to Sofyan et al. (2021), sports have become an indispensable part of human life, especially for those who view athletics as a fundamental aspect of their religious beliefs. For instance, Islam recommends swimming, running, horseback riding, archery, and wrestling (Kızar 2018; Marwat et al. 2014; Shavit & Winter 2011). Similarly, Christianity embraces athletics as part of its witness (Blazer, 2019). Sports such as cricket, football, hockey, volleyball, baseball, and basketball were among the earliest sports played by Christian missionaries, educators, and YMCA officials (McLeod et al., 2018). In Jewish culture, baseball, basketball, boxing, football, cricket, and tennis are played by immigrants from America (Alpert 2019; Dart 2021). Buddhists promote their religion by playing basketball (Casas 2017; Yu 2011), and Hindus learn to wrestle and play kabaddi (Bhattacharya 2012). This close relationship between sports and religion emphasises the importance of sports for religious adherents.

Researchers worldwide are increasingly interested in studying the relationship between religion and sports, as evident in the works of Carlson (2014), McLeod et al. (2018), Mazurkiewicz (2018), Blazer (2012), Trothen (2019), and Watson & Parker (2014). One study by Mackintosh and Dempsey (2017) delved into how young people perceive their religious identity (Islam) concerning their participation in sports. In the context of Christianity, Blazer (2014) explored how Christian values can validate or refute modern sporting ideals and practices and how they can contribute to the future of sports. The connection between sports and religion is essential for developing harmony, stability, community, and peaceful coexistence, as Jona and Okou (2013) pointed out. In modern sports culture, self-promotion and pride are virtues, and sports and religion provide individuals with a sense of status, self-worth, and identity, according to Clark (2015).

Although certain researchers believe that religion plays a crucial role in enhancing sports performance, some do not concur with this view. This disagreement stems from the common misconception that religion and sports have no connection. According to Cheng (2019), religion does not impact an individual's exercise choices. Furthermore, it is challenging to determine how religion affects sports (Noh & Shahdan, 2022), and researchers in both athletics and religion have expressed reservations about this topic (Parker & Watson, 2014). Most social scientific research on sports tends to downplay the significance of examining the religious dimensions of sports (Gibbons et al., 2017), and athletes often separate their religious beliefs from their sports practices, viewing sports as a secular endeavour (Ronkainen et al., 2019). Due to its influence on the social self and physical culture, especially in education and sports, religion receives less attention than other topics (Benn et al., 2011). Therefore, the lack of empirical research in sports and religion (Scholes, 2015) highlights the need for special consideration and attention (Alpert, 2014).

Encouraging the growth and development of scientific publications related to sports and religion is necessary to enable the field to compete with other areas. In order to gain a more

comprehensive understanding of the distribution of sports and religion research, our research utilises scientometric analysis. Several studies have explored different subdomains of these fields, such as the development of faith in young athletes who participate in sports (Livingston, 2019), attention to confession rituals and performance-enhancing drugs (Blazer, 2020), the role of sports pastors in critical examining sports and its relational dynamics (Jones et al., 2020), the psychological perspective of religion and spirituality in sports (Noh & Syahdan, 2020), insights from religious studies about the sport as a system of meaning (Sosis & Goalkeeper, 2022), religious treatment for elite athletes' pre-competition emotions (Hagan, 2021), and religion-based physical activity intervention (Silfee et al., 2017).

This study attempts to contribute to a better knowledge of the current publication patterns in sports and religion research. This comprehension can facilitate future research endeavours on sports and religion for scholars and academics. In contrast to other broad topics, however, there is a shortage of scientometric reviews of sports and religion research. This study aims to fill this void by conducting a scientometric analysis utilising the ScientoPy, VOSviewer, and datasets gathered from the Scopus and WoS databases. This study seeks to address the following research questions:

RQ1: What is the distribution of articles published in each database over the years, and how are the subject areas distributed? What types of documents are included?

RQ2: Who are the most prolific authors publishing articles on sports and religion?

RQ3: Which countries, institutions, and scientific sources are the most active in publishing articles on sports and religion?

RQ4: What are the most commonly used keywords by authors, and what terms have been popular in the past two years?

THE RATIONALE FOR CONDUCTING SCIENTOMETRIC ANALYSIS

In line with the introduction context, we have chosen to conduct a scientometric analysis for this study to contribute to advancing research on sports and religion. Scientometrics quantitatively analyses scientific activities, encompassing input, output, and processes, using mathematical statistics, computational technology, and other mathematical approaches (Zhou et al., 2019). The field of scientometrics employs quantitative research methodologies to explore the evolution of science as an information process (Mingers & Leydesdorff, 2015; Ramy et al., 2017; Chellappandi & Vijayakumar, 2018; Gonzales et al., 2021), as well as communication patterns and science policy (Mohan & Kumbar, 2021; Velmurugan & Radhakrishnan, 2015). Furthermore, it examines scientific outcomes' trends and gradual development (Nyika et al., 2021).

Scientometrics has evolved significantly from the sociology of science and is now more closely aligned with library and information science (Leydesdorff & Milojevi, 2015). A deeper comprehension necessitates scientometric analysis (Lai et al., 2017). Scientometrics frequently utilises statistical and mathematical methods to analyse scientific literature quantitatively and qualitatively (Nath & Jana, 2021). The combination of scientometrics and social network analysis

has made a compelling argument supporting research collaboration (Ceballos et al., 2017). Scientometric data aids in assessing the breadth and progress of scientific research and serves as a criterion for evaluating the standards and excellence of scientific research productivity (Wani & Zainab, 2017; Young et al., 2015). ScientoPy is a script-based Python tool that enables temporal scientometric analysis. Temporal analysis may be used to determine the emergence of new phenomena and their development into emerging trends or issues (Ruiz-Rosero et al., 2017).

METHOD

Selection, retrieved, and collection of data

Scientometric analysis is a technique that enables researchers to comprehend the nature of research based on existing literature. In this study, scientometric analysis is employed using the information framework mapping method to examine the current state of research and organise the theoretical structure of publications (Abdullah, 2021a). A likely reason is that this approach assists in understanding the publication patterns in sports and religion better. Furthermore, this method enables the evaluation and incorporation of established research directions while comprehending developing trends in the field (Abdullah, 2021b). Consequently, it is vital to use a multidisciplinary database to search and identify literature related to sports and religion. It is essential to perform a database search with high-impact factors to obtain a list of high-quality and frequently cited papers. Thus, the Scopus and Clarivate Web of Science (WoS) databases were selected for this study as they meet these requirements. ScientoPy is a tool that can process datasets retrieved from these two primary databases (Ruiz-Rosero et al., 2019).

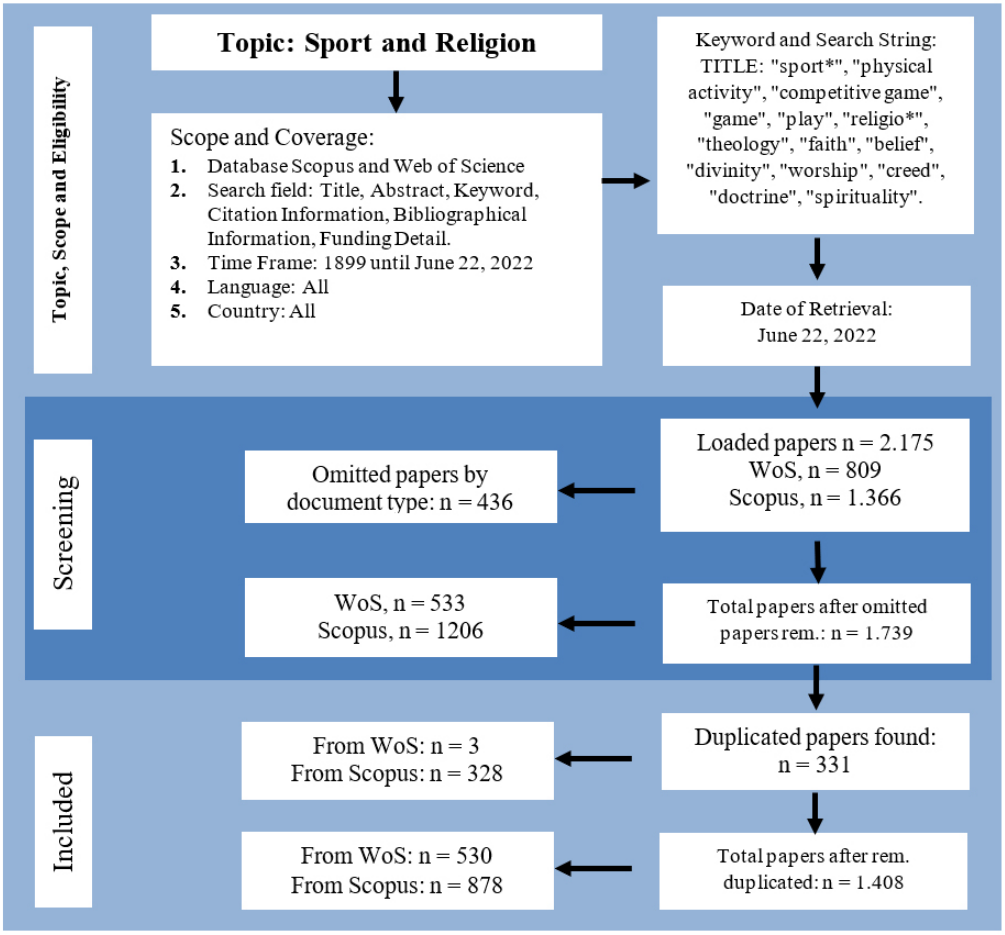
ScientoPy is a Python script that automatically generates and reports on the main topic (based on the author's keywords), the author's country, institution, publication, and related documents. This automated data synthesis avoids the potential for bias, as in individual studies. The results obtained in processing different data have greatly helped researchers (Abdullah & Sofyan, 2023; Cruz-Ordonez et al., 2018; Ruiz-Rosero et al., 2017). The tool used to analyse the bibliography of documents is a different literature review manuscript called ScientoPy (Pabon et al., 2020).

A search was carried out on June 22, 2022, to compile a list of publications related to sport and religion without considering the year of publication by Scopus and WoS. The initial approach used TITLE-ABS-KEY in Scopus and Topic in WoS for string searching. However, after manually examining the documents, it was discovered that many articles were unrelated to sports and religion. Therefore, the search method was revised to use the search string TITLE. ScientoPy is a valuable tool for ensuring that the data collected from Scopus and WoS databases is free of overlapping or redundant datasets during the preprocessing stage of scientometric analysis. It is too capable of categorising popular, specialised, and trending topics in scientometric data analysis. The PRISMA flowchart is also a helpful tool to guarantee that papers are located, assessed, and submitted using a standardised and transparent method.

Figure 1 illustrates the method for collecting documents from Scopus and WoS databases. This process likely involves identifying relevant keywords and search terms, specifying search criteria and filters, and exporting datasets for analysis. The data collected from Scopus and WoS

databases can then be preprocessed using ScientoPy to remove any duplicates or inconsistencies of the datasets. Once the data has been cleaned and organised, it can be used for further analysis and visualisation, such as generating citation networks, co-authorship networks, or keyword co-occurrence maps.

Figure 1. Flow chart of data collection approach (adopted from Moher et al., 2009).



Data analysis strategy

Figure 2 gives a summary of the preprocessing phase that employs ScientoPy. It illustrates the number of documents extracted from each database and the number of duplicate entries removed. The chart suggests that Scopus contained more papers after eliminating duplicates than WoS. The preprocessing stage resulted in a total of over 300 publications that were deemed valid for this study. This is because a minimum threshold of 300 validated publications is generally expected for conducting bibliometric analyses (Donthu et al., 2021).

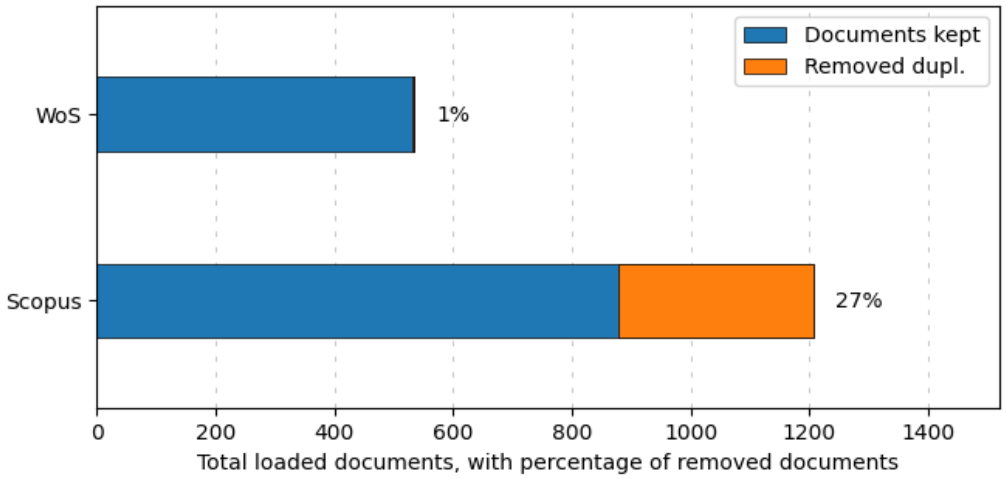


Figure 2. Preprocessing of data from the WoS and Scopus databases

After obtaining validated datasets, the subsequent stage involves running a scientometric analysis with ScientoPy and VOSviewer. This study applies ScientoPy to investigate developments and research trends in sports and religion. Ruiz-Rosero et al. (2019) revealed that ScientoPy employs five visualisation charts - timeline, trend bars, evolution, and word cloud - to present the distinctive features of the study. Nevertheless, the authors employed four visual charts, excluding bars, to interpret the results and gain diverse information in this study. VOSviewer is used to construct bibliometric mappings to explore the co-occurrence of author keywords. Van Eck and Waltman (2010) quantified that VOSviewer includes visual components derived from mapping techniques that transform CSV data into clusters or diagrams. As a result, mapping algorithms enable researchers to analyse detailed data such as authors, institutions, locations, citations, co-citation, and other refinement components (Abd Aziz et al., 2020). This study used the author's keyword as the analysis unit to investigate the co-occurrence analysis type.

RESULTS

This section offers readers an understanding of the current status and trends in sports and religion research. Indeed, the insights from this analysis can be invaluable for future researchers, as they provide a comprehensive reference point for gaining in-depth knowledge of sports and religion. The analysis begins with a descriptive overview of publication trends in sports and religion, encompassing the number of publications over time, highly productive authors and institutions, and the most frequently cited papers. This overview can facilitate the identification of the most influential authors and institutions in the field and offer insights into the main research topics and themes. Subsequently, the researchers perform a content analysis to recognise the most common research topics and themes in sports and religion literature. This involves scrutinising the publications' titles, abstracts, and keywords to recognise the frequently occurring topics and themes. The researcher then applies clustering algorithms or network analysis to recognise the connections between these topics and themes and visually present the primary research directions

and subfields in sports and religion.

Ultimately, the researchers performed a bibliometric analysis to pinpoint the most influential journals and highly cited papers in sports and religion. This approach can shed light on the impact of various journals and publications and the crucial research domains propelling the field's development. Through the analysis, the researchers can offer readers a detailed summary of the present research situation in sports and religion, along with significant findings about the main research directions and future trends shaping the field.

The evolution of publications, significant subject areas, and document type specifics

Analysing publishing trends yearly can be beneficial in identifying research topics. Databases provide a multitude of advantages, such as tracking personal career progress, identifying partnership and funding opportunities, locating relevant literature, selecting appropriate journals for publication or subscription, and more (Pranckute, 2021). Therefore, it is crucial for future researchers and readers to understand the research theme, which can attract aspiring scholars seeking to enhance the factors that impact annual publication fluctuations (Abdullah & Sofyan, 2022).

Figure 3 shows a significant growth in the number of publications related to sports and religion after 2015, with a higher increase observed in Scopus compared to WoS. Scopus is considered a leading data source due to its high-quality scientific publications across different academic fields. It is frequently updated and preferred by researchers in various fields due to its high impact factor.

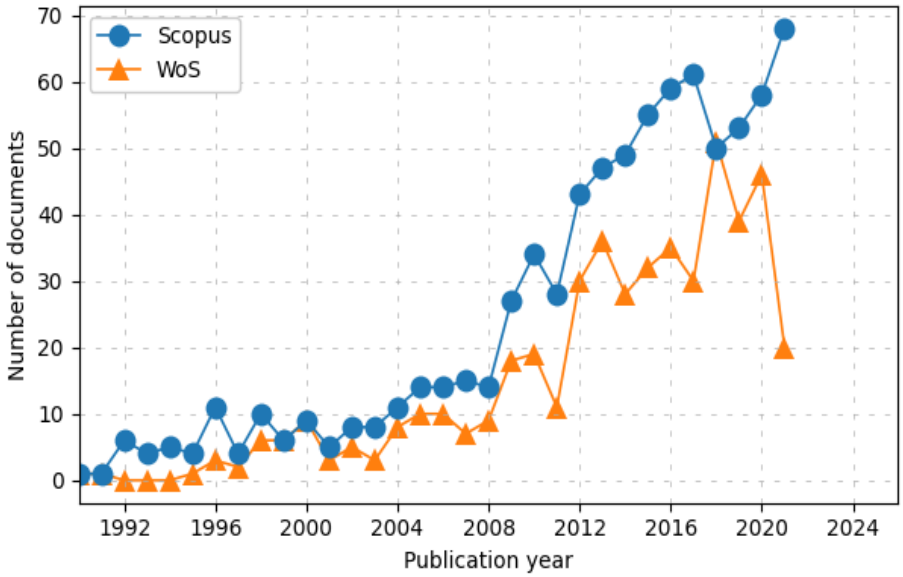


Figure 3. Timeline graph of publication productivity

Although Scopus is a well-regarded source for scientific publications, it is crucial to recognise that its impact factor is not necessarily higher than WoS's. The impact factor measures the average number of citations published in a particular journal received in a given year and is calculated by Clarivate Analytics, the parent company of WoS. In contrast, Scopus employs its measure of citation impact known as the Scopus CiteScore. WoS and Scopus have strengths and weaknesses, and researchers may use one or both databases based on their research requirements. It is always

advisable to consult multiple sources and evaluate the quality of publications individually.
Scopus has a more comprehensive journal coverage than WoS, while WoS continues to be more selective in its journal coverage (Singh et al., 2021). Over the years, Scopus has earned an equal place as a comprehensive source of bibliographic data and has proven reliable and, in some ways, even better than WoS (Zhu & Liu, 2020; Harzing & Alakangas, 2016).

The increasing research interest in sports and religion in both databases demonstrates the importance of these topics for advancing research on sports and religion issues. For example, although religious or spiritual research in sports psychology is relatively neglected compared to the general psychology or medical science literature, previous research has highlighted the need to further study its importance in athletes' lives (Noh & Shahdan, 2022). Over the past 40 years, there has been a steady growth in the academic literature on sports and religion (Mazurkiewicz, 2018). Scholars exploring the intersection of sport, spirituality, and religion have developed rapidly in recent years (Trothen, 2019; Watson & Parker, 2014). These scholars and others have demonstrated the importance of introducing new theories and methods to studying sports and religion.

A crucial aspect of researching religion and sports is to analyse and assess theoretical and conceptual frameworks from different fields of study, as emphasised by Smith and Waller (2018). While no research solely concentrates on the relationship between religion and an athlete's career development and transition, several studies in sport psychology and sociology have touched on the intersection of religion and sports (Ronkainen et al., 2019). Moreover, religion has been found to be a crucial source of significance for some athletes who face challenging situations such as injury or subpar performance (Nesti, 2011).

It is imperative to review relevant research publications as this allows the identification of essential areas in which research on sport and religion has been carried out. The top 20 subject categories that can be used to classify sports and religion research from the Scopus and WoS databases are depicted in Figure 4. Based on Figure 4, "Religion" has been identified as the most investigated area, with a total of 147 documents. These results indicate that research in the field of religion mainly focuses on psychological aspects, health and physical activity. This is evidence that sport has the capacity to achieve goals similar to those achieved by organised religions (Bain-Selbo & Sapp, 2016; Trothen, 2019). The relationship between sport and religion has been intertwined and influential for centuries, dating back to ancient times, as noted by Alpert (2014).

As indicated by 87 documents, the second study area is "Social Sciences-Other Topics." One possible reason for misconceptions about integrating religious values into sports is a lack of understanding of the intersection of sports and religion. Both scholarly discourse and public perception often associate sports with religion, despite the fact that the definition of sports does not necessarily have a direct connection to religion, even though athletes may also be members of religious communities (Ronkainen et al., 2019; Barnat, 2019).

Figure 4. Word cloud graph of subject areas

Figure 5 displays the categories of documents that can be identified using ScientoPy, which include high-ranking research publications based on SJR (Scimago Journal Rank) and JCR (Journal Citation Reports). It should be noted that certain document types, such as books, editorials, errata, reports, and meeting abstracts, are not eligible for publication. However, it is possible to adjust the ScientoPy settings to modify the filtering of document types.

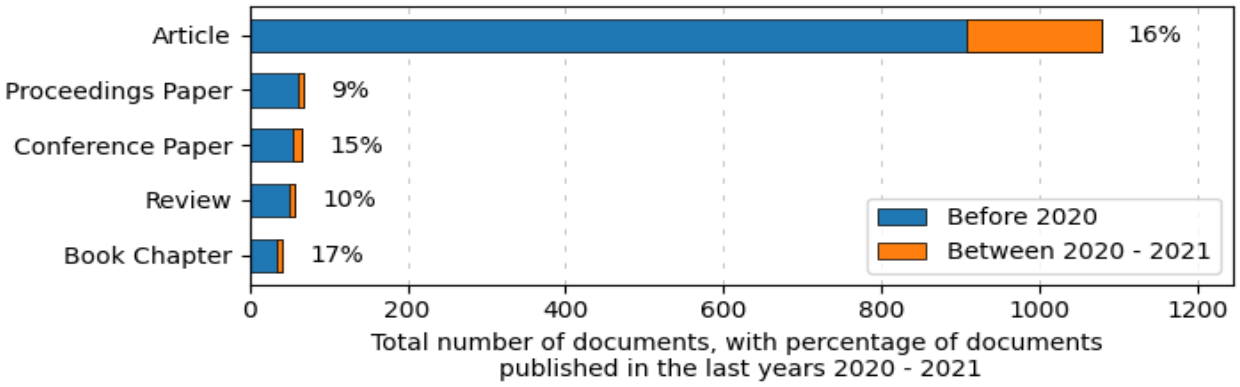


Figure 5. Documents type related to sport and religion that have been tracked

Figure 5 shows that articles are the most commonly tracked document type, with 1,077 documents and a declining AGR of -2.0, indicating a decrease in the number of publications on the topic. This means that there are differences in the average number of articles published per year compared to the previous year. Proceedings papers are the second most common document type, with 68 documents, followed by conference papers, review papers, and book chapters, with 66, 57, and 42 documents, respectively. Book chapters accounted for 16.07% of sports and religion

publications in 2020 and 2021, with other document types accounting for more than 10%, including articles (15.08%), conference papers (15.02%), and reviews (10.05%), following the current trend.

The proactive authors

Figure 6 represents the top 20 authors by the number of publications on sports and religion research in both databases. The thickness of the words describes that higher frequency. In this study, Parker, A., and Wilcox, S., were the most proactive authors, with a total of seven publications produced. Based on the authors' expanded results in ScientoPy, an article co-authored by Parker, A., with Sarkar, M., and Hill, D.M., published in 2014, entitled "Working with religious and spiritual athletes: Ethical considerations for sport psychologists," got the highest number of citations with 24 citations. This article is about how sports psychologists can better navigate the often-challenging landscape of working with athletes whose everyday lives and identities are based on religious and spiritual associations. Then, the article written by Wilcox, S. et al. (2007), entitled "The Health-e-AME Faith-Based Physical Activity Initiative: Description and Baseline Findings", which was published in Health Promotion Practice, Vol. 8, No. 1, pages 69-78, obtains 53 citations. The overview of the development, implementation, and baseline findings of faith-based physical activity (PA) initiatives across the United States are significantly enhanced by this study.

Figure 6. Word cloud graph of proactive authors

A second proactive author, Bain-Selbo, E., has published six articles related to sports and religion, and based on the author's expanded results in ScientoPy, an article written by Bain-Selbo, E., in 2019 in the journal Religions, entitled "Affect Theory, Religion, and Sport". Based on the article, Bain-Selbo, E. concludes that a proper view of influence theory is essential for studying sports' religious or spiritual dimensions. Moreover, it holds great promise as a tool for understanding the religious or spiritual dimensions of secular or seemingly non-religious cultural phenomena, particularly sports (Bain-Selbo, 2019).

The authors' proactive evaluations and publications show that the study of sports and religion covers various topics involving physical activity, health, mental health, and psychology. Indirectly, this topic can inform readers and other researchers that sports knowledge and religion are closely related and often interest previous researchers. As a result, there is a growing demand for a thorough examination of studies related to sports, physical activity, mental health, religion, and spirituality.

The most active countries, institutions, and scientific sources

The study has created a list of countries with the most highly ranked publications on sports and religion, ranking them in the top ten. According to Figure 7, the United States has the highest number of publications, with 457 documents published. The United Kingdom (142), Canada (81), and Australia (76) follow as the second to fourth countries with over 70 documents published. Spain has attracted the highest percentage of publications related to sports and religion in 2020 and 2021, with 31.08%, while Canada (28.04%), Germany (26.07%), and China (26.01%) have published papers with over 20% in the same period. This analysis helps to identify which countries are actively researching sports and religion-related topics.

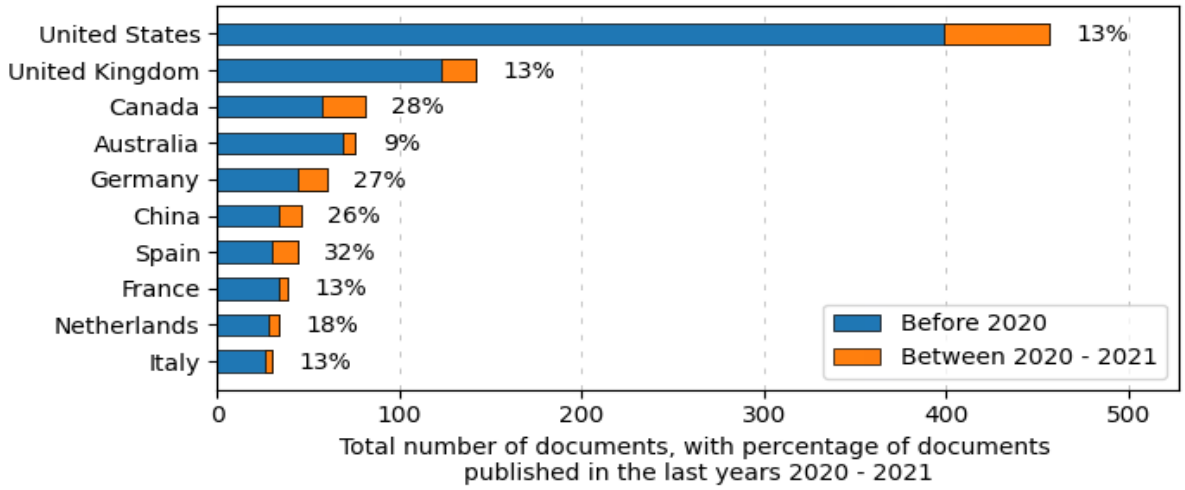


Figure 7. The top ten most active countries in the field of sport and religion

Table 1. The top ten scientific sources

Rank	SourceTitle	Total	AGR	ADY	PDLY	h-Index
1	Games and Economic Behavior	19	-0.5	01.00	10.05	10
2	Religiosus Ludens: Das Spiel Als Kulturelles Phanomen in Mittelalterlichen Klostern Und Orden	16	00.00	00.00	00.00	1
3	Religions	14	-2.0	01.05	21.04	5
4	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	12	02.00	02.00	33.03	2
5	Journal of Religion & Health	10	00.00	00.00	00.00	6
6	Journal of Disability and Religion	10	00.00	00.00	00.00	3

7	Psychology of Sport and Exercise	10	00.00	01.00	20.00	8
8	Journal of Economic Theory	9	00.05	00.05	11.01	7
9	Journal of Sports Sciences	8	-0.5	00.00	00.00	4
10	Frontiers in Psychology	7	-0.5	02.00	57.01	3

Description: AGR (average growth rate); ADY (average documents per year); PDLY (percentage of documents in last years)

Every author featured in the publication has an institutional affiliation which ScientoPy uses in its processing. Researchers can benefit from this information when searching for research residencies or enrolling in academic programs or research projects, as it helps them to identify the most relevant institutions in the field (Abdullah & Sofyan, 2023). The study also enhances the reputation of the institutions and encourages further writing to achieve high standing. Figure 8 is a word cloud that illustrates the 20 most productive institutions in sports and religion-related publications. As shown in the figure, the larger the size of the institution, the greater the number of publications. According to the current study, Pennsylvania State University (USA), University of Gloucestershire (UK), University of Split (Croatia), and University of Tennessee (USA) are the top four institutions, each with six published documents. Indiana University (USA), Stetson University (USA), University of Gdask (Poland), University of South Carolina (USA), and Western Kentucky University (USA) follow closely with five published documents each.

Researchers can choose research sources or participate in some of their academic programs or research projects by knowing which institutions are most representative in the disciplines of sport and religion. The scientific source with the most significant number of published article documents is "Games and Economic Behavior," which has 19 documents. Measuring Beliefs in an Experimental Lost Wallet Game by Dufwenberg and Gneezy (2000) gained 235 citations, making it the article in this journal with the most citations. With 16 documents, the scientific source "Religions" comes in second place for having the most papers published. The ten most fruitful published scientific sources on sport and religion are shown in Table 1, along with brief descriptions.

The projected of relevant authors' keywords and trending topics

The term "author keyword" refers to a specific keyword that the author of a document chooses to help readers and researchers find relevant information within the document. Various search engines, databases, and journal sites commonly use this keyword. ScientoPy has the ability to use author keywords to track the progression of a particular research topic or search query. In this section, the author's keywords from previous studies are analysed to determine research trends. To ensure accuracy, similar American and British spellings, as well as singular and plural keywords, can be combined, along with their abbreviations. This manual process helps to organise the data and eliminate duplicate terms, resulting in more complete results.

Figure 9 shows ten keywords from previous research. As seen in Figure 9, the larger the keyword size, the more significant the number of articles. In 170 documents, the keyword "physical activity" appears most frequently in this analysis. In second place is the keyword "religion", which has been used in 70 articles. The third most common term is "beliefs", which appears in 69 publications. In

fourth place is the keyword "sports", which has been used in 51 articles. Based on the results, it is imperative to recognise that physical activity, beliefs, religion, and sports are the basis for studying sports and religion in the context of sports and religion. Faith-based organisations promise to promote physical activity, consequently tackling health disparities. However, in order to accurately evaluate the effectiveness of services provided by faith-based groups, high-quality randomised clinical trials are required (Tristao Parra et al., 2017). The impact of an athlete on political and collective action and the interaction of race, sport, gender, and religion are presented (Fontanilla, 2020). Although "motivation" is placed ninth in accordance with the present trend (2020 and 2021), its PDLY is ranked first with 50.00%. Exercise (29.04%) and self-efficacy (20.00%) are other terms having published papers with more than 20% in 2020 and 2021.

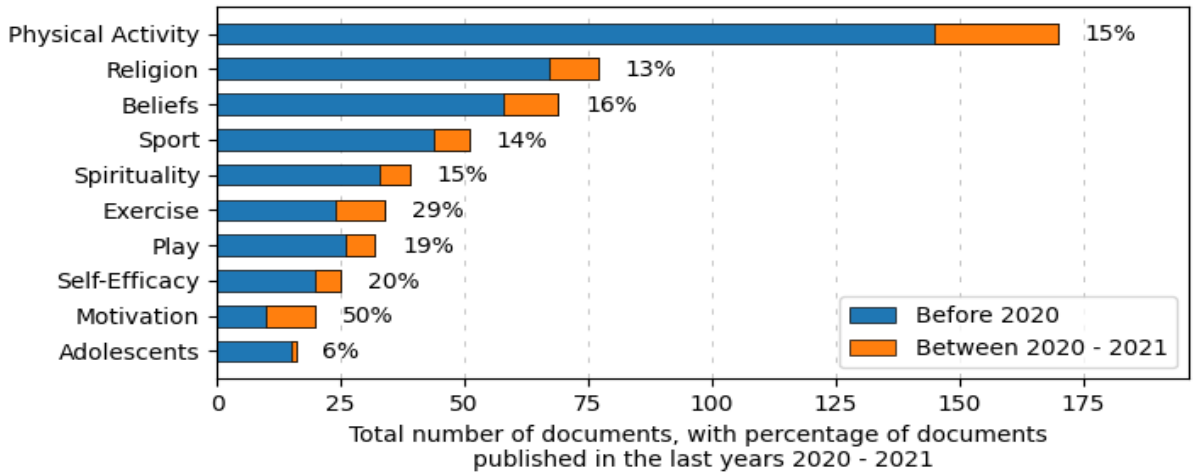


Figure 9. Word cloud graph of the ten authors' keywords

The co-occurrence of author keywords produced by VOSviewer is also examined in this study. After that, a concurrent keyword network was carried out using VOSviewer software (van Eck, 2010; 2019) and a thesaurus file (Gutiérrez-Salcedo et al., 2017) to remove duplicate terms from our database. This software is a popular keyword-processing tool (Hoppen & Vanz, 2016). These keywords consist of the author's keywords, displayed below the abstract, and ISI's KeyWordsPlus, which are words or phrases frequently appearing in the article reference title but not in the article title itself (Jiménez-Garca et al., 2020). Prior to delving into the findings, a thesaurus file with alternate spellings, abbreviations, and singular and plural combinations was created (Abdullah, 2022).

VOSviewer displays relationships between keywords. VOSviewer is a widely used tool for visualising and analysing bibliometric networks. In VOSviewer, the size of a node represents the frequency of a particular term or keyword in the dataset, while the thickness of the line connecting two nodes represents the strength of their co-occurrence. The overlay diagram in Figure 10 highlights the author's keyword and its connections to other keywords using colour, node size, and line thickness. The statement also suggests that only 28 out of 2,901 keywords met the minimum requirement of having at least ten occurrences in the dataset. This indicates that the authors may have filtered the dataset to focus on the most relevant and frequently occurring keywords. Additionally, the statement suggests that the blue nodes in the diagram represent previously researched terms,

while the red nodes represent new or less researched terms. This could indicate that the authors are attempting to identify emerging trends or areas of research that require further investigation.

The VOSviewer results allow us to conclude that the most frequently used keywords throughout 2014 were "beliefs" (74 occurrences), "adolescents" (18 occurrences), "game theory" (16 occurrences), "health" (15 occurrences), "culture" and "physical education" (13 occurrences), "attitudes" (12 occurrences), "children" (10 occurrences). The keyword strength with "physical activity" showed that "beliefs" resulted in 30 link strengths, "adolescents" (11 link strengths), "health" (10 link strengths), "culture" (4 link strengths), and "children" and "physical education" (3 link strengths). The newest keyword that started after 2017 is "play," with 34 occurrences. This keyword has three link strengths with "religion", "sport" (1 link strength), "spirituality" (1 link strength), and "children" (1 link strength). Other new keywords are "religiosity" (18 occurrences), "video games", and "qualitative research" (10 occurrences).

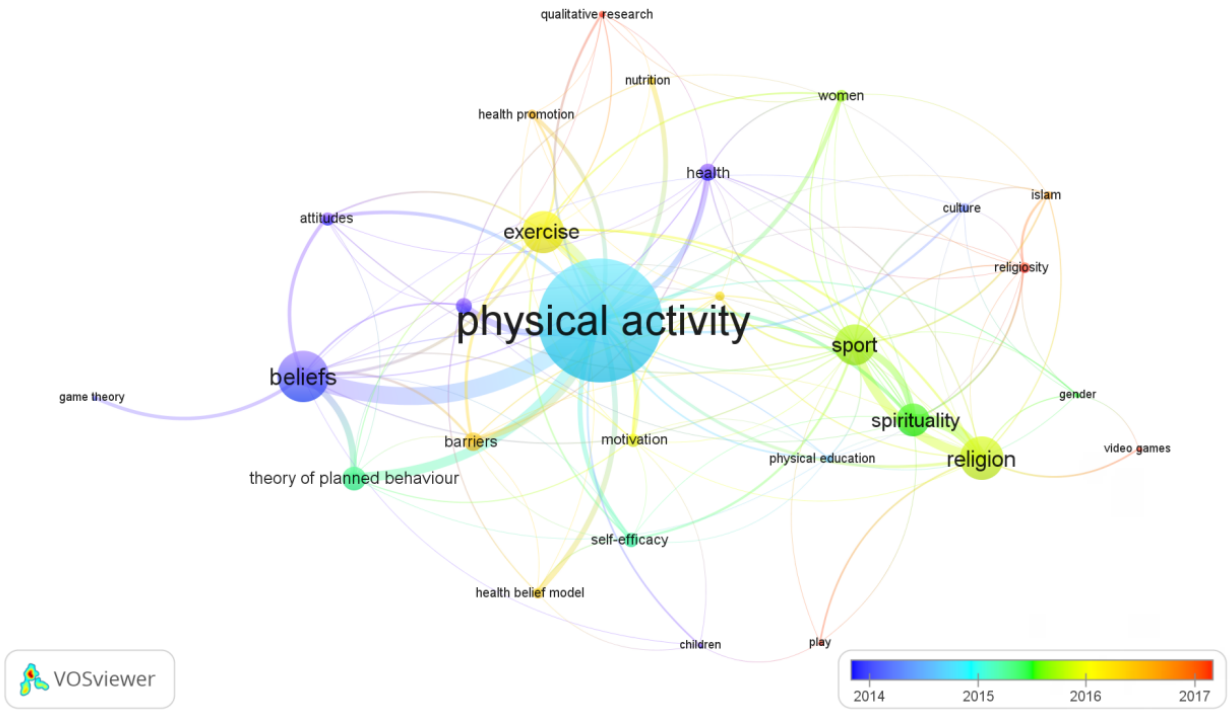


Figure 10. Overlay visualisation of the co-occurrence of authors' keywords

Academics in sports agree that the body and embodied activities such as sports have deep theological meaning (Sullivan, 2019). Any practice can virtually express physical development and attainment and add deep spiritual insight into our daily lives (Hutch, 2012). However, there has been no investigation into the adverse psychological effects of religion on sports (Noh & Shahdan, 2022). However, players in various sports have long been encouraged to play their best game for the glory of God (Purdy, 2016). Several sports psychology and sociology studies have explained how religion and sports intersect (Ronkainen et al., 2019).

ScientoPy can be used to identify trending topics by analysing the top author keywords with the highest AGR (average growth rate) as described in the "Topic growth indicators" section. Figure 11

is a plot that shows the evolution of the most popular trending topics in sports and religion. The plot shows the cumulative number of documents published for each topic on the left-hand side, while the right-hand side shows the AGR of each topic for the period 2021-2022, with the X-axis representing the PDLY (percentage of documents in the last years).

The trending topic with the most considerable absolute growth is "physical activity," indicating that this topic has seen the highest increase in publications in the period analysed. The statement also states that the trending topic with the most considerable relative growth is "osteoarthritis," suggesting that this topic has seen the highest increase in publications relative to its previous activity level.

Figure 11 represents ten trending topics based on the author's keywords, implying that the authors have used ScientoPy to analyse the keywords in the dataset and identify the topics seeing the highest growth.

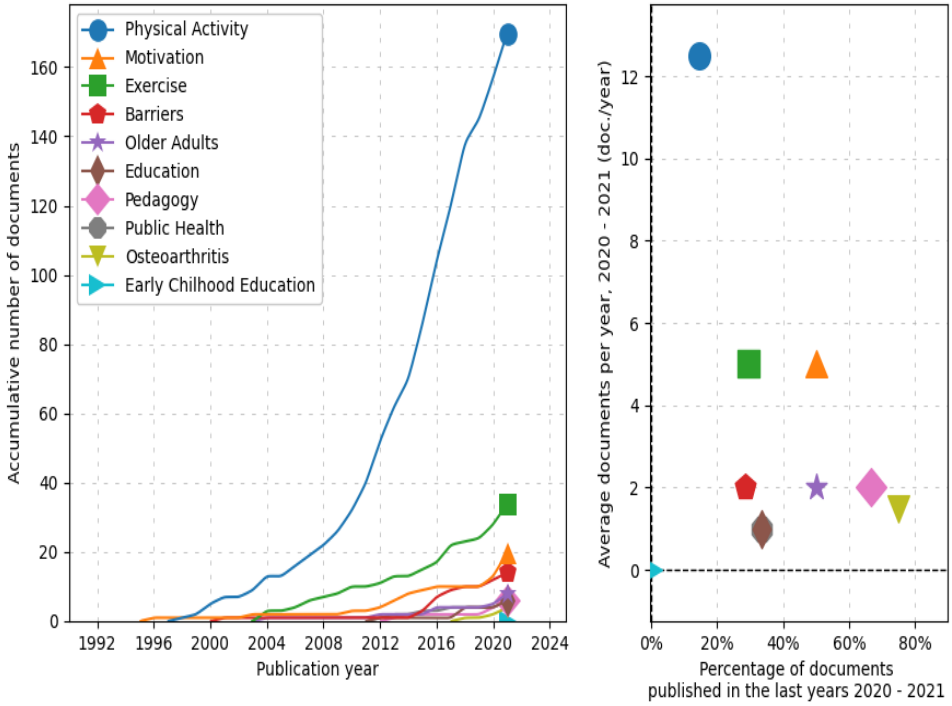


Figure 11. Top ten trending topics based on the author's keyword

DISCUSSION

The present study offers a comprehensive review of the vast body of research examining the intersection of sports and religion, utilising two highly regarded databases, namely Scopus and WoS. Through content analysis of authors' keywords, the study has identified areas of concern that warrant further investigation. The study has maintained a consistent approach by formulating research questions and ensuring the discussion remains focused on the predetermined topic. The outcome is a thorough and in-depth analysis of the subject matter.

The increasing research interest in sport and religion in both databases demonstrates the importance of this topic for advancing research on sports and religion issues. For example, although religious and spiritual research in sports psychology has been relatively neglected compared to general psychology or medical science literature, previous research has highlighted the need to learn more about its importance in the lives of athletes (Noh & Shahdan, 2020). Over the last 40 years, there has been a steady growth in the academic literature on sport and religion (Mazurkiewicz, 2018). Scholars exploring the intersection of sport, spirituality, and religion have proliferated recently (Trothen, 2019; Watson & Parker, 2012). These scholars and others have demonstrated the importance of introducing new theories and methods to studying sport and religion.

Based on its excellence in scientific work for various academic fields, Scopus has proven to be a top data source. Scopus has a high impact factor. The WoS continues to be more selective in covering journals, while Scopus has a broader range of journals (Singh et al., 2021). In recent years, Scopus has established itself as a reliable source of comprehensive bibliographic data and is, in some respects, even superior to WoS (Zhu & Liu, 2020; Harzing & Alakangas, 2016). As a result, many universities require professors to publish their academic papers in Scopus-indexed journals to promote the prestige of their universities, attract new students, and absorb research funding. In addition, universities require full-time professors to include articles in the WoS. From another point of view, students, for example, we can see that publication in Scopus or WoS is quite a challenge that must be overcome.

There is no doubt that every professional should respect the personality's authentic aspects and spiritual needs so that he or she can remember these five features of spiritual health in preparation for actual activities in physical education, sports training, or sports performance (Jirásek, 2015). Perhaps more importantly, scholars should seek to critically engage theoretical and conceptual models from all disciplines when studying religion, physical education, and sports (Smith & Waller, 2018). While there has been no specific research on the intersection of religion and an athlete's career development and transition, previous studies in the fields of sport psychology and sociology have provided insights into this area (Ronkainen et al., 2019). However, further research is necessary to fully understand the significance of religion in the lives of athletes (Noh & Shahdan, 2022).

The first piece on the subject of religion and sports to appear in either database was titled "Psychological, Pedagogical, and Religious Aspects of Group Games" and was authored by L. Gulick in 1899 for the periodical "The Pedagogical Seminary." This article makes an effort to tie some of the studies together and offer some potential directions. This is more illustrative than definitive. It generally presents summaries, conclusions, and points of view. The studies conducted concern: 1) the psychology of play, especially in the plays of Anglo-Saxon teenage boys; 2) the relationship between this instinct to play and the serious business of life, especially with the higher functions of social and psychic life; 3) the ways in which a genuinely religious life of service to humanity can be initiated and nurtured adequately in the boy; and 4) the proper direction of activities for organisations to foster religious life.

Another interesting discussion that can be drawn from this research is that academics of physical education and sports agree that the body and its embodied pursuits, such as sports, have profound religious significance (Sullivan, 2019). Physical activity and exercise can offer deep spiritual insight

into our daily lives and practically express physical progress and accomplishment (Hutch, 2012). However, no studies have examined the detrimental psychological impact of religion on physical education and sports (Noh & Shahdan, 2022). However, athletes in various sports have long been urged to give everything for the glory of God (Purdy, 2016). Several studies in sport psychology and sociology have explained the relationship between religion and sports (Ronkainen et al., 2020). While schools and school districts may enforce dress codes, they may not explicitly prohibit students from wearing clothing that conforms to their religious traditions. Because wearing certain jewellery serves as a reminder of faith, students are allowed to wear crosses (Protestants), crosses (Catholics), stars of David (Jews), or upright pentagrams (Wiccans) to school and, by extension, to physical education (Kahan, 2011). According to Macdonald (2003), physical education is one of several subjects that fall under the umbrella of health and physical education, health education, outdoor education, home economics, and religious education. It is embedded in all strands of Australia's health and physical education curriculum, including spirituality, according to Lynch (2015). In Brazil, how to relate Christian teachings in other ways to manage the bodies they learn is outside the domain of religion and the extent to which physical education creates tension in that relationship (Rigoni & Daolio, 2014). Physical education in many Western countries has mainly been influenced by orthodoxy and tenacious Christian principles (MacAloon, 2006) and Protestant morality (Robinson, 2018).

Based on the results of the keyword analysis, first, the findings indicate that it is essential to recognise that physical activity can be used as a starting point for studying sports and religion. Faith-based organisations plan to promote physical activity, which will help address health inequities. High-quality randomised clinical trials are needed to reliably assess the efficacy of services offered by faith-based organisations (Tristo et al., 2018). In addition, there are faith-based programs to promote physical activity (Bopp et al., 2012; Joseph, 2017), and the use of these interventions can be a successful strategy (Duru et al., 2010). It is crucial to conduct more in-depth and comprehensive studies on the impact of excessive physical activity or exercise leading to death, as many cases of sudden death are triggered and occur in both athletes and non-athletes. Over the past decade, researchers have concentrated on determining the true incidence and causes of sudden cardiac death in athletes. A 2011 study using the National Collegiate Athletic Association (NCAA) database revealed that only 56% of the 80 deaths between 2004 and 2008 were due to cardiac causes. The leading causes of sudden non-cardiac death are heat stroke and sickle cell disease (Harmon et al., 2011). Maron et al. (2016) released a large study in 2016 using data from the US National Registry of Sudden Death in Athletes from 1980 to 2011. There was a total of 2,046 athlete deaths, with 802 certified as sudden cardiac death by autopsy. Drug use and sickle cell disease are the most common non-cardiac and non-traumatic causes of sudden death. It is currently not feasible to find a practical solution to this issue. Notwithstanding, if the role of religion and spirituality is considered, the most effective approach would be to rely on prayer for protection, guidance, and support while dealing with the risks and uncertainties associated with sports. Adhering to religious principles can provide security and guidance in navigating such situations.

Second, related to the immense relative growth of keywords, namely "osteoarthritis". Knee osteoarthritis is the most common type of osteoarthritis (Davatchi et al., 2008), ranks 11th out of

291 and is the leading cause of pain, impaired mobility, and socioeconomic costs on a global scale (Whittaker & Roos, 2019). The likelihood of injury to the knee increases when an athlete has had a previous injury and makes the existence of post-traumatic development more meaningful (Vann et al., 2018). In these cases, many injured athletes turn to their religious or spiritual practices or beliefs to help cope with the stress that could lead to stopping competing (Najah et al., 2017) and facing critical moments such as injury or poor performance (Nesti et al., 2017). The findings in this group of athletes support the idea that religion plays a constructive role in enhancing adaptive coping and reducing negative emotions in athletes with career-threatening injuries (Najah et al., 2017), hopelessness, and anxiety (Shadan et al., 2022), mainly as a result of the injury. Osteoarthritis is among the most common causes of knee discomfort and decreased athlete performance. Previous studies have shown that athletes are more likely than the general population to develop knee osteoarthritis (Altamura et al., 2020). In addition to occurring in athletes, knee injuries are common in the elderly. Activities and routines carried out by each religion are different and have specific characteristics in worship. For example, since childhood, Muslims have been taught to perform "Shalat" worship, which involves many flexion movements. Worship "Shalat" is obligatory and sunnah (mandatory: 5 times a day, unlimited sunnah). So, it is clear that Muslims perform the "Shalat" (flexion) movement several times a day, so consciously or not, these activities carried out regularly can train knee strength. In addition, Islam requires Muslims to pray in congregation in the mosque, which involves walking and some movement of the knees, even though the degree of flexion is not as extensive as during the prayer ritual. From a medical perspective, the movement involved in prayer can stretch the soft tissues around the knee and reduce stiffness and contact stress on the articular cartilage (Chokkhanchitchai et al., 2010).

Therefore, various elements must be considered in encouraging the willingness of individuals to develop their identity through sports that prioritise religious values. Concerned students, athletes, managers, coaches, policymakers, spectators, and physical education teachers can develop new and better methods for incorporating religious principles into sports practice with this in mind. Programs such as providing facilities for religious leaders or religious experts to be able to add a religious touch to athletes are significant because they can make athletes appreciate everything that is gained sincerely, such as defeats and injuries. Thus, there is a great need for further development of the constellation between religion, sports performance, and physical activity to obtain more comprehensive information for the development of science and to create a new civilisation.

CONCLUSION

Failure to integrate religion into physical activity, such as physical education and sports, can lead to an imbalance between physical and spiritual health. It can undermine the principles of sportsmanship and fair play. In order to foster the willingness of individuals to develop their identity through sports that uphold religious values, multiple factors must be considered. Students, athletes, managers, coaches, policymakers, spectators, and physical education teachers should devise innovative approaches to incorporate religious principles into sports practice. One way to achieve this is by offering facilities for religious leaders or experts to impart religious teachings to

athletes. Such programs are crucial because they can help athletes appreciate the genuine gains that come with experiences such as defeats and injuries. Hence, there is an urgent requirement to conduct extensive studies on how religion, sports performance, and physical activity intersect. This would facilitate the acquisition of thorough knowledge that can be used to propel scientific advancement and promote the development of a new civilisation.

This study is a starting point for future research on the intersection of sports and religion. It can lead to more in-depth investigations, such as systematic literature reviews, meta-analysis, thematic analysis, and empirical studies, to obtain more accurate information about this research's content, method, discussion, and results. Future research can also examine elements of fundamental theories of ideals, reality, practicality, nature, and humanism, which are analysed concretely in sports and religion. Additionally, most studies on the intersection of religion and sports have taken place in Western countries where Christianity holds a dominant position, leaving limited research on the relationship between sports and religion in other major religions such as Islam, Buddhism, Hinduism, and Judaism. Consequently, future researchers are strongly encouraged to delve into these religions in the context of sports and religion.

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Development of a Questionnaire Focused on Sports Coaches Learning

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ABSTRACT

Coaching is one of the most demanding social, helping and pedagogical professions. Therefore, research attention is rightly paid mainly to formal coach education aiming at adequate preparation for the practice of this profession. In recent years, however, many empirical studies have demonstrated that non-formal coach education is playing an increasingly important role in coach development in addition to formal coach education. At the same time, research findings show that it is not only the completed "official" coach education that is crucial for the professional development of each coach, but above all, it is the complex results of their lifelong learning. Therefore, it is essential for various sports institutions, for sports educational facilities, especially for coach educators, to have information about the course, features, and potential problems related to lifelong learning of specific sports coaches. Therefore, our paper aims to create a research tool – a questionnaire that identifies the essential circumstances of lifelong coach learning. The design of the questionnaire builds on our previous research on formal, non-formal and informal coach education and, in particular, on the results of many analogous international empirical studies on coach learning. These starting points show that the following areas play an essential role in the lifelong learning process of coaches: (1) personal sports and coaching experience, (2) reflection (self-reflection) of this experience, (3) professional sharing of coach experience, (4) mentoring and (5) accessible and understandable coach learning information resources. We prepared a working version of the questionnaire based on the above principles. This research tool aims to identify sports coaches' learning and education processes. We designed the questionnaire containing 66 items (closed, open, semi-closed, and scales) to suit various respondents – coaches (multiple types of sports, competitive and recreational sports, different age groups, beginners and experienced coaches, etc.). With the help of experts, the questionnaire and the validation

process was designed in the Czech language and took place in the Czech sports environment. The first stage of verifying the draft version of the questionnaire consisted of an expert assessment. A total of 6 active coaches (three male coaches and three female coaches from the environment of top, competitive and hobby sports), who were acquainted with the theoretical basis of the questionnaire, recommended minor corrections to the questionnaire. The second stage of the questionnaire verification took place in interviews with six coaches (again working in competitive and leisure sports) who were not acquainted with the theoretical basis of the questionnaire. This stage focused on the clarity and unambiguity of individual items. The revised questionnaire was subsequently converted into an electronic form. The functionality of the final electronic version of the questionnaire was verified within a pilot study (n = 18).

Keywords: coaching knowledge transfer; informal coach education; peer-to-peer learning; mentoring; professional sharing

INTRODUCTION

Quality performance in any activity is primarily related to human learning. Empirical research focused on learning and education is intensively devoted to human activities (professions), the successful performance of which, due to its complexity, requires a vast amount of adequate competencies, i.e. not only knowledge and skills but also attitudes and incentives. Many kinds of research are therefore devoted to the issue of learning and education for complex social professions, e.g. teachers (Šeďová et al., 2016; Švaříček, 2011) or doctors (Alshok, 2016, p. 792).

The demanding social, helping, and educational professions also include coaching. In coaching, the focus is mainly on licensed coach education. The definition of this education is a process in which future or current coaches learn to coach (Trudel & Gilbert, 2006, p. 516). Coach education should ensure adequate preparation for successful coach practice. It turns out, however, that in sports coach education (especially in the Czech Republic), formal education with a transmissive conception still prevails (Kovář, 2011). However, numerous global researches document that in addition to formal (licensed) education, nonformal education also plays an increasingly important role in the necessary coach professional gradation (Mallett et al., 2009; Martens, 2006; Nelson, Cushion, & Potrac, 2006). Research findings (Mc Carthy, 2020) further demonstrate that the performance of coaches is not determined only by their completed coach education. The coach activities reflect the complex results of their lifelong learning, i.e. all forms of organized and, at the same time, individual coach education and autonomous learning.

Research on coach learning, which fits into the broader framework of adult learning and education, can be based on various theoretical concepts. A constructivist approach is currently predominant in the study of coach learning and education (Leduc, 2012, p. 4). He describes learning as a process in which the learner constructs his experiences. Our experiences are the constructs of our perception and awareness of the world, and we primarily learn from these experiences.

Empirical research focused on the lifelong learning processes of coaches (e.g. Mc Carthy, 2020) identifies many significant areas in the professional gradation of coaches. It turns out that effective

forms of learning, especially for coaches, consist of a whole range of individual and social activities. These are mainly the following areas:

1. gaining personal sports and coach experience,
2. reflection and self-reflection of these experiences,
3. professional sharing of coach experiences,
4. mentoring and
5. effectively use accessible and understandable information resources for coach learning.

(1) Personal sports and coach experience

Personal and professional experience is significant in coaching or the whole complex of complex social, helping and incredibly educational professions. Analogously to coaches, teachers help other people in their development. They consider their practice the most significant source of their professional theory. "The main principle behind a teacher's educational theory is his experience that it works" (Švaříček, 2009, p. 317). Teachers compare old and new knowledge to see if the newly created solutions match the authentic experience. Teachers primarily rely on their personal experience, "only when they encounter a problem do they seek advice from their colleagues" (Švaříček, 2009, p. 319).

The professional activities of coaches are also primarily based on personal sports experience. These experiences come from one's own sports career, reflect positive or even negative experiences with their coaches and are gradually supplemented by the acquired coach experience. These three aspects significantly influence novice coaches' work and, as documented by the case studies of excellent sports coaches (e.g. Jones et al., 2004), are also crucial for expert coaches. The importance of coach experience is reflected in decision-making on specific coaching issues, and the most experienced coaches can choose the assumption of a strategic coordination role (Vergeer & Lyle, 2009).

The interviewed coaches further believe that coach experiences include practical day-to-day coaching and many other aspects of a coach's life (Mc Carthy, 2020, p. 44). Experience with own coaching is incredibly vital. For example, many research participants reported that their time as a coach provided them with opportunities to improve their coach skills. "I think I'm always getting better as a coach through experience" (Greenberg & Culver, 2020, p. 22).

(2) Reflection and self-reflection of experiences

Research shows that coaches learn especially in such a way when they reflect on coaching experiences from practice (Gilbert & Trudel, 2006). Therefore, reflection on the coaching experience is a crucial element of coach education (Cushion et al., 2003). At the same time, reflection offers a conceptual framework for connecting and understanding coach education, theory and practice (Nelson & Cushion, 2006). Reflection and self-reflection, as a vital part of a coach's learning, can take place, for example, by sharing ideas and experiences in peer group learning or using challenging questions posed by a mentor (Mc Carthy, 2020). Coaches above all appreciate this way of learning. On the contrary, they often criticize the mandatory completion of formal coach education precisely because these courses for coaches do not reflect their everyday coaching experience.

Deliberate reflection can play a significant role in the professional development of coaches. In this case, experienced coaches intentionally set aside more time to reflect on their coaching practices (Greenberg & Culver, 2020).

(3) Professional sharing of coach experiences

Armour (2011) emphasizes that for coach education and learning effectiveness, it is essential if coaches can collaborate and share information with other colleagues as part of their development. In this way, communities of practice can be created, which Culver and Trudel (2006, p. 98) characterize as a group of people - sports coaches who share a common interest, set of problems or passion for a specific topic and who deepen their knowledge and expertise in this area through ongoing interaction.

In particular, peer learning develops within these professional communities, i.e. learning "taking place between two or more persons who are not in a mutually hierarchical relationship" (Brücknerová, 2021, p. 13). Peer learning promotes friendly relationships and is used in human resource management in organizations. Today, peer learning is primarily associated with user forums and social networks. Peer learning develops communication and interaction, which coaches greatly value in their professional development (Greenberg & Culver, 2020). The cooperation of coaches and their shared reflection facilitate coaches' learning and, thus, a supportive coaching environment (O'Dwyer & Bowles, 2021).

Mc Carthy (2020) states that even if some coaches are not explicitly involved in communities of practice, they use peer-to-peer learning, which is a very effective way of learning for them. Involvement and engagement in contacts with other world experts are especially typical for globally successful coaches (Mc Carthy, 2020, p. 44).

(4) Mentoring

Today, not only sports unions and associations or sports faculties participate in the lifelong learning of coaches. Sports clubs and sports centres must also actively support the education and learning of their coaches. Within this "club" education, mentoring plays a key role, where experienced coaches pass on their knowledge to younger colleagues. Mentoring is now widely advocated as an essential part of coach learning, both informally and as a constituent feature of coach development programmes (Bailey et al., 2019). The coaching environment thus increasingly becomes not only a place where athletes learn. However, more recently, it has also begun to be a place where coaches' professional learning and development take place (Cushion, 2006).

At the same time, mentoring is related to the requirements of coaches who prefer learning through informal ways in their development. Mentoring can be a typical example of such learning. Mentoring is effective because coaches learn within a social and cultural construct and gain experience through interactions with coaches-mentors (Cushion, 2006). Mentoring is more than just imparting technical knowledge and coaching tips. The entire process involves observing the practitioner and "…imitating and reflecting on coaching practices" (Mc Carthy, 2020, p. 38).

Jones et al. (2009) point out that mentoring on a general and specific level – i.e. within sports coaching – is challenging to define. An effective mentoring program will mainly consist of a number of the following elements:

- It is formalising the mentoring relationship and developing the ground rules and expectations for the relationship.
- It is identifying the needs of the person being mentored at the beginning of the relationship.
- They are setting goals for the mentoring experience and periodically checking that these goals are being met.

- It provides a challenge for both the mentor and coach.
- It is flexible in the degree of formality involved in the mentoring programme.
- It provides training for mentors. In this context, mentors should have the opportunity to share their experiences.
- Mentoring is a fluid and dynamic process requiring patience.
- The degree of mutual trust between mentor and mentee appears necessary for a successful mentoring relationship.
- The mentoring process should be facilitative and nurturing, not allowing mentors to dominate (Jones et al., 2009, p. 281).

At the same time, the key condition for an effective mentoring relationship is terms of trust (Bailey et al., 2019, p. 81).

Mentoring is traditionally understood as a collegial relationship between two individuals – a mentor and a mentee. In the elite sport environment, the use of multiple mentoring is now recommended, and specifically to enhance bespoke mentee development (Sawiuk et al., 2017, p. 411).

Lefebvre et al. (2021) state that mentoring can fulfil other functions beyond the traditional conceptualizations of mentoring, e.g., protect coaches from threats to their job security (i.e. protection from adversity), serve as role models, and contribute to their career advancement via employment opportunities.

(5) Accessible and understandable information resources for coach learning

Knowledge transfer, i.e. the transfer of scientific information into practice, is key in every professional activity, i.e., coaching. Its essential part consists of accessible and understandable information resources for coaches learning. The history of sports proves that when it was possible to transfer the results of science into a coaching practice effectively, athletes achieved excellent results. For example, we can recall the phenomenal results of athletes in ancient Crotone in the years 588-488 BC. At that time, athletes from Crotone won more than 20 Olympic victories. In Crotone at this time, a unique symbiosis of philosophy and science (Pythagoras and his followers), especially medicine and sports, arose, creating extremely stimulating conditions for developing an original coaching concept. This situation may explain that in this century, athletes from Crotone were better than representatives of other ancient Greek city-states (Mann, 2001). The effective use (unfortunately, often misuse) of sports knowledge undoubtedly contributed to the extraordinary results of the athletes of the former Soviet Union at the beginning of the second half of the 20th century. Bourne (2016, p. 67) aptly described these sporting achievements as the rise of the "Heavy Red Sports Machine".

Coaches currently have more extensive information resources (primarily English-language scientific literature available in cyberspace). However, research results show that a specific problem of coach learning is the "gap" between the findings of sport and movement sciences and coaching practice (Esteves et al., 2010; González-Rivera et al., 2017; He et al., 2018; Kubayi et al., 2019). The stated situation can thus deepen the paradox that the amount of available knowledge (relevant scientific knowledge) coaches do not need to reflect in their learning, which should mainly develop their professional competencies. Therefore, various intervention strategies to strengthen and facilitate the transfer of scientific knowledge into coaching practice must also participate in the adequate development of coach education and learning.

Effective transfer of the latest knowledge, i.e. the scientific understanding of the sport and movement, into coaching practice thus constitutes a crucial requirement for the effective learning of all coaches. Çelik (2020) reminds us that sports and sports education existed primarily in practical activities for a very long time, i.e. all participants in sports and sports education are physically present. However, times have changed dramatically, especially in sports education, and computer technologies have firmly established themselves. In this context, the concept of e-learning today represents a significant trend that will continue to develop dynamically. Mainly, the covid-19 epidemic significantly contributed to this development in sports education. E-learning in the field of sports sciences is more focused on individual participants (Çelik, 2020) and constitutes an essential source of learning, especially for coaches.

Currently, substantial sources of informal learning for sports coaches are textual and visual information, especially videos on the Internet (Koh et al., 2018). Current professional knowledge, especially in sports and movement sciences, is thus primarily available via the Internet, most often in English. The language competence of the coaches, especially their active knowledge of English, can thus form one of the significant obstacles in their learning (He et al., 2018).

Effective transfer of knowledge is also a significant task for coach educators. They must develop support structures that enable coaches to identify better and use quality information sources. The goal is to create a supportive social environment that will contribute to coaches' learning so that their informal development is sufficiently open, reflexive and critical (Stoszkowski & Collins, 2016).

The professional development of coaches is a multi-layered complex of formal, nonformal and informal education and learning. In particular, the learning processes of the coaches themselves are of key importance in this process. Werthner and Trudel (2006) defined the typical so-called learning situations of sports coaches. They emphasized that in the practice of coach education, there is no significant polarization between cases of directed learning (primarily within formal courses for coaches) and undirected learning (e.g. during discussions with other colleagues). At the same time, they emphasized the importance of reflection using quality teaching materials, i.e. external experience or internal experience, i.e. empiricism, which already forms the cognitive structure of the learning coach. Respecting the importance played by all three types of learning situations mentioned should influence the development of coach education. Special efforts should be made to develop materials for coaches that are relevant to them and ensure that qualified teachers and instructors effectively distribute them. Facilitating indirect learning situations for coaches is less obvious but still significant. Coaches and their educators should realize that indirect learning situations do not always have to be random. "Coaches can seek out and even create these situations themselves, and sports organizations should support them in these activities" (Werthner & Trudel, 2006, p. 209).

METHODS

The stated starting points show that many aspects, conditions and processes play a significant role in the lifelong learning process of coaches. Therefore, it is essential for various sports institutions and sports educational facilities, especially coach educators, to have information about the course, features, areas, and potential problems related to the lifelong learning of specific sports coaches.

Therefore, our paper aims to create a research tool – a questionnaire that identifies the essential circumstances of lifelong coach learning.

The stated starting points show that individual sports and coaching experience, reflection and self-reflection of these experiences, professional sharing of coaching experiences, mentoring and quality information resources for coach learning play an essential role in the lifelong learning process of coaches. In this context, we are next to the main research question – How do sports coaches learn? – formulated five secondary research questions. These questions specifically focus on the five areas listed above.

The construction of the questionnaire follows, on the one hand, Czech research on formal, non-formal and informal coach education and learning (Jůva & Tomková, 2010; Gállová & Jůva, 2018; Kotlík & Jansa, 2020). The main starting points for creating the questionnaire were international theoretical and overview studies and the conclusions of empirical research on coach learning. A brief overview of them provides the introduction of this article. Pervasive empirical research by Nelson (2010), namely questions for interviews with coaches (Nelson, 2010, p. 208) and a questionnaire (Nelson, 2010, p. 210–215), had a concrete methodological contribution to the creation of the described questionnaire.

We prepared a working version of the questionnaire based on the above principles. This research tool aims to identify sports coach learning and education processes. We designed the questionnaire containing 66 items (closed, open, semi-closed, and scales) to suit various respondents – coaches (male and female, beginners and experienced coaches, multiple types of sports, competitive and recreational sports, and different ages groups, etc.).

The first stage of verifying the draft version of the questionnaire consisted of an expert assessment. A total of 6 active coaches (three male coaches and three female coaches from the environment of top, competitive and hobby sports), who were acquainted with the theoretical basis of the questionnaire, recommended minor corrections to the questionnaire.

The second stage of questionnaire verification took place in the form of interviews with six coaches (again, three female coaches and three male coaches) working in elite sports, performance sports and sports for health who were unfamiliar with the questionnaire's theoretical basis. This stage focused on establishing the comprehensibility and clarity of individual items. In this phase, we tested the wording of the questionnaire questions in a probe using an interview (Gavora, 2010, p. 124). Respondents were tasked with explaining whether they understood each question and how they understood it. Only a few minor corrections resulted from this probe. At the same time, this phase found that less than 5% of the responses selected were N – Don't Know in the range of scaled items.

The revised working version of the questionnaire was subsequently converted into an electronic form in the Google Forms environment (https://docs.google.com/forms), which enables the export of results to MS Excel and other statistical programs. The functionality of the final electronic version of the questionnaire was verified within a pilot testing, with the participation of 18 respondents. The technical validation of the instrument was carried out without any problems.

RESULTS

On the basis of an extensive literature study of conducted and published research in our area of interest, we identified 5 areas related to the process of coach education. We then constructed our research instrument around these sections.

The first section reflected **(1) Personal sport and coach experience** (Švaříček, 2009; Jones et al., 2004; Vergeer & Lyle, 2009; Mc Carthy, 2020; Greenberg & Culver, 2020). We designed complex questions, primarily capturing the development of one's own coaching practice from education to consideration of one's own sport experience.

(2) Reflection and self-reflection of experiences was the second section of our instrument (Gilbert & Trudel, 2006; Nelson & Cushion, 2006; Mc Carthy, 2020; Greenberg & Culver, 2020). It appears that the coaches' expertise develops especially when they reflect on coaching experiences. Reflection also provides a conceptual framework for connecting and understanding the relationship between theory and practice. **(3) Professional sharing of coaching experiences** is a powerful tool for coaching gradation (Armour, 2011; Culver & Trudel, 2006; Bruckner, 2021; Greenberg & Culver, 2020; O'Dwyer & Bowles, 2021; Mc Carthy, 2020). For coach education and learning to be effective, it is essential that coaches are able to collaborate and share information with other colleagues as part of their development. In this way, professionally focused communities can emerge. Today, peer learning is mainly associated with user forums and social networks.

Informal activities of sports clubs and individuals are increasingly involved in the lifelong learning of coaches. For this reason, we have created and included section **(4) Mentoring** (Bailey et al., 2019; Cushion, 2006; Mc Carthy, 2020; Jones et al., 2009; Sawiuk et al., 2017; Lefebvre et al., 2021). Thus, the coaching environment is increasingly becoming more than just a place where athletes learn. More recently, however, it is also becoming a place where professional learning and development for coaches takes place. At the same time, mentoring is related to the requirements of coaches who prefer learning through informal ways for their development. Mentoring can be a typical example of such learning. It is effective because coaches learn within a social and cultural construct and gain experience through interactions with coaches-mentors.

The last section of the developed tool **(5) Accessible and understandable information resources** for coach learning alludes to the situation that a specific problem of coach education is the „gap" between sport and exercise science knowledge and coaching practice. It turns out that not all research results are understandable for coaches. This is particularly reflected in the fact that for some coaches, ‚scientific language' and active knowledge of English is a limiting barrier to their professional gradation (Mann, 2001; Bourne, 2016; Esteves et al., 2010; González-Rivera et al., 2017; He et al., 2018; Kubayi et al., 2019; Çelik, 2020; Koh et al.) In this section, the questionnaire asks to what extent trainers use Czech and English written information sources, whether they actively participate in conferences, workshops, video lectures, search for information in professional journals, and so on.

After identifying 5 sections, we created specific questions and had 6 experts (coaches) from the sports environment (3 male and 3 female coaches from top, competitive and recreational sports) to assess these. Based on their recommendations, we made minor adjustments to the questionnaire, especially in the areas of education, the use of electronic educational materials and social networks

for sharing experiences (for example: not all coaches passed the matriculation exam, drawing information from podcasts and audiobooks...). The second phase of the questionnaire validation took the form of interviews with six coaches (again working in competitive and recreational sport) who were not familiar with the theoretical basis of the questionnaire. This phase focused on the clarity and unambiguity of the items. The revised questionnaire was subsequently converted into electronic form. The functionality of the final electronic version of the questionnaire was verified in a pilot study (n = 18). It should be noted that this was a validation of a research instrument, not empirical research per se.

The final product was the design of our research instrument. The created questionnaire contains five parts. In the first part, 14 items determine primary personal and professional data, educational attainment, and personal sports and coaching experience. The second part of the questionnaire is crucial from the point of view of its goals – it ascertains the course and circumstances of coach learning. The 25 items in this section are related to reflection and self-reflection of coaching and others, mainly social, empirics, the way of obtaining professional information, the use of informal coach education offers, the way of solving coaching problems and the sharing of professional experiences. This part further examines the view of coaches on effective coach learning activities or their issues and barriers.

The third part of the questionnaire reflects the cooperation of the addressed coaches with mentors. The 12 items of this part determine specific forms of cooperation between mentor and mentee and, above all, the importance of mentoring in the development of the addressed coaches. The fourth part of the questionnaire examines specific sources of coach learning. Twenty-one items ask about using printed resources, especially the work of coaches with electronic information resources. The final part of the questionnaire ascertains other stimuli for coach learning. These data, focused on future recommendations and proposed measures for coaches, will be necessary, especially for coach educators who work in sports associations, sports faculties, and individual sports clubs.

DISCUSSION

As part of the pilot verification of the questionnaire, we recorded mainly positive reactions from the respondents. The contacted coaches confirmed the importance of their own experience, reflection and self-reflection, and especially mentoring in their professional development. They have expanded the range of learning resources to include some other areas that – from their point of view – play an increasingly important role in coach learning (e.g. audiobooks or podcasts).

Along with Nelson et al. (2013), we hypothesize that coaches who strive to become better practitioners will provide detailed evaluations and recommendations for effective coach education and learning practice when completing the questionnaire.

CONCLUSION

Based on the content analysis of scientific texts focused on the issues of coach learning and education, we created and verified a research tool – a questionnaire – called "How sports male and

female coaches learn to coach". The questionnaire is available in the Czech version in the Google Forms electronic environment (Czech title „Jak se sportovní trenérky a trenéři učí trénovat"). In the following stages of our work, we anticipate the standardization of this questionnaire for the Czech cultural environment and subsequent translation into English. However, we are fully aware of the difficulties associated with the dynamic changes in social reality and the differences in different cultural and linguistic contexts.

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The First Season After the COVID-19 Pandemic: Cardiorespiratory and Statistics' Performance in Czech Ice Hockey Players

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ABSTRACT

The study describes the cardiorespiratory and statistical performance of ice hockey players during the season of 2020 after the COVID-19 lockdown'. Eight elite Czech male players (4 non-COVID-19 and 4 COVID-19 groups) were evaluated before and after the competition season. Players performed a cardiorespiratory exercise test and the maximal oxygen consumption, ventilatory threshold, respiratory compensation point, maximal heart rate and test time were measured. The number of matches, goals and plus/minus statistics were retained. No significant differences between groups before and after the season for all cardiorespiratory responses were found, and the no-COVID-19 group played more games. The conclusion highlights that the cardiorespiratory performance place all players (with and without COVID-19 history) in similar conditions to be prepared for the next season. Due to a wide variation among players' statistics, based on plus/minus parameters, it cannot be established that the 2020 season impaired the players' statistics.

Keywords: ice hockey; Covid-19; physical performance; plus/minus statistics

INTRODUCTION

The first season of 2020/2021 after a lockdown due to the SARS-CoV-2 (COVID-19) pandemic was a unique condition for team sports, in which new restrictions and changes in the rules were implemented to minimize the negative impact on player welfare and to avoid in-team transmission (Herrero-Gonzalez et al., 2020). Nevertheless, the preventive measures were not enough to reduce the players' infection. A higher in-game team-to-team transmission of COVID-19 was demonstrated in the Finnish ice hockey league. During a 16-day follow-up period, one asymptomatic carrier in a team led to 49 infections in five teams (Kuitunen et al., 2021).

A few studies have reported the consequence of COVID-19 infection in team players' cardiorespiratory capacity. Fikenzer et al. (2021) described that elite handball players with a history of COVID-19 infection presented a significant reduction in cardiopulmonary performance compared to uninfected teammates (Fikenzer et al., 2021). Parpa and Michaelides (2022) reported that soccer players infected with the COVID-19 virus presented a significant decrease in maximal oxygen consumption (VO_{2max}) after 60 days of recovery. Besides the impairment of the cardiorespiratory performance, the players' unavailability to play could also affect their performance during the season (Parpa & Michaelides, 2022).

In the ice hockey discipline, which presents a long competition season, information about the effect of COVID-19 infection on players during the 2020 competitive season is still unclear. Such information may help to understand what occurred in the season and what could be incorporated in similar situations in case of a new lockdown or transmissive virus. The aim of the study was to describe the first season after lockdown 2020/2021 in a Czech ice hockey team, reporting the players' cardiorespiratory responses and their statistics during the season. For this purpose, a comparison between players infected by the COVID-19 virus against those not infected was performed. Team statistic was compared to the previous season (2019-2020 and 2018-2019). According to the literature, we hypothesize that players diagnosed with COVID-19 positive will present lower values of cardiorespiratory parameters and a decrease in game statistics compared to those teammates not infected.

METHODS

Participants

The ice hockey team investigated was composed of 43 players registered in the 2020-2021 Extraliga, in which 26 of them attended the laboratory to perform a cardiorespiratory test. For the purpose of the study, data from 8 ice hockey players (age 27 ± 5.16 years; body mass 88.2 ± 9.03; height 183 ± 7.46 cm), measured before and after the season, was retained. The inclusion criteria were to visit the laboratory before and after the season. Only 8 players have data in two moments. Most of players was not able to do second measurement (transferred or did not able to play in A team). Goalkeepers were excluded from the study. After the season, the players were separated into a group with No-COVID-19 (n=4) for those who reported no infection during the season and a group COVID-19 (n=4) for those who reported being infected during the season. Players signed informed consent at the beginning of their clinical evaluation in both conditions, pre- and post-competition, stating that their personal data could be used for research purposes (Approval number: EKV-2021-062).

Design

A retrospective design was used to describe the cardiorespiratory performance of ice hockey players assessed in laboratory conditions, and to describe the statistic during the season. The team was first evaluated in the laboratory post-COVID-19 lockdown to verify the players' functionality to engage in the competition season (August 2020) and measured again after the season (April 2021)

as a preparation for the next season (2021-2022). In the first measurement, all players reported negative for COVDI-19 infection and were evaluated by a cardiorespiratory exercise test (CPET) performed on a treadmill. After the season, they performed the second CPET on a cycle ergometer. Four of 8 players reported positive for COVID-19 infection during some point in season. (Figure 1). The players' statistics during the season was taken from the team website and compared with the previous season (2019-2020 and 2018-2019).

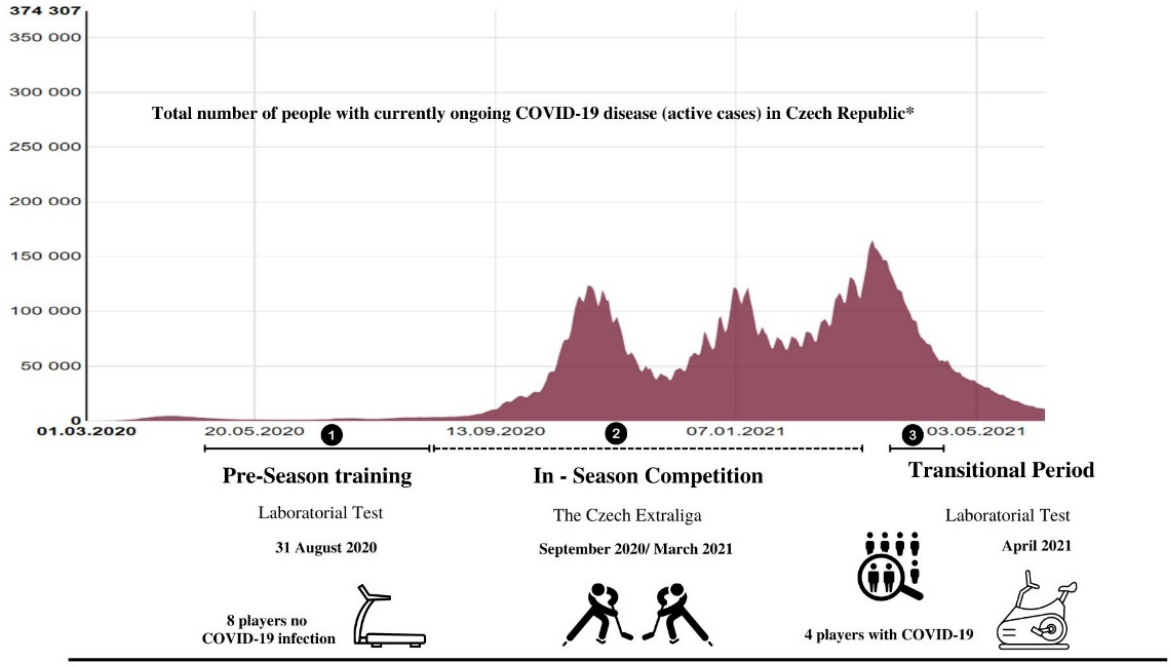

Figure 1. Study design.

1-Pre-season training period from May to the end of August of 2020. Laboratory test on 31st August on the treadmill, with no COVID-19 infection and lower rates of infection in the Czech Republic. 2- Competition season from September 2020 to March 2021 with a significant increase in COVID-19 infection in the Czech Republic (the second way). 3- Transitional period in April 2021. Laboratory test on the cycle ergometer.
*Source: (*COVID-19, Onemocnění Aktuálně MZČR*, 2022).

Ice hockey Extraliga 2020-2021

The ice hockey Extraliga in 2020-2021 had the participation of 14 teams, from 14 different cities around the Czech Republic. It was a total of 52 games for each team during the main season, in which the teams travelled at least once a week to compete in an away venue. After the main season, the team played 9 more games in the play-off and dropped out in the quarterfinals, finishing in 9th place (*Hokej.cz*, 2022).

Cardiorespiratory parameters

Before each cardiorespiratory exercise test (CPET), all players completed an anamnesis and meet the conditions about their actual health, genetic predisposition to cardiovascular diseases, non-acute diseases, infections or inflammations, or traumas influencing physical performance. The CPET was performed on a treadmill in the first evaluation and on a cycle ergometer in the second.

CPET protocol in the treadmill was designed as an incremental test on the Lode Katana ergometer (Netherlands) to volitional exhaustion. The test started with a speed of 8 km/h and 1 % of inclination each 2:30min. An increase in the speed of 0.5 km/h was implemented every minute and an increase of 1% on inclination was implemented every two minutes. CPET protocol in the cycle ergometer was designed as a ramp test on the Lode Excalibur ergometer (Netherlands) to volitional exhaustion. The test started 30 seconds without any resistance for a warm-up, following resistance of 1 Watt per kilogram of body weight (W/kg), increasing 0.33 W/kg each minute. Players were in-structed to keep constant rotations per minute (rpm) pedalling as long as possible (70-80 rpm).

In both tests, the oxygen consumption (VO_2) was measured during the test using breath-by-breath gas exchange analysis (Cortex METALYZER® 3B, Biophysik, Leipzig, Germany). After the test, data were processed using MetaSoft®Studio software to de-rive the following variables: maximal oxygen consumption (VO_{2max}), oxygen uptake at ventilatory threshold (VO_{2vt}); respiratory compensation point (VO_{2rc}); maximal heart rate (HR_{max}). Also, the time in the cycling and treadmill test was retained.

Anthropometric measurements

The body height was recorded using a wall stadiometer SECA 285 (Germany). Body composition was measured with direct analysis of segmental multi-frequential bioelectric impedance (SMF-BIA method) using the instrument InBody 770 (Cerritos, California, USA).

Players' statistics

Information about the players' statistics was taken after the end of the 2020-2021 season based on the season statistics displayed on the team website: www.hc-kometa.cz. Information about the number of matches in which the players started, goals and plus/minus statistics were collected. It was considered the players' statistics only on the seasons that he played in the selected team.

Statistical analysis

Values are presented in median with minimum and maximum. Comparison between groups was performed by non-paired t-test. Data were analysed using statistical software JAMOVI 2.2.5. and statistical significance was set at $p \leq 0.05$.

RESULTS

Cardiorespiratory responses and body mass are displayed in Table 1 (median, minimum and maximum). No significant differences between Non-COVID-19 and COVID-19 groups both before and after the competition season for all cardiorespiratory responses (e.g. oxygen uptake at the ventilatory threshold, respiratory compensation point, maximal heart rate and time in the test) nor for body mass.

Table 1. Cardiorespiratory responses and body mass pre and post-2020/2021 season

Pre-Season	Non-COVID-19 (n=4)	COVID-19 (n=4)	*p*
CPET (treadmill)			
VO_{2vt} (ml/kg/min)	32.5 (27.8 – 36)	34.3 (30 – 39.9)	0.402
$VO2_{rc}$ (ml/kg/min)	45 (38 – 47.7)	43.8 (38.4 – 50.3)	0.967
RT (min)	12 (10.3 – 14.3)	13.7 (10.1 – 14.3)	0.115
HR_{max} (bpm)	185 (185 – 186)	193 (185 – 206)	0.563
Body mass (kg)	90.7± 3.88	83.1± 9.03	0.173
Post-Season			
CEPT (bike)			
VO_{2vt} (ml/kg/min)	29.3 (25.9 – 31.4)	29.4 (25.1 – 31.2)	0.920
$VO2_{rc}$ (ml/kg/min)	37.3 (35.9 – 39)	40.3 (34 – 46.5)	0.322
CT (min)	10.1 (9.4 – 13.4)	10.6 (10.1 – 12.3)	0.105
HR_{max} (bpm)	186 (184 – 189)	194 (185 – 206)	0.871
Body mass (kg)	92.0 ±2.55	81.2 ±10.92	0.102

*CPET= cardiorespiratory exercise test; VO_{2vt} = oxygen uptake at ventilatory threshold; $VO2_{rc}$ =respiratory compensation point; CT= cycling time; RT= running time; HR_{max} = maximal heart rate. cardiorespiratory exercise test (CPET).

Table 2 presents the description of each player about their performance in the competitive season of 2020–2021, and previous seasons 2019–2020 and 2018–2019. As expected, the No-COVID-19 group played more games during the 2020–2021 season compared to the COVID-19 group (143 *versus* 118 games). Players presented a wide variation among them throughout the season, based on plus/minus parameters, therefore it cannot be established that the 2020-2021 season presented a decrease in the players' performance, especially in the COVID-19 group.

Table 2. Ice hockey player statistics for the 2020-2021, 2019-2020 and 2018-2019 seasons.

		GP			Goals			Plus/Minus		
	Position	**2020–2021**	**2019–2020**	**2018–2019**	**2020–2021**	**2019–2020**	**2018-2019**	**2020–2021**	**2019–2020**	**2018–2019**
No COVID-19										
Athlete 1	Forward	52	51	52	15	29	22	5	1	15
Athlete 2	Forward	19	23	-	0	1		-5	3	-
Athlete 3	Defender	51	51	52	0	1	3	6	-1	4
Athlete 4	Defender	21	48	50	1	0	2	-2	0	-7
Total		143						4		
COVID-19										
Athlete 5	Forward	49	38	52	12	12	17	10	-3	18
Athlete 6	Forward	14	15	13	1	1	0	-1	-5	-3
Athlete 7	Forward	20	-	-	3	-	-	-3	-	-
Athlete 8	Forward	35	49	16	4	1	1	0	-2	1
Total		**118**						**6**		

* GP= games played.

DISCUSSION

The present study focused on describing the cardiorespiratory and statistics performance in an ice hockey team during the Extraliga 2020-2021 in the Czech Republic, comparing players with and without COVID-19 diagnosis. It was found that the cardiorespiratory parameters did not differ between players who were infected with the COVID-19 virus during the competitive season compared to those who were not infected. In addition, no consensus about impairment on players' statistics (based on plus/minus results) was observed in the 2020-2021 season compared to the previous season 2019–2020 and 2018–2019.

In terms of cardiorespiratory parameters, it has been described that the COVID-19 infection caused functional impairment of cardiopulmonary performance (Fikenzer et al., 2021) reducing players' maximal respiratory oxygen uptake (VO_{2max}) (Fikenzer et al., 2021; Parpa & Michaelides, 2022), maximal respiratory minute volume (VE) (Fikenzer et al., 2021), respiratory compensation point (VO_{2RC}) (Parpa & Michaelides, 2022), and increase the maximal heart rate during CPET. Interestingly, the same parameters assessed in the present study by the CPET test demonstrate to be similar among the ice hockey players. These results place all players (with and without COVID-19 history) in similar conditions to be prepared for the next season. Due to no previous study, it was not possible to verify if similar outcomes are also presented in ice hockey players from different teams.

Considering the unavailability to play and the restriction on training together as a team, it was hypothesized that players that were infected by COVID-19 during the competitive season had a decrease in their statistics, however, no impairment on players' plus/minus statistics was consisted in the 2020-2021 season compared with the previous one nor the players with COVID-19 infection during the season compromised their statistics compared to their counterparts. The No-COVID-19 group played more games compared to COVID-19 players, but with no influence on game statistics. The plus/minus statistics are calculated based on how many goals the team scored (plus) and how many goals the team conceded (minus) while the player is on ice (Lundgren et al., 2016), however, besides this index being widely used and registered in the National Hockey League (www.nhl.com), player's performance in the ice involves a complex interaction of physical performance, contact skills and decision-making ability. In the soccer league, the game performance comparison of COVID-19 and no-COVID-19 season was also controversial. No difference in running performance during the game comparing the season disrupted by the pandemic (2019-2020) to a control season (2018-2019) was found in LaLiga (Brito de Souza et al., 2021). On the contrary, in another soccer league, a match analysis reported that after the lockdown, the games presented a significant decrease in goal attempts, distance covered and an increase in fouls committed (Santana et al., 2021). Furthermore, despite a set of recommendations for home training, the return to training and competition after lockdown and COVID-19 infection for athletes (Bisciotti et al., 2020; Phelan et al., 2020; Stokes et al., 2020), performance alterations due to the lockdown were observed in previous review studies (Córdova-Martínez et al., 2022; Paludo et al., 2022).

To the best of our knowledge, this is the first study to describe the cardiorespiratory and statistics performance of ice hockey players during the first competitive season of 2020–2021, the

first season after the COVID-19 lockdown. However, some limitations should be highlighted. The reduced number of players assessed, together with no information about the period of the season in which the player had COVID-19 and the severity of the is the major limitation. The results should be carefully interpreted, and extrapolation could be made after further investigations.

CONCLUSION

The results suggest that despite the COVID-19 infection during the 2020-2021 competitive season, no significant differences in cardiorespiratory parameters were found, demonstrating that ice hockey players with COVID-19 history performed similarly in the cardiorespiratory test to those who were not diagnosed with it. The statistic during 2020-2021 was not impaired for the most of players, compared to the previous season, even with players with no-covid participating in more games. Monitoring the cardiorespiratory parameters in those players infected is recommended, due to the uncertain consequence of the virus on cardiorespiratory function in long term. Also, further investigation can add the use of GPS to evaluate the effect of COVID-19 infection on physical game performance. The literature regarding ice hockey on the topic of the effect of COVID-19 infection still is scarce and the present study comes to add a piece of information about it.

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The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Research Ethics Committee of Masaryk University (EKV-2021-062).

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Use of Rate of Force Development in Field Testing of Ice-Hockey Players

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ABSTRACT

Introduction: Ice hockey is a power-speed sport played on ice. The surface specification is very different from a normal surface, so looking for the most appropriate measurements and specific off-ice tests is important to define ice hockey performance better. Therefore, the main purpose of this research was to determine the relationship between the rate of force development (RFD) in back squats with commonly used off-ice and on-ice tests. Methods: The research involved a junior ice hockey team with 15 players (181.8 ± 4.1 cm; 80.7 ± 8.8 kg; 18.4 ± 0.9 yrs) playing in the highest junior competition of Czech hockey. Players performed all tests in one day divided into two blocks – off-ice block (OFF) in the morning and on-ice block (ON) in the afternoon, respectively. The OFF contained a 30 m sprint test with a 15 m split (SP15; SP30), plyometric tests (broad jump - BJ; countermovement jump - CMJ), and a velocity squat protocol (VSP). Finally, in the ON, speed and coordination tests were performed: 30 m forward skating with 15 m split (FW15 and FW30); 30 m backward skating with 15 m split (BW15 and BW30); Weave agility test (WAT); Transition test (TT) and Pro-agility test (PAT). Results: No significant results were found between the RFD and coordination tests (TT, WAT, PAT) and CMJ. Significant correlations were found between RFD40kg and SP30 ($r = -.865$; $p < .01$) and BJ and RFD40kg, respectively ($r = .649$; $p < .05$). However, as the back squat loads increase, the correlation strength decreases between RFD and SP30 ($r = -.677$; $p < .01$ for RFD50kg and $r = -.560$; $p < .05$ for RFD60kg). Furthermore, a strong degree of correlation was observed between RFD40kg and FW15 ($r = -.699$; $p < .05$) and also FW30 ($r = -.705$; $p < 0.05$). Conclusion: The study results show a significant relationship between RFD and commonly used off-ice and on-ice tests.

Keywords. Ice hockey; field testing; rate of force development; RFD; velocity training

INTRODUCTION

To maximise the athlete's performance, it is necessary to use such means that a performance transfer from a nonspecific environment to a specific one. In ice hockey, the development of strength, power, and speed is mainly trained in a nonspecific environment (Boucher et al., 2020; Delisle-Houde et al., 2019; Farlinger et al., 2007; Janot et al., 2015; Krause et al., 2012; Runner et al., 2016). In addition to plyometrics and speed tests, strength exercises with nonmaximal resistance can also be used to determine the power level of the athlete. In these exercises, in addition to the weight lifted (force), we are also interested in the speed of the barbell (velocity). The relationship between these quantities is represented by the force-velocity curve, which is inverse, i.e., as the force increases, the velocity decreases, and vice versa (Zatsiorsky & Kraemer, 2014).

Athletes must train with variable resistances and speeds, mainly applied in the preparatory phase. One of the goals of strength and conditioning training is to develop as much resistance as possible in the shortest possible time. The level of this ability is measured using a rate of force development (RFD) (Aagaard et al., 2002).

Although heavy squats are used most frequently in research to determine the strength of the lower extremities, their direct effect on on-ice performance is debatable (Dæhlin et al., 2017; Edman & Esping, 2013; Henriksson et al., 2016; Janot et al., 2015; Runner et al., 2016). According to Virgile (2019), lower body power production appears to be the most significant contributor to on-ice speed in ice hockey.

For this reason, this research aims to determine the relationship of power using RFD from the back squat with nonmaximal resistance with commonly used motor tests in ice hockey.

METHODS

Participants

Fifteen male elite junior ice hockey players (181.8 ± 4.1 cm; 80.7 ± 8.8 kg; 18.4 ± .9 yrs) participated in the study and were members of a junior ice hockey team in Brno, Czech Republic. All participants (or their legal representatives) signed an informed consent voluntarily agreeing to participate in the research. The Ethics Board of Masaryk University accepted the study.

Table 1. Description of the tested participants

Player	Height (cm)	Weight (kg)	Age (yr)
1	178	74.2	18.7
2	183	85	17.8
3	181	79.4	17
4	185	86.4	18.5
5	187	106.1	19.5
6	177	70.6	18.2
7	180	77.1	19.4

8	183	84.5	19.5
9	184	89.1	17.5
10	185	76.7	17.6
11	186	81.3	17.5
12	182	77.5	18
13	174	74.8	19.6
14	187	79.6	17.6
15	175	68.5	19.5

Test design

The collection of demographic data and consent to participate in the research was carried out the day before the intervention. Participants were instructed to limit secondary physical activities 24 hours before testing. The use of ergogenic substances and other stimulants was prohibited during the testing. The test day was divided into two blocks: off-ice block (OFF) in the morning and on-ice block (ON) in the afternoon. Both blocks were preceded by a team warm-up that lasted 10 minutes.

The OFF contained a 30 m sprint test with a 15 m split (SP15; SP30), plyometric tests (broad jump - BJ; countermovement jump - CMJ), and a velocity squat protocol (VSP). Speed tests were measured using timing photocells (Brower Timing Systems®, Salt Lake City, UT), CMJ was monitored using My Jump 2 (My Jump Lab®, Carlos Balsalobre, Madrid, Spain), and BJ using a Tape measure. Two trials were performed for each test, and the best score was selected for analysis. An extra attempt was allowed in case of a mistake.

The VSP was performed for three repetitions with gradually increasing loads of 40-50-60-70-80 kg depending on the squat velocity. Performance measurement was monitored using the TENDO Power Analyser (Tendo Sport®, Trenčín, Slovakia).

When the weight of the barbell was reached, when its speed exceeded the limit of 0.75 m/s in the concentric phase, the protocol was terminated. The given speed is considered the borderline area for strength-speed performance, approximately 70 % 1RM (Balsalobre-Fernández & Torres-Ronda, 2021).

The best repetition with the highest power was selected for each weight from the measured values, from which the average RFD was calculated. The formula of the average RFD is calculated in the same way as the index of explosiveness (IES) from peak force and time to peak force (Zatsiorsky & Kraemer, 2014):

$$IES = \frac{peak\ Force}{Time\ to\ peak\ Force}$$

Finally, speed and coordination tests were performed in the ON - 30 m forward skating with 15 m split (FW15 and FW30); 30 m backward skating with 15 m split (BW15 and BW30); Weave Agility Test (WAT); Transition test (TT) and Pro-agility test (PAT). Measurements were made using photocells (Brower Timing Systems®, Draper, UT). The participants underwent two trials, and the best score was selected for analysis. An extra attempt was allowed in case of a mistake. The layout of the ON is graphically represented in Figure 1.

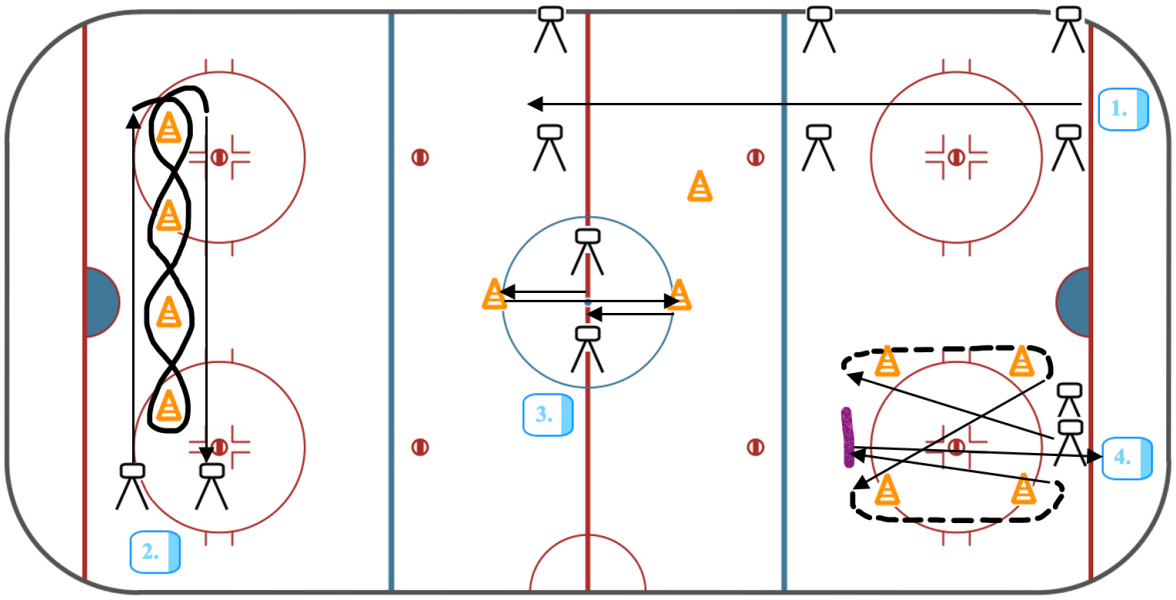

Figure 1. Visual representation of the ON (Note: 1. = FW15, FW30, BW15, BW30; 2. = WAT; 3. = PAT; 4. = TT)

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Macintosh, Version 28.0 (IBM Corp., Armonk, NY) program. Descriptive data were summarised as mean ± standard deviation (SD). Due to the lower number of respondents, Spearman's correlation coefficient was used for statistical analysis, the strength of which is divided into categories in the attached table no.2.

Table 2. The Strength of Spearman's Correlation

Spearman correlation	
.00 - .19	Very weak
.20 - .39	Weak
.40 - .59	Moderate
.60 - .79	Strong
.80 – 1	Very strong

RESULTS

The results are shown in Tables 3-5. Tables 3 and 4 describe the mean results and the standard deviation of the OFF and the ON, respectively. The resulting correlations of the RFD with other tests and statistical significance are shown in Table 5. The strength of the correlation is visually represented using a blue color scale.

Table 3. Results from the OFF testing

	Mean	SD
SP15 (s)	2.40	.08
SP30 (s)	4.29	.14
BJ (cm)	261	12
CMJ (cm)	50.1	5.3
RFD (N/s)		
40 kg	5857	1239
50 kg	6545	1060
60 kg	6723	1341
70 kg	6750	1102
80 kg	7255	1368

Table 4. Results from ON testing

	Mean	SD
FW15 (s)	2.51	.12
FW30 (s)	4.30	.16
BW15 (s)	3.01	.15
BW30 (s)	5.16	.23
WAT (s)	10.53	.28
TT (s)	15.55	.30
PAT (s)	4.79	.18

There were no significant correlations with the RFD and TT (r = -.287), WAT (r = -.375), PAT (r = -.469; p = .124), BW15 (r = -.473; p = .121), BW30 (r = -.396) and CMJ (r = .219). The significant RFD correlations with SP15 (r = -.639), SP30 (r = -.865), BJ (r = .649), FW15 (r = -.699) and FW30 (r = -.705) were measured at 40 kg. For the RFD50kg, correlations with SP15 and BJ were also observed, but only with moderate strength (r = -.536 and r = .561). As the back squat loads increase, the correlation strength shows a decreasing trend between the RFD and SP30 (r = -.677; r = -.560; r = -.653 and r = -.549).

Table 5. Spearman correlation results

	SP15	SP30	BJ	CMJ	FW15	FW30	BW15	BW30	PAT	WAT	TT
RFD 40 kg	-.639*	-.865**	.649*	.219	-.699*	-.705*	-.473	-.396	-.469	-.375	-.287
RFD 50 kg	-.536*	-.677**	.561*	.160	-.132	-.166	.052	.016	-.113	.093	.107
RFD 60 kg	-.474	-.560*	.406	.022	.002	- .059	.271	.132	-.103	.108	.093
RFD 70 kg	-.350	-.653*	.541*	.027	-.189	-.222	-.044	-.183	-.194	-.007	-.128
RFD 80 kg	-.427	-.549*	.504	.000	-.059	-.070	-.027	-.114	-.150	.134	.100

Note: *p < .05; ** p < .01

DISCUSSION

The primary methodological considerations for this study included a relatively small homogeneous sample (n = 15), which possibly limits the generalisability of our findings outside of elite-level hockey players.

As a significant finding of this study, FW30 and FW15 are strongly correlated with RFD40kg. There is no research, to our knowledge, that deals with the dependence between the exact quantities. Korte (2020) investigated a similar relationship with ice performance, applying a weighted CMJ for 20, 40, and 60 kg. He found a significantly strong correlation between CMJ with 40 kg and 30 m on-ice sprint ($r = -.686$; $p < .001$) and 15 m on-ice sprint ($r = -.634$; $p < .001$), which is similar to our findings for FW30 ($r = -.705$; $p < .05$) and FW15 ($r = -.699$; $p < .05$). Furthermore, at higher barbell weight, the strength of the correlation decreases to medium for both the 30 m distance ($r = -.592$; $p < .001$) and the 10 m distance ($r = -.516$; $p < .001$).

The explosive power of the lower extremity is very well tested and developed not only with CMJ but also with BJ (Blanár et al., 2019; Dobbs et al., 2015; Runner et al., 2016). Our research demonstrated a strong positive correlation between RFD and BJ ($r = .649$; $p < .05$). As mentioned by Maffiuletti et al. (2016), in their review, RFD is best trained by exercises that involve explosive muscle contraction; therefore, the relationship we found between BJ and RFD is justified.

The RFD did not correlate with any on-ice agility test or BW15 and BW30. We explain this by the fact that in agility tests, in addition to speed and explosive muscle contraction, more factors manifest themselves, such as skating technique, changes in direction speed (CODS), balance, and coordination (Behm et al., 2005; Dawes et al., 2012; Hojka et al., 2016). In addition, Henriksson et al. (2016) examined unilateral and bilateral jump variations in on-ice agility and found that the strongest correlations of on-ice agility tests existed with unilateral jumps.

Allisse et al. (2017) documented the development of performance profiles of elite ice hockey players of the age group over 12 months and found that in the off-season, a reverse skating speed test showed a significant deterioration in performance. This may be due to the need for more specific stimuli in off-ice training and long periods without on-ice training, where this skill is best trained. This may explain the inconsistent results of other research looking at BW tests and off-ice performance assessments (Delisle-Houde et al., 2019; Runner et al., 2016). Our research was carried out at the end of the training period, so even here, the deterioration of the BW performance could be reflected. The accurate precision of the relationship needs to be taken with a grain of salt.

A very strong correlation was found between RFD and SP30. SP15 only correlates with RFD40kg and RFD50kg. In the acceleration phase, the athlete is in a greater forward bend, the foot's contact time with the ground is higher, and he participates to a greater extent in the movement and horizontal force (Kawamori et al., 2013). During acceleration, when the athlete moves to the maximum velocity phase, the torso straightens, the foot's contact with the ground is shortened, and the contribution of horizontal force to the movement is also reduced (Nagahara et al., 2018). A significant difference between these phases was investigated by Hunter et al. reported that sprint velocity at 16 m after a start was significantly correlated with horizontal force. This leads to the consideration that the maximum velocity phase from the point of view of biomechanics corresponds more to the execution of the back squat than the acceleration one.

The correlation decreased with increasing weight. From the references mentioned above, the correlation between SP30 and RFD decreases because the higher weight reduces the speed of the squat execution. Thus the explosive power activity of the lower limbs was not optimal (Kraemer & Spiering, 2006). More research is needed to confirm this assumption and for a definitive conclusion.

CONCLUSION

The study aimed to determine the power relationship using RFD from the back squat with nonmaximal resistance with commonly used motor tests in ice hockey. The TENDO power analyser was used to measure barbell velocity. RFD was calculated as IES from peak force and time to peak force (Zatsiorsky & Kraemer, 2014). From off-ice tests, SP30 correlated best with RFD40kg ($r = -.865$; $p < .01$), and from on-ice tests showed a strong correlation with FW30 ($r = -.705$; $p < .05$).

These results provide new insight into the relationship between force-velocity and on-ice performance because no other research has yet dealt with the same research problem.

The findings should help clarify the importance of testing the nonmaximal resistance squat with rapid execution as a middle measure of performance between bodyweight jumps and heavy squats.

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Socio-Culturally Different Motor Skills of Czech Children with ASD Aged 7–10 Years Assessed by the Test TGMD–3

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ABSTRACT

Background: Autism spectrum disorders (ASD) are associated with delayed gross motor development and limited ability to imitate human movements. The Test of Gross Motor Development – Third Edition (TGMD-3) is declared for use in children with ASD (Ulrich; 2013, 2019). TGMD-3 was developed in the US and included culturally different elements, such as the Striking of the stationary ball and Underhand throw, performed according to US practice. The pilot study aimed to assess whether the diagnostic tool TGMD-3 is a reliable tool in the Czech environment for diagnosing motor skills in children with ASD. The aim of the research was 1) to record and describe the reactions of children with ASD to culturally different elements in the motor test TGMD-3 and 2) to compare their ratings with the other items of this subtest.

Methods: This pilot study included participants (n = 16, 1 girl, age range 7–10 years, Mage=9.125, SD=1.89 years) with ASD. The participant's physical performance was assessed with the TGMD-3 motor test (Ulrich, 2016) using visual support (Allen et al., 2017) according to the instructions of the Examiner's Manual Test TGMD-3 by four independent examiners. The qualitative assessment of the participant's behavior was evaluated using Flanagan's CIT (Critical Incident Technique) principle, verified for pedagogy and sports areas in the Czech Republic (Válková et al., 2012).

Results: The manifest indicators of locomotor and ball skills were significant ($p < .001$). The pilot study confirmed the factorial structure of the Test TGMD-3. The TGMD-3 showed good levels of internal consistency and also interrater and intrarater reliability. The limited ability to imitate (characteristic of children with ASD) probably significantly influenced the culturally different performance of the Underhand throw movement element. The culturally different skill Striking of the stationary ball had a very motivating effect and can be described as the so-called "novelty effect," which is known in the TD population aged 7–10 years.

Conclusion: This pilot study confirms the factorial structure and applicability of the TGMD-3 motor skills test in the Czech sociocultural environment for children with ASD (with modification of the administration process based on the principles of structured learning (Možná & Válková, 2022) and visual support (Allen et al., 2017)). The limiting factor was the deliberate selection of the group and the small number of participants. Further cross-cultural studies of the TGMD-3 can potentially expand the current diagnostic methods of motor skills in children with ASD.

Keywords: autism spectrum disorders, ASD, motor, TGMD-3, Socio-culturally different skills

INTRODUCTION

Autism spectrum disorders (ASD) are neurodevelopmental diseases characterized by impairments in communication, social communication, and stereotyped restricted behavior and interests (APA, 2015; MKN-10, 2021). ASD is associated in up to 80% with deficits and delays in motor development (Sansi et al., 2021). Motor difficulties are not among the diagnostic criteria of ASD (APA, 2015; MKN-10, 2021) and are not described in every individual with ASD (APA, 2015; Dewey et al., 2007; MKN-10, 2021; Wang, 2022). Nevertheless, motor difficulties have been referred to since the 1950s in the original article by Leo Kanner (Kanner, 1943) and Hans Asperger (Asperger, 1943). In addition to the widely reported gross and fine motor deficits (Asperger, 1943; Cairney et al., 2019; Colombo-Dougovito & Block, 2019; Crucitti et al., 2019; Čadilová et al., 2012; Fahimeh et al., 2020; Kanner, 1943; and review, e.g., Wang, 2022) authors of research studies in children with ASD often also note a limited ability to imitate movements (Liu et al., 2014; Smith & Bryson, 1994).

Appropriate diagnostic tools for routine use in practice are a prerequisite for early intervention in motor skills. This is crucial both from the point of view of the need for comprehensive care for these children and for increasing their quality of life (Brusseau et al., 2018; Colombo-Dougovito, 2017; Chan et al., 2016; Hulteen et al., 2015; Palmer et al.., 2020). Standardized motor tests are especially suitable for accurate and repeatable diagnosis. (Psotta, 2014) In the Czech Republic, of the standardized motor tests, only the Movement Assessment Battery for Children, 2nd edition (MABC-2) test has established norms. The normative sample was generated from the typically developing children (TD) population. (Psotta, 2014)

The TGMD-3 test (Ulrich, 2013, 2017, 2019) was designed in the USA, and the norms for the population of TD children were also created in the sociocultural environment there. The test is declared for use in children with ASD (Magistro et al., 2018; Ulrich, 2019). The TGMD-3 test consists of two subtests – locomotion and ball skills. The Ball Skills subtest contains culturally different elements, such as the Two-hand strike of a stationary ball and the Underhand throw, performed according to US customs. For these reasons, modifications have been created in the European sociocultural environment in some states (Wagner et al., 2017), which do not contain these elements typical of the US environment.

The purpose of the pilot study was to assess whether the TGMD-3 diagnostic tool can be used in the Czech sociocultural environment to diagnose motor skills in children with ASD, thus expanding the possibilities of motor skills evaluation tools for this population. Furthermore, to summarize the data for effectively selecting a suitable variant of the TGMD-3 test, which would be crucial in further assessing motor skills on a more extensive research sample. The aim of the research was 1) to record and describe the reactions of children with ASD to culturally different elements in the ball skills subtest of the TGMD-3 motor test and 2) to compare their ratings with other items of this subtest.

METHODS

Participants

This pilot study included participants (n = 16, 1 girl, age range 7-10 years, M_{age}=9.125, SD=1.89 years) with ASD. All 16 participants with ASD were included in the study because they met the participation criteria: age 7–10 years, officially diagnosed with ASD (documented by a medical report), do not suffer from a sensory disorder such as vision and hearing disorders, and have a place of permanent residence in the Czech Republic according to their date of birth.

The research sample is gender unbalanced due to the recruitment method of participants for this study, which took place during restrictive measures during the COVID-19 pandemic. Legal guardians enrolled their children in this research with voluntary participation. At the same time, the ratio between included boys and girls in this research confirms the uneven distribution of ASD in the population of boys and girls, which has been repeatedly declared worldwide. (APA, 2015; MKN-10, 2021; Zeidan et al., 2022)

Procedures

This pilot study is part of a more extensive research project, *Verification of motor skills assessment tools in Children with autism spectrum disorders* - MUNI/A/1534/2020, supported by a specific Faculty research grant from Masaryk University Sport and Education. A pilot study was conducted to verify the use of the TGMD-3 diagnostic tool on a population of children with ASD. Special emphasis was placed on the culturally different elements of the TGMD-3 test. As part of this project, information booklets are created for people caring for children with ASD, as well as doctoral and diploma theses that focus on the issue of standardized motor tests that are suitable for this specific population of children with ASD (Možná, 2022; Podhorná, 2022). The project was approved in its entirety by the Ethics Committee of Masaryk University.

Participants were assessed with the TGMD-3 motor test (Ulrich, 2013, 2019) using visual support (Allen et al., 2017). Each participant completed one practice, and then two scored trials. Scores were recorded only during the two scored trials. Four independent examiners assessed the participants‘ physical performance according to the instructions of the Examiner‘s Manual Test TGMD-3 (Ulrich, 2019). All raters had university degrees in physical education and sport, exactly two with a bachelor‘s degree and two with a doctoral degree. All team members required 95% interobserver agreement on a pre-coded sample of data.

The first step of this study was a meeting with the parents of children with ASD to collect data about the participant‘s health status (personal and family history) and to evaluate the fulfillment of the

entry criteria of the research. Furthermore, a functional communication and motivational strategy was established for each participant with ASD. Attention was also focused on choosing a suitable environment for performing the motor test and deciding on the presence of other persons during the motor test - parents, teachers, or assistants. Insufficient time before implementing the TGMD-3 motor test became parents' information about the course of the testing, which also contained graphically processed information for children with ASD. This information included a photo of the test team members. This step was intended to minimize distractions that could potentially limit participants' cooperation with PAS. To increase the feasibility of the TGMD-3 test were used motivational elements and strategies (especially the implications of structured learning and the TEACCH program (Možná, 2022)). These implications have already been verified in the population of children with ASD in the Czech Republic using standardized motor tests (Možná & Válková, 2022).

Before starting the testing process, the trained administrator filled in the data about the child (age and gender of the child, date of testing, laterality); subsequently, following the instructions of the Examiners manual (Ulrich, 2019), the TGMD-3 test was performed.

TEST OF GROSS MOTOR DEVELOPMENT—3RD EDITION (TGMD-3)

This test includes two parts: a performance test and a checklist. The TGMD-3 (Ulrich, 2019) assessed fundamental motor skills on six locomotors and seven ball skills. The participants were scored according to the original scoring process of the TGMD-3. "For each of the 13 TGMD-3 movement tasks, three to five criteria are formulated to enable a differentiated assessment of the movement quality" (Wagner et al., 2017). One practice trial and two evaluated trials are always performed. If the child performs the given skill correctly according to the prescribed criteria, he gets 1 point. If the given criterion is missing in the attempt, 0 points are awarded. When evaluating the test, the sum is determined by the raw skill score. A maximum of 46 points can be obtained in the Locomotor Skills subtest. A maximum of 54 points can be obtained in the Ball Skills subtest (Ulrich, 2019).

The TGMD-3 still needs to establish standards for the Czech population, and an official Czech translation is also missing. Original recording sheets in English were used in this study. A publicly available video demonstrating the administration of the TGMD-3 motor test by test author Professor Dale Ulrich (https://www.youtube.com/watch?v=9WggHyZpXl0) served as a model for the test administrators to demonstrate the motor tasks. According to the prescribed instructions, the administrator demonstrated each movement skill to the participant.

SOCIO-CULTURALLY DIFFERENT MOTOR SKILLS OF TGMD-3

Researchers in some countries are deliberately modifying the motor skills of TGMD-3. (Duncan et al., 2019; Tamplain et al., 2019; Wagner et al., 2017). The reasons for changing the TGMD-3 test are: improving the feasibility of the test in the school environment (Tamplain et al., 2019) or sociocultural differences in the background. (Wagner et al., 2017) Wagner et al. (2017) excluded the movement task "Two-hand strike of a stationary ball" because they "did not see complex phylogenetic relevance within this particular task" (p. 32).

TWO-HAND STRIKE OF A STATIONARY BALL

Movement task Two-hand strike of a stationary ball evaluates the child's skill with five criteria. 1) Does the preferred hand grip the bat over the non-preferred hand; 2) makes the non-preferred hip/shoulder point straight; 3) if does the hip and shoulder rotate back and forth while performing the movement; 4) does the child take steps with the non-preferred leg; and 5) does the child hit the ball, so that headed straight ahead. (Ulrich, 2019)

UNDERHAND THROW AND OVERHAND THROW

The movement task Underhand throw evaluates the skill using four criteria. 1) If the preferred hand swings down and back, reaching behind the trunk; 2) the child steps forward with the foot opposite the throwing hand; 3) if the ball is tossed forward, hitting the wall without a bounce; and 4) hand follows through after ball release to about chest level. (Ulrich, 2019)

The movement task Overhand throw also evaluates the skill based on four criteria. 1) If the windup is initiated with a downward movement of hand and arm, 2) hip and shoulder rotate to the point where the non-preferred side faces the wall, 3) if the child steps with the foot opposite the throwing hand towards the wall and 4) throwing hand follows through after ball release across the body towards the hip on the non-throwing side. (Ulrich, 2019)

The underhand throw is common in the Czech Republic. However, its execution is culturally different. Among the criteria mentioned above, the criteria relating to the leveraging phase differ. The design is typical for the US environment (especially characteristic of baseball – a traditional sport).

QUALITATIVE EVALUATION OF CULTURALLY DIFFERENT ELEMENTS IN TEST TGMD-3

The qualitative assessment of the culturally different elements of the TGMD-3 test is based on the basic principle of the CIT concept (Flanagan, 1954), i.e., the application of process evaluation based on Flanagan's critical cases (Flanagan, 1954). In his original work, Flanagan (1954) defines a critical case as "any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act" (p. 327).

The scoring evaluation process corresponds to DIC-CIT (Válková et al., 2012), where behavioral manifestations leading to successful mastery of the skill are coded plus, and behavioral manifestations hindering successful mastery of execution are coded minus.

RESULTS

The pilot study results are also presented in case studies of individual participants, which allow better descriptive and comparative possibilities than the only statistical numerical expression on a small research sample (especially for further research in a heterogeneous population of children with ASD). Another reason for the simultaneous casuistic interpretation of the results was, in addition to the small size of the research sample, also the deliberate selection of participants, which was related to the restrictive measures in the Czech Republic during the COVID-19 pandemic.

SUMMARY OF QUANTITATIVE RESULTS FROM CASE STUDIES OF PARTICIPANTS WITH ASD

The summary results of the TGMD-3 motor test of the research group shows in Table 1.

Table 1. Descriptive term of the test TGMD-3

Descriptive Term	Total
Impaired od Delayed	3
Borderline Impaired or Delayed	6
Below average	2
Average	5

The results of the Descriptive term of the overall result of the TGMD-3 show that children with ASD aged 7-10 years can perform motor skills test with a modification of the administration process based on the key principles of structured learning and the TEACCH program (Možná & Válková, 2022) and visual support (Allen et al., 2017). The TGMD-3 with visual support protocol (Allen et al., 2017) and implications of the principles of structured learning and the TEACCH program (Možná & Válková, 2022) show good levels of internal consistency and also interrater and intrarater reliability. The manifest indicators of locomotor and ball skills were significant ($p < .001$). The pilot study confirmed the factorial structure of the Test TGMD-3.

SUMMARY OF QUALITATIVE RESULTS FROM CASE STUDIES OF PARTICIPANTS WITH ASD

Responses of children with ASD to culturally different items on the TGMD-3 motor test

The reactions of children with ASD were recorded on a video recording, which was subsequently analyzed repeatedly. The culturally different element of the Two-hand strike of a stationary ball was motivating (according to CIT) for participants with ASD aged 7-10 years. In the research group (n=16), only one participant had an adverse child reaction to this task. The following paragraph describes this behavioral process in detail: Participant 3.

Participant 3- qualitative description of behavior

The child lost motivation to test for the Skip movement task in the Locomotor subtest when he lost motivation during the execution of this movement task (he did not perform the second evaluated trial). The child's parent was present during the testing. The procedure for motivating the child and the possible possibility of interrupting/postponing the TGMD-3 testing was consulted with the parent. This situation was followed by an interruption of testing for 9 minutes and 40s (subtracted from the video recording), supplemented by motivational elements and a short rest. The Horizontal jump and Slide items also record refusal to perform a movement task. Even in the movement task, the Two-hand strike of the stationary ball does not motivate the child to perform the activity. He throws the bat around the testing room and repeatedly kicks the tripod. According to the parent, this behavior is not a manifestation of anger but a reluctance to perform the given activity. The child communicates verbally in a minimal, limited way. He usually communicates with the

parent using signs, gestures, and possibly one-word expressions. The participant was presented with other following test movement tasks, and he spontaneously participated only in the item: Kick a stationary ball, which he performed even after the second evaluated trial in the following six unrated trials. He continued with motor testing with interest and performed the Underhand Throw and Overhand Throw tasks without needing additional motivational elements. However, it did not meet the defined monitoring criteria, and both items were scored as 0.

From the research group, the remaining 15 children performed the movement task Two-hand strike of the stationary ball without 2) loss of motivation during the execution of this movement task. However, it was noted in three participants 3) loss of motivation to continue the implementation of the TGMD-3 test and start the next test task. In all three cases, the reason was the child's preoccupation with this activity, which he did not want to end. In these three cases mentioned above, staying longer with this activity was necessary and performing other unrated attempts. This need was most prominently noted in participant 4.

Participant 4- qualitative description of behavior

This participant was very successful in both evaluated attempts. In the first attempt, he only failed to meet the criterion: non-preferred hip/shoulder faces in the straight-ahead direction. On the second attempt, he already achieved the maximum possible score for this item. After this attempt, he refused to end the activity. Thus, it was necessary to continue the non-scored trials for another 5 minutes and 20 seconds (subtracted from the video recording). After this time, he was already willing to proceed with the TGMD-3 test without using other motivational elements. There was no pressure on the child to finish the Two-hand strike of the stationary ball activity, only the child was motivated verbally, and by the presentation of the next movement element that followed. Based on the initial interview with the parent, it was necessary to take into account the fact that the participant had repeated bouts of anger with self-aggressive manifestations in the past. He participated in the testing accompanied by a parent and an intact sibling. The child's motivation process was consulted with the parent during testing.

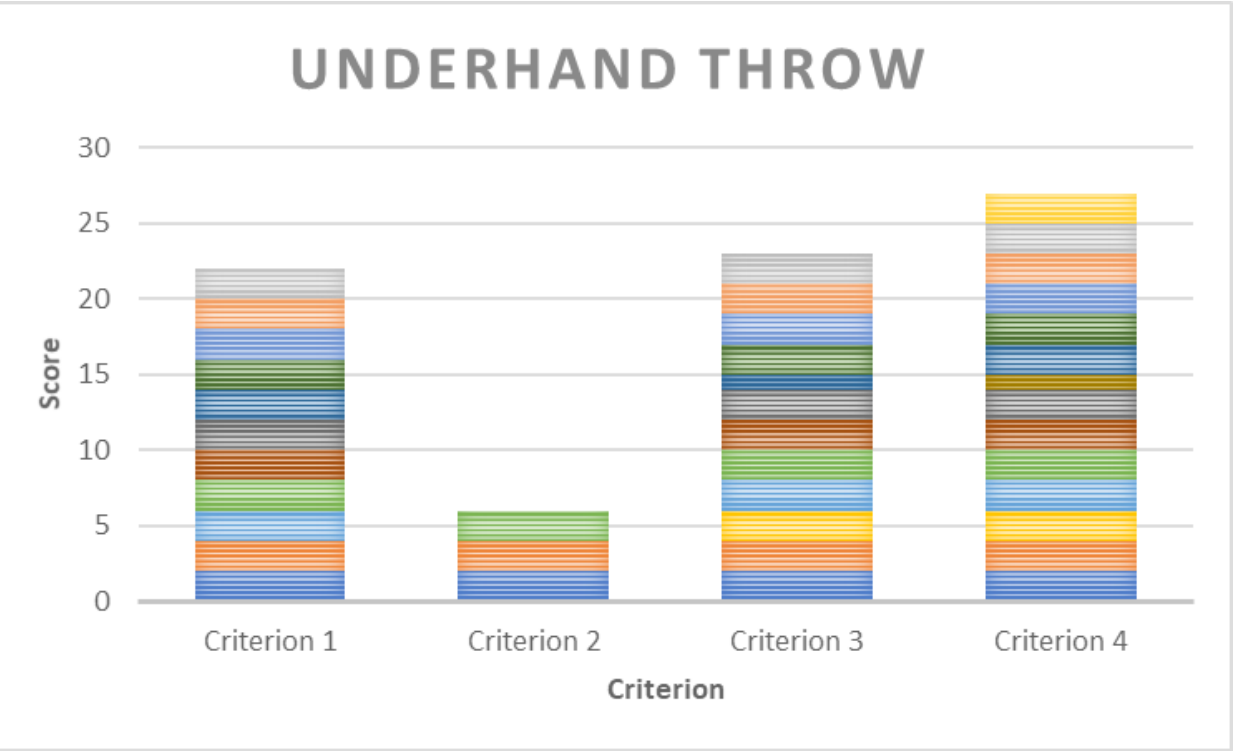
COMPARISON OF THE ASSESSMENT OF CULTURALLY DIFFERENT ELEMENTS IN THE BALL SKILLS SUBTEST IN THE TGMD-3 TEST WITH OTHER ITEMS OF THIS SUBTEST

For this heterogeneous population of children with ASD, the comparison of the assessment of culturally different elements in the Ball skills subtest in the TGMD-3 test includes the necessity to consider not only the quantitative expression within the standardized TGMD-3 test, which gives the appropriate score for each movement task. It is also necessary to collect other qualitative data to complement this information. As part of implementing the TGMD-3 ball skills subtest, according to the CIT scoring (Flanagan, 1954; Válková, 2012), a highly variable ability to concentrate in the performance of movement tasks was recorded in the participants, associated with fluctuations in the performance of movement tasks. It was also possible to observe a specific "novelty effect" as a motivational factor (according to CIT), typical for the TD population aged 7-10 years.

When evaluating the ball skills subtest, the most culturally different performance was manifested in the movement task Underhand Throw. Only three participants met the second evaluated

criterion: the child steps forward with the foot opposite the throwing hand (Ulrich, 2019). These 3 participants achieved the maximum score in both trials evaluated. In total, they received 2 points (each participant). On the contrary, the remaining 13 participants did not receive any points for this criterion in both evaluated trials. Detailed results are visualized in Chart 1.

Figure 1. Total summary of scores of the movement task Underhand Throw (Ulrich, 2019).



Four criteria of the movement task Underhand Throw (Ulrich, 2019, p.19):

1. "Preferred hand swings down and back, reaching behind the trunk;
2. Steps forward with the foot opposite the throwing hand;
3. Ball is tossed forward, hitting the wall without a bounce;
4. Hand follows through after ball release to at least chest level."

DISCUSSION

Cross-cultural validity and modifications of the TGMD-3 test for use in sociocultural areas other than the US were discussed by Duncan et al., 2019; Tamplain et al., 2019; Wagner et al., 2017. The reasons for changing the TGMD-3 test were: improving the feasibility of the test in the school environment (Tamplain et al., 2019) or non-complex phylogenetic relevance and sociocultural differences of the area (Wagner et al., 2017).

In an article by Valentini, Zanella, and Webster (2017), content validity is assessed in 597 Brazilian children aged 3–10 years. In addition to evaluating the test's construct validity, the authors addressed the cross-cultural translation of the TGMD-3 into Brazilian Portuguese. Intrarater and interrater reliability was described as good to excellent.

In Germany, Wagner, Webster, and Ulrich (Wagner et al, 2017) used a German translation of the TGMD-3 to assess the motor skills of 189 TD children. In this version, the test task Two-hand

strike of a stationary ball, has been removed. According to the authors' conclusion, test-retest and intrarater reliability were rated as excellent.

The validity of the test was verified on the population of children with ASD directly by its author, Professor Ulrich Dale (2019), who published the results in the Examiner's Manual Test TGMD-3 (p. 64). A sample of TD children based on age, sex, race, and ethnicity was compared with a sample of 33 children and ASD. Intrarater and interrater reliability were also described as good to excellent. The results, therefore, correspond to the results we found in this pilot study of children with ASD aged 7-10 years in the Czech sociocultural environment.

CONCLUSION

A limiting factor for the possibility of generalizing individual findings to the entire population of children with ASD aged 7-10 years in the Czech sociocultural environment is mainly the intentional selection of the research group and the small number of participants in this pilot study. The size of the research sample and the choice of participants were influenced by restrictive measures in the Czech Republic during the COVID-19 pandemic.

In addition to the standardized evaluation of the TGMD-3 test in children with ASD, we recommend expanding the data collection with additional qualitative evaluation. The risk that a motor test may be significantly influenced by non-motor factors that prevent the child from demonstrating actual motor ability is undoubtedly higher in children with ASD than in children of the general population of the same age. Seemingly banal details, which are not commonly encountered in the population of TD children aged 7–10, can affect the course of the situation (according to CIT) (non-preferred color of the ball, different tennis racket than the one the child is using).

In conclusion, it is necessary to mention that even in this small sample of children with ASD in the Czech Republic, it was possible to observe a specific "novelty effect" as a motivational factor (according to CIT), which is typical for the TD population aged 7-10 years. It is advisable to keep this phenomenon in mind and verify it in further research on a more extensive set of participants.

This pilot study demonstrated the feasibility of the test TGMD-3 (Ulrich; 2013, 2019) across children with ASD in the Czech sociocultural environment – with a modification of the administration process based on the principles of structured learning (Možná & Válková, 2022) and visual support (Allen, 2017). The factorial structure and applicability of the TGMD-3 motor skills test in the Czech sociocultural environment for children with ASD were confirmed.

Further research using the diagnostic instrument TGMD-3 in children with ASD in the Czech Republic, as well as the standardization of this instrument in the Czech population, has the potential to expand diagnostic methods in the field of motor skills and thus contribute to the possibilities of evaluating motor performance in children with ASD.

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What Do Experts Think About the Sustainability of Kiteboarding?

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ABSTRACT

The relationship between sports and sustainability has been recognised for 30 years, but the impacts of developing sports remain unknown. By combining a scoping review with the Delphi method, our study uncovers the positive and negative impacts of kiteboarding on the social and natural environment. In addition to expected impacts such as improving the fitness of an individual and generating conflicts among kiteboarders and beachgoers, our findings reveal surprising impacts, most of which positive because the experts primarily regard kiteboarding as an environmentally friendly sport. The only severe environmental impact identified by the experts was the lack of recycling of kiteboarding products. Despite the widespread perception of kiteboarding as a sport that contributes to climate change, the experts failed to reach a consensus on the severity of the carbon footprint of kiteboarders, who travel to distant locations. This study highlights the importance of assessing the environmental effects of individual sports.

Key words: kiteboarding, kitesurfing, sustainability, sport, impacts

INTRODUCTION

Sustainable development is increasingly becoming the most widely accepted concept of the global society, concerning all human activities, including sports. The relationship between sports and the natural environment, in particular, has been recognized for its importance for humanity since the 1994 Olympic Winter Games in Lillehammer, Norway, when concerns about the negative impacts of sports on the environment were addressed for the first time (Trendafilova et al., 2014). Since then, 'respect' for the environment has been officially adopted as a pillar of Olympianism

(Welters, 2019). As a result, the organizers of major sporting events now propose green venues and programs based on an environmentally conscious conception of sports, whilst a growing body of scholarship address sustainability in sports (Welters, 2019; Trendafilova et al., 2014).

In the context of the sustainability movement, major sporting events have tried to follow sustainability principles, as shown by the London or Tokyo Post-Games Sustainability Reports, highlighting the achievements of these Olympic Games in combating climate change and promoting a circular economy and a sustainable society (The London Organising Committee of the Olympic Games and Paralympic Games Ltd., 2012; The Tokyo Organising Committee of the Olympic and Paralympic Games, 2021). However, major international events are not the only sports activities that effect environment. For this reason, an increasing number of sports organisations within the framework of the UN "Sports for Climate Action" Agenda (UN, 2023) and the IOC Sustainability Strategy aim at taking a broader responsibility for sustainable development. For example, the *Sustainability Agenda 2030: A bold ambition for sailing's contribution to global sustainability* brings together perspectives on the sustainability of water sports and specific goals that must be fulfilled to create a sustainable future for sailing and water sports of the world (for more details see World Sailing, 2018). These goals are also pursued by the International Kiteboarding Association (IKA) (IKA, 2023). Therefore, the interest in sustainability issues has been permeating a wide range of sports, including individual sports and recreation activities, which also have a strong, negative impact on the environment (McCullough, Pfahl, and Nguyen, 2016).

Although sustainability in sports has been a research subject for almost 30 years, the concept remains abstract and fluid, lacking a consensus definition (Millington et al., 2022). This difficulty in defining a concept as complex as sustainability in sports was thoroughly documented by Tangen (2021). Nevertheless, the definition by Fyall and Jago (2009) seems to be useful, notwithstanding its generality or perhaps precisely because of it as they describe the two-way relationship between sports and sustainability. First, "it is important (…) to understand the impact that sport (…) has on the external environment so that these impacts can be more effectively managed". Second, "it is also important that the impact of changes in the external environment on the sustainability of sport (…) are understood in order to ensure the long-term viability of the sector". In other words, when exploring sustainability in sports, both of these aspects should be considered, namely impacts and development. The authors also emphasize the fact that sustainability in sports includes not only to an environmental dimension but also social and economic dimensions (Fyall and Jago, 2009).

On the one hand, the sports industry acts as a key contributor to economic and social development globally (Fujiwara, Kudrna, and Dolan, 2014). Economically, the sports industry provides significant benefits such as employment, revenue from commercial activities, and prosperity. Socially, sports promote community building, raise the awareness of sustainability and reduce crime, in addition to changing lifestyles of individuals and possibly increasing the levels of disposable income by helping to avoid healthcare costs (Taylor et al., 2015). On the other hand, considering its impacts on the environment, the sports movement must take the necessary steps towards social and environmental responsibility (see, e.g., Trendafilova et al., 2014; Trendafilova and McCullough, 2018). And by sports movement we mean not only the sports industry and organizers of major sporting events but also participants in recreational sports.

Sports, nevertheless, differ in their impacts and development. Major recreational sports such as golf (Wheeler, 2006) or skiing and related recreational activities (Rixen, and Rolando, 2013) have well-known environmental impacts. But new sports are also emerging, with unknown impacts and unclear development options. One such newly emerged sport is kiteboarding, whose environmental and societal impacts have never been comprehensively addressed thus far, prompting controversies and uncertainties about its future.

In this study, we combine two research methods, namely the Scoping review and the Delphi methods, to better understand the interplay between kiteboarding and the social and natural environment. Our goal is to identify themes discussed in literature and, according to experts' opinions, uncover the most serious impacts of kiteboarding on the social and natural environment. Uncovering these themes and impacts is an important milestone in understanding the sustainability of kiteboarding. As such, this study may foster the development of kiteboarding impact indicators and help to educate kiteboarders on behaviors that protect the social and nature environment. Moreover, this study also contributes with yet another piece of information to the mosaic of sustainability in sports, thereby advancing knowledge on environmental policy, management and education, in line with Cury, Kennelly, and Howes (2022).

THEORETICAL BACKGROUND

Kiteboarding, also known as kitesurfing, is a relatively new water sport that combines surfing with windsurfing, wakeboarding and paragliding. Kites were first used to drag people on the water surface in the 1970s. In 30 years, kiteboarding became safer and more accessible across the world and soon after considerably more popular. Now, kiteboarding is regarded as one of the fastest-growing water sports, but its popularity has also highlighted its negative environmental impacts.

Some studies have highlighted the negative effects of kiteboarding on coastal organisms such as nesting turtles (Matias, Carvalho, and Brasileiro, 2020) and, above all, on birds (Brosnan et al., 2018; Davenport and Davenport, 2006; Global Kitesport Association, 2017; Krüger, 2016; Le Corre, Gélinaud, and Brigand, 2009; Liley et al., 2011; Smith, 2004; Vistad, 2013, 2014). From a production or technological point of view, the large amount of short-lived equipment used in kiteboarding, mostly in the Global South, is concerning, especially because some of the materials may be toxic (Soltani et al., 2020). Kiteboarders produce a lot of waste (Terranea, 2019), including greenhouse gas (GHG) emissions, producing carbon dioxide in their frequent travels by plane and car (Wicker, 2018). Thus, kiteboarders are generally more carbon-intensive than the average general population (Wicker, 2018), and their effects are compacted by climate change.

In turn, Buckley (2017) underscored the effect of climate change on this sport. In line with the definition of sustainability in sports by Fyall and Jago (2009), changes in the natural environment can have an impact on kiteboarders. As a case in point, Ventin, Troncoso, and Villasante (2015) described how water pollution can affect or even preclude kiteboarding.

In terms of social sustainability, kiteboarding is credited with many positive impacts on fitness and health by reducing stress (Ceylan Akçakoyun, and Sukan, 2016; Le Corre et al., 2020) and contributing to a healthier lifestyle (Bekaroglu and Bozo, 2017). And by improving mental health,

kiteboarding may also have a positive effect on self-esteem (Buckley, 2018b), leading to better overall health and social behavior (Mann, 2004). Nevertheless, some studies have indicated specific health risks associated with this sport, such as sunburning (De Castro Maqueda et al., 2020) and injuries, including serious trauma (Kristen, Syré, and Humenberger, 2014; Hall et al., 2020).

The social impacts of kiteboarding on coastal communities is another important topic. Some authors highlight conflicts between kiteboarders and other water sports athletes and even among kiteboarders as coastal zones become increasingly overcrowded (Bozzo et al., 2015; Cabezas-Rabadán et al., 2019; Whitfield and Roche, 2007; Derriks, 2017, 2018; Needham et al., 2008; Szuster et al., 2020; van Bergen et al., 2020). In the Global North, kiteboarding is banned in several locations because this sport is considered too dangerous for other people (Seabreeze.com.au, 2008; Surfertoday, 2005), with conflicts between kiteboarders and local communities inevitably arising when locals lack access to the benefits of sports and tourism but are forced to bare their negative consequences (Macedo and Ramos, 2012). In the Global South, such conflicts emerge in undeveloped locations where kiteboarding tourism has been growing (Macedo and Ramos, 2012; Walczak and Levine, 2016).

Notwithstanding the above, kiteboarding has been recognized as a beneficial activity for local economies in many locations of the Global South (see, e.g., Nazli and Musal, 2018; Jasińska, 2019; Kulczyk et al., 2018; Woźniak et al., 2018; Korneevets et al., 2018; Fadda, 2019, 2020; Greenaway, 2017; Mateos, 2016; Bula, 2016; González Martí, 2018). And other economic benefits have been identified by researchers. Kiteboarding is an interesting business with large innovation potential (Carter, Milton, and Hanke, 2014; Lina Lundgren et al., 2011; Miclea, Hodirnau, and Csatlos, 2016; van der Vlugt, 2009; Zimoch et al., 2013). Furthermore, the innovation and development of new kites may be used not only in sports but also in renewable energy generation, including wind turbines (Argatov and Silvennoinen, 2010; Ryan Buckley et al., 2008; Canale, Fagiano, and Milanese, 2007; Cartier, Murphy, and White, 2010; Isabella, Rodden, and Blouin, 2007; Jimenez, Roth, and Frewin, 2011; O´Connor, Aye-Addo, and Perez, 2014; Oehler and Schmehl, 2019; Rao, 2019b, 2019a; Salma, Friedl, and Schmehl, 2020).

METHODS

In order to achieve our goal of identifying the most serious impacts of kiteboarding on the environment based on literature review and experts' opinions, we used two methods, namely the Scoping review and the Delphi method.

To analyze the broad theme of kiteboarding sustainability lacking a comprehensive analysis, a Scoping review was the first and right step to mapping the research field. Using this method, we summarized evidence to provide an overview of studied resources without critically appraising individual studies or synthesizing the in-depth evidence from different studies (Pham et al., 2014; Peterson, 2016). For this purpose, we followed the approaches developed by Levac, Colquhoun, and O'Brien (2010) and Colquhoun et al. (2014).

Initially, we searched for relevant research studies in three online databases, namely WoS, Scopus, and SPORTDiscuss. These databases are leading bibliographic resources, providing

comprehensive citation data from relevant academic disciplines related to our research question. Searching for articles in these databases enabled us to gather scientific data about relationships between kiteboarding and sustainability. Moreover, because scoping reviews also include gray literature (e.g., dissertations, research and projects reports, government reports, conference papers, and other relevant information), this step helps to increase the comprehensiveness of the review process and to reduce the publication bias associated with white literature (Paez, 2017). For this reason, we also used Google Scholar, which is not a human-curated database but rather an Internet search engine, comprising books, reports, theses, preprints and other such resources. The searching terms were *kiteboarding*, *kitesurfing*, *snowkiting*, and *landkiting*. The search was conducted in January 2020 and limited to articles published before 1.1.2020.

In the screening phase of the Scoping review, the papers written in English were screened and appraised according to two criteria. The first criteria concerned the research background – in articles listed in both WoS and Scopus and in gray literature; the articles were required to state the research question, describe the method, report results, and include references. In the gray literature, in particular, this criterion ensured the necessary quality of the resources. The second criterion focused on kiteboarding – the documents were required to mention one of the above keywords in their title or abstract or, more likely, to contain relevant information on the sustainability of kiteboarding.

In the eligibility phase of the Scoping review, the full text of each selected documents was assessed for relevance, defined as concrete information or findings about a link between kiteboarding and at least one of the sustainability pillars (economic, social, and environmental). In this phase, 79 papers were excluded, most of which because they merely mentioned kiteboarding as a popular activity or as an example of a modern extreme sport without any particular findings related to sustainability. The final pool of documents amounted to 158 resources.

This final pool was subsequently subjected to an in-depth content analysis. To reduce potential bias caused by article selection and further analysis, all aforementioned steps were separately completed by two researchers, and differences in findings were discussed until reaching a consensus. Upon strong disagreement between the researchers, a third (independent) researcher was involved in the process. Regular research meetings were held during this process to discuss all challenges and uncertainties.

In the content analysis, the documents from the final pool were examined for their relationship with one of the three sustainability pillars (environmental, social and economic), which were split into several sub-categories according to common topics found in the documents. First, one researcher created a codebook listing all relevant topics and their definitions. Subsequently, in the text analysis, the second researcher applied and adjusted the codebook. Lastly, the two researchers discussed the codes and categories to reach the final version of the codebook. Thus, the codes and categories in the codebook are the product of a consensus among coders, applying the principle of dialogical intersubjectivity (see, e.g., Smalling, 1992).

All documents were recoded again, in accordance with the new codebook and by both researchers. Once again, the data were compared to increase objectivity. After this phase, several topics were identified (see Table 1). These topics became the starting point for the subsequent Delphi method.

The Delphi can be regarded as a formal consensus method measuring and/ or developing consensus among stakeholders (Jones and Hunter, 1995). Using this method, a group of anonymous experts share expectations and opinions about real-world problems and forecasting (see, e.g., Landeta, 2006). Recently, the Delphi method has been used to determine various sustainability factors, including those associated with sports and tourism, especially when assessing sustainability factors (see, e.g., Mallen et al., 2010; Ocampo et al., 2018; Asmelash and Kumar, 2019; Fallah and Ocampo, 2021; Glibo, 2022).

The literature on the Delphi method is vast. Some authors prefer starting with an iterative process using a questionnaire or even open-ended questions (Green, Hunter, and Moore, 1990; Szpilko, 2014), while others criticize this iterative process for its inability to produce the level of information that a thorough literature review should generate (Green, Hunter, and Moore, 1990; Miller, 2001). The second approach, which consists of defining questions by literature review, more optimally provides us with the possibility to ask pertinent questions even in such a broad theme – the sustainability of kiteboarding. For this reason, we used the Scoping review results – impacts of kiteboarding on the social and nature environment (see Table 1) – to develop a questionnaire.

A key step in the Delphi method is the selection of experts. The objective is to create a panel with a wide range of experts with appropriate knowledge and from different backgrounds (academia, business, politics, and other areas) (Rowe and Wright, 2001). The optimum number of experts lies between 5 and 20. However, the real number depends on the diversity of the themes because they must be covered by experts with the appropriate knowledge. We argue that the Scoping review is a necessary step for identifying relevant experts without which the required expertise remains unknown or, at best, underestimated.

Based on our Scoping review, we identified the following fields of expertise needed to acquire sufficient knowledge through a balanced panel: coastal tourism, sustainability in sports, kiteboarding equipment manufacturing processes, kiteboarding industry management, local governance in sites affected by kiteboarding, environmental protection on sites affected by water sports tourism, including kiteboarding, sports media and professional kiteboarding. Since kiteboarding is a sport practiced in many locations, in many countries, we aimed at reaching out to geographically diverse experts from different areas of expertise, among other parameters. For each area of expertise, we identified relevant organisations, including universities, local government institutions, non-governmental organisations, enterprises, media covering kiteboarding and the environment, and kiteboarders associations. Of the 19 organisations contacted with a request for suggesting experts for a Delphi panel, 6 got back to us with their suggestions of experts. In total, 17 experts were individually invited to participate in the survey. Ultimately, 11 experts from the United States, Brazil, the Netherlands, Germany, Denmark, Sri Lanka, the Czech Republic and Australia took part in two rounds of our Delphi survey. These experts represented non-governmental organisations, the media – environmental documentary filmmakers, kiteboarder associations, universities and enterprises, and experts covered all necessary fields of expertise. Unfortunately, no local government representatives accepted the invitation even though universities, kiteboarding platforms and non-governmental organisations often collaborate with local government representatives, who have knowledge to share.

The themes generated through the Scoping review in table format (see Table 1) were shared online with these experts, who were asked to assess the severity of kiteboarding impacts on the social and natural environment using a 5-point scale – from extremely severe (5) to not at all severe (1), and to add supporting comments if needed. They were also asked to include missing impacts of kiteboarding when addressing the sustainability of kiteboarding. All experts remained anonymous to avoid influencing their opinion. The first round of answers was analysed towards reaching a 70% consensus, in accordance with Okoli and Pawlowski (2004).

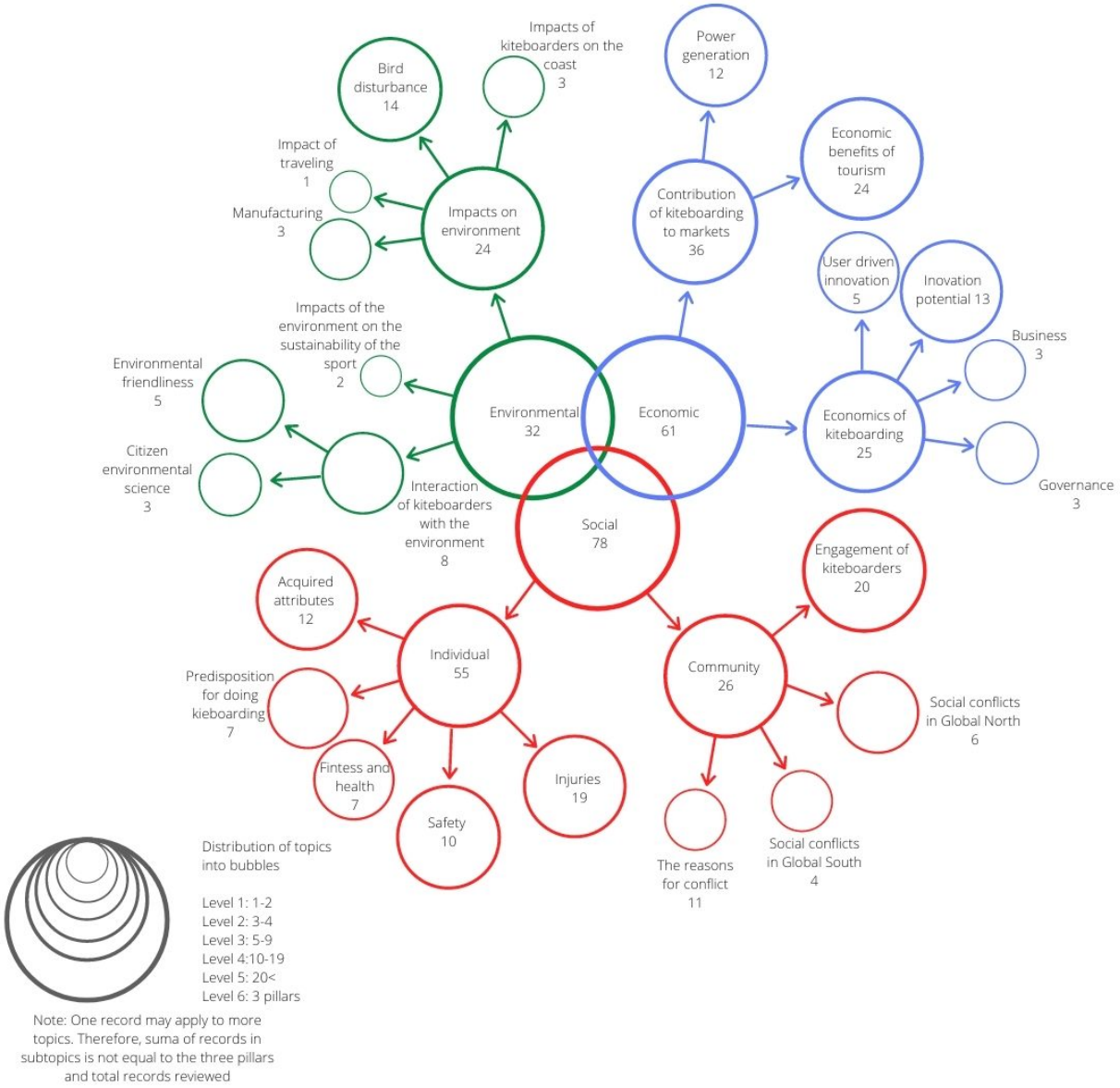
The first round, however, did not bring any consensus among experts, so the table with results was amended and sent online to the same experts again. The experts were asked to consider their previous responses and possibly change them according to other experts' ideas and comments. All 11 experts were willing to participate in the second round of the Delphi method although some had to be reminded to do so several times.

Scholars have long debated how many rounds the Delphi method should encompass and even whether a consensus must be reached. Yet both debates remain controversial and hence unresolved (there is a concern about reaching a false consensus just to finish the survey resulting from fatigue) (see, e.g., Humphrey and de Wit, 2018). Beiderbeck et al. (2021) argue that disagreement among experts is a valid and highly insightful outcome, especially in prospective studies. Bearing in mind differences between Delphi studies, three types of termination criteria are mentioned, namely time- (i.e., number of rounds or specific period), participant-, and consensus-related criteria. For our Delphi study, we set two rounds because we used the Scoping review to gather existing information from other experts to prepare the questionnaire. This Scoping review can be understood as the first round of the study although the experts (the reviewed authors) differed from the experts who participated in the Delphi study. Moreover, a two-round study enabled us to ensure the consistency of experts' thoughts since they had to recall their thought process, albeit without demanding too much time from the participants with dissenting views, thus avoiding dropouts.

RESULTS

The final resource pool analysed in the Scoping review contained 158 documents about kiteboarding published between January 2004 and December 2020, including journal articles (100), reports (22) (mostly environmental reports or coastal management plans) and theses (18). These documents were sorted and clustered according to three sustainability pillars and sub-themes (see Figure 1). Detailed results of the review in tabular format are available from https://bit.ly/kitescopereview

Figure 1 Reviewed documents sorted and clustered according to three sustainability pillars and sub-themes



In total, 13 negative impacts (highlighted in grey in Table 1) and 6 positive impacts of kiteboarding on the natural and social environment were identified and discussed in the sustainability context in the literature. Most sustainability studies mainly assess the negative effects of human activities on the environment. However, this biased analysis provides only a one-sided view of activities. In particular, disregarding the positive economic and social benefits of sports, such as promoting both physical and mental health, fostering sustainable community development and boosting friendships, results in a distorted and incomplete perspective of the sustainability concept.

In the first round of the Delphi method, experts added four new impacts of kiteboarding on the natural and social environment, all of which were positive (see text written in italics in Table 1). One expert assessed kiteboarding as sport with a low environmental impact with the following justification: "*People kite- instead of wakeboarding behind a motorboat (much less sustainable in terms of environment and fossil fuels). The use of wind is a reason why I like kiteboarding.*" The same expert also added that kiteboarding had a positive impact associated with the positive relationship between

the sport and environmental protection: "*Kiteboarding as a way for people to appreciate and connect with the natural environment, which means they care more about it and want to preserve it*." Another expert expanded the list of positive environmental impacts of kiteboarding by adding the community-associated impact of this sport (sense of belonging) and comment on it, stating that "*Kiteboarding is an exclusive club that creates a strong sense of community and belonging. At least in my Country* (the specific name is omitted for anonymity), *if you see another kiteboarder on the beach, there's a 90% chance you're going to become friends.*" Lastly, the support of eco-business was also mentioned: "*Our Organisation* (the specific name is omitted for anonymity) *actively funds and organises local tree-planting and ocean clean-up initiatives to preserve the beauty of learning to kitesurf here. We also purchase as much of our stock from as low an impact suppliers as we can funding them to continue to make responsible business more viable*." The statement is in line with the previously added impact emphasizing the relationship between this sport and environmental protection.

Table 1 Impacts identified in the Scoping review and supplemented by experts' opinions

	Environmental	Social	Economic
Kiteboarding impacts on the water and coast	Degradation of marine ecosystems	kite boarders' injuries and safety	
	Degradation of coastal ecosystems	Improving fitness and health, including mental health	
	Bird disturbance	Learning new skills	
	Activity with a low environmental impact	Conflicts with other kiteboarders and/or beachgoers, including safety	
	Positive experience from practicing a sport related to the natural environment – advocacy for environmental protection	Conflicts with local authorities or environmental protection institutions	
		Sense of belonging in the community	
Kiteboarding impacts related tourism	Impact of traveling (carbon footprint)	Social interaction with the local community	Direct economic benefits to kite-related tourism businesses– regional (schools, shops, and bars)
	Overload of waste and lack of sources (drinking water)	Conflicts between the kiteboarding tourism industry and artisanal activities (e.g., fishing)	Indirect economic benefits for local businesses (hotels, restaurants)
			Secondary economic benefit from supporting eco-businesses
Manufacturing	Sourcing materials	Violation of the human rights of workers in factories	Added value to the economy
	Manufacturing and transportation carbon footprint		
	Insufficient recycling of kiteboarding products		

In the first round of the Delphi method, 70% consensus among the experts was not reached for any of the impacts listed above (Table 1). In the second round, once the experts reviewed the other experts' thoughts and comments, consensus was reached for 14 impacts (see Table 2).

As shown in Table 2, the experts scored the positive social and economic impacts of kiteboarding in the field of sustainability with the second-highest severity level (very severe), indicating that kiteboarding improved athletes' fitness and health, enabled them to develop new skills and fostered social interactions with a local community. They also emphasized that positive experiences in nature lead to environmental advocacy and that kiteboarding also brings economic benefits to local businesses. As the only severe negative impact, they identified the insufficient recycling of kiteboarding products.

Another cluster of impacts was scored by experts as moderately severe. Two positive impacts were related to social and economy factors; one was the impact on sense of belonging to the kiteboarders' community, and the other one was the economy benefit of this sport for countries where kiteboarding equipment is manufactured. In turn, two negative impacts of kiteboarding were also assessed as moderately severe by the experts, namely conflicts with other beachgoers and kite boarders, with nearly all experts commenting about possible solutions to this problem, which is likely why they assessed such conflicts as a moderate severe impact) and the violation of workers' human rights. However, two experts argued merely intuitively rather than based on evidence, as shown in their comments: "*Hard to tell what is happening behind closed doors*."

The last cluster referred to impacts scored with low severity or importance. The experts admitted that kiteboarding may cause the marine ecosystems degradation and mostly commented on cases of kiteboarding in locations with vulnerable ecosystems, albeit not in their country, or of occasional vandalism. Similarly, they did not rule out conflicts with artisanal activities (e.g., fishing), but they highlighted an easy way to solve potential conflicts in advance. The experts also admitted that kiteboarders' injuries are a potential impact on the health system of tourist areas with limited healthcare resources. Nevertheless, they stated that injuries occur infrequently because most kiteboarders follow rules of safety. Lastly, the experts acknowledged the secondary economic benefit from supporting eco-businesses as an impact with low importance, without justifying this rating in any comment.

Table 2 Distribution of impacts by severity/ importance

		Positive	Negative
5	**Extremely severe/ important**		
4	**Very severe/ important**	• Environmental advocacy stemming from positive experiences in nature • Improved fitness and health • New skills • Social interactions with the local community • Indirect economic benefits for local businesses (hotels and restaurants)	• Insufficient recycling of kiteboarding products
3	**Moderately severe/ important**	• Sense of belonging • Added value to the economy	• Conflicts with other kiteboarders and/or beachgoers • Violation of workers' human rights in factories

2	**Low severity/ importance**	• Secondary economic benefit from supporting eco-businesses	• Degradation of marine ecosystems • Athletes' injuries and safety • Conflicts of the kiteboarding tourism industry with crafts (e.g. fishing)
1	**Not at all severe/ important**		

The other eight impacts failed to reach 70% consensus among the experts. However, some of them nearly came close to crossing the 70% threshold, including the carbon footprint of manufacturing and transporting kiteboarding equipment, sourcing material, and conflicts with local authorities and environmental protection institutions. All three impacts were assessed as very severe. A similar level of agreement was reached on the carbon footprint related to traveling and on direct economic benefits of kiteboarding-related tourism business, which were assessed as moderately severe (highlighted in grey in Table 3).

Table 3. Experts' impact assessment on a 5-point scale

Impact	Assessment				
	Not at all severe	**Low severity**	**Moderately severe**	**Very severe**	**Extremely severe**
Degradation of coastal ecosystems	45.5%	18.2%	36.4%	0%	0%
Bird disturbance	0%	18.2%	27.3%	45.5%	9.1%
Carbon footprint of traveling	0%	0 %	63.6%	27.3%	9.1%
Overload of waste and lack of sources (drinking water)	0%	18.2%	54.6%	27.3%	0%
Sourcing of materials	0%	18.2%	18.2%	63.6%	0%
Carbon footprint of product transportation	0%	9.1%	27.3%	63.6%	0%
Conflicts with local authorities or environmental protection institutions	0%	18.2%	9.1%	63.6%	9.1%
Direct economic benefits to kiteboarding-related tourism businesses– regional (schools, shops, and bars)	0%	0%	63.6%	9.1%	27.3%

DISCUSSION

The concurring experts' opinions on the positive and negative impacts of kiteboarding reflect well the relationship between sports and sustainable development. On the one hand, sports promote sustainable development (UNGA, 2015), but on the other hand, in many spheres, both sports and sports-related tourism can create pressures, even, causing tensions between various sports activities overlapping in the same area, between different social groups, such as interest groups in

business (Ramallal et al., 2010), and between kiteboarding and environmental protection (Bellan, G. & Bellan-Santini, D., 2001).

In terms of social sustainability, the experts considered that the sport has a very positive impact on physical and mental health, in line with Ceylan et al. (2016), Le Corre et al. (2020) and Buckley (2018b). This perspective was expressed in several experts' arguments. One expert stated: "*Not much has made me more fit and excited to get active than kitesurfing and I see that for a lot of our clients*." Another expert noted: "*Physical and mental health are greatly improved by these* activities." Mental health is also associated with an enhanced "sense of belonging", which was rated as a moderately severe impact by the experts.

The experts, conversely, disregarded kiteboarding injuries a serious issue even though some authors, e.g., Hall et al. (2020), have indicated that high-energy sports. including kiteboarding, naturally result in serious traumatic injuries to the shoulders, knees and head (L. Lundgren, Brorsson, & Osvalder, 2011; Paiano et al., 2020). In this study, the experts corroborated the findings of Diewald et al. (2019), Midway, Wagner, and Burgess (2019) and Wiesner (2017), who have emphasized the need to be aware of risks and observe safety rules. This point of view was expressed in several statements, such as "… *most injuries are from those that venture out of accepted rules and regulations for the sport."* or "*Kiteboarders choose to partake and are aware of the risks. Don't see an undue burden put on healthcare systems*."

The experts rated social interactions with the local community as a highly positive impact, confirming the UN agenda: "*We recognize the growing contribution of sport to the realization of development and peace in its promotion of tolerance and respect and the contributions it makes to the empowerment of women and of young people, individuals and communities as well as to health, education and social inclusion objectives"* (UNGA, 2015). The experts' opinions complemented this statement when highlighting that "[social interactions] *provide new perspectives and may influence humanitarian behaviour. Inspire and share the stoke*" or *„There are nice examples of where kiteboarding benefits and integrates with local communities, or act as therapy/better activity for some".*

The consistency of their opinions is patent in their disregard for conflicts between kiteboarding tourism and artisanal activities, which could result in potential conflicts with local communities, assessed as impacts with low severity. By contrast, the experts regarded conflicts with other kiteboarders or beachgoers as moderately severe. According to Pereira et al. (2014) and Walczak and Levine (2016), experts tend to focus on good beach management plans and compliance with rules across all coastal users. As a case in point, one of the experts who participated in this study commented that: "*When right of way rules are broadly taught and adhered to there is minimal conflict. Self-taught kiteboarders seem to be the worst offenders for creating conflicts as they feel incorrectly wronged as they don't know the right of way rules*."

The agreement among experts was relatively good in the field of the economic sustainability of kiteboarding. The kiteboarding market has been growing, and more people are interested in this sport. As such, kiteboarding has become a suitable business opportunity (Hellblom and and Sparre, 2007). The experts, accordingly, regarded kiteboarding as a sport with a moderately high/severe value to the economy through equipment manufacturing; however, they rated the economic benefits for local business (hotels and restaurants) resulting from kiteboarding tourism

development as very important, as shown by their comments: "(…) *especially valid for windy locations which enjoyed little to no tourism before their potential for kitesurfing was discovered. For example, Tarifa, Kalpitiya, Zanzibar, Kenya*." or "(Kiteboarding) *can be a massive source of income and provide resources to underdeveloped areas*". Yet, according to the experts, the importance of secondary economic benefits resulting from supporting/ sponsoring eco business is low.

In the field of environmental sustainability, one expert added a new theme/ impact – "kiteboarding is a sport with a low impact on the environment". His argument is in line with the view of Huddart and Stott (2019), who assessed kiteboarding as a non-motorised sport less harmful than motorised water sports. Such a generally defined theme is difficult to assess on a severity or importance scale. However, the experts believed that kiteboarding is an environmentally friendly sport based on their understanding of its environmental impacts. Thus, the only severe impact identified by the experts was the lack of recycling of kiteboarding products. By contrast, degradation of marine ecosystems was perceived as a problem with low severity, as argued by Huddart and Stott (2019). For example, one expert stated: "*I have not witnessed this. As it is a "human powered" activity", I believe this impact to be minimal*."

Surprisingly, no consensus was reached among experts about the carbon footprint of kiteboarders, who often travel to remote locations, although IKA, for example, calls for restricting air travel emissions and using public transport and green vehicles, in accordance with the World Sailing Agenda (IKA, 2023). Most experts assessed this carbon footprint as moderately severe environmental impact with arguments such as "*Should be mindful of our travel methods and frequency but people are going to travel, sport or not*." or "*a relatively small kite community.*" Similarly, there was no consensus on the severity of carbon footprint caused by the transportation of kiteboarding products although nearly all experts focused on buying local kiteboarding products.

Among the experts, there was little consensus on other environmental impacts of kiteboarding, reflecting different experiences. Furthermore, environmental impacts also vary with the location, as explained by de Sousa et al. (2011), Ariza, Pons, and Breton (2016), Krüger (2016), Derriks (2017, 2018) and Matias, Carvalho, and Brasileiro (2019). The experts were aware of possible impacts but unable to simply assess them, as expressed in the following statements: "*Depends on locations, some environments are more fragile than others*" and "(....) *there it's a sensitive area for native birds. However, we formed demarcated areas for travel and also through kitesurfing, funding for research projects especially with conservation were started. So I would say it depends on the ethos of how manages and does thing*." The experts' individual experiences are reflected also in their assessment of conflicts with local authorities or environmental protection organizations, but once again, those experiences depend on the location where they kiteboard.

CONCLUSION

Combining two methods (Scoping review and Delphi method) allows us to understand how kiteboarding sustainability is currently regarded by researchers and by experts in this sport. This study shows that kiteboarding has significant positive impacts, especially in terms of social sustainability by strengthening the physical and mental health of an individual and by promoting

respect between and empowering individuals and communities. Both researchers and experts recognise the economic benefits of kiteboarding as indirect benefits for touristic areas, especially for hotels, restaurants and other hospitality services. In the post-pandemic period, sports, including kiteboarding, considerably foster economic and personal well-being.

The negative impacts of kiteboarding must also be considered, though. Experts and researchers alike indicate the contribution of kiteboarding to climate change in the form of GHG emissions. However, experts consider that the environmental impact of these emissions (moderate) is less important than the impact resulting from the lack of recycling of kiteboarding equipment (severe). And while some studies address the various impacts of kiteboarding on marine and costal ecosystems, experts dismiss this problem because they regard kiteboarding as sport with a low environmental impact. Nevertheless, they admit that kiteboarding may have negative impacts on ecosystems in some localities, which can lead to conflicts with local authorities or environmental protection institutions. In this regard, both researchers and experts agree on the importance of adequate coastal and beach management aimed at not only promoting environmental protection but also avoiding conflicts between different beachgoers and coastal users.

Kiteboarding experts also stress the need to educate kiteboarders on injury-prevention strategies and safety rules to keep other beachgoers safe and to protect ecosystems and the natural environment through coast responsibly. They believe that most kiteboarders follow these rules based on their own positive experience, that kiteboarding leads to environmental advocacy and that beach management should prevent conflicts, which can impair kiteboarding experiences.

The results of our study may contribute to the development of a set of indicators to help kiteboarders assess behaviour related to their sport. This assessment tool may also serve as an educational tool for raising awareness to even partly negative impacts of kiteboarding on sustainability. Such an approach will help to enforce the aforementioned safety rules protecting the social and natural environment. As a result, many organisations, including World Sailing, are publishing educational guides highlighting the environmental and social impacts of specific sports, including individual sports. As such kiteboarding may stand alongside other sports that contribute to maintaining both a healthy lifestyle and environmental sustainability.

LIMITATIONS OF THE STUDY

Although we combined two qualitative research methods to identify themes related to the sustainability of kiteboarding and assess its most serious impacts based on experts' opinions, all qualitative research methods have limitations. The first method, scoping review, also includes grey literature and thus studies with questionable quality (Daudt, van Mossel, and Scott, 2013). For this reason, we introduced the research background criterion to ensure the quality of such sources. In fact, both grey literature and articles found in WoS and Scopus were required to clearly state the research question, in addition to including other sections such as methods, results, and references. Moreover, the grey literature analysed in this study consisted of dissertations, research, governmental and committee reports, and conference papers, among others, whose evidence most often meets quality standards *a priori*. Furthermore, the language bias of this study may be criticized because we only selected articles

written in English for the Scoping review. Nevertheless, this eligibility criterion is in line with an increasing trend to publish in English to share information globally. Ultimately, we believe that we did address most known themes and impacts of kiteboarding on sustainability because the experts from different countries only added two other impacts.

The second method, Delphi, entails some bottlenecks, but we adopted specific approaches to overcome these obstacles, as discussed in depth in the Methods section. A limitation of the Delphi method that was not discussed above and should be considered here is the bias in sample selection. In this study, we identified and contacted relevant organisations, including universities, local government institutions, non-governmental organisations, enterprises, media outlets, and kiteboarding platforms, among others, requesting their suggestions of experts for the Delphi panel in each field of expertise related to kiteboarding sustainability, excluding those from local government institutions. Nevertheless, people from the other organisations regularly collaborate with local authorities, so even public administrators might have been represented to some extent, albeit indirectly, and therefore their knowledge was not completely overlooked.

Another limitation that should be considered is that all experts volunteered to participate in this study. Volunteering is always hard to avoid in sociological research such as this study. However, the sustainability of kiteboarding requires respondents who meet specific subject matter criteria and who are willing to address such a complex topic. Readers should be aware that the respondents of our study do not represent all experts on the sustainability of kiteboarding. But despite the limitations discussed above, our comprehensive and in-depth study has the potential to enhance the current knowledge on the sustainability of kiteboarding.

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Investigating the Impact of Eight Weeks of Aerobic Training on Liver Enzymes and Hematological Profile in Children With Leukemia

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ABSTRACT

The objective of the evaluation was to study and determine the impact of eight weeks of aerobic training (AT) on liver enzymes and changes in hematological profile in children with leukemia. In this semi-experimental and applied study, 24 children in the age range of 7-10 years referring to hospital were randomly classified into two control (n=12) and experimental (n=12) groups. experimental group have eight-week AT with 40% to 70% of heart rate reserve, three sessions per week, the controls didn't exercise training program was observed in during the study. Liver enzymes such as Aspartate aminotransferase (AST) and alanine aminotransferase (ALT), Hemoglobin (Hb), White Blood Cells (WBC), platelets (PLT), and bilirubin were measured. Data analysis using a paired t-test and analysis of covariance was performed with SPSS software (version 18). The results showed that moderate-intensity AT had a significant effect on hemoglobin and liver enzyme levels and a significant increase in Hb ($p<0.05$) and significant reduction the ALT and AST ($p<0.05$), whereas there was no significant influence on WBC, ALT, and bilirubin ($p>0.05$). AT may accelerate the oxygen supply and reduce liver damage caused by medications in children diagnosed with leukemia without having corrupting effect on PLT, bilirubin, and safety factors.

Keywords: Aerobic training, Leukemia, Children, Liver Enzyme, Hematological profile

INTRODUCTION

There are four major types of leukemia. Acute lymphoblastic leukemia (ALL) is the most common type of leukemia that affects children. In ALL large numbers of white blood cells (WBC), that called blast cells, are released before they are ready (Eghbalian, Monsef, & Mousavi, 2009; Lago et al., 2021)

The prevalence of the disease is about 40 children in one million children under the age of 15, and each year about 2,000 new cases of ALL are reported in children in the United States (Kuehn et al., 2021). Leukemia is a common cancer in Iran and the prevalence of this disease is increasing (Farhood, Geraily, & Alizadeh, 2018). Cancer treatments include surgery, biological therapies (including immunotherapy and gene therapy), radiotherapy and chemotherapy (Najafi-Vosough et al., 2022). Complications of chemotherapy for children with ALL include an increase in liver enzymes (ALT and AST), fatty liver, abnormalities in blood coagulation factors, and an increase in bilirubin, as well as a decrease in WBC, ALT, and Hb (Belson, Kingsley, & Holmes, 2007). Anemia is one of the most important and common problems in patients undergoing chemotherapy (Boyadjiev & Taralov, 2000). Various studies have reported a high prevalence of anemia in patients receiving chemotherapy (Kitano et al., 2007; Wojtukiewicz et al., 2009) .

Most cancer patients who suffer from fatigue and muscle weakness are encouraged to rest and avoid exercise to reduce fatigue and improve pain symptoms (Courneya & Friedenreich, 2007). In recent decades, the use of exercise programs as an effective intervention to improve the quality of life of cancer patients has attracted the attention of scientists (Lin et al., 2021; Mujtaba, Mazhar, & Tanzeel, 2021). Many studies have been conducted on the effect of physical activity on various diseases (Courneya & Friedenreich, 2007) but there are limit studies about effect of physical activity on ALL. The first goal of cancer treatment is to eradicate the disease. If this initial goal cannot be met, the next objective was relieving sings and maintaining the quality of life for the rest of the patient's lifetime. Shamsoddini at al. (2015) research has shown that exercise has a significant effect on liver enzymes, to some extent the treatment of fatty liver in patients that have hepatic fat with nonalcoholic fatty liver disease and an increase in the number of WBC and RBC, and reduces the risk of immune diseases (Hashida et al., 2017; Moosavi-Sohroforouzani & Ganbarzadeh, 2016; Shamsoddini et al., 2015).

Numerous studies have shown that AT improves hemoglobin and red blood cell counts in individuals during treatment and after chemotherapy (Gasmi, Benaicha, Rouabhi, & Kebieche, 2021; Kazemi et al., 2009; Mittelman, 2003). Physical exercise as a therapy that can restore physical and functional capacities; however, it is essential to understand its effect and role in improving the symptoms of patients with ALL. There are few studies investigating the effect of AT on liver enzymes and hematological profile in children with leukemia. The question now is whether AT can have beneficial effects on the side effects of chemotherapy for children with leukemia?

METHODS

Subjects

The method of this research is applied and semi experimental. Statistical population of this study included all children with leukemia was admitted to charity supporting for children with cancer. A block randomization method with a block size of four was used to randomize patients. For this purpose, four sheets of paper were prepared. The letter I (under treatment with exercise program) was written on two sheets and the letter C (control group) was written on the other two sheets. The sheets were mixed together and then randomly drawn out one at a time for each patient without replacement until all four sheets were drawn. This method is repeated until all 24 patients were randomized. A block randomization method with a block size of four was used to randomize patients. For this purpose, four sheets of paper were prepared. The letter I (under treatment with exercise program) was written on two sheets and the letter C (control group) was written on the other two sheets. The sheets were mixed together and then randomly drawn out one at a time for each patient without replacement until all four sheets were drawn. This method is repeated until all 24 patients were randomized. The sample size was estimated to be 24 according to the single proportion equation with a 95%-confidence interval. Statistical sample include 24 children aged 7 to 10 years that referred to hospital for treatment and were divided randomly into two control (n=12) and experimental (n=12) groups.

In this study, the AT group performed exercises with an average intensity of 40 to 70% percent of heart rate (Naderifar, Mohammad khani Gangeh, Mehri, & Shamloo Kazemi, 2022).

The inclusion criteria included 7 to 10-year-old children with fatty liver disease who were confirmed by ultrasound with acceptable sensitivity and specificity and had undergone chemotherapy in the hospital. All people are in the remission phases of the disease. Exclusion criteria included chronic medical and orthopedic conditions that prevent exercise, use of beta-blockers, hemoglobin less than 8 g/dL, PLT less than 20,000(U/L), muscle fatigue and weakness, abnormal pulse rate, bone pain, chest pain, severe nausea or nausea during exercise, vomiting 24 to 36 hours before exercise, dizziness, lightheadedness, blurred vision, shortness of breath, and shortness of breath (Eghbalian, Monsef, Alam Ghomi, & Monsef, 2013).

The study protocol was approved by the human research Ethics Committees of the Research Ethics Committees of Shahid Beheshti University, Iran. This informed consent form was obtained from their parents.

In order to increase the validity of the research and prevent the effects of puberty and body size on the research findings, the 5-step Tanner Maturity Questionnaire was used to determine the maturity status and to measure anthropometric indicators (fat percentage, Height and weight). Blood samples were taken from the subjects before the first training session. All subjects were presented in laboratory at 9 to 11 morning. In order to evaluate the liver fat in the participants, sonography was used by a radiologist in all participants using the same equipment at hospital. Sonography of liver tissue was performed only before the test because one of the conditions for subjects to enter the plan was to have fatty liver. After the 8-week exercise training program, the participants were asked to repeat and perform the tests in the same manner and order. For

preventing the occurrence of the acute adverse effects of exercise training program, post-testing was performed 48 hours after the end of the training intervention.

All activities of the experimental group were performed in the occupational therapy hall of hospital under the supervision of oncology specialist, occupational therapist and master student of sports physiology. The control group did just their own daily routine exercises.

Aerobic Exercise Intervention

The subjects of the experimental group were first examined by sport medicine. After the approval of the relevant specialist to participate in the training session. The individuals participated in AT for eight weeks and three sessions per week. Each session lasting for 20–45 minutes, which was increased over time (Table 1). The AT consisted of three phases including warm-up, training and cool down. The participants were asked to warm up for a determined time (in the range 5–7 min), and then entered the main part of the exercise where AT using a treadmill, then after completing the exercise, the subjects cool down for 5 to 7 minutes.

Borg test and heart rate test were used to control the intensity of exercise, so that due to the young age of children, picture of Borg test was used and the target heart rate was 40 to 70% HR reserve. The first week of AT started with an intensity of 40–60% of the reserve heart rate and gradually increased during eight weeks, and in the last week the intensity of the AT reached between 55–70% of the reserve heart rate. To measure the target heart rate in each AT session, the reserve heart rate formula (% exercise intensity × (HRmax − HRrest) + HRrest) was used. Treadmill model (DIAMOND 5051) made in Korea was used for aerobic exercise. To measure the subjects' heart rate, a polar heart rate monitor made in China with a wrist monitor was used. Three sessions per week, each session lasting 20 to 45 minutes.

Table 1. Exercise protocol

Variable	First Week	Second Week	Third Week	Fourth week	Fifth week	Sixth Week	Seventh Week	Eighth week
Intensity of training	40–60 %HRR	40–60 %HRR	45–65 %HRR	45–65 %HRR	50–65 %HRR	50–65 %HRR	55–70 %HRR	55–70 %HRR
Time of training	20 Min	25 Min	25 Min	30 Min	35 Min	40 Min	45 Min	45 Min

Maximum heart rate was calculated using the formula (25): HRmax = age-220

Measurement of white cells and their separation

In the laboratory, the amount of neutrophils, monocytes and eosinophils was determined using microscopy and leukocyte formula. ethyl alcohol was used to prepare and fix the blood spread and then stained with ready-to-dye solutions available in the laboratory. In Bagisma staining, the cytoplasm of blue basophilic cells and the cytoplasm of acidophilic cells turn red and the nucleus of the cell turns purple. Immersion oil was used on the slides to count white blood cells and one hundred cells were counted in a zigzag pattern. This method of determining the type of white blood cells is

called the percentage of leukocyte formula, which in normal and adults includes: 50–70% neutrophils, 25–40% lymphocytes, 3–8% monocytes and 1–4% eosinophil's and less than 1% Is a basophil.

- **Hb:** To measure the amount of hemoglobin, a special kit for Monobind 1 and ELISA method was used.
- **ALT**: To measure the indicators, a platelet was made by Sysmex automated cell counter device model 1800 XT.
- **Bilirubin**: To measure bilirubin, spectrophotometric method was used with BT3000 device and Pars test kit.
- **Liver enzymes**: ELISA kit for aggregation of ALT and AST enzyme activity in AU400 chemical analyzer.

Statistical analysis

The Levene and Shapiro–Wilk tests were used to determine the equality of variances and normal distribution of the data, respectively. Data are represented as mean ± standard error (SD). The changes within each group were undertaken using paired t-tests. Statistical significance was accepted when $P<0.05$. Moreover, SPSS software version 18.0 (SPSS, Inc. Chicago, Illinois, USA) was used for data analysis. o determines whether exercise and medication (Experimental group) had a greater effect on AST enzyme or drug use alone (control group) the effect coefficient t was used.

RESULTS

In the experimental group the mean age, height and weight was 8.67±1.98 years, 133.58±8.73 cm, 33.59±9.57 kg, respectively. In the control group the average age, height and weight was 8.42±1.21 years, 130.04±6.21 cm, and 33.91±8.03 kg, respectively.

Table 2. Liver enzymes and hematological profile in children with leukemia

Groups	Variable	Pre mean ± SD	Post Mean ± SD	P-value
Experimental	AST (U/L)	93.33±13.71	48.92±11.81	<0.001
Control		92.92±16.05	68.67±30.11	0.026
Experimental	ALT (U/L)	102.75±13.05	57.75±19.84	<0.001
Control		103.83±13.79	79.75±24.70	0.002
Experimental	WBC ($\times 10^9$/L)	4.1±0.59	4.43±0.81	0.295
Control		4.22±0.80	4.15±0.52	0.840
Experimental	Hb (g/dL)	10.74±1.23	12.75±2.83	0.050
Control		10.77±1.72	10.56±1.40	0.693
Experimental	PLT (U/L)	255.75±56.42	262.50±33.38	0.707
Control		256.67±56.40	254.08±32.90	0.886
Experimental	Bilirubin(mg/L)	0.68±0.25	0.50±0.12	0.083
Control		0.61±0.26	0.59±0.18	0.817

AST: Aspartate aminotransferase, ALT alanine aminotransferase, WBC: white blood cell, Hb: hemoglobin, PLT: platelets, SD: Standard error,

There was no significant difference between the two groups in terms of height, weight, age and body mass index (P<0.05) and the two groups were homogeneous.

Also, the results of T-Test showed (Table 2) that there was not significant difference between pre-test and post-test in both control and experimental groups. There was significant difference between the pre-test and post-test in the change of AST, ALT and Hb in the experimental group (P≤0.05), while no significant difference was observed between the pre-test and post-test in the control group (P>0.05). To determine whether exercise and medication (Experimental group) had a greater effect on ALT enzyme or drug use alone (control group), the effect coefficient t was used. According to the calculations, the effect on ALT enzyme was 93.01% in the experimental group, and 58.77% in the control group. As shown, the effect of AT on ALT and AST enzymes reduction was greater. According to the calculations, the effect on AST enzyme was 86.18% in the experimental group and 23.23% in the control group. There was no significant difference in ALT and bilirubin between pre-test and post-test in the control and experimental groups.

DISCUSSION

The results showed those eight weeks of AT significantly reduced liver AST and ALT liver enzymes in children with leukemia. The results of the present study were consistent with the findings of Suzuki et al. (2006) and Davoodi (2012) studies. This can be due to the type of training, duration of training, age of the subject, clinical condition of the subject, and intensity of training. Studies show that exercise may modulate liver fat directly by altering liver fat oxidation (Lee, 1998). During exercise the increased O_2 demand of skeletal muscle is mainly matched by increasing muscle blood flow by increasing cardiac output, by modulating blood flow distribution among active and inactive organs, and by optimizing microcirculation (Welch et al., 2012). Aerobic activity may further reduce ALT and AST levels by reducing oxidative stress and inflammation (Shamsoddini et al., 2015). Moosavi-Sohroforouzani and Ganbarzadeh (2016) reported that AT effectively decreased the ALT and AST in patients with fatty liver disease. In addition, Ghamarchehreh et al. (2019), reported a significant reduction in ALT and AST levels after eight weeks of AT regardless of weight. It is noteworthy that few studies have focused on the role of aerobic and resistance exercises on ALT and AST levels in patients with leukemia. Changing the lifestyle, losing weight and exercising seem to be appropriate as the first line of treatment. The positive role of regular exercise training against liver injury, inflammation reduction, liver injury and fibrosis has been reported through macrophage filtration (Kawanishi et al., 2012). In this study, the results showed that eight weeks of AT has a significant effect on Hb in children with leukemia. This was consistent with the results of Rezaei Seraji et al., (2012). and Dimeo et al. (1997) studies. In the present study, it was observed that AT has significantly increased the resting Hb concentration of children 7 to 10 with cancer. These findings are inconsistent with the results of Françoise (Alijani Renani, Keikhai, Ghadimi Mahani, & Latifi, 2012; Charnay-Sonnek & Murphy, 2019; El-Sayed, Sale, Jones, & Chester, 2000). One of the possible reasons for the difference between the results of the present study and Françoise research is the age of the subjects. Because in the study, the elderly over 65 years were studied (Charnay-Sonnek & Murphy, 2019). It is noteworthy that from the age of 20, the production of red blood

cells and Hb decreases (Gligoroska et al., 2019). It seems that the main factor of this adaptation is the lack of tissue oxygen and the increase in the need for tissue oxygen, which is created by proper training stimuli. The results demonstrated that eight weeks of AT increased the number of platelets in the blood, but this increase was not significant. This increase may be attributed to the release of fresh platelets from the vascular bed of the spleen, bone marrow and other PLT stores in the body. It also stimulates the bone marrow to make new ALT. Eight weeks of aerobic exercise reduced the total bilirubin level of leukemia patients, but this decrease was neither significant compared to the pretest nor to the control group (Pfalzer, 1989). Health organizations worldwide advocate increased regular physical activity as a potent treatment of NAFLD and for the prevention of steatohepatitis and associated metabolic comorbidities. All kinds of exercise interventions (e.g., endurance and resistance exercise, a combination of both, or unstructured increase in daily physical activity) are effective in ameliorating NAFLD (Hoene et al., 2021). Lack of significant increase in plasma levels of plasma bilirubin can be attributed to a significant increase in total antioxidant capacity. The increase in post-match bilirubin is attributed to injuries caused by foot injuries and increased iron catabolism (Alavi, Dorostymotlagh, Mahmoodi, Jarollahi, & Chamari, 2007). Due to the moderate intensity of exercise and an increase in Hb in the exercise group, the decrease in bilirubin could be due to increased antioxidant capacity (Swift, Johannsen, Earnest, Blair, & Church, 2012). At any given capillary blood flow, the amount of O_2 unloaded from Hb to the cells of working muscle can be increased greatly by decreasing Hb-O_2 affinity (Mairbäurl, 2013).

The results showed that eight weeks of AT had no significant effect on the number of WBC in children with cancer. Moreover, Ag. Daud et al. (2019) reported that mean total leucocyte count increased significantly ($p<0.05$) immediately after exercise at all intensities and durations. Leukocytosis was the most obvious and consistent change that occurred during or after exercise (Neves et al., 2015). A precise definition of an individual's workload that consists of intensity and duration of exercise is crucial as it will affect blood viscosity and blood flow during and immediately after exercise (Mairbäurl, 2013). Some previous studies have showed that endurance training reduces hematocrit and increases hemoglobin with platelets (Belviranli, Okudan, & Kabak, 2017; Wardyn et al., 2008). However, most of the previous studies have reported that the changes in the number and distribution of leukocytes and their subclasses due to the exercise are temporary and unstable, and it is not clear to what extent these factors affect the immune system. In addition to platelets, bilirubin, and safety factors, lipid profile levels possible is suggested.

CONCLUSION

Eight weeks of AT may help prevent damage through decreasing serum levels of liver enzymes and significant increase in Hb, whereas there was no significant influence on WBC, PLT and bilirubin.

Conflict of interest: the authors declare that they have no conflicts of interest.

Informed consent: All participants provided written informed consent to participate in this study

Ethical approval: Ethical approval was IR.SBU.REC.1400.031

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Investigate Relationship between Grit, Coach Leadership Style with Sports Motivation and Athlete Satisfaction While Training After COVID-19

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ABSTRACT

Purpose: The study aims at identifying the relationship between grit, coach leadership style, sports motivation and athlete's satisfaction. Methods: Correlational studies are used to see the relationship between grit, coach leadership style, sports motivation and athlete's satisfaction. Participants involved in this study are athletes in rowing (n=30). Grit, coach leadership style, sports motivation and athlete's satisfaction was assessed by Questionnaire. Nonparametric calculation through Spearman's Rank Correlation was used to test the relationship between the variables. Results: This study showed several results. First, there was a positive relationship between grit with sports motivation and athlete's satisfaction ($p<0.05$). Second, there was a positive relationship between coach leadership style with sports motivation and athlete's satisfaction ($p<0.05$). Conclusions:Thus, our research highlights the importance of a trainer's girt and leadership style to create a positive relationship with sports motivation and satisfaction in athletes in carrying out training activities.

Keywords: coach leader, athlete psychological, competitive sports

INTRODUCTION

The COVID-19 pandemic left a lot of losses in competitive sports (e.g., rowing) activities expecially towards athletes. Several data show that the COVID-19 had given several negative impacts namely the decline in athletes' psychological aspects (Purc-Stephenson et al., 2022)and student-athletes had to maintain their training at home. It is unclear what personal and contextual factors facilitated student-athletes' ability to maintain their training routines at home when social distancing and

lockdown (SD/L, such as motivation to exercise (Lautenbach et al., 2021), many athletes felt dissatisfied towards sports activities during the COVID-19 era.

Sports motivation is an aspect affected by the presence of COVID-19 (Leyton-Román, Vega & Jiménez-Castuera, 2021; Poczta, Almeida, Paczyńska-Jędrycka & Kruszyńska, 2022), and currently has been claimed did not indicate any enhancement in athlete. Basically motivation is an encouragement to be more active in carrying out sports activity which can be came from internal or external factors (De Francisco, Arce, Sánchez-Romero, Vílchez, 2018; Batista et al., 2019; Kovács et al., 2022)we are more likely to maintain our commitment to sport into adulthood and even throughout our lives. In our research, we used the PERSIST 2019 database, which contains data from students at higher education institutions in Hungary, Slovakia, Romania, Ukraine, and Serbia. We used factor analysis to isolate four sports motivation factors (intrinsic, introjected, extrinsic, and amotivation. Data has documented that sports motivation has an important role to trigger athlete to be more often conducting sports exercises (Clancy, Herring & Campbell, 2017a; Moradi, Bahrami & Dana, 2020; Demirci & Eraslan, 2020), becomes the main strength to involve in competition (Yukhymenko-Lescroart, 2021), and as a parameter for athlete to achieve high performance (Junior et al., 2021; Roiek et al., 2023). According to Bowman-Smart, Hilary, Savulescu & Julian (2021), states that motivation is an important component for determining the success of an athlete in competitive sports in the future. In addition, Scoffier-mériaux, d'ArriPe-Longueville, Woodman, Lentilon-Kaestner & Corrion (2020), reported that athletes with high motivation could show sportsmanship behavior and avoid doping.

In recent years, many people put attention on athlete's satisfaction which has been extensively researched during and after the COVID-19 pandemic crisis (Xitao et al., 2021). Data shows that COVID-19 has forced all athletes to stay at home and could not carry out sports activities in public places within groups, and added with the isolation policy issued by the government. This is the main cause of athlete satisfaction in exercising decreased drastically (Mehrsafar et al., 2021; Shpakou et al., 2022). Athlete satisfaction can be interpreted as a feeling of pleasure or satisfaction when they are involved in training or sports (Fouraki, Stavrou, Apostolidis & Psychountaki, 2020). According to Jin, Kim, Love, Jin & Zhao (2022), athletes feel satisfied if the coach presents a meaningful physical exercise to them (Jawoosh et al., 2022). On the contrary, if the training program presented tends to be monotonous and boring, the athlete will feel dissatisfied or disappointed. A previous study reported that athlete's satisfaction was the key to success in increasing their physical performance to a higher level (Mohamed Shapie, Zenal, Parnabas & Abdullah, 2016; Onal, 2022). Ivantchev & Stoyanova (2019), explained that satisfaction is an important factor to support athletes in achieving success in sports activities. In addition, athlete satisfaction is a parameter for them to stay in the sports camp or leave it (Reza, Behnam, Ozra & Abbas, 2016)fulfilled as a field study. The statistical population included all athletes invited and presented in the national camps of wrestling (free and Greco Roman wrestling. Grit and coach leadership style are claimed to have a close relationship to trigger a higher or lower sports motivation and satisfaction among athletes.

Grit is claimed to be an important factor in sports training activities, because a higher grit help athletes to survive with a variety of problems (Luthans, Luthans & Chaffin, 2019). According to Cruz et al (2021), Grit is an individual personality in managing and carrying out actions persistently to achieve

high performance. Another theory explains that grit is basically a passion or endurance behavior to deal with difficulties to achieve goals (Bliss & Jacobson, 2020). Previous research has reported the benefits of the development of grit which can improve the degree of health and physical fitness (Cosgrove, Chen & Castelli, 2018), even assists someone in increasing motivation in mastering sports skills (Ueno, Suyama & Oshio, 2018). An athlete with a well fostered grit has a great spirit, perseverance or fighting spirit in long term, so that it can be used to achieve goals optimally. On the contrary, a lower grit could cause athletes to fail in his career (Frontini, Monteiro, Rodrigues, Matos & Antunes, 2022).

Coach leadership style when it becomes an interesting research topic among researchers in the last few years and is claimed to have an important role in training activities (Jin, Kim, Love, Jin & Zhao, 2022). Coach leadership style can be interpreted as a leadership style of a coach in training his athletes. For example, the style of giving instructions to athletes to carry out physical training tasks or skills in certain sports (Jawoosh et al., 2022). In addition, Fouraki, Stavrou, Apostolidis & Psychountaki (2020), explained that the coach leadership style was related to how a coach showed his behavior when in training athletes such as authoritarian, democratic, angry or relaxed. Many previous studies found that the coach leadership style played an important role in the training process, because it could help athletes in developing performance related to their psychological, tactics, techniques and physical (Bum & Shin, 2015; Jin, Kim, Love, Jin & Zhao, 2022). El-saleh & Althawabeyeh (El-saleh & Althawabeyeh, 2020), reported that the coach leadership style was important to influence the psychological of the athletes and became the key to the team‘s success in winning the competition.

Although research on grit, coach leadership style, sports motivation and athlete’s satisfaction have been well documented in previous studies, but there were only focused on evaluating per variable (Jawoosh et al., 2022; Jin, Kim, Love, Jin & Zhao, 2022), and it was limited studied about these variables simultaneously. In addition, there are still limited researchers who analyze girt, coach leadership style, sports motivation and athlete‘s satisfaction in rowing athletes, so there is an urgent need to study these aspects. Our research tried to present a novelty in revealing grit, coach leadership style, sports motivation and satisfaction of athletes from rowing. In addition, the other novelty in this study was to reveal the relationship of each variable through non-properic analysis with Spearman‘s Correlation Coefficients. This study contributes to important information to athletes and trainers about the importance of fostering and developing aspects of grit and coach leadership style, sports motivation and satisfaction. This study aims to investigated the relationship between the grit and coach leadership style variables, sports motivation and athlete’s satisfaction.

METHOD

Participants involved in this study are athletes in rowing (male, n=30, age: Mean=15.60 ± Standard deviation = 0.6, height: Mean =162.60 ± Standard deviation = 4.9, weight: Mean = 57.53 ± Standard deviation = 5.6). All participants came from Karawang city (Indonesia) and they were selected randomly. Before the research was carried out, all participants were required to sign a letter which stated their willingness to become a participant and participate in all activities in this study. Participants involved in this study were given a reward of 15 USD as a gratitude.

Measures

Grit. Instrument for assessing the level of grit is a grit scale that has been widely used in previous studies (Martínez-Moreno et al., 2021). The grit scale has 8 question items from 2 subscalaies namely

Consistency of Interest (COI) consisting of four question items, for example „I often set goals but choose to pursue others" and Perseverance of Effort (POE) which also has four questions, For example „I am a hardworking athlete" (Rumbold et al., 2022). This instrument is assessed using a Likert scale from point 1 (not reflecting me at all) up to 7 (extremely reflecting me) (Frontini, Monteiro, Rodrigues, Matos & Antunes, 2022; Martínez-Moreno et al., 2021). In this study, validation was conducted and obtained COI with the Cronbach's Alpha value was 0.94, while POE value was 0.95.

Coach leadership style. This study used to assess the leadership behavior of the coach through Leadership Scale for Sport (LSS). This instrument has 40 items of questions from five subscales, namely: training and instructions (13 items), democratic behavior (9 items), authority behavior (5 items), social support (8 items) and positive feedback (5 items) (Jawoosh et al., 2022). This question item was answered with a Likert scale from 1 (strongly disagree) up to 7 (strongly agree) (Jin, Kim, Love, Jin & Zhao, 2022).

Sports motivation. This study adopted Sport Motivation Scale-II (SMS-II) to evaluate the motivation level to exercise among athletes. This instrument has 18 items of questions from 6 subscales, namely: intrinsic (3 items), integrated (3 items), identified (3 items), intrujeksi (3 items), external (3 items) and motivation (3 items). These questions can be answered with a Likert scale from the value of 1 (does not correspond at all) to 7 (Correspond complelely) (Junior et al., 2021).

Athlete's satisfaction. Athlete Satisfaction Questionnaire (ASQ) was used in this study to assess the athletes' satisfaction. This instrument has 14 question items from 4 subcales namely satisfaction with training and instruction (3 items), satisfaction with personal treatment (5 items), satisfaction with team performance (3 items) and satisfaction with individual performance (3 items). The question items in ASQ were answered with the Likert scale from the value of 1 (very dissatisfied) up to 7 (very satisfied). The athlete who got the highest score shows the highest level of satisfaction (Jawoosh et al., 2022).

Procedure

This research was conducted in February 2023 at Singperbangsa University Karawang with number: 278/SP2H/UN64.10/LL/2023 and this research followed the rules and guidelines of the World Medical Association Code of Ethics (Helsinki Declaration for Humans). On February 17, 2023 the trainer participants filled out the grit and coach leadership style questionnaire from 08.00–09.00 in the morning. Whereas on February 18, 2023 the athlete participants filled out the sports motivation and athlete's satisfaction questionnaires from 09.00–10.00 in the morning. The filling process was closely monitored by the research team, to ensure that the results could be obtained objectively.

Statistical analysis

To determine the relationship between each grit and coach leadership style variable, sports motivation, athlete's satisfaction, this study used IBM SPSS version 25.0 to process data. Descriptive statsitics were presented in mean and standard deviation (X±S). In this study, the data was not normally distributed, non -parametric calculations were used to find out whether there was a relationship between the variables. This study used Spearman's Rank Correlation Coefficient (r).

RESULTS

In this study, the normality test was declared abnormal ($p<0.05$). Table 1 shows the descriptive statistical testing results (X±S). Based on the Spearman's Rank Correlation Coefficient testing restuls, there was a positive relationship between grit and sports motivation ($p<0.05$) (Table 2),

grit with athlete's satisfaction (p<0.05) (Table 3). While Table 4 shows the same results, there was a positive relationship between coach leadership style with sports motivation (p<0.05) and coach leadership style with athlete's satisfaction (p<0.05) (Table 5).

Table 1. Means and SD of each variable

Variable	X±S
Grit	
Consistency of Interest	23.70±2.61
Perseverance of Effort	23.85±4.06
Coach leadership style	
Training and Instructions	22.25±4.84
Democratic Behavior	20.45±4.89
Authority Behavior	14.90±4.43
Social Support	18.20±4.73
Positive Feedback	17.70±5.43
Sports motivation	
Intrinsic	16.25±3.41
Integrated	15.05±3.63
Identification	14.95±3.47
Introjection	14.20±4.06
External	16.05±4.22
Amotivation	15.50±3.99
Athlete's satisfaction	
Satisfaction with training and instruction	16.00±3.46
Satisfaction with personal treatment	21.90±9.17
Satisfaction with team performance	17.20±2.66
Satisfaction with individual performance	16.65±4.84

Table 2. Spearman's correlation between Grit and Sports Motivation

	Correlation p-values	Grit-Consistency of Interest	Grit-Perseverance of Effort
Sports Motivation			
Intrinsic	r	0.666**	0.725**
	p	0.001	0.000
Integrated	r	0.590**	0.744**
	p	0.006	0.000
Identification	r	0.573**	0.429*
	p	0.008	0.048
Introjection	r	0.515*	0.476*
	p	0.020	0.034
External	r	0.701**	0.461*
	p	0.001	0.041
Amotivation	r	0.737**	0.467*
	p	0.000	0.038

**p<0.05, * p<0.01

Table 3. Spearman's correlation between Grit and Athlete's Satisfaction

	Correlation p-values	Grit-Consistency of Interest	Grit-Perseverance of Effort
Athlete's Satisfaction			
Satisfaction with training and instruction	r	0.538*	0.554*
	p	0.014	0.011
Satisfaction with personal treatment	r	0.753**	0.804**
	p	0.000	0.000
Satisfaction with team performance	r	0.665**	0.770**
	p	0.001	0.000
Satisfaction with individual performance	r	0.843**	0.621**
	p	0.000	0.002

**p<0.05, * p<0.01

Table 4. Spearman's correlation between Coach Leadership Style and Sports Motivation

	Correlation p-values	Training and Instruction	Democratic Behavior	Authority Behavior	Social Support	Positive Feedback
Sports Motivation						
Intrinsic	r	0.627**	0.701**	0.525*	0.586**	0.553**
	p	0.003	0.001	0.017	0.007	0.011
Integrated	r	0.458**	0.557*	0.529*	0.527*	0.496*
	p	0.045	0.011	0.016	0.017	0.026
Identification	r	0.470**	0.522*	0.476*	0.434*	0.447*
	p	0.041	0.018	0.034	0.030	0.048
Introjection	r	0.612**	0.516*	0.439*	0.446*	0.562*
	p	0.004	0.016	0.031	0.027	0.010
External	r	0.620**	0.480*	0.564*	0.664**	0.526*
	p	0.003	0.032	0.010	0.001	0.017
Amotivasi	r	0.484**	0.470*	0.675**	0.578**	0.900**
	p	0.037	0.036	0.000	0.008	0.000

**p<0.05, * p<0.01

Table 5. Spearman's correlation between Coach Leadership Style and Athlete's Satisfaction

	Correlation p-values	Training and Instruction	Democratic Behavior	Authority Behavior	Social Support	Positive Feedback
Athlete's Satisfaction						
Satisfaction with training and instruction	r	0.556*	0.655**	0.459*	0.431*	0.488*
	p	0.011	0.002	0.044	0.046	0.026
Satisfaction with personal treatment	r	0.478*	0.429*	0.542*	0.818**	0.509*
	p	0.029	0.047	0.016	0.000	0.022
Satisfaction with team performance	r	0.472*	0.497*	0.675**	0.641**	0.517*
	p	0.034	0.026	0.000	0.000	0.021

	Correlation p-values	Training and Instruction	Democratic Behavior	Authority Behavior	Social Support	Positive Feedback
Satisfaction with individual performance	r	0.588**	0.526*	0.554*	0.557*	0.744**
	p	0.007	0.018	0.012	0.011	0.000

**p<0.05, * p<0.01

DISCUSSION

Our research aims to reveal the relationship between grit with coach leadership style, sports motivation, and satisfaction in athletes.

First, the grit variable has a positive relationship with sports motivation in athletes. That is because, grit is an important aspect to create persistence, active or never give up attitude among athletes when facing various difficulties in training activities (Ueno, Suyama & Oshio, 2018; (Rumbold, Dunn & Olusoga, 2022). The previous studies results reported that a higher grit level would increase motivation (Eskreis-winkler, Shulman, Beal & Duckworth, 2014; Santana-monagas & Núñez, 2022), and good participation in sports activities (Schmidt, Fleckenstein, Retelsdorf, Eskreis-Winkler, 2019; Marentes-castillo, Castillo, Tomás, Zamarripa & Alvarez, 2022). The grit was used in sports to overcome all the difficulties or ideas experienced by athletes, to enhance motivation in achieving higher goals (Hein, Kalajas-Tilga, Koka, Raudsepp & Tilga, 2019)df = 31; CFI = .958; RMSEA = .053. Other studies reported similar results, girt can trigger a higher interest and motivation (Santana-monagas & Núñez, 2022), a never give up personality or diligent to conduct sports exercises (Cruz et al., 2021) or in physical activity (Cosgrove et al., 2018). According to Whitfield & Wilby (2021), girt and motivation have a close relationship to obtain optimal long term goals.

Second, the grit variable has a close relationship with athletes' satisfaction. Grit could promote fighting spirit to achieve goal, and also to help people reach a much higher level of satisfaction, for example getting a brilliant achievement (Tang, Te Wang, Guo & Salmela-Aro, 2019). The previous studies results show that a person with a high grit level is the main force to achieve high satisfaction in his life (Liu, Yu, Ye & Yang, 2022). This was also explained Li, Fang, Wang, Sun & Cheng (2018), that grit was an important factor and triggered the emergence of satisfaction in a person. Basically, grit can help an athlete to encountere severe challenges in his life, including in sports activities (Rumbold et al., 2022), although athletes experience difficulties and failures, an athlete will never give up and keep trying until success (Moen & Olsen, 2020). The findings in this study are in line with previous studies that reportd a positive relationship between grit with the level of athlete's satisfaction in conducting sports activities (An, Sato & Harada 2021). On the other hand, research explains that grit is an important component in achieving the success and achievement, so that the athlete's satisfaction will increase significantly (Guelmami et al., 2022; but no tools have been developed considering specific contexts such as physical education and sport. Objectives: The objective of this study is to develop and test a measurement scale to assess Grit in the context of physical education and sport. Methods: Two exploratory (Phase 1Jin, Kim, Love, Jin & Zhao, 2022).

Third, coach leadership style variable has a positive relationship with sports motivation. That is because the leadership style of a coach when training athletes will be a determinant for their level of motivation in participating exercise activities. Various and fun leadership styles can trigger high motivation. On the contrary, the boring and without variation leadership style cause athletes to get bored and loss motivation for training (Guelmami et al., 2022)but no tools have been developed considering specific contexts such as physical education and sport. Objectives: The objective of this study is to develop and test a measurement scale to assess Grit in the context of physical education and sport. Methods: Two exploratory (Phase 1. Previous research reported that democratic leadership styles have a positive relationship and can affect the level of motivation among athletes (Jin, Kim, Love, Jin & Zhao, 2022). Other research also supports the findings in this study which explains that the coach‘s leadership style has a strong relationship with athlete motivation (Nasiruddin, Fauzee, Sin & Omar, 2020).

Lastly, the coach leadership style variable has a relationship with satisfaction in athletes. That is because, the leadership style possessed by the coach could attract athletes' attention, so that it causes them more satisfied in carrying out every training activity. On the contrary, if athletes uninterest with the coach‘s leadership style, it has an impact on the decline of satisfaction or performance level. This is also in line with the previous studies, which show that the leadership style has a high correlation with the satisfaction of soccer players (Calvo & Topa, 2019). Recent studies explained that the selection of appropriate leadership styles in training athletes was an important factor to trigger the emergence of athlete‘s satisfaction, and it predicted that the performance of athletes had also increased (Jawoosh et al., 2022). Fouraki, Stavrou, Apostolidis & Psychountaki (Fouraki, Stavrou, Apostolidis & Psychountaki, 2020), evaluated 206 team sports athletes and the findings showed that the coach leadership style was positively correlated with the satisfaction of athletes.

The uniqueness and novelty in these findings is the positive relationship of grit and coach leadership style variables with sports motivation and satisfaction of athletes in rowing.

CONCLUSION

Based on the explanation of the results and discussion, it can be concluded that it is proven positively there is a relationship between the grit variable and coach leadership style with sports motivation and satisfaction athletes in rowing. This study contributes to provide information for coaches and athletes about the importance of fostering and improving the quality of grit and coach leadership style which have a relationship with the level of sports motivation and satisfaction in athletes. Nevertheless, this study has limitations, which only involved athletes from Karawang city (Indonesia). Therefore, it is recommended that future research involved athletes from several regions. Further studies need to be carried out in comparing grit and coach leadership style with sports motivation and satisfaction of female athletes, so that later it can be observed the difference between male and female athletes in grit and coach leadership style, sports motivation and satisfaction.

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Time Changes in Resisted Sprinting With a Weighted Vest: 5 % of Body Weight or Back Squat?

The Use of The 1RM Back Squat and Body Weight as Load Strategy in Weighted Vest Sprinting

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ABSTRACT

The purpose was to investigate whether runners who do not squat their body weight once will not be overloaded with a weight vest with a load of 5% of BW and will not maintain 95% intensity across ten repetitions of a 20-meter sprint. Eight adult female students (24,05±1,15 years old; body height 168±4,24 cm; body weight 60,39±5,53 kg) from the Faculty of Sports Studies at Masaryk University in the Czech Republic participated in this study. The categories were: 1 = NBW (1RM in the squat is relative body weight ± 5 kg), 2 = LBW (1RM in the squat is lower than BW-5 kg) and 3 = HBW (1RM in the squat is higher than BW +5 kg). The measurements were taken on three different days, each day running with another experimental condition: free sprinting, weighted vest sprinting with a 5% load of BW, and weighted vest sprinting with a 5% load of 1RM squat. With a weight vest with resistance at the level of 5% of body weight, during 49 sprints, the intensity decreased to a maximum of 4.82% (participant 4, NBW group, 1st run). Although, with weight vest resistance at the level of 5% of the 1RM back squats, during 68 sprints, the intensity decreased by a maximum of 6.59% (participant 1, NBW group, 8th run). It seems that the level of strength abilities of the lower limbs did not play a role in this, we can calculate 5% intensity from both BW and 1 RM squat. Since the HBW group could maintain the required intensity even at significantly higher weights than 5% BW, further research with a larger research sample is needed.

Keywords: sprint training, resistance sprinting, weighted vest

INTRODUCTION

Many team and individual sports, including track and field, require running sprinting ability, which consists of the acceleration phase and maximal velocity phase (Cronin & Hansen, 2006; Harrison & Bourke, 2009; Lockie et al., 2012; Young & Pryor, 2001). The effective use of the force produced by the athlete's body in short periods determines the athlete's ability to accelerate, reach and maintain maximum velocity (Cronin & Hansen, 2006). Step length, step frequency, and the direction of the propulsive force applied during the running step are limiting factors in both aspects (Morin et al., 2011). Specific training methods are needed to overload the neuromuscular and physiological systems with the aim of causing adaptations that transfer to reaching maximum sprinting potential (Hicks, 2017).

Resisted sprint training

The more appropriate use of resisted sprint training is to improve the acceleration phase rather than the maximal velocity phase. Due to the different kinematics of the both phases, it is necessary to overload them differently (Hicks, 2017). To improve sprint ability, six resisted sprinting methods are widely used: wearing a weighted vest, external load at the distal limb segment, pulling a parachute, uphill running, resisted treadmill sprinting and towing sledges (Rumpf et al., 2014). Limb loading is a method in which an external weight is typically added to the end of the limbs. This is likely to increase the moment of inertia that demands higher muscle activity (Hay, 1985). Studies by Ropret et al. (1998) and Martin (1985) show that an external load at the end of the lower limbs causes a reduction in sprint velocity. A reduction in the step frequency causes the speed reduction mechanism, with the step length remaining relatively identical. On the contrary, uphill running appears to be a suitable method for developing stride length. Increased gravitational action demands the production of higher propulsive forces provided by hip extensors. The expected manifestation should be an increase in step length when sprinting on a flat platform (Faccioni, 1993). Also the pulling parachute method is based on overcoming the added aerodynamic drag force applied in the horizontal direction. This may lead to an improvement in strength-specific sprinting ability through an increase in stride length (Alcaraz et al., 2008). Resisted treadmill sprints are differentiated according to whether the treadmills are motorized/non-motorized and curved/non-curved. For land sprints over a shorter distance (10 yards), it correlates with a moderate incline setting at a higher resistance. Whereas for ground sprints over 30 yards, a lower resistance setting at a higher incline is more appropriate (Peacock et al., 2019).

Weighted vest method

The weighted vest method potentially increases the ability to produce ground reaction forces and power production during sprint-running by evenly distributed overloading near an individual's centre of mass (Macadam, Cronin, & Simperingham, 2017). Wearing a weight vest during sprints offers a greater vertical vector-training stimulus. In contrast, sledge pulling, especially at a higher percentage of body weight, is more suitable for horizontally oriented development (Cross et al., 2014). By wearing a weight vest with adequate weight, the vertical forces increase with each contact with the ground, thus increasing the demands on the eccentric strength of the extensor muscles (Faccioni, 1993). This effect could potentially increase the muscles' ability to store and utilise elastic

energy. Furthermore, the weighted vest method simultaneously improves strength and technique elements of sprint training (Cronin & Hansen, 2006).

To effectively develop the running sprinting ability, a certain level of intensity is necessary. The acceleration phase should be produced at a minimum of 95% intensity of a 1RM (Cissik, 2005; Hansen, 2014; Rogers, 2000; Schiffer, 2011). That means a maximum time with or without additional weight should be at most 105% of baseline time (the maximum speed without additional resistance). Furthermore, Haugen et al. (2019) recommend intensity higher than 98% of a 1 RM to enhance acceleration. The amount of resistance in the resistance sprinting method varies. Resistance-induced reduction in power time is the determining factor for categorisation: light (< 10% velocity decrement), moderate (10–15%), heavy (15–30%), and very heavy (> 30%) loads (Petrakos et al., 2016). When using the resistance method, it is necessary to consider whether we aim for an acute or longitudinal effect and adjust the intensity of the selected resistance accordingly. It was found that with increasing vest load (5-40% BW), the time of sprint running on all distances (10 m to 50 m) increases significantly linearly (Macadam et al., 2019). Carlos-Vivas et al. (2019a) found that incremental loads of 10% BW resulted in maximal velocity decreased by 4–5% with each increment. This finding may indicate that the weighted vest method affects the maximum velocity phase more than the acceleration phase.

Considering the conditions of maintaining high intensity during sprint performances, the question is whether the recommended % of additional resistance should be calculated as a percentage of body weight. Therefore, the main idea is whether runners who do not have sufficiently developed lower limb strength abilities (testing by 1 RM squat test) and squat less than their body weight run with a vest with a resistance that represents a high load for them.. So weaker individuals who run with resistance not tied to actual muscle strength are likely overloaded. In contrast, stronger individuals whose squat 1RM is greater than their body weight can run with meagre resistance, which probably does not leave enough stimulus. Because they could run up to 105% of unresisted sprinting time with a more weighted vest.

METHODS

Participants

Eight adult female students (24,05±1,15 years old; body height 168±4,24 cm; body weight 60,39±5,53 kg) from the Faculty of Sports Studies at Masaryk University in the Czech Republic participated in this study. All of them were sport active, had previous experience with sprint running, and were familiar with the sprinting technique. They were also familiar with the technique and testing 1RM in squats to 90° in the knee joint. The results on 1RM squat were 67,86±11,61 kg. The participants were also divided into three categories based on the results of 1RM squats related to their body weight. Categories were: 1 = NBW (1RM in the squat is relative body weight ± 5 kg), 2 = LBW (1RM in the squat is lower than BW-5 kg) and 3 = HBW (1RM in the squat is higher than BW +5 kg). The distribution of participants in groups was in NBW (n = 4), LBW (n = 1) and HBW (n = 2). Participants number 2, 3, 4, 5 completed all 3 measurements. The other female runners (number 1, 6, 7, 8) did not take all the measurements due to other obligations. No proband was injured during the measurement.

The participants signed the Consent to participate in the research and processing of personal data, in which participants were informed about the study's aim and potential risks, and that data would be processed anonymously.

Test design a data collection

All measurements were conducted at the athletics stadium in Brno on the 10th, 17t^{h} and 24thMay 2022, with similar weather and time conditions on all three measuring days. On each measuring day (seven day rest between the measurements) participants performed one measured repetition of a free 20-meter-long sprint to determine the base time (0th time) with 3-minute rest. Then they run the ten experimental repetitions of a 20-meter-long sprint with different load on each day.The rest interval was 3 minutesbetween each sprint . Each day was testing another experimental condition. Three experimental conditions were designated: free sprinting, weighted vest sprinting with a 5% load of BW, and weighted vest sprinting with a 5% load of 1RM squat. Fifteen minutes warm-up (same for all testing conditions) consisting of a 3-minute continuous jogging and dynamic stretching with specific running drills and threesprints on 20-meters approx. at 60, 80 and 95% subjective effort was performed before the measured sprints. Time was measured by the TCi System (Brower Timing Systems, USA). All the measured sprints were conducted from a standing start position with the legs in stride 50 cm behind the first-timer gate at the belt height of athlete. The participants were allowed to start at leisure, and no starting signal was given.

The 1RM squat test was modified slightly from the established protocol in McBride, Triplett-McBride, Davie, & Newton (2002). This test was performed using a free weighted bar in the rack. A number of warm-up trials were given in the 1RM test protocol using bar weight 20 kg (4-6 repetitions), then 30% (8–10 repetitions), 50% (4–6 repetitions), 70% (2–4 repetitions), and 90% (1 repetition) of an estimated 1RM either from the subject's recommendation. From this point, the weights were increased to a point where the individual had 3–4 maximal efforts to determine the 1RM. Each subject was asked to lower the bar to the point where the knee angle was under 90°, marked by adjustable stoppers. Adequate rest was allowed between trials (3–5 minutes).

Due to the impossibility of measuring the wind conditions and because of the measurements on three different days, we analyse the data in terms of intensity loss using the 0th time (base time as free running) and the times in the subsequent ten runs in different conditions. The intensity limit for defining the intensity needed to develop the acceleration rate was set at 105% of the base time (time 0). For the reasons mentioned above, we did not conduct an inter-individual analysis between the individual experimental conditions.

RESULTS

Free running sprint times

The results in first Table 1 show times for baseline time (the first 20m-run), followed by times for the next ten 20-meter-long sprints. The participants were divided according to their strength test on the squat to the strength groups. Only one 20m-long sprint was observed as running up to 105% from the baseline time. It was participant number 7 from the HBW group in her 10th sprint.

Table 1. Time for 20-meters free runs (1.-10. attempt) without any additional weight in seconds

	PN	SG	Baseline (s)	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Mean	SD
FREE RUNNING (WITHOUT)	1	NBW	3.64	3.59	3.62	3.58	3.61	3.56	3.58	3.57	3.56	3.59	3.56	3.58	0.02
	2	NBW	3.60	3.62	3.57	3.64	3.61	3.67	3.62	3.62	3.62	3.65	3.64	3.63	0.02
	3	NBW	3.93	3.91	3.89	3.90	4.00	3.88	3.70	3.67	3.93	3.98	3.69	3.86	0.11
	5	LBW	3.63	3.71	3.76	3.71	3.79	3.73	3.81	3.74	3.75	3.74	3.77	3.75	0.03
	6	HBW	3.40	3.45	3.40	3.41	3.40	3.45	3.46	3.42	3.49	3.45	3.46	3.44	0.03
	7	HBW	3.30	3.36	3.32	3.30	3.32	3.26	3.33	3.35	3.39	3.43	**3.57***	3.36	0.08
	8	NBW	3.45	3.48	3.52	3.41	3.53	3.52	3.56	–	3.61	3.48	3.47	3.51	0.05

SD = standard deviation; PN = participant number; SG = strength group.

** Time higher than 105% of baseline time without any additional resistance*

– Time not measured because of TCi System error

Subsequently, we examined the consistency of the results of individual participants in free runs from the two indicators (Table 2). The first indicator was the percentage result of the slowest measured time, with the time as the baseline time. When running without external (additional) resistance, only one participant (no. 7 from the HBW group) estimated a higher value than the baseline time, specifically in run no. 10, whose intensity reached 108.18% of the baseline time.

The second indicator is the number of runs classified as the fastest run of 10 measured for each participant, which is also shorter than the baseline time. In the running, without resistance (free running), five participants achieved a better time during the ten measured times than in the first run (referred to as the baseline time).

Table 2. Differences between the fastest and slowest free-run attempts and baseline (also without any additional weight)

	PN	SG	Baseline (s)	Intensity limit 105% (s)	1–10. attempt		Diff. MAX-MIN (s)	Diff. MIN-BASE (s)	Diff. MIN-BASE (%)	Diff. MAX-BASE (s)	Diff. BASE x MAX (%)
					Min (s)	Max (s)					
FREE RUNNING (WITHOUT)	1	NBW	3.64	3.82	3.56	3.62	0.06	-0.08***	97.80	-0.02	99.45
	2	NBW	3.60	3.78	3.57	3.67	0.10	-0.03***	99.17	0.07	101.94
	3	NBW	3.93	4.13	3.67	4.00	0.33	-0.26***	93.38	0.07	101.78
	5	LBW	3.63	3.81	3.71	3.81	0.10	0.08	102.20	0.18	104.96
	6	HBW	3.40	3.57	3.40	3.49	0.09	0	100.00	0.09	102.65
	7	HBW	3.30	3.47	3.26	**3.57***	0.31	-0.04***	98.79	0.27	**108.18****
	8	NBW	3.45	3.62	3.41	3.61	0.20	-0.04***	98.84	0.16	104.64

PN = participant number; SG = strength group;

** time higher than 105% of Baseline time without any additional resistance*

*** % up to 105 %*

**** the fastest time from 1–10. running attempt faster than the baseline*

Sprint times with vest weight 5% of body weight

The results in Table 3 show times for baseline time (the first 20m-run), followed by times for the next ten 20-meter-long sprints, which were runs with weighted vest corresponding to the 5% of body weight. The participants were divided according to their strength test on the squat to the strength groups. We found no result with a time higher than the time corresponding to 105% of the baseline time for any participant or in any run.

Table 3. Times for 20-meters runs (1–10. attempt) with a weighted vest with 5% of body weight in seconds

WITH 5% OF BODY WEIGHT	PN	SG	Baseline (s)	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Mean	SD
	2	NBW	3.59	3.64	3.60	3.60	3.63	3.62	3.61	3.66	3.61	3.62	3.59	3.62	0.02
	3	NBW	4.14	4.07	3.85	3.93	3.89	3.91	3.84	3.84	3.84	3.80	3.93	3.89	0.07
	4	NBW	3.53	3.70	3.67	3.64	3.59	3.66	3.66	3.64	3.68	3.65	3.62	3.65	0.03
	5	LBW	3.88	4.01	3.82	3.80	3.80	3.88	3.88	3.85	3.91	3.82	–	3.86	0.06
	8	NBW	3.56	3.60	3.42	3.57	3.62	3.60	3.54	3.58	3.64	3.62	3.61	3.58	0.06

SD = standard deviation; PN = participant number; SG = strength group.

– Time not measured because of TCi System error

Table 4 shows the differences between the fastest and slowest runs. We identified 4 participants who could run in at least one of the ten measured runs with a vest weighing 5% of their body weight faster than during a basic free-run of the test marked as baseline time.

Table 4. Differences between the fastest and slowest run with the weighted vest with 5% of 1RM back squat attempt and baseline without additional weight

WITH 5% OF BODY WEIGHT	PN	SG	Baseline (s)	Intensity limit 105% (s)	1–10. attempt		Diff. MAX-MIN (s)	Diff. MIN-BASE (s)	Diff. MIN-BASE (%)	Diff. MAX-BASE (s)	Diff. BASE x MAX (%)
					Min (s)	Max (s)					
	2	NBW	3.59	3.77	3.59	3.66	0.07	0	100.00	0.07	101.95
	3	NBW	4.14	4.35	3.80	4.07	0.27	-0.34***	91.79	-0.07	98.31
	4	NBW	3.53	3.71	3.59	3.70	0.11	0.06	101.70	0.17	104.82
	5	LBW	3.88	4.07	3.80	4.01	0.21	-0.08***	97.94	0.13	103.35
	8	NBW	3.56	3.74	3.42	3.64	0.22	-0.14***	96.07	0.08	102.25

PN = participant number; SG = strength group;

**** the fastest time from 1–10. running attempt faster than the baseline*

Sprint times with vest weight 5% of 1RM back squat

The results in Table 5 show times for baseline time (the first 20m-run), followed by times for the next ten 20meterlong sprints with vest weighted 5% of 1RM back squat (to the 90° of knee flexion). The participants

were divided according to their strength test on the squat to the strength groups. We observed that values higher than 105% of the baseline time (free running) were measured in two participants during the ten measured sprints. The first was participant number 1 (PN 1) from the NBW category, and she exceeded the 105% baseline time twice in runs no. 5 and 8. The second was participant no. 6 (PN 6), who was in the HBW category. PN6 exceeded the 105% baseline time in runs no. 5 and no. 6.

Table 5. Times for 20-meters runs (1.–10. attempts) with a weighted vest with 5% of 1RM back squat in seconds

WITH 5% OF BACK SQUAT	PN	SG	Baseline (s)	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Mean	SD
	1	NBW	3.49	3.60		3.63	3.52	**3.68***	3.58	3.35	**3.72***	3.63	3.64	3.59	0.10
	2	NBW	3.64	3.67	3.73	3.64	3.61	3.70	3.72	3.64	3.74	3.66	3.61	3.67	0.04
	3	NBW	3.65	3.77	3.73	3.64	3.68	3.72	3.71	3.70	3.74	3.68	3.60	3.70	0.04
	4	NBW	3.63	3.64	3.65	3.69	3.71	3.66	3.68	3.67	3.70	3.70	3.73	3.68	0.03
	5	LBW	3.63	3.70	3.78	3.74	3.79	3.77	3.73	3.74	3.78	3.79	–	3.76	0.03
	6	HBW	3.38	3.54	3.48	3.52	3.54	**3.57***	**3.59***	3.52	3.53	3.51	3.45	3.53	0.04
	7	HBW	3.42	3.43	3.43	3.35	3.44	3.44	3.47	3.46	3.4	3.57	3.54	3.45	0.06

SD = standard deviation; PN = participant number; SG = strength group.

** Time higher than 105% of baseline time without any additional resistance*

– Time not measured because of TCi System error

Table 6 shows the differences between the fastest and slowest test runs with a vest weighted 5% of 1RM back squat (90° knee flexion). The slowest runs identified that exceeded the threshold of 105% of the baseline time were compared with a baseline time at the level of 106.59% (for PN1) and 106.21% (for PN6).

We identified four participants who could run in at least one of the ten measured runs with a vest weighing 5% of 1 RM back squat faster than during a basic free-run of the test marked as baseline time.

Table 6. Differences between the fastest and slowest run with the weighted vest with 5% of 1RM back squat attempt and baseline without additional weight

WITH 5% OF BACK SQUAT	PN	SG	Baseline (s)	Intensity limit 105% (s)	1.–10. attempt		Diff. MAX-MIN (s)	Diff. MIN-BASE (s)	Diff. MIN-BASE (%)	Diff. MAX-BASE (s)	Diff. BASE x MAX (%)
					Min (s)	Max (s)					
	1	NBW	3.49	3.66	3.35	**3.72***	0.37	-0.14***	95.99	0.23	**106.59****
	2	NBW	3.64	3.82	3.61	3.74	0.13	-0.03***	99.18	0.10	102.75
	3	NBW	3.65	3.83	3.60	3.77	0.17	-0.05***	98.63	0.12	103.29
	4	NBW	3.63	3.81	3.64	3.73	0.09	0.01	100.28	0.10	102.75
	5	LBW	3.63	3.81	3.70	3.79	0.09	0.07	101.93	0.16	104.41
	6	HBW	3.38	3.55	3.45	**3.59***	0.14	0.07	102.07	0.21	**106.21****
	7	HBW	3.42	3.59	3.35	3.57	0.22	-0.07***	97.95	0.15	104.39

PN = participant number; SG = strength group;

** time higher than 105% of the baseline time without any additional resistance*

*** % up to 105 %*

**** the fastest time from 1.–10. running attempt faster than the baseline*

Comparison of the investigated methods

When comparing all investigated methods, we found that in free running testing, in one run out of a total of 69 measured (the time of the 7th run PN7 was not measured), there was an increase in time compared to the initial measurement (baseline time of free running) by over 105%, specifically 108.18% in 10th run of PN7. When running with a vest weighing 5% of body weight, all of the total 49 measured runs (run no. 10 at PN5 was not measured) were within the limit of 105% of the baseline time. When running with a vest weighted a 5% of 1RM back squat (90°knee flexion), we recorded an increase in time over 105% of the baseline time (free running) in two of the seven participants, where these two participants overcame the intensity of 105% twice. Participant No. 1 from the NBW category ran over 105% of the baseline time in the 5th and 8th runs when the slowest time was equal to 106.59% of the baseline time. Participant No. 6, from the HBW category, ran above 105% of the baseline time in runs. No. 5 and 6, when the slowest time corresponded to 106.21% of the baseline time. This means that out of 68 measured runs with a vest of weight as 5% of the 1RM back squat, only four runs exceeded the baseline time above 105%, of which the absolute highest overrun was at 106.59% of the baseline time (free running).

Furthermore, we noted that many of the test runs in all conditions achieved faster times during these ten tests runs than during the essential measurement of the baseline time as free running. Specifically, in free running testing, a total of 5 participants out of 7 achieved a better time than the baseline time at least once during the ten measured runs. When running with a vest weighing 5% of body weight, they achieved a better time than the baseline time at least once during the ten measured runs, baseline time, and measurement of 3 female participants out of a total of 5. Four out of the seven female runners, when running with a vest weighing 5% of 1RM back squat, achieved a better time than the baseline time at least once during the ten measured runs.

DISCUSSION

This study aimed to evaluate whether determining the external load (expressed as a percentage) with the resisted weighted vest method is better from body weight or the 1 RM squat exercise.

The data suggest no drop in intensity below our chosen threshold of 95% in both resistant conditions (above 105% time of baseline free running time). With a weight vest with resistance at the level of 5% of body weight, during 49 sprints, the intensity decreased to a maximum of 4.82% (participant 4, NBW group, 1st run). Although, with weight vest resistance at the level of 5% of the 1RM back squats, during 68 sprints, the intensity decreased by a maximum of 6.59% (participant 1, NBW group, 8th run).

The maintenance of intensity above the level of the established 95% threshold during resistance sprints with a vest weighing 5% of body weight corresponds to the results of the studies of Alcaraz et al. (2008); Carlos-Vivas et al. (2019a); Carlos-Vivas et al. (2019b); Cross et al. (2014); Gleadhill et al. (2021) and Siperingham & Cronin (2014). In these studies, the authors evaluated the effect of a weighted vest with resistance at a level between 5% and10% of body weight as a decrease in intensity of 2.2% to 4.7% (the variable evaluated was time or velocity).

To the best of our knowledge, we have not found any studies analysing kinematic parameters during weighted vest resistance sprints with a 5% load calculated from maximal squat power.

Therefore, we cannot assess the conformity/inconsistency of our measured results with the previous ones.

One of the limitations of this study was the instability of the weather conditions on a different measurement day. Unfortunately, the wind speed and direction were not measured by any instrument. These factors could significantly affect the times measured in the runs. The generalisability of the results is limited by the size of the examined data-set as a whole. Because of this, even the individual strength categories (NBW, HBW, LBW) needed to be more significant. Furthermore, the variability of the examined group in terms of strength abilities of the lower limbs needed to be greater.

The avenues for future research include obtaining data in a running tunnel to ensure the stability of weather conditions to make the data as reliable as possible. Also, for a more significant impact, it would be necessary to include more subjects with a wide range of lower limb strength ability levels in the research. Assessing the effects of a weight vest with a higher percentage resistance would be interesting. Another avenue for future research could be an overview of the intensity curve during repeated sprints over a longer distance (e.g., 50m). In such a stretch, increasing fatigue could play a more significant role. In addition, an insight into the kinetic (or kinematic) indicators during the maximum velocity phase and not only during the acceleration phase would be obtained.

CONCLUSION

Sprinting with a weighted vest is a form of sprint training suitable to improve the kinetics and kinematics of sprint performance in developing athletes. Specifying information and strategies to set the load during sprint resistance training using a weight vest is essential. In our study, we dealt with a different approach than the one most often used when using a weight vest - adjusting the resistance according to the current power capabilities of the lower limbs. Our 5% load from a 1 RM squat did not cause a decrease in intensity below 95% during repeated sprint runs. Also, at 5% BW load, the intensity was maintained above 95% across repetitions. The level of strength abilities of the lower limbs did not play a role in this. However, further studies need to be conducted on a more extensive and variable research set to achieve a higher degree of generalisation.

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