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Changes and Differences in Body Composition and Strength Abilities of Athletes in Fitness and Bodybuilding at Different Intervals of Rest

Jan Caha, Jan Cacek, Jan Ondráček,Tereza Králová, Přemysl Šimon, Simon Šiška, Klára Vomáčková, Michal Žák, Tomáš Vodička

Masaryk University Brno, Faculty of Sports Studies

Abstract

Efforts to increase muscle mass (hypertrophy) are required in sports that are dedicated to lifting or weightlifting. Bodybuilding methods with moderate load and relatively short rest between sets and exercises for a selected muscle area, that induce a high amount of metabolic stress, can be effective for hypertrophy of muscle tissue.

The paper deals with changes in body composition (muscle mass, adipose tissue and bone mass), and changes in the manifestations of maximal strength of the extensors and flexors of the lower and upper limbs in relation to different periods of rest (30 s, 60 s, 120 s). The research was carried out on 23 participants, aged 18–30 years, who were elite, natural bodybuilders, during a 5-week intervention of bodybuilding training.

There are several outcomes which resulted from the study. At a statistical significance level of 5%, there was no significant difference in muscle tissue hypertrophy between the groups. The athletes who had a 60 second ret period achieved a two-fold increase in the percentage of fat free mass compared to the other two groups. At a statistical significance level of 5%, we noticed significant differences in the maximum force increase of the knee joint flexors, only in Group 3 (120 s) and by up to 11%. Significant differences in muscle strength increase were also observed in groups 2 and 3 in the elbow extensors and in the elbow flexors of Group 1 only.

Key words: *hypertrophy, muscle mass, body fat, biceps, quadriceps*

INTRODUCTION

Efforts to increase muscle mass or hypertrophy are required and targeted in sports that are dedicated to lifting or weightlifting, in aesthetic sports like fitness and bodybuilding, and generally in sports that require performance based on highly developed strength capabilities. Consequently, finding the optimal way to build muscle mass is essential for bodybuilding and fitness. The primary goal of this study was to investigate this. (3)

Due to the strong correlation between muscle size and muscle strength, increasing muscle mass in athletes with a strong force element (powerlifting, weightlifting, rugby) is one of the main goals of their training. However, muscle mass is also the most crucial element in bodybuilding, fitness and all the disciplines of coordination-aesthetic sports included in these categories. Here, the athletes are judged by the amount and quality of their lean muscle mass. This can also be seen at the recreational level of fitness and bodybuilding, where there is a growing trend for individuals to attempt to increase or build muscle mass from an aesthetic and functional point of view. The amount of muscle mass and balance of individual sport is one of the most essential elements of these sports, and may even be essential for success in sporting competitions. (3, 7).

Appropriately applied strength training leads to both muscle mass and strength development. The mechanism and impact of strength training can be summarized in 3 key points (3, 2, 4, 6).

The mechanism of training leading to hypertrophy

1. Mechanical tension – is associated with the use of training weights – the size (intensity) of training weights (load), which put the muscle under the maximum possible (new) tension, which subsequently induces muscle growth and recruitment of new muscle spindles = myofibrillar hypertrophy (1, 2, 3).
2. Muscle damage – muscle damage and microtrauma formation stimulates the muscle to grow but at the same time it must not be high enough to exceed the regenerative capacity and muscle protein catabolism should not outweigh the production of new proteins. For greater muscle damage, it is advisable to put more emphasis on the eccentric phase of movement (control of the weight in eccentric phase), which can last for 3–4 seconds and is associated with higher formation of waste metabolites (metabolic stress) (1, 2, 3).
3. Metabolic stress – a series with longer time under tension (TUT) puts considerable demands on the metabolism of muscle cells, particularly in larger muscle groups such as the legs or back, as well as the organism as a whole. In long-term series, the muscle moves into a state of oxygen deficiency (hypoxia). This condition causes the leaching of many substances that are expected to have a positive impact on muscle proteosynthesis = sarcoplasmic muscle hypertrophy (1, 2, 3).

Strength training has several highly significant impacts on the body of a sports person. The most obvious impacts are related to the amount of muscle mass, which is represented by the muscle cross-section and muscle strength. Properly applied strength training can lead to a maximum strength increase of more than 20% in a 21-week training program. A similar effect on muscle mass and strength has also been described in strength-training women (9, 8).

Muscle mass and its strength both decrease during ageing, especially from older adulthood, both in men and women (10). It is believed that the decrease in muscle mass is due to a reduction in the size of a number of different individual muscle fibers, especially muscle fibers with the fastest activation – fast-twich muscle fibers (11). The decrease in age-related strength may also be due to a reduction in the maximal voluntary activation of the agonist muscle or changes in co-activation of the antagonist working muscle. The decrease in muscle mass and strength associated with age is not surprising, as ageing is very often associated with a decrease in the number of daily activities, but also with a general decrease in the number of activities and their intensity and thus lower activation of individual muscle groups and fibers (12, 13, 14).

Progressive strength training not only in young and middle-aged people but also in older men and women, can lead to a significant increase in strength and muscle mass. This could be primarily due to the observed significant nerve adaptations, especially during the first weeks of training (12, 13, 27), suggesting a significant increase in maximal electromyographic (EMG) activity of trained agonist muscles associated with decreased antagonist coactivation. This has been particularly found in older women (12, 13, 14).

Various types of strength training cause acute and in some cases, chronic hormonal changes, which appear to play an essential role in mediating hypertrophic signaling reactions (15). The three most studied of these hormones are insulin growth factor (IGF-1), testosterone and growth hormone (GH). We regard these as the most important in terms of anabolic reactions and responses to strength training, both in their acute and chronic response and changes concerning strength training (2).

As we have already described, the initiation of muscle hypertrophy by strength training seems to reflect three essential elements: mechanical tension, muscle damage and metabolic stress (4, 6),

ultimately influenced by several training factors. Relevant variables which may have an influence on the outcome here, include: intensity, weight, rest, choice of training or exercises, muscle failure and repetition rate, i.e. different training methods or practices in general (2).

Break between training series – actual data synthesis

Rest periods between training sets significantly affect overall training time, acute regeneration of forces and energy substrates, and thus also impact on metabolic stress and the subsequent length of a work series, and the ability to deliver maximum power. These usually range from 30 to 300 seconds (s). They can be divided into short rest periods (up to 30 s), medium rest periods (up to 60 s) and long rest periods (180–300 s) (22).

Short rest pauses (up to 30 s) generate high metabolic stress, but do not provide enough rest for subsequent maximum power. However, they are believed to be effective in building muscle mass (24, 26).

Moderate breaks are a compromise between short and long. They provide sufficient time to regenerate the energy reserves used in non-maximum workout training and cause high metabolic stress (23). They are also associated with higher hypoxia, which may subsequently have a more significant impact on muscle mass, but also with a higher hormonal "peak" in response to strength training (20).

Long rest pauses are advantageous for maximum regeneration of forces between series and thus possible maximization of mechanical tension and utilization of higher loads. Metabolic stress is not as high as for short or medium rest breaks (21, 25).

The findings of previous studies that have investigated which length of rest period are more beneficial in terms of more pronounced muscle hypertrophy, have varied. More often, experts tend to believe that more pronounced muscle hypertrophy is noticed at pauses longer than 60 seconds, as well as an increase in muscle strength (16). Rest pauses, which help to achieve better results in muscular hypertrophy of the lower body, could also be beneficial for muscle hypertrophy (17).

Aims of the study

The aim of this study is to determine which rest periods have a higher influence on muscle tissue growth, decrease the amount of fatty tissue, and also to decide which type of rest leads to higher strength gains in typical strength training, which may be referred to as "hypertrophy training for bodybuilders". Details on the training plan we used in the research can be found in supplement 1.

METHODS

Experimental Approach to the Problem

Each subject visited the laboratory on 2 occasions separated by 5 weeks. On visit 1, the subjects were assessed for body composition (FFM – fat free mass, fat, muscle mass, bone density) and maximal strength of the arm extensors and flexors, and the leg extensors and flexors. On the second visit, the same values were examined as during the first visit, ie body composition on a DEXA device and the maximum strength of the extensors and flexors of the arms and legs on an isokinetic dynamometer.

Subjects

A group of 23 men aged 18–35 years (n = 23, with 7–9 in each group), who were performance level, natural bodybuilders, were selected for the study. All subjects had more than 5 years of

training experience and were trained in proper exercise technique. All subjects had been free of any lower-body, musculoskeletal, or neuromuscular injuries for the previous 6 months. All subjects claimed no current or previous use of any anabolic steroids.

All subjects refrained from other physical activities that could have affected the outcome of the experiment. Simultaneously, they followed the prescribed nutritional plan, where they consumed protein at the level of 2 g/kg body weight and did not use any specific food supplements, which may have had a significant impact on performance. All subjects were advised to maintain a balanced energy intake and typical nutrition comprised of a dietary intake of 40–50% carbohydrates.

Before visiting the laboratory the subjects were instructed in further aspects of dietary behavior, including the omission of alcohol and stimulants, such as nicotine.

Procedures

Resistance exercise protocol

The training program was clearly explained to all subjects and any individual discrepancies in exercise technique were standardized. The training protocol was identical for all subjects (see supplement 1), except for the difference in rest time between training sets. The subjects followed the training protocol for 5 weeks.

Bone densitometry machines DEXA (body composition)

Dual energy X-ray absorption spectrometry (DEXA) has high accuracy for body composition analysis. It was used to determine body fat, net body weight, total body weight, bone density and adipose tissue distribution of all subjects.

Isokinetic dynamometer (muscle strength)

An isokinetic contraction is a muscular contraction that accompanies a constant velocity of limb movement around a joint. The velocity of movement may be maintained constantly by using a special dynamometer. The resistance of the dynamometer is equal to the muscular forces applied throughout the range of movement. This method allows the measurement of muscular forces under dynamic conditions and provides optimal loading of the muscles. However, during movements in the vertical plane, the torque registered by the dynamometer is the resultant torque produced by the muscular and gravitational forces (5).

Statistical methods used in research

Comparison of the FFM difference, fat and % fat for the 3 groups according to the length of rest (30, 60 or 120 s) was performed using an ANOVA. The presumption of data normality was verified by the Shapiro-Wilk test, the presumption of homogeneity of variance by the Leven test.

Descriptive statistics were calculated for each variable: the mean, standard deviation, median, minimum, and maximum, which are presented in both tables and box charts. The selected significance level was 0.05, calculations were performed using the program Statistica.

Research questions

1. RQ: Will there be significant differences between the investigated subjects in muscle hypertrophy at 5-week follow-up?
2. RQ: Will there be significant differences between the subjects studied in the increase in maximum force of the extensors and flexors of the upper limbs at 5-week follow-up?
3. RQ: Will there be significant differences between the study subjects in the reduction of adipose tissue at 5-week follow-up?

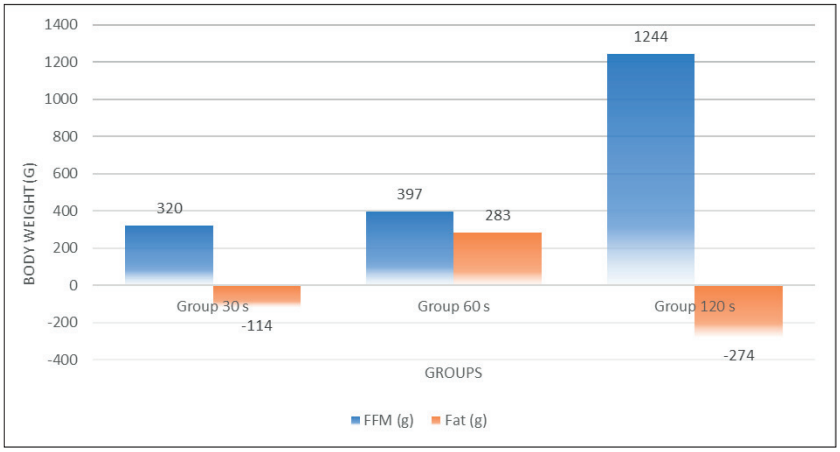

Figure 1. Changes in body composition (g)

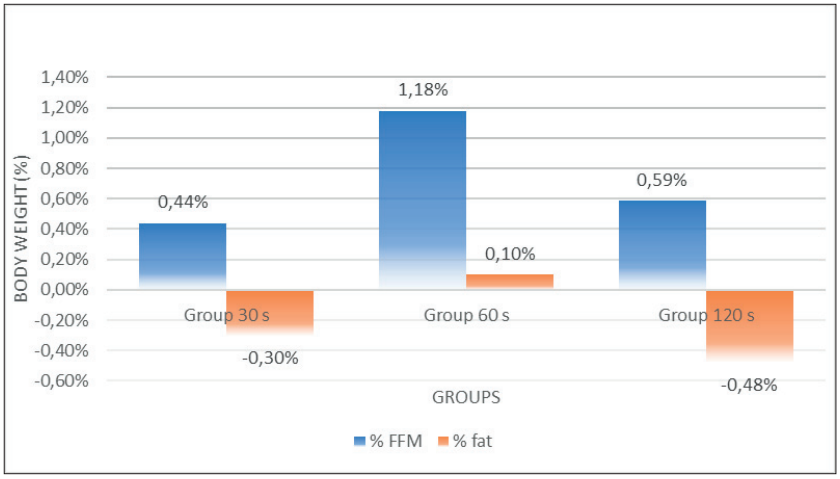

Figure 2. Changes in body composition (%)

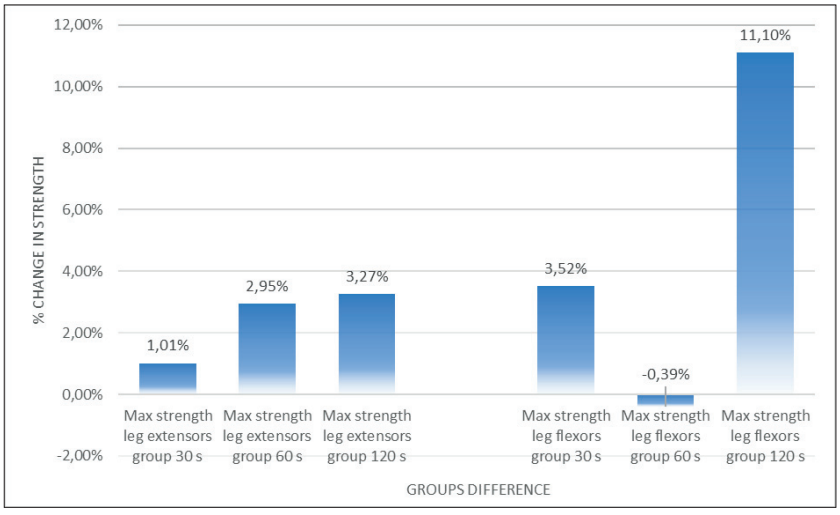

Figure 3. Changes in Lmaximal strength (legs)

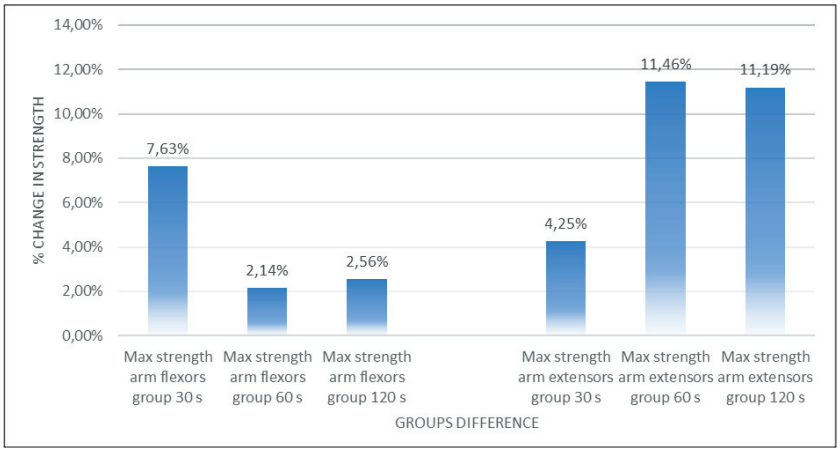

Figure 4. Changes in maximal strength (arms)

Table 1. Changes in body composition

	FFM (g)	Fat (g)	% fat	% FFM
Group 30 s	320	–114	–0.30%	0.44%
Group 60 s	397	283	0.10%	1.18%
Group 120 s	1244	–274	–0.48%	0.59%

Table 2. Changes in arm strength

Group and body part	Change (%)
Max strength of arm flexors group 30 s	7.63%
Max strength of arm flexors group 60 s	2.14%
Max strength of arm flexors group 120 s	2.56%
Max strength of arm extensors group 30 s	4.25%
Max strength of arm extensors group 60 s	11.46%
Max strength of arm extensors group 120 s	11.19%

Table 3. Changes in leg strength

Group and body part	Change (%)
Max strength of leg extensors group 30 s	1.01%
Max strength of leg extensors group 60 s	2.95%
Max strength of leg extensors group 120 s	3.27%
Max strength of leg flexors group 30 s	3.52%
Max strength of leg flexors group 60 s	-0.39%
Max strength of leg flexors group 120 s	11.10%

RESULTS

Body composition

After the 5 week training program we found the following results. At a statistical significance level of 5%, there was no significant difference in muscle tissue hypertrophy. Group 3 (120 s rest) achieved a four-fold increase in FFM compared to the other two groups in absolute numbers (1244 g). But the largest percentage increase was achieved in group 2 (60 s), with an increase of 1.18 %.

In absolute numbers, the highest muscle hypertrophy was seen in group 3 (120 s), which had an average of 1224 g, and which was more than in groups 1 and 2. These groups had total hypertrophy of 320 g and 397 g respectively. However, percentages are more relevant for determining the impact of training. Here, the greatest hypertrophy was achieved by group 2 with an increase of 1.18 %, followed by group 3 with an increase of 0.59 % and group 1 with an increase of 0.44 % (figure 1 and 2).

The highest fat loss occurred in group 3 (120 s), with an average loss of 274 g. Fat loss was also recorded in group 1, the group with the shortest rest time of 30 seconds, and totalled 114 g. The group with a mean rest period of 60 seconds gained 283 g of body fat.

The highest changes in percentage of body fat were greatest in group 3 with the longest rest time, namely -0.48%. The remaining two groups demonstrated a decrease of 0.3 % body fat in group 1, and an increase of 0.1% of body fat in group 2.

Muscle strength

At a statistical significance level of 5%, we noticed significant differences in the increase in maximum force of the knee joint flexors in only group 3 (11.1 %). Significant differences in muscle strength increase were also observed in groups 2 and 3 in the elbow joint extensors (11.46 % and 11.19 % respectively) and in the elbow joint flexors only in group 1 (7.63 %).

DISCUSSION

The aim of this study was to determine which of the rest times in strength training has the highest efficiency in relation to the growth of muscle mass and strength. Simultaneously, a further goal was to unify the current ambiguous results of professional studies dealing with the topic of the development of muscle mass in athletes. For higher specificity, we selected experienced athletes from a coordination-aesthetic sport i.e. bodybuilding.

In earlier studies Willardson (2006), Goto (2004), Ratames (2007), Kreamer (1990), Kreamer (1991) and Miranda (2007), the authors agree on the effect of strength training using different rest periods on the development of muscle tissue. Goto (2004) reports short rest intervals (30 s) as being suitable for muscle tissue growth, while Kreamer (1990, 1991) recommends the use of rest periods of 60–90 seconds and Miranda (2007) suggests the possibility of using long pauses (above 120 s) for adequate muscle hypertrophy. The authors do not agree on the ideal length of rest period or the development of muscle tissue. However, there is agreement that there should not be an ideal rest period between work series for the development of maximum strength.

In the study, we have demonstrated the effect of strength training on body composition, both on the amount of muscle tissue and body fat. These were measured using a DEXA bone densitometer. We have also demonstrated the effect of strength training on muscle strength and the effect of maximum force measured on an angular isokinetic dynamometer.

The highest relative change in muscle mass was recorded in group 2. This does not confirm the previously highlighted assumption that longer pauses also mean higher gains in muscle tissue, as the increase in muscle mass of 1.18% was not significant. However, in regard to the experience of the participants (who had more than 4 years of systematic training) and the length of the intervention, this result can be considered interesting and usable in training practice. Experienced athletes do not see such a rapid increase in muscle mass as beginners, so we can consider this percentage increase to be beneficial. Changes in body fat composition did not show a direct dependence on the rest break used in the training plan.

Changes in strength dispositions were not a direct goal of the training plan, which was conceived as a "hypertrophic training plan". Even so, there were significant changes in the increase in strength, although unevenly across the groups (figure 3, figure 4). This can be attributed to the inappropriate prioritization of some muscle groups in traditional bodybuilding training plans and the correction of muscle imbalances based on the training plan used during the experiment.

The answers to the research questions are based on following sentences. We did not find significant differences between the groups in muscle hypertrophy (RQ1). However, significant differences were found between the groups in the increase in maximum strength of the extensors and flexors of the upper and lower limbs. (RQ2) There were no significant differences between the groups in the reduction of adipose tissue (RQ 3) found in the study.

PRACTICAL APPLICATION (CONCLUSION)

The practical application of the findings will help us to establish more effective training programs that are targeted towards the appropriate rest time needed for muscle hypertrophy. It will also allow us to shorten the required training unit. This information may find practical application in bodybuilding training and in the creation of fitness training plans that are aimed at increasing muscle mass and strength.

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This manuscript is original and not previously published in any form including on preprint servers.

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SUPPLEMENT

Supplement 1. – training plan

- Training with 80 % of 1RM (1 repetition maximum)
- In the third week you go to 85 % of 1RM
- TUT (time under tension) = 3-0-1-0
- Rest period: 30, 60 or 120 seconds.
- Cardiovascular training is recommended as active regeneration after strength training

Weekly Training Plan

- Mon – training 1
- Tue – training 2 – cardio activity 10 min
- Wed – free day
- Thu – training 3
- Fri – training 4
- Sat – training 5 – cardio activity 10 min
- Sun – free day
- Repeat the cycle for subsequent weeks

Training Components

1) Warm up with 5–10 min of cardio activity
2) Joint mobilisation
3) Dynamic stretching and core activation
4) Main training program

Training 1

Exercise	Series	Repetition/weight (% 1RM)
Dumbbell bench press	4*	7–8 (80 %)
Incline benchpress	3*	7–8 (80 %)
Incline fly press	3	7–8 (80 %)
Pec deck	3	7–8 (80 %)
Cable fly	3	7–8 (80 %)
Dumbbell curl	4	7–8 (80 %)
Hammer curl	4	7–8 (80 %)

* before the main series, a series with 20 % and 40 % 1RM is completed

Training 2

Exercise	Series	Repetition/weight (% 1RM)
Dumbbell shoulder press	4*	7–8 (80 %)
Machine shoulder press	3	7–8 (80 %)
Lateral raise	3	7–8 (80 %)
Frontal raise	3	7–8 (80 %)
Rope tricep pushdowns	4	7–8 (80 %)
Overhead tricep extension	4	7–8 (80 %)

* before the main series, a series with 20 % and 40 % 1RM is completed

Training 3

Exercise	Series	Repetiton/weight (% 1RM)
Back squat	4*	7–8 (80 %)
Leg press	3*	7–8 (80 %)
Quadricep extensions	3	7–8 (80 %)
Prone leg curl	3	7–8 (80 %)
Romanian deadlift	3	7–8 (80 %)
Standing calf raises	3	6–12 (80 %)

* before the main series, a series with 20 % and 40 % 1RM is completed

Training 4

Exercise	Series	Repetiton/weight (% 1RM)
Lat pulldown	4*	7–8 (80 %)
Pull ups	3	7–8 (80 %)
Bent-over barbell rows	3	7–8 (80 %)
Seated cable rows	3	7–8 (80 %)
Cable pullover	4	7–8 (80 %)
Hyperextension	3	15

* before the main series, a series with 20 % and 40 % 1RM is completed

Training 5

Exercise	Series	Repetiton/weight (% 1RM)
Bicep curl	4*	7–8 (80 %)
Preacher curl	3	7–8 (80 %)
Tricep benchpress	4*	7–8 (80 %)
Tricep dips	3	7–8 (80 %)
Rope tricep pushdowns	4	7–8 (80 %)
Crunches	3	7–8 (80 %)
Sitting twists	3	7–8 (80 %)

* before the main series, a series with 20 % and 40 % 1RM is completed

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Influence of Plyometric Training on the Level of Speed Ability with Changes of Direction in Ice Hockey

Marián Knechta[1], Ivan Čillík[1], Jiří Zháněl[2]

[1]*Matej Bel University, Faculty of Arts, Banská Bystrica, Slovakia*
[2]*Masaryk University, Faculty of Sports Studies, Brno, Czechia*

Abstract

AIM: *Speed skills are among the decisive factors in sports performance in ice hockey. Therefore, it is necessary to examine them in all age categories. Our goal was to determine the effect of plyometric exercises on the level of running and skating speed at 40 m with changes of direction in young hockey players aged 14–15 years.*

METHODS: *The research group consisted of 33 ice hockey players (Male; age: 14.7 ± 0.7; height: 166.5cm ± 7.3; weight: 53.4kg ± 6.9) divided into two sets. Experimental group (n = 18), and control group (n = 15). During 8 weeks, the players completed training units of general preparation and training units on ice, in the experimental set was added an experimental factor of plyometric exercises carried out according to the training protocol. Speed diagnostics consisted of the following two tests: running at 40 m with changes of direction and skating forward at 40 m with changes of direction.*

RESULTS: *Between the results of the tests in running speed and skating speed, significant differences were found both in the pretest and in the posttest between the experimental (EXP) and the control (KO) set in favor of the EXP set. Thus, the EXP set did not show the effect of plyometric exercises on improving the level of running speed and only a small effect on improving the level of skating speed.*

CONCLUSION: *The results of the quasi-experiment showed that the influence of plyometric exercises on the improvement of the level of running and skating speed of the players of the experimental group was not proven. In further research, it will be necessary to modify the training protocol and verify its application to comparable files.*

Key words: *running speed, skating speed, plyometric exercises, training protocol.*

INTRODUCTION

Ice hockey is one of the most dynamic, fastest and toughest sports in the world, which places extreme demands on the athlete's muscle load. Speed skills are one of the most important factors in a hockey player's performance. Perič and Dovalil (2010), Boyl (2016), Owen and Dellal (2016), Jebavý and Hojka (2017) characterize speed skills as the ability to perform activities with maximum intensity resp. develop the maximum possible speed in the shortest possible time with a movement activity of up to 20 seconds, without almost any resistance. In ice hockey, speed manifestations are tied to specific motor skills, determined by skating and activity on ice. Tóth (2010), Joyce and Lewindon (2014), Skahan (2016) and others agree that a characteristic feature of the current development of world hockey is the process of its further intensification, i. increased pace of play, which leads to more performed individual game activities and game combinations. In this context, the development of speed skills is becoming even more important, which is one of the important factors in increasing the effectiveness of the hockey player's technical skills. The volume of performed intensive activity of the player increases, the action of the player takes place under increasing temporal and spatial pressure, which is one of the characteristic features of

modern ice hockey. Plyometric training is often used to develop the explosive force of the lower limbs, which is needed in skating. Hansen and Kennelly (2017) say that the plyometry method is based on the principle of stretching and shortening. Its characteristic feature is the eccentric contraction caused by (rapid braking) and subsequently the fastest possible transition to the opposite direction, the so-called concentric contraction. At present, plyometry is widespread and used in almost all sports. Authors such as Lockwood and Brophey (2008) and Lee et. al. (2014), Haukali and Tjelta (2015), Deahlin, et. al (2017) examined plyometry in direct relation to the speed of skating. Chu (1998) argues that puberty is the fastest growing period, and therefore the best time to develop speed-strength skills in ice hockey players, who are increasingly in demand in today's hockey and players who do not have these qualities have no chance. to promote in an international forum. Also on the basis of the above research, in which the authors focused on plyometric exercises, we decided to do our research with players aged 14–15. Another reason is the fact that Slovak players in the youth categories lag behind their peers from hockey-developed countries in the speed of skating. The aim of the research was to determine the effect of plyometric exercises according to the selected training protocol on the level of running and skating speed at 40 m with changes of direction in young hockey players aged 14–15.

METHODS

The research sample

A total of 33 ice hockey players aged 14–15 (male; age: 14.7 ± 0.7; height: 166.5cm ± 7.3; weight: 53.4kg ± 6.9) were involved in the research, divided into two subsets, the control group (KO) (n = 15) and the experimental group (EXP) (n = 18) players. Both teams play the highest cadet competition in Slovakia (Top 14).

Table 1. Basic statistical characteristics of experimental and control set

Variables/Groups	Experimental (n = 18)				Control (n = 15)				d	ES
	M	SD	Min.	Max.	M	SD	Min.	Max.		
Age (years)	14.8	0.6	14.2	15.4	14.6	0.8	14.1	15.4	0.28	small
Height (cm)	165.0	8.0	156	173	168.0	6.5	158	175	0.41	small
Weight (kg)	52.6	7.2	45	65	54	6.6	48	69	0.20	small
BMI	19.5	2.1	17.4	21.6	19.1	3.5	15.6	22.6	0.14	trivial

Explanation: n = number of subjects; M = mean; SD = standard deviation; d = effect size index; ES = effect size

Procedure

For the research, we chose a field two-group time-parallel model of the quasi-experiment type, in which it was not possible to randomly (randomize) assign the monitored objects to individual experimental conditions. Two sets of hockey players already existed before the experiment was set up, so it is a type of experiment of so-called non-equivalent groups requiring pretest and post-test of the experimental and control group. The research itself took place during the competition period from September 2019 to January 2020. The initial measurements of the experimental set took place on 16 September 2019 off-ice and on-ice. The initial measurements of the control group took place on September 23, 2019 off-ice and on-ice. This was followed by an 8-week experimental period. During the experimental period, the players of both groups completed training units on dry land and ice. The players in the experimental set completed 5 training units on ice

per week for 60 minutes and one competitive match. The players in the control group completed 4 training units on ice per week in the range of 75 minutes and one competitive match. The training units of the general training were completed by the players in the experimental and control group 3 times a week in the range of 60 minutes. An experimental factor of plyometric exercises was added to the experimental set, which players performed twice a week in the range of 20–25 min before the training unit on the ice. After warming up, there was an experimental stimulus in the form of plyometric exercises in the form of circular training, where subjects completed exercises at 9 stations, each station had one to two subjects, exercises in three rounds with a total of 360–366 different reflections, one training session. unit with a load and rest interval of 1: 3. Training methods on-ice were a similar nature in expermiental and control files according to the methodological guideline of SZLH.

Table 2. Training protocol of the experimental set

Tuesday		**Thursday**	
Exercise name	Number of repetitions	Exercise name	Number of repetitions
Squats with jump and pole on the shoulders (16–20kg)	10	Squat + lunge sideways + jump	10
Star jumps on the tire (40 cm)	15	Jumps to reproduction + preloading with (5 kg) disc	20
Ascents on the tire (40 cm) with one foot alternately	20	Side jumps on one leg	20
Jumping in a lunge with turning the torso and arms with a (3–5 kg) disc	10	Jump on and off the crate (40 cm)	12
Jumps over obstacles 4pcs	16	Hockey jump + vertical jump with (3–5 kg) medicine ball	12
Jumps on one leg Right 5, Left 5	10	Jumps over obstacles 4pcs sideways	12
Hockey jumps with folding (3–5 kg) reel	20	Obstacle jump + side shift + obstacle jump	10
Jumps with 180° turn	10	Squat + jump on one leg, right 8 left 8	16
Jump on the box (40 cm) – jump off – jump over the obstacle (40 cm)	10	The advantage of dumbbells to lunge with (16–20kg) bar	10
Together	360	Together	366

Output measurements were performed in both sets under the same conditions as the input measurements. in experimental group 25.11.2019 and in control group 2.12.2019. This was followed by a post-experimental period, during which the players in both sets underwent the same training and match load as in the experimental period. The players of the experimental ensemble did not complete the experimental factor of the plyometric exercise. We performed post-experimental measurements 8 weeks after the end of the experimental period, under the same conditions as the previous measurements. In experimental group 20.1.2020 and in control group 27.1.2020.

Research methods

Performance in the non-standardized "run / skate test for 40 m with changes of direction" was determined using the following protocol: 10 m run / skate, 180° turn, 20 m back / skate, 180° turn, 10 m run / skate back (Figure 1). The first test was performed off ice (running speed) and

the second test was performed on ice (skating speed). It started from a standing start on its own initiative, while the player on the ice and off the ice had to cross one line with one foot, which indicated the length of the section. The players warmed up before each discipline, passing each test 2 times. In the evaluation, we recorded the better of the two experiments, the time was recorded using photocells.

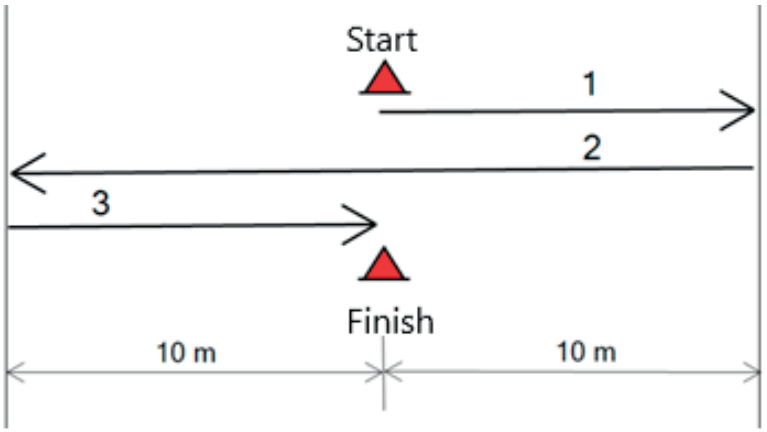

Figure 1. Test scheme for running / skating at 40 m with changes of direction

Statistical methods

With respect to quasi-experiment research with relatively small intentionally selected files, instead of the standard two-way ANOVA, we assessed differences in mean values using effect size theory (ES; Cohen, 1988; Hopkins, 2016). When summarizing the data, we used Microsoft Excel software, we processed the statistical data in the statistical program Statistica (version 13.2), or using the statistical calculator Social Science Statistics (https://www.socscistatistics.com/). To assess the differences in mean values, we used the effect size (ES) index d, which can be interpreted according to Cohen (1988) as small (d = 0.20), medium (d = 0.50) or large (d = 0.80), Hopkins (2002) uses for values d <0.2 interpretation "trivial".

RESULTS

Figure 2 graphically shows the results of a 40 m running speed test with changes in the direction of the experimental (EXP) and control (KO) sets.

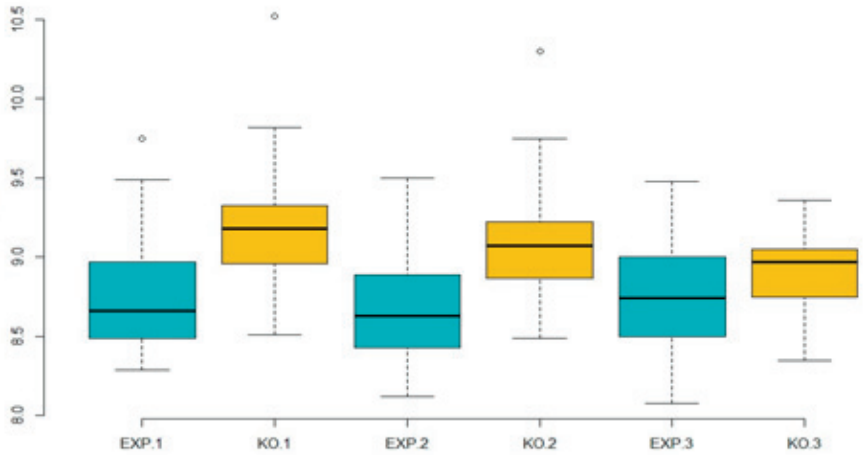

Figure 2. Results of running speed of experimental and control set in test 40 m with changes of direction

Note: EXP 1 = experimental file, input testing, EXP 2 = experimental file, output testing, EXP 3 = experimental file, post-experimental testing, KO 1 = control file, input testing, KO 2 = control file, output testing, KO 3 = control set, post-experimental testing

Table 3 shows the results of the 40 m running speed test with changes in the direction of the experimental and control sets and their statistical assessment. Assessment of the significance of differences in mean values (M) between input testing (EXP 1), output testing (EXP 2) and post-experimental testing (EXP 3) of the experimental set, as well as between input testing (KO 1), output testing (KO 2) and post-experimental testing (KO 3) of the control file was performed using the effect size (ES) index d.

Table 3. Test of running speed at 40 m with changes of direction (s) - files EXP and KO

EXP (*n* = 18)	**M**	**SD**	**Min**	**Max**	**EXP 2** (*d*)	**EXP 3** (*d*)
EXP 1	8.75	0.39	8.29	9.75	0.16	0.03
EXP 2	8.69	0.38	8.12	9.50		0.13
EXP 3	8.74	0.37	8.08	9.48		
KO (*n* = 15)	**M**	**SD**	**Min**	**Max**	**KO 2** (*d*)	**KO 3** (*d*)
KO 1	9.18	0.49	8.51	10.52	0.15	0.75*
KO 2	9.11	0.45	8.49	10.30		0.61*
KO 3	8.88	0.28	8.35	9.36		

Notes: EXP = experimental file; KO = control file; n - number of subjects; M = mean; SD = standard deviation; Min = minimum value; Max = maximum value; d = effect size index (* = medium)

Significant differences were found between the results of the running speed tests of the EXP and KO files both in the pretest (EXP 1 x KO 1, d = 0.97, large) and in the postest (EXP 2 x

KO 2, d = 1.01, large) in favor of the group EXP, in post-experimental testing, the differences can be evaluated as small, again in favor of the EXP set (EXP 3 x KO 3, d = 0.43, small). These differences found between the EXP and KO sets successively during the 1st, 2nd and 3rd testing (0.43; 0.42; 0.14 s) were always in favor of the EXP set. It is obvious that even after 8 weeks of intervention (EXP group) the difference between the two groups hardly changed (EXP 2 x KO 2; dif = 0.01 s). It is therefore not possible to compare the effect of plyometric exercises between the EXP2 and KON2 sets, but only between the EXP 1 – EXP 2 sets, resp. EXP 2 – EXP 3. During the 16-week time period, the following character of the results of the EXP set was gradually recorded in three tests: M = 8.75–8.69–8.74 (s). After completing the plyometric exercises, there was only an insignificant improvement in the level of mean values of the running speed test results (dif = 0.06 s), the effect of the intervention was not proven (d = 0.16, trivial). In post-experimental testing (EXP 3), only a slight decrease in the level was found both compared to the 1st test EXP 1 (d = 0.03, trivial) and compared to the 2nd test (d = 0.13, trivial). Thus, the effect of plyometric exercises on the improvement of the running speed level was not demonstrated in the EXP group. The test results for the KO group had the following character in the 16-week time period: M = 9.18–9.11–8.88 (s). While there was only a slight improvement between the results of the pretest (KO 1) and the postest (KO 2) (d = 0.15, trivial), there was a significant improvement in both the pretest (d = 0.75, medium) and the post-experimental testing (KO 3). and posttest (d = 0.61, medium). This can be attributed to influences that are difficult to identify, such as the number of matches played in the period under review.

Figure 3 graphically shows the results of a skating speed test at 40 m with changes in the direction of the experimental (EXP) and control (KO) sets.

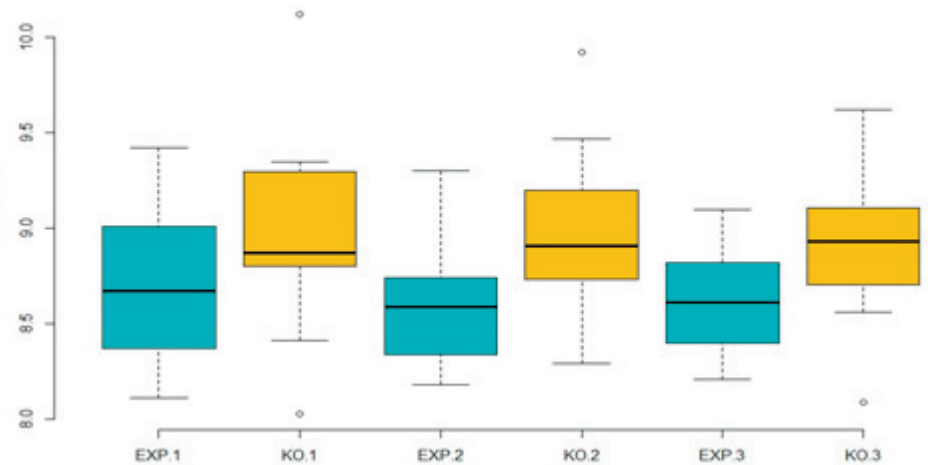

Figure 3. Results of the skating speed of the experimental and control set in the test 40 m with changes of direction

Note: EXP 1 = experimental file, input testing, EXP 2 = experimental file, output testing, EXP 3 = experimental file, post-experimental testing, KO 1 = control file, input testing, KO 2 = control file, output testing, KO 3 = control set, post-experimental testing

Table 4 shows the results of the skating speed test at 40 m with changes in the direction of the experimental and control set and their statistical assessment. Assessment of the significance of differences in mean values (M) between input testing (EXP 1), output testing (EXP 2) and

post-experimental testing (EXP 3) of the experimental set, as well as between input testing (KO 1), output testing (KO 2) and post-experimental testing (KO 3) of the control file was performed using the effect size (ES) index d.

Table 4. Skating speed test at 40 m with changes of direction (s)

EXP (*n* = 18)	**M**	**SD**	**Min**	**Max**	**EXP 2** (*d*)	**EXP 3** (*d*)
EXP 1	8.70	0.39	8.22	9.42	0.27	0.27
EXP 2	8.60	0.34	8.18	9.30		0.03
EXP 3	8.61	0.28	8.21	9.30		
KO (*n* = 15)	**M**	**SD**	**Min.**	**Max.**	**KO 2** (*d*)	**KO 3** (*d*)
KO 1	8.96	0.48	8.03	10.12	0.04	0.17
KO 2	8.94	0.42	8.29	9.92		0.13
KO 3	8.89	0.34	8.09	9.62		

Notes: EXP = experimental file; KO = control file; n - number of subjects; M = mean; SD = standard deviation; Min = minimum value; Max = maximum value; d = effect size index (d <0.2 = trivial; d <0.5 = small)

In the skating speed test, there were between the mean values of the EXP and KO sets both in the pretest (EXP 1 x KO 1, d = 0.60, medium) and in the postest (EXP 2 x KO 2, d = 0.89, large) and in post-experimental testing (EXP 3 x KO 3, d = 0.90, large) significant differences in mean values were found. These differences found between the EXP and KO sets successively during the 1st, 2nd and 3rd tests (0.26, 0.34, 0.28 s) were lower in the running speed test, but always in favor of the EXP set. It is obvious that even after 8 weeks of intervention (EXP set) the difference between the two sets hardly changed (EXp 2 x KO 2; dif = 0.08 s). It is therefore difficult to compare the effect of plyometric exercises between the EXP2 and KON2 groups, but only between the EXP 1 – EXP 2, resp. EXP 2 – EXP 3. Again, it is difficult to compare the effect of plyometric exercises between the sets EXP2 and KON2, but only between the groups EXP 1 – EXP 2, respectively. EXP 2 – EXP 3. During the 16-week time period, the following character of the results of the EXP set was gradually recorded in three tests: M = 8.70–8.60–8.61 (s). After completing the plyometric exercises, only a small effect of the intervention was demonstrated (d = 0.27, small), in post-experimental testing (EXP 3) only a small decrease in levels was found compared to the initial testing EXP 1 (d = 0.27, small) and none compared to the 2nd testing EXP 2 (d = 0.03, trivial). Thus, only a small effect of plyometric exercises on the improvement of skating speed was demonstrated in the EXP group. The test results for the KO group had the following character in the 16-week time period: M = 8.96–8.94–8.89 (s). Thus, there was only a slight improvement between the results of pretest (KO 1) and postest (KO 2) (d = 0.04, trivial), with post-experimental testing (KO 3) there was a slight improvement compared to pretest (d = 0.17, trivial) and and posttest (d = 0.13, trivial).

DISCUSSION

In a 40 meter forward skating test with changes of direction, authors such as Mascaro (1992), Behm et. al. (2005) and Blanár (2019) dealt with similar tests such as sprint with changes of direction to 4x10 m, sprint with changes of direction to 4x9 m, Pro agility test at 5-10-5 yards, test of skating at 5-7-5 m or Weave agility test in different age categories. Behm et.al. (2005) worked on research with thirty hockey players with an average age of 19 years. The aim of his work was to find out what effect balance and speed-strength exercises have on the stability of players and

maximum speed in skating. He tested speed, speed with changes of direction, stability during braking and stability during rotation. He found that significant differences were recorded at 0.05% statistical significance, especially in equilibrium tests. In his study, Mascaro (1992) tested sixteen professional hockey players after the end of the season with an average age of 23.3 years, with only 9 players included in the final evaluation of the results. In the dry he tested a sprint for 40 yards, a vertical jump and a long jump from the spot. There was only one test on the ice, a sprint for 60 yards. The biggest statistical dependence was shown between a vertical jump and skating at 60 yards, probably because ice hockey players train more on-ice than on dry land. In the youth category (U18) Blanár (2019) measured an average time of 4.90 ± 0.22 s in the agility test for 5-10-5 yards, in the same test focused on the speed of skating, the average performance was 4.69 ± 0.22 s. the results in tests with changes in direction in running speed and skating showed that players are faster in skating than in running, which is in line with our results in the EXP file and partly in the KO file, where there was better performance in two measurements in skating speed and in one at running speed (about 0.01 s). Novák (2019) worked on research with 14 ice hockey players with an average age of 14.8 during the current season from September to December 2017. He divided the players into two experimental groups. In both groups, in addition to the classic training program, players completed 3 training units for 20–30 minutes focused on agility. In the first group, players performed agility training on ice twice a week for 4 weeks, followed by a 2-week rest period, followed by a 4-week off-ice agility training. In the second group, the program was performed in reverse, 4 weeks of agility training off the ice, two weeks of rest and 4 weeks of agility training on ice. The tests consisted of an accelerating skating of 6.10 meters, a skating of 35 meters, a S corner test, a braking test, a weave agility test and a reaction test. His study showed that one or the other program of including training units for the development of agility of players in puberty had a positive effect in all tested skating tests, although agility training directly on ice had a slightly more favorable effect in terms of reactive agility. Its results do not agree with ours, because in our country the effect of plyometric exercises was not demonstrated either on ice or on dry land. Lee, et. al (2014) worked with 20 ice hockey players aged 18–22 years in research, where he found that a 12-week plyometric exercise program had a positive effect on the skating speed of players with changes of direction in the experimental group in 5x18 m and line drill tests. In the control group, players also improved in the 5x18 m test but significantly worsened in the line drill test. Its results do not match ours. The differences compared to our research were in the duration of the plyometric exercise program, the age category as well as in the effectiveness of the program.

CONCLUSION

Based on the analysis of the results of the quasi-experiment, it was shown that the training protocol in this form does not affect the improvement of running speed and skating speed in ice hockey. Significant differences between the experimental (EXP) and control (KO) sets in favor of the EXP set were found between the results of the running speed and skating speed tests, both in the pretest and in the postest. The EXP group did not show the effect of plyometric exercises on the improvement of the level of running speed and only a small effect on the improvement of the level of skating speed. With regard to the published knowledge about the influence of plyometric exercises, it would therefore be appropriate to modify the training protocol and verify its effectiveness in performance-balanced sets.

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Deep Squat – Should We Be Afraid?

Petr Schlegel, Adrián Agricola, Dana Fialová

Department of Physical Education and Sports, Faculty of Education, University of Hradec Králové, Czech Republic

Abstract

Squats are among the basic exercises that have become an integral part of exercise programs. It is commonly used by athletes in many sports. Its potential is shown in the development of strength, power, and overall sports performance. The aim of the study was to verify inconsistent views on deep squats, technical design, and related health risks. For the review, the terms "squat, knee, biomechanics, deep, patellofemoral, back squat, performance, arthritis, health, injury, risk" were used, for searching were used databases Web of Science, PubMed, Springer, and Scopus. It turns out that the technique of performing a deep squat has its strict principles, which must be respected and which have a significant impact on the benefits and risks. From loading, the lower position represents an increase in compressive and shear forces on the patellofemoral joint. However, this is a natural state that is not risky. Health hazards cannot be based on analytical-mathematical models, which are insufficient in this aspect. Extreme long-term exposure carries the risk of permanent consequences in the form of osteoarthritis. For prevention or recovery, it is possible to use effective aids like sleeves, kinesio taping, bandages or "knee savers".

Key words: *training, performance, knee, patellofemoral*

INTRODUCTION

The inclusion of squats among the basic exercises has a rich history. In modern history, it can be found in Die deutsche Turnkunst (Jahn, 1816), where a variant is used where the exerciser is on tiptoe and performs the full range of motion. This variant was dominant and commonly used at the beginning of the 20th century when it was recommended by personalities such as Eugen Sandow (Sandow, 1894) or George Hackenschnidt (Todd & Hemme, 2013). At the same time, they practiced with different loads, which were held in the hands or placed on the shoulders. With the execution of a squat with the whole feet on the ground, already mentioned by Beaujeu (1828) and also recommended a variant on one leg.

The deep (back) squat with whole feet on the ground and a large barbell placed behind the neck probably originated thanks to Heinrich Steinborn (the 1920s), who was the first to publicly demonstrate it. He lifted the barbell without help from the ground himself - first he leaned over and then squatted. In this way, he could squat with almost 240kg (Giessing & Todd, 2005). The practice gained popularity and spread rapidly. For its functionality, the squat started to be included in bodybuilding, weightlifting, and other power training sessions. Roughly, in the 1950s, it became their normal part.

Since the 1960s, there have also been critical views on the proper use of deep squats. Studies support these views, experts in the fields (Klein, 1961) and are becoming known to the general sporting public. Some opinions have persisted to this day, and in the area of sports there is no clear, unified view of deep squats (Escamilla et al., 2009).

Squats are often used by athletes for strength training, compensation or rehabilitation exercises (Schoenfeld, 2010). It is also applied to the general public to develop fitness. It is therefore important to know the advantages and risks of this exercise. The (deep) squat will be understood in the text as a variant where the knee has an angle <90° (below parallel) in the lower position. The aim of the study was to evaluate different views on performing a deep squat, to analyze the optimal technical design, and to evaluate the possible risks in its use.

METHODS

The authors performed a literature review of available human studies on the research topic describing frequently discussed topics in the sports world – a deep squat. The research studies were selected on the basis of research topics such as "squat, knee, biomechanics, deep, patellofemoral, back squat, performance, arthritis, health, injury, risk" found in databases Web of Science, PubMed, Springer, and Scopus. The terms used were searched using AND to combine the keywords listed and using OR to remove search duplication where possible. The end of the search period is limited by February 2020. The quality of the studies was assessed independently by at least two authors, the subjective evaluation was guided by PEDro scale guidelines. Only studies with full agreement were included.

The inclusion criteria were as follows: the period of the publishing of the article was limited by February 2020; only reviewed full-text studies in scientific journals or relevant books were included. The exclusion criteria involved: specific target groups – children, seniors, diseased persons. Figure 1 below then illustrates the selection procedure.

RESULTS AND DISCUSSION

Altogether 3,383 were identified in all these databases. After removing duplicates and titles/abstracts unrelated to the research topic, 262 studies remained. Of these, only 44 articles were relevant to the research topic. These research studies were classified according to their relevancy (Fig. 1). The information found in the selected studies on the deep squat is described and discussed in the following sections.

Optimal squat technique

The squat is a complex movement that can be divided into three parts (Kritz et al., 2009; Myer et al., 2014): 1. starting position, 2. eccentric/descending phase, 3. concentric/ascending phase. The starting position is usually associated with the correct alignment of the body and the optimal settlement of the external load. The main task is to activate all important muscle groups and to take a position complemented by quality inhalation, creating the necessary tension in the center of the body. The descending phase aims to maintain tension throughout the body as well as the fluency of movement up to the limit point at the bottom. The transition to the ascending phase must be controlled without loss of tension throughout the whole body. When moving upwards, it is necessary to maintain the position of all body segments, there is also exhalation. The squat ends in the starting position (Krause et al., 2015; Ramirez et al., 2018).

Correct technical performance is crucial to getting the benefits of squatting (Schoenfeld et al., 2010; Yavuz & Edgar, 2017). On the contrary, deviations are associated with the risk of overloading and accidents (Fry et al. 2003, Hartmann & Wirth, 2014). The entire movement must be controlled. Attached Table 1 shows body parts that must be monitored and adjusted optimally. The description is valid for all three movement parts.

Figure 1. An overview of the selection procedure.

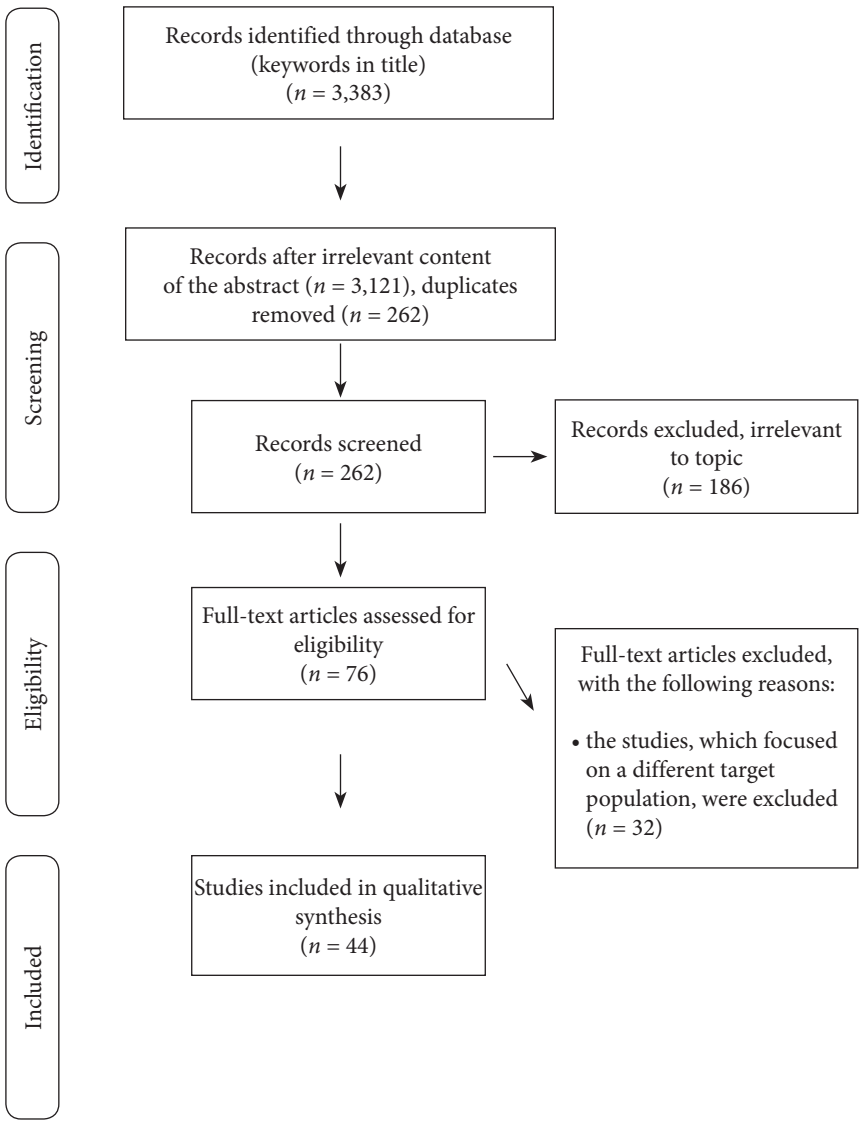

Table 1. Optimal squat kinematic consideration (Kritz et al., 2009; Myer et al., 2014).

Body part	Position	Viewing position
Head	neutral (to slight extension)	lateral, anterior
Thoracic spine	slightly extended and held rigid	lateral
Lumbar spine	neutral	lateral
Hip joints	flexed and aligned, neutral pelvic tilt, symmetric, slightly external rotated	posterior, anterior
Knees	aligned with feet	anterior
Tibial angle	adequate, unrestricted	lateral
Ankles	neutral	anterior, posterior
Foot	flat, stable on the ground	anterior, lateral, posterior

Biomechanical analysis

There are many variations of squats. However, the deep squat is most commonly used in Olympic weightlifting or powerlifting, when the upper pelvis reaches below the patella level as it moves down. Other common variants are partial squat and half squat, i.e., 40° resp. 70–100° in the knee joint (Schoenfeld, 2010). It can often be said that the squat, i.e., 100° or more, is not safe for the knee joint (Escamilla et al., 2008) and is overloaded, negatively affecting knee stability and soft tissue. It is true that when squatting, there is really a greater load on the soft structures of the knee. At various stages of the movement, there is an increase in shear forces (Escamilla, 2001), which must be taken into account by means of a suitable performance. The highest anterior cruciate ligament load (ACL) occurs in flexion of 15–30° and decreases significantly after exceeding 60° (Li et al., 2004). In contrast, the posterior cruciate ligament (PCL) is the most heavily loaded in the 90° flexion (Logterman et al., 2018) and has a greater force on it when moving down (up to 40%) (Escamilla et al., 2009). Both ACL and PCL are important for the knee stability, while ensuring optimal transmission of lower limb muscle strength to the joint (Cox & Bordoni, 2019). With greater flexion, the load on both ligaments decreases (Hehne, 1990) and in the context of the above, it is not necessary to worry about the increased range of motion. Conversely, the study of the difference between weightlifters and the control group regarding PCL and ACL found both ligament hypertrophy in favour of weightlifters (Grzelak et al., 2012).

The technical performance of the squat has a significant effect on the forces acting on the ankle, knee or hip (Wilk et al., 1996). Maximum compression forces are monitored around 90° flexion. In the course of the squat, the quadriceps, gluteal muscles and hamstrings are dominant. The measured EMG values show their highest activity in the range of 80–100° (Yavuz & Erdag, 2017). The correct activation of hamstrings during squatting relieves tension in ACL (Biscarini et al., 2014). Foot position, resp. external rotation, in the hip together with the position of the torso and the load have a significant effect on the activity of the involved muscles and also the transfer of forces to the musculoskeletal system. In this respect, the particular performance has a significant impact (posture width, torso slope, downward movement speed, knee anterior-posterior position, or external load position) (Contreras et al., 2015; Fuglsang et al., 2017; Kushner et al., 2015; Walsh et al., 2007). In addition, the position of the foot or resp. heel elevation compared to flatbed on ACL (Toutoungi et al., 2000), both eccentric (26 vs 95N) and concentric phase (28 vs 49N).

Controversies about squatting

The first blow for a deep squat was the 1959 research by Dr. Klein. He tried to confirm the hypothesis that the knee ligament was stretched too deeply due to a deep squat, and therefore there is mobility (instability) in the knee (Klein, 1959). The results confirmed this, although from today's point of view the study had major shortcomings. One of the great limitations was the absence of double blindness. Another important limitation was the testing of passive joint mobility. Bill Star, who was part of the research, said that when he was tested, he was extremely pressing on his knee to a great pain (Todd, 1984). Two years later, there was the second blow for the deep squat, made again by Klein (Klein, 1961). By being a recognized authority, his views have taken hold. The final recommendation was to make the squat parallel. This information was published in expert journals and was taken over by various health institutions or the military, which made this information even more popular. Unfortunately, these recommendations also appeared in textbooks and professional books and were therefore considered to be true. Already in the 1960s, coaching authorities publicly opposed it, but in vain. For many decades, such a deep squat came to a black list (Todd, 1984). Although many studies emerged that contradicted this fact, a reversal occurred in the 21st century (Myer et al., 2014).

An important factor in the squat includes compression forces acting on the patellofemoral joint. According to the research by Escamilla (Escamilla, 2001), values increase proportionally with flexion of the knee and reach a peak at 130°. This fact is associated with possible deformation consequences when performing the deep squat. It is necessary to emphasize that the review lists studies that both use a mathematical model and did not directly measure. An analytical model can be used to calculate the effect of patellofemoral forces, taking into account all squat variables – femur and tibia length, patellar tendon length, body weight vector, or segmental angles (Fekete et al., 2014).

Mathematical models do not take into account the change of contact/friction surfaces in the knee or the function of the knee as a dynamic system, where the forces are distributed over all parts (Hehne, 1983). The neglect of rotational movements in the transverse plane (approximately 12°), which occur during the ascending phase of squatting, is also viewed critically. Natural internal rotation and adduction also influence the resulting action of forces (Kapandji, 2009). However, the claims of Escamilla (2001) do not coincide with Ahmed (Ahmed et al., 1983) or Hehne (Hehne, 1990), where different conclusions are drawn from the forces. To explain the measured values, it is important to realize that in any movement some forces act on soft structures or joints. An example is a push-up, where the wrist is also loaded, and it is not necessary to treat it as a risky matter (Polovinets et al., 2018).

Negative effects of squatting

Unfortunately, there are no studies on the long-term effects of the squat on the entire knee structure. A study by Kujala et al. (1995), which examined knee osteoarthritis in various sports. The results of weightlifters, where frequent use of deep squats can be expected, were comparable to long-distance runners. Thus, it can be concluded that the "wear and tear" is caused by excessive exercise load, not by a specific exercise. These are confirmed by Driban et al. (2015) who associate arthritis most with the sports of football, wrestling, weightlifting, American football, long distance running. An extreme case of using a deep squat (on tiptoe) is baseball, specifically the position of the catcher. The athlete will do a lot of squats during the match and also have to endure them for some time. This is subsequently associated with osteochondritis (McElroy et al., 2016). As with Olympic weightlifting or powerlifting, it is part of sports performance, which is a big difference from using squats as part of strength training or as an exercise for the general population.

There are situations where the use of deep squats must be limited or strictly adapted to the individual's state of health. One case is the cam morphology of the hip joint, which may be present without symptoms of impingement (Bagwell & Powers, 2017). In these subjects, it is important to emphasize external hip rotation, enhanced extensors, and avoidance of large flexion (Catelli et al., 2018). In the presence of femoroacetabular impingement, an asymmetric design occurs, which must be avoided due to the automation of the movement pattern (Diamond et al., 2017). In general, good hip condition (muscle pain, fatigue, tightness) have a significant effect on squat performance and performance (Cheatham et al., 2017).

During squats, the ligaments stabilize the knee joint and thus have an important function. When they are injured or removed, the optimal technical design is affected (in the frontal and sagittal planes) and the resulting forces change not only in the knee but also in the entire locomotor system (Slater & Hart, 2016). Free posterior cruciate ligament causes an increase in patellofemoral pressure (Shoifi Abudakar et al., 2016). In contrast, anterior cruciate ligament dysfunction tends to restrict forward knee movement (Stone et al., 2017).

As part of rehabilitation or prevention, various methods and aids are used to alleviate the forces acting on the knee joint. Orthoses are often used, which, when worn correctly, positively affect balance, coordination, proprioception, or muscle power (Baltaci et al., 2011). Knee sleeves

have a similar function, although here the effect is amplified by subjective feeling (Sinclair et al. 2019). Knee wraps are also used in power sports, but they are not recommended for the general public or frequent use. In addition to increased discomfort, they cause a change in squat kinematics and may reduce the work of the vastus lateralis (Gomes et al., 2015). In contrast, kinesio taping can be recommended, which is a suitable method of knee fixation that does not alter muscle activation and brings a feeling of knee stability (Sarrão et al., 2016). "Knee support" or "knee savers" are used to mitigate the negative effects of deep squat positions on the tiptoes of baseball players (catchers). Their application is functional: they reduce the tension of the knee joint, reduce the forward movement of the knee, reduce the speed of the ascending phase (Doodley et al., 2019). However, it is a specific tool that is used only in this sport.

CONCLUSION

Deep squat has been associated for centuries with exercises that develop strength, fitness, and health. There are opinions supported primarily by historically older studies on the potential hazards related to knee instability or by theoretical-analytical models proclaiming overloading of the patellofemoral joint. However, such conclusions do not coincide with relevant studies. With optimal technique and sensible exercise selection, there is no greater risk in healthy individuals without degenerative anatomical changes. In order to assess the effects of the squat forces on the ankle, knee, hip, spine, it is necessary to take into account the technique and also individual anatomical differences. The knee joint is naturally adapted to move to a full squat and nothing prevents its use. Of course, with repeated and long-lasting high loads exceeding the adaptation potential, wear and tear associated with irreversible changes can occur. Functional aids are available for prevention or prophylaxis when the knee is subjected to deep squats.

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SOCIAL SCIENCES

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Psychological Context of Overtraining Syndrome in Elite Athletes in Adolescence: Literature Review

Iva Burešová[1], Petr Květon[2], Martin Jelínek[2]

[1]Faculty of Arts, Masaryk University
[2] Institute of Psychology, Czech Academy of Sciences, p.r.i.

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Abstract

The article presents an overview of important findings concerning the overtraining syndrome (OTS) in elite athletes in adolescence. Although the scientific community agrees that OTS is a multifactorially determined and individually variable phenomenon, which can have a serious impact on the individual, there are still some inconsistencies. Therefore, in our study we focused on the terminology of the phenomenon, its prevalence, etiology and symptomatology. We paid specific attention to psychological instruments of detecting OTS indicators. Given that in the period of adolescence the training process in the majority of sport disciplines intensifies significantly, the context of developmental changes during this period in relation to OTS is discussed. The final part of the study summarizes the basic principles of prevention of this pathological phenomenon.

Key words: *pathological form of fatigue, overtraining, developmental specifics of adolescence, athletes*

1. INTRODUCTION

In the framework of elite competitive sports, the primary goal of the athletes is to maximize their performance. Usually, only those individuals who can cope with all the demands placed on them by the sport itself and by their environment can reach the performance level that allows them to compete at a national and international level (Sekot, 2014). Depending on individual dispositions and broader socio-cultural-economic conditions of an elite athlete, regular sports activity at the high performance level can play an important protective but also negative role in his or her further development and sports career (Bianco et al., 2019; Merkel, 2013). Namely, high performance sports activity is closely associated with demands, often extreme, placed on physical and mental performance of adolescent athletes. At the same time, the ever-increasing popularity of elite sports brings along an increased pressure in terms of professionalization of sports disciplines (Schubring & Thiel, 2014). Sports load, which is associated with high performance activities of adolescents, is then also connected with high training frequency, intensity and duration. Increasing this load is a necessary pre-condition for improving sports performance, however, besides the required progress, without sufficient physical and mental regeneration it can result in increased fatigue, which can turn into its subchronic or even chronic form, in other words, the overtraining syndrome – OTS.

A whole number of significant bio-psycho-social influences are reflected to various degrees in the highly individual multifactorial reasons for the occurrence of OTS. These influences become particularly important in adolescence, when elite athletes are undergoing physical and mental maturation. The specific combination of internal and external conditions in the development of these adolescents subsequently determines whether the sports activity will potentiate the growth

of individual areas of their development and thus play an important protective role, specifically in their physical and mental health area, or whether it will lead to a development of the pathological form of fatigue – OTS, increased injuries and eventually result in the end of the elite athlete's career (Bean et al., 2014; Difiori et al., 2014). Considering the above, early diagnosis as well as prevention of OTS play a crucial role. Both areas represent a great number of challenges for the professionals. The diagnostic procedures to detect OTS currently in use face several limitations, which will be discussed further on. Preventive steps for OTS are generally well known among professionals and laymen alike, however, they are not adequately and systematically included in the training of elite athletes. This opens up space for inappropriate load, in other words overload, placed on adolescent elite athletes, which in turn can easily lead to this pathological form of fatigue since it occurs during this key and very sensitive developmental stage. The number of serious injuries and mental issues, among other things, which are significantly on the rise in adolescence, attest to the immediate need of addressing this question (Hamlin et al., 2019; Wyatt et al., 2013).

2. PROCEDURE

We started the literature search in abstracts by using the terms overtraining, training distress, athlete burnout combined with sport, athlete, exercise. We used EBSCOhost (limited to APA PsychInfo, APA PsycArticles and Academic Search Ultimate databases) and Google Scholar search engines. We only included studies that were published in peer-reviewed journals, monographs and book chapters written in English, Czech or Slovak language. We build our review on sources published in the past twenty five years. Initial search on EBSCOhost returned 980 records of peer-reviewed articles and search on Google Scholar returned additional 93 articles. After initial title screening, we identified 359 unique sources which were directly related to the topic of the review. We read the abstracts of these studies and identified the key themes to be able to outline the final structure of the review. Sources highly relevant to the identified themes (N = 119) were read in full-text and 62 of them were selected for the review as they fully cover the whole spectrum of the reviewed topic.

3. FUNDAMENTAL TERMINOLOGY

In professional literature, the overtraining syndrome (OTS) is usually described in the framework of individual forms of fatigue, which are associated with sports load, one of which is the chronic pathological form resulting from a reaction to prolonged high performance training load without adequate physical and mental regeneration (Carter et al., 2014). Fatigue, in sports context, is considered a complex, multifaceted phenomenon of various mechanisms of origin (e.g. type of stimuli or effort, length, frequency and intensity of the sports activity, etc.), which can be manifested by physical, mental, and physiological (local or general) fatigue. In a nutshell, in this context it can be defined as the inability of the organism to maintain the required/expected performance, whereby, the physical and mental state of the athlete as well as specific conditions of the environment play a significant role here (Halson, 2014). In view of the above, Carter, Potter, and Brooks (2014) state that common acute overload (OL) resulting from sports load, can lead to overreaching (OR), which can be in a form of functional overreaching (FOR) or non-functional overreaching (NFOR). Non-functional overreaching is considered acute pathological fatigue and can thus no longer be seen as a common or desired fatigue reaction to training load. Such

a training maladaptation occurs mainly because of lack of balance between a sports load (e.g. excessive training demands, change in training schedule, monotony of training, and psychosocial stress) and regeneration, and it can potentially lead to chronic pathological fatigue, which tends to be associated with the occurrence and development of OTS.

Due to the fact that the subject area discussed above lacks terminological uniformity represented by the following most frequently used terms: training load syndrome, burnout syndrome, adaptive failure, syndrome of inexplicable decrease in performance, exhaustion, and others (Kreher & Schwartz, 2012), we are basing the classification of fatigue and corresponding terminology on the joint consensus of the European College of Sports Science (ECSS) and the American College of Sports Medicine (ACSM) as expressed by Meeusen et al. (2013). *Functional Overreaching – FOR* is the result of the athlete's deliberate increase of the level of sports load followed by a decrease in performance without serious negative symptoms. Such an increase in load in the form of short-term functional overreaching will then lead to better performance after recovery. The time necessary for regeneration ranges from days to weeks. *Non-Functional Overreaching - NFOR* is the result of disregarding the ratio between sports load and sufficient regeneration, resulting in prolonged load such as decrease in performance, increased fatigue, decreased vitality, sleep disruption, psychosocial stress, disruption of hormonal functions, and others. The time necessary for regeneration ranges from weeks to months. *Overtraining Syndrome – OTS* is the result a combination of multifactorial causes, while sports load itself is a very important but not the only reason for OTS. An individual suffering from OTS experiences prolonged decrease in performance, mood swings, neurological, endocrine and immune system disorders, etc. The time necessary for regeneration is in the range of several months. The onset and development of OTS has such long-term impact on the athlete that it can lead to early retirement from his/her athletic career (Tod et al., 2012).

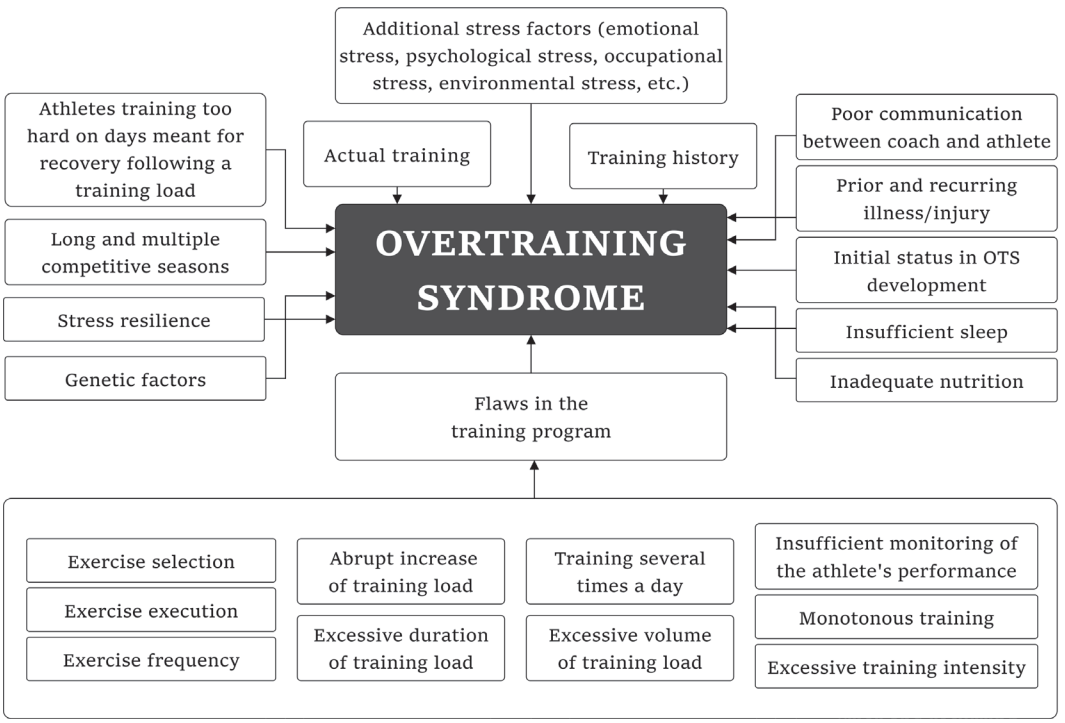
4. PREVALENCE, ETIOLOGY AND SYMPTOMATOLOGY OF OTS

Tod et al. (2012) posit that the range of recorded occurrence of exhaustion, overtraining or burnout among athletes is very broad, from 18 to 91 percent. Meeusen et al. (2013), however, most likely presents a more realistic OTS prevalence, i.e. from 7 to 64 percent. The author points out that an athlete, who has manifested an onset of OTS is very susceptible to not only further develop it but also to relapse. Winsley and Matos (2010) present a narrower definition of OTS occurrence, estimating it to be prevalent in adolescent athletes at about 30 to 40 percent. In case of athletes competing at the highest level the estimate of OTS occurrence is somewhat higher, some authors claim it is up to 60 percent (Kreher & Schwartz, 2012). Be that as it may, it is necessary to look at differences in the demands placed on athletes in different sports disciplines. Research studies repeatedly recorded a more frequent OTS occurrence in girls, who specialized in a sport very early, particularly in individual sports (Matos et al., 2011; Walters et al., 2018). The discrepancy in the prevalence of OTS is caused by a number of limitations of research studies dealing with this subject, for example, the use of different research methods, the heterogeneity of the research sample, data collection at various stages of the training cycle, the competition season, etc. In spite of the fact that data in professional literature concerning OTS in adult and adolescent athletes are not completely unanimous, professionals in this field do agree that OTS presents a significant problem, which affects not only elite athletes' progress in their sports discipline but also their physical and mental health, which can play a key role in subsequent stages of their development in adolescence.

4.1 Risk factors contributing to the occurrence and development of OTS

Tod, Thatcher, and Rahman (2012) identify the following risk factors contributing to the occurrence and development of OTS: *biological factors* (talent and disposition affecting the ability to deal with the training amount and intensity); *situational factors* (competition season progression, demands outside their sports activity); *interpersonal factors* (relationship with coaches and parents, etc.); *athlete factors* (fear of not being picked for a competition, ability to deal with pre-competition nerves, etc.); *sociocultural factors* (pressure by peers, family, fans). In their research study, Carter et al. (2014, see Fig. 1) present a diagram of possible causes of OTS development, in which the dominant role is played by principles of a training program. When these principles are disrupted, in combination with other factors, the results may be a maladaptive reaction to an excessive training load. In line with this, Lehmann et al. (1998) confirm that the risk of OTS is increased by one-sided monotonous training, lack of good rest, excessive volume or training load in combination with a large number of competitions. Many authors perceive overtraining as the last of the three maladaptive phases of training. In this context, Matos et al. (2011) describe the first of these phases as a training plateau, the second as the occurrence of psychophysiological dysfunctions, and in the third phase, which some authors describe as burnout, the athlete's ability to react to stress has been exhausted. However, burnout and OTS are two different concepts, which should not be used interchangeably. The key to the differentiation between burnout and overtraining can be the motivation to continue training, where the overtrained athlete can still be motivated to continue to train while the burned out athlete is not (according to some models overtraining is the so-called prerequisite for burnout).

Figure 1. Causes of Overtraining Syndrome (adapted from Carter et al., 2014, p. 4)



At the same time, OTS is typically accompanied by high interindividual variability of symptoms. An athlete with a beginning or fully developed OTS may experience sympathetic as well as parasympathetic changes or combinations thereof (Wallace et al., 2009). Parasympathetic changes, ascribed to OTS, occur more often in endurance sports athletes, while sympathetic changes are more common in anaerobic sports (Urhausen & Kindermann, 2002). Moreover, the occurrence and development of OTS is associated with a number of additional symptoms (see Table 1).

Table 1. Main symptoms of OTS (adapted from Carter et al., 2014)

Parasympathetic changes (more common in aerobic sports)	Sympathetic changes (more common in anaerobic sports)	Additional symptoms
fatigue	insomnia	eating disorder
depression	irritability	weight loss
bradycardia	restlessness	muscle pain/stiffness
loss of motivation	tachycardia	decreased concentration and attention ability
	hypertension	anxiety
	absent-mindedness	lethargy

OTS symptoms can be divided into several basic areas, in which they manifest themselves to a significant degree. *Performance symptoms* include, for example, decrease in specific and general performance, deficiency in agility, speed, strength and endurance, aversion to sports activity, insecurity during training or learning new elements or during a performance, fear of training sessions and competitions. *Somatic symptoms* include changes in reaction time, sweating, disruption in concentration, sleep and digestion, blood pressure fluctuation, consistent fatigue, and increased occurrence of illnesses. *Neuropsychological symptoms* involve feelings of unrest and tension, increased irritability, apathy or, vice versa, oversensitivity, inappropriate mental reactions (explosions of aggression, or lachrymosity), indecisiveness, depression, disruptions in perceiving the outside environment (heat, noise), changes in libido, etc. (Meeusen et al., 2013). The symptoms of overtraining in adolescents are identical to those of the adult population. Some other symptoms specific to adolescents are: more conflicts with the family, partner, trainer or friends; decreased interest in trainings and competitions; increased frustration during training sessions; decrease in self-confidence; difficulties with concentrating on specific tasks; irritability; depression; gloom; and increased level of stress subjectively perceived (Hollander et al., 1995). Hoffman and Kaminsky (2000) point out that OTS symptoms are often underestimated because of their highly individualized variability, and that the occurrence of OTS can be the tip of the iceberg, following repeated warnings in the form of symptoms, to which the athlete and the coach did not pay enough attention.

4.2 OTS models

It is quite obvious from the above that the occurrence of OTS presents not only a multifactorial but also a highly individually variable picture of the causes. Currently, there is no unequivocal agreement among the authors specializing in this area, concerning the causes of OTS and its expressions or whether OTS develops continually, exclusively from repeated or long-term non-functional overreaching, or whether OTS can occur as a result of some significant trigger stressor, which would seriously negatively affect either functional or non-functional overreaching. This is the reason for the development of several theoretical OTS models. The following are key multisystemic OTS models: The Multi-Systemic Model of Overtraining (Meyers & Whelan, 1998);

The Conceptual Model of Overtraining (Kenttä & Hassmén, 1998); and The Overtraining Risks and Outcomes Model (Richardson et al., 2008).

The Multi-Systemic Model of Overtraining by Meyers and Whelan (1998) emphasizes the necessity of a complex understanding of the sources of load/stress affecting athletes. At the same time, it is creating a framework for understanding the reasons why athletes with similar abilities and skills undergoing almost identical sports load manifest a relatively broad range of reactions to this load, going from positive all the way to negative forms of adaptation. The authors also emphasize that their model includes, in addition to the interaction between load/stress and compensation strategies, other variables in the process of OTS development. Among these are a) variables pertaining to sports training, b) biological, cognitive, behavioral, and emotional characteristics of the athlete, including his/her sports ability and skills, and c) factors coming from a broader environment involving interaction with coaches, teammates, peers, family members, other persons close to them, and teachers, as well as the effects of cultural and economic situation. The key assumption of this model is the premise that an individual's experience in one type of environment/context will influence the experience in other contexts. The authors of the model take into account not only currently present load/stressors within various systems and contexts but also significant past events and experiences from the athlete's life to date.

Kenttä and Hassmén (1998; 2002) presented a *Conceptual Model of Overtraining*, which encompasses the process of adaptation and maladaptation to load in the context of broader conditions in the athlete's life, while taking into account sports as well as non-sports factors, which can potentially lead to the development of OTS. This model defines overtraining as an interaction process, which comprises three main systems: physiological, psychological and social. In each one of them there are three dynamic components, which influence the overall equilibrium between load/stress and regeneration: stress, resilience toward stress and recovery. In this model, the central aspect of negative adaptation to sports load is physiological stress (e.g. training), illness or using medication is not taken into account. Psychological (intrapersonal) stress occurs, when, for example, there is a discrepancy between the athlete's expectations and his/her actual performance, while social stress is defined as the result of interaction with others. In the end, psychological and social stress in combination with physiological stress determine the degree of actual stress experienced by the athlete. The conceptual model of overtraining applies a holistic approach to the evaluation of the athlete's actual state and actual resilience, level of experienced stress and activities supporting the athlete's regeneration. The athlete's resilience, according to this model, determines the level of stress the individual is able to tolerate; for example, there is neuromuscular resilience (i.e. aerobic and anaerobic capacity), resilience to psychological stress (i.e. self-confidence level, anxiousness, motivation, focus, mental health and attitudes), or resilience to social stress (i.e. ability to create, cope with and maintain relationships with others). These types of resiliences together create the athlete's overall resilience to various types of stresses (Kenttä & Hassmén, 1998).

Richardson et al. (2008) in *The Overtraining Risks and Outcome Model* concentrate mainly on the risk factors influencing negative adaptation to sports load and thus potentially playing an important role in the development of OTS (e.g. some training aspects, situational and environmental stressors, interpersonal aspects, the athlete's physical condition, his/her beliefs and attitudes, etc.) The concept of the model involves four hierarchically arranged levels describing the relationship between stress, recovery and overtraining in athletes. Level 1 describes risk factors, which can deepen reaction to stress, and divides them into situational, intrapersonal and interpersonal factors. Level 2 deals with the imbalance between stress and recovery, which can lead to the first warning signs of overtraining (indicating that the athlete is not able to cope with the demands of the sports load or the demands in other parts of his/her life). Lever 3 includes the

athlete's reaction to these warning signs. These reactions are influenced by the factors described in Level 1 and together they determine whether the athlete will be able to recognize the symptoms of overtraining and choose the appropriate strategy to cope with them. Level 4 represents the consequences, where in general, the athlete can adapt and return to the original balance between stress and recovery or, if the athlete does not recognize the signals or has an inappropriate reaction, s/he can end up with a full development of OTS.

All the above discussed models are focused on the process of adaptation/maladaptation to load, which can lead to OTS. At the same time, they emphasize the necessity of a contextual approach to researching, diagnosing and preventing OTS. Furthermore, in the context of the occurrence of OTS, there is another condition, which needs to be taken into account in adolescents and that is the developmental specifics of adolescence, because this developmental stage is undoubtedly one of the key phases of development during which elite athletes experience a number of significant biological, psychological and social changes (Dennison, 2016), which can often play a fundamental role in the occurrence of OTS.

5. DEVELOPMENTAL SPECIFICS OF ADOLESCENCE IN THE CONTEXT OF OTS DEVELOPMENT

During adolescence elite athletes are undergoing not only a number of developmental changes, which will be discussed later, but also their sports career requires of them significant changes in the training. Nowadays, training in all sports disciplines changes from a specialized training to elite training. Peřič (2004) characterizes specialized training mainly by gradually increasing intensity of training load and crossing over to a target training stimuli, while elite training is defined primarily by high volume and intensity of training units. This type of training in adolescent athletes should be adjusted not only to the type of a given sports discipline but also to their biological age, while taking into account biological, in other words, anatomic-physiological peculiarities of the physical load placed on a developing organism as well as the appropriateness of the psychosocial demands placed on these athletes. In practice, however, elite training is often not adjusted to the corresponding developmental specifics of a given age group, despite the fact that adolescent elite athletes differ from adults in such important features as the skeletal system, heat tolerance, heart functions, thought process or self-regulation (Martinková, 2013). Neither do coaches give enough consideration to the fact that this developmental stage is characteristic for significant interindividual as well as intraindividual variability in the maturity of the adolescent, in the framework of all the areas of development discussed below. Moreover, a significant role is played by genetic and gender influences and broader sociocultural and socioeconomic conditions. Thus, each adolescent individual may react differently to the identical degree of sports load (Rearick et al., 2011), and these individual differences are manifested predominantly in the developmental areas discussed in the following sections.

5.1 Physical Development

Physical changes during adolescence are determined predominantly by physiological growth along with significant hormonal changes, which potentiate physical and motor development of the adolescent. During this period, there is a significant progress in the area of fine motor skills (hand-eye coordination, dexterity development), as well as gross motor skills (stability, control of core and limbs), coordination and overall physical performance and endurance (Kučera et al., 2011), growth of muscle mass, and important skeletal changes. Optimizing the intensity of sports load is, therefore, very important during this developmental stage, mainly because of the possible

benefits of a regular sports activity, as proven by a great number of research studies. Regular sports load in adolescents is associated with, for example, the improvement in mineralization and volumization of bones, or with changes in the progress of sexual maturity (Bertelloni et al., 2006), and its positive role in maintaining optimal weight has been proven by many studies (Janssen & LeBlanc, 2010). The level of physical development in elite athletes is simultaneously an important source of self-concept, self-esteem and self-confidence and it is reflected in the process of identity creation (see next section).

5.2 Cognitive Development

The maturation process of cognitive functions is reflected in important quantitative and qualitative changes in the thought processes, be it a metacognitive development, thinking flexibility, abstract, hypothetical-deductive thinking or the development of memory and imagination, all of which are reflected primarily in the precision of the sports performance. Furthermore, the development of metacognition in elite athletes plays a key role, mainly in adopting the correct strategies, attitudes or understanding of mechanism by means of which it is possible to attain higher or better sports performances. At the same time though, the early changes in the dopaminergic systems are behind the fact that the reasoning of adolescents is set up to search for extraordinary experiences, which is reflected in their risk-taking tendency, because they are still unable to resist potentially dangerous but highly attractive impulses (Pate et al., 2000). This fact, can then be manifested in, for example, underestimating the current or long-term sports load and so contribute to OTS development.

5.3 Emotional Development

The emotional rollercoaster in this developmental stage is primarily the result of hormonal changes manifested in emotional egocentrism, mood change, oversensitive reactions, feelings of frustration, expressions of instability, irritability and emotional confusion. As early as 1996, Steptoe and Butler came to the conclusion that intensive participation of adolescents in sports is positively associated with lower emotional stress and higher level of emotional well-being, regardless of gender, or socioeconomic status. A study by Brosnahan et al.(2004) has shown the important protective effect of regular sports activity on mental health, mainly in the context of decreased occurrence of feelings of sadness, depressive symptomatology and risk of contemplating or even planning suicide, which happens to be one of the most often stated reason for untimely death during this developmental stage. However, there are negative aspects of sports activities connected with development of OTS, which bring undesirable negative changes in emotionality, such as mood swings, increased impulsivity or irritability (Sagar et al., 2009).

5.4 Personality Development

Within the framework of adolescence and according to broader conditions involved in the development of an individual, a highly specific process of personality individuation and development of social as well as personality aspects of identity is taking place (Schwebel et al., 2016). Herein, the social role of an elite athlete plays an undoubtedly significant role, and as previously mentioned, regular sports activity is reflected in the level of self-concept, self-esteem and self-confidence (Stein et al., 2007). At the same time, sports activity can have a positive influence on behavioral development in terms of learning fair-play or personal responsibility (Escartí et al., 2010; Wiese-Bjornstal et al., 2009). During this developmental stage, there are also significant changes happening as far as internal and external motivation is concerned, and internal differentiation of self-regulation mechanism and coping strategies is taking place as well. The utilization of these is, to a great extent, influenced not only by regular sports activity but also by its broader

circumstances (type of sports discipline, difficulty of the physical and mental sports training, etc.). In this context, the development of the introspection ability is very important, because, for example, by self-monitoring, an individual can identify and control his/her performance mechanisms, which is also the basic condition for preventing OTS (MacIntyre et al., 2014). As far as OTS is concerned, research has found its significant associations with some personality traits – primarily neuroticism (Sagar et al., 2009), conscientiousness (Judge & Ilies, 2002), or maladaptive forms of perfectionism (Gucciardi et al., 2012).

5.5 Social Development

A number of research studies prove the positive effect of intense physical activity on social functioning of an individual (Allison et al., 2005). Undoubtedly, participating in sports has a positive effect on social development of adolescents, because it develops not only their ability to cooperate but also a broader spectrum of other social skills associated with, for example, emotional control (Eime et al., 2013). Moreover, Lansford (2016) claims that an individual who socializes is usually happier and more adaptable than socially isolated individuals. Merkel (2013) further points to the importance of social support and acceptance, which makes it possible to be part of a team in the context of prevention of risk behavior, including suicide risk. She bases her claim on the assumption that athletes who have a strong social support are more resilient to negative impacts. Elite athletes' social development in adolescence is dependent not only on the quality of family, peer and later partner relationships but also on the important role of the relationships in school and sports environment (particularly with the coach). In the context of OTS development another key role is played by parent and coach motivation climate, which affects the way elite athletes perceive, evaluate and react to situations associated with overcoming sports load and attaining goals. Numerous research results connect maladaptive behavior patterns and motivation with performance motivation climate (Weigand et al., 2001).

5.6 Academic path development

One of the specific areas, which in adolescence can significantly contribute to the occurrence and development of OTS, involves school work demands. Around the age of 15 the majority of adolescents is completing the so-called compulsory schooling, which generally brings a change in the environment as well as relationships. At this time, adolescent athletes, while deciding about their possible professional sports career, are confronted by the pressure to also take on the responsibility of choosing their future profession. During adolescence, this usually results in a greater conflict between the demands associated with school preparation and the demands placed on sports performance. There are many research studies addressing the issue of premature career ending of elite athletes (Latorre-Román et al., 2018), nonetheless, the number of studies dealing with premature ending of elite athletes' academic path is far lower. Professional literature seems to include rather works testifying to the positive influence of sports performance on school success. Georgakis et al. (2015) carried out an analysis of the relationships among academic results in elite athletes and their peers. Their findings indicated that in spite of demanding training and certainly demanding time schedules, elite student athletes reached the same or better school results than their peers. A study by Baron-Thiene & Alfermann (2015), dealing with the optimization of the conditions for linking academic education of adolescent athletes attending sports schools and their sport career concluded that a significant role in maintaining the students' successful sports performance is played mainly by their personality characteristics, motivation and will. A study by Sorkkila et al. (2020) focused on examining the sources of the development of burnout syndrome in adolescent athletes in the context of school work demands. The results, as far as elite athletes are concerned, indicate that the burnout syndrome in sport is not context specific and that elite

athletes, who are in danger of experiencing burnout in sport, are simultaneously experiencing symptoms of school burnout, which subsequently spill over to the area of sport. At the same time, some OTS models consider the burnout syndrome to be one of the most significant results of overtraining, when the athlete is no longer able to cope with the physical and psychological demands of the sport. Tod et al. (2012) define burnout syndrome as "withdrawing from the sport, physically or psychologically, characterized by a diminishing feeling of the ability to succeed, by devaluing the activity and by exhaustion".

6. MEASURING METHODS

Based on all the above, it is clear that identifying OTS requires a complex and multidisciplinary diagnosis in order to encompass all the key areas in which all the main symptoms are reflected. Alves et al. (2006) divided these symptoms into six categories: *physiological* (e.g. pulse frequency in the morning hours); *psychological* (e.g. mood swings, sleep disturbances, increased emotional lability, propensity to conflicts, decreased self-esteem); *biochemical* (e.g. low concentration of muscle glycogen, mineral deficit); *immunological* (e.g. higher concentration of specific as well as unspecific immunocompetent cells in the body); *performance* (e.g. decrease in performance, decreased ability to reach maximum performance); and *cognitive indicators* (e.g. decrease in concentration or decreased psychomotor tempo). The basic principle of diagnosing the pathological forms of fatigue, therefore, is to identify changes in the overall reaction of the organism and the speed of recovery following a load. According to Kreher and Schwartz (2012), overtraining diagnosis focuses on three basic areas: decrease in performance, mood swings, and absence of symptoms indicating a different explanation for the decrease in performance. If after the unexplained decrease in performance the athlete returns to previous performance level in less than 3 weeks, it is considered overreaching, however, if the return to previous performance level lasts longer, it is usually considered overtraining. Unfortunately, presently there is no diagnostic tool that would be able to unequivocally diagnose OTS and the degree of its development. This is due to the general as well as highly interindividual variability of its symptoms, which are also often characteristic of a whole number of common illnesses. To date, we are not able to differentiate between overreaching and overtraining with a satisfactory diagnostic certainty.

6.1 Medical and non-medical methods used in OTS diagnosis

Simply put, specific procedures used to diagnose OTS can be divided into medical and non-medical methods. Unfortunately, the medical methods have not been able to find the so-called final biomarker, which would be able to distinguish functional overreaching from nonfunctional one and both types from OTS (Carter et al., 2014). As discussed above, OTS symptoms are relatively nonspecific and can also represent the symptoms of many other illnesses, which must first be eliminated when diagnosing OTS. That is the reason why identifying OTS must involve a very complex clinical diagnostic process, including medical history, sleep quality evaluation, looking at nutrition, injuries, and training in relation to the athlete's individual personal history. This means that in the framework of identifying OTS, a number of specific biomarkers are examined, such as oxygenation stress, hematological and immunological markers, and others, in addition to the common laboratory screening tests (blood panel, speed of erythrocytes sedimentation, C-reactive protein, iron, creatine kinase, and thyroid stimulating hormone levels) (Kreher, 2016). Moreover, checking immunoglobulin, cortisol or uric acid levels, maximal heart rate, heart variability, or lactate exchange values during performance testing are all part of the evaluation process. Very often the OTS diagnostic process also utilizes physiological and functional tests, which aid in

proving excessive load on the body (Meeusen et al., 2006; 2013). The most promising results in terms of differentiating between overreaching and overtraining lie in the combination of using performance testing and physiological markers.

On the nonmedical level, to map OTS a combination of the following methods is used most commonly: self-assessment, retrospective or present-focused questionnaires and methods aimed at subjective evaluation of the degree of perceived psychological load, training diaries and direct observation. Performance tests can also be utilized focused on psychomotor tempo and attention concentration (e.g. Stroop test) as well as other cognitive tools (Hausswirth et al., 2013). In terms of the above, it is worth to mention that similarly to the case of biomarkers, none of the psychological methods used (see the overview of tools used in OTS diagnosis in Table 2) makes an unequivocal final diagnosis possible. These diagnostic tools are used in research and practice, mainly as indicators of the degree of psychological load in elite athletes which accompany OTS.

Table 2. The most commonly used methods to determine psychological symptoms of OTS

Method	Reference	Description
Daily Analysis of Life Demands of Athletes (DALDA)	Rushall, 1990	Self-report of sources of stress in everyday life (part A, 9 items) and symptoms of experienced stress (part B, 25 items).
Profile of Mood States (POMS)	McNair, Lorr, & Droppleman, 1971	Self-report scale for profiling affective states and moods. 65 items (short versions were published too).
Le Société Française de Médecine du Sport (SFMS)	Legros, 1993	Scale determining the presence of overtraining symptoms in physical and emotional area. 54 items.
Training Distress Scale (TDS)	Raglin & Morgan, 1994	Method focused on key physical (e.g. muscle and joint pain, lack of energy, etc.) as well as mental aspects (e.g. lack of concentration, irritability, etc.) of sports load. 19 items.
Recovery Stress Questionnaire for Athletes (RESTQ)	Kellmann & Kallus, 2001	Complex method focused on expressions of stress and strategies to cope with it. 76 items.
Short Overtraining Symptoms Questionnaire (SOSQ)	Lemyre, Roberts, & Stray-Gundersen, 2007	Brief questionnaire designed to determine symptoms of overtraining. 5 items.

Despite high individual variability of symptoms intertwined with different degrees of intensity in the diagnostic panel of OTS, some symptoms compared to others occur more frequently, for example, mood swings, depression, sleep and eating disturbances, lowered immunity, concentration difficulties and others (Lastella et al., 2018). Given what has been said, psychological tools with good psychometric parameters appear to be very suitable in terms of quick accessibility of information about the development of the symptoms of OTS, which are relatively easy to track at low cost over time. Currently though, even in this area there is a lack of sufficient relevant conclusions which would offer adequate basis for diagnostically differentiating between functional and non-functional overreaching and between both of those and the overtraining syndrome.

7. PREVENTION OF THE OCCURRENCE AND DEVELOPMENT OF OTS

Based on the discussion above, it is possible to summarize that the fundamental building block of preventing the occurrence and development of OTS in adolescence is mainly respecting the developmental specifics and individual variability of adolescent elite athlete's psychological and physical prerequisite for a performance in a specific, given sports activity as well as continuously monitoring the current level of this activity. At the same time, it is advisable to carry out monitoring throughout training and subsequent recovery, assuming that symptoms of overtraining are not underestimated by athletes and coaches alike, and neither are illnesses and injuries, and that sufficient time is allowed for necessary healing and recovery. As presented by Carter et al. (2014), another condition for a successful preventive approach to OTS is to setup and utilize individual training plans, which accommodate the athlete's disposition and actual state. These individual plans should include corresponding compensation exercises, recommendations for supplemental sports, and suitable components of active and passive regeneration. Certainly, adequate nutrition, taking suitable supplements, keeping a good drinking and sleeping regime plays an indispensable role in preventing OTS. Another important role can be played by physical therapy (massage, electrotherapy, magnetotherapy, wraps, positioning, corrective taping, etc.), and support psychological measures (stress management, pre-start stress regulation, psychohygiene, visualization, communication with the coaches, cooperation with a psychologist, or a mental coach). There is another important aspect of OTS prevention, one that is neglected in conditions of the Czech Republic, and that is a competence development of the coaches (communication ability, empathy, planning, methods and organization of training) and, in general, education of coaches and athletes concerning the negative impact of excessive training load.

8. CONCLUSION

The aim of the presented study was to describe the key aspects of the overtraining syndrome in elite athletes with a specific focus on the developmental stage of adolescence. Key areas of psychosocial development of an individual in relation to risk factors for OTS development were mapped. Moreover, the study presented models of the mechanism behind the occurrence of this specific pathological form of fatigue and suggested possibilities for its diagnosis and prevention. If the training of an adolescent athlete does not adjust to his/her current individual development, the athlete can experience overtraining, which increases the risk of development of negative responses to training load. Taken in the context of the volatile course of developmental changes in adolescence, if the load is unsuitable, overtraining of a particular individual can occur more readily than during later stages of development. A timely recognition of the symptoms of OTS, its complex diagnosis and subsequent optimal selection of adequate combination of strategies supporting complete recovery and regeneration of the organism of the athlete is important not only for preventing negative impact of overtraining on current physical and mental health of adolescent elite athletes but also for averting the negative effects of OTS persisting into subsequent developmental stages and keeping the adolescents participating in the sport while moving up to the adult competition categories.

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Contact Information

e-mail: buresova@phil.muni.cz

Could Gamification Present a Significant Topic for the Philosophy of Sport?

Emanuel Hurych

Masaryk University, Faculty of Sports Studies, Brno

Abstract

This article focuses on the phenomenon of gamification in the context of the philosophy of sport. Gamification is usually understood as a process of adding games or game-like elements to some activity in order to encourage participation. It takes the techniques that game designers use to engage players and applies them to motivate people in different spheres of our lives.

It should be emphasized that gamification itself is not about games; it is not about the digital world, nor is it primarily about sport. However, it is a phenomenon that originated in the world of games and gained its content in the digital world. Gamification is also close to the phenomenon of play because it was invented by those people who were playing games.

The main question asked in the text is whether gamification, although it is not primarily about games or sports, can be a crucial topic for the philosophy of sport.

This article proposes some opportunities for philosophical approaches to gamification within kinanthropology. The ethical discourse is mentioned in the context of normative ethics. The ontological discourse is followed in the context of the digital world and the phenomenon of sportification.

One of the possible areas of interest in the philosophy of sport can be presented by monitoring and scheduling endurance sports activities. This issue is developed within the article on the ontological level, especially. The sociologically based study about gamification-form-above and gamification--from-below by Woodcock and Johnson is examined via Patočka's concept of three movements of human existence. It was included in the article mainly as an example to illustrate the great diversity of possible philosophical approaches.

It appears that gamification in sport is rapidly spreading, and it will be examined within different empirical studies more and more. This article argues that this phenomenon is also an interesting topic for the philosophy of sport.

Keywords: *gamification, play, game, sport, philosophy.*

GAMIFICATION AS A PROCESS

Gamification is usually understood as a process of adding games or game-like elements to some activity to encourage participation. Gamification takes the techniques that game designers use to engage players and applies them to motivate people in different spheres of our lives (Çeker & Özdaml, 2017). Kim, Park and Baek (2009, 801) tried to identify the differences between gamification and game-based learning. They indicated that in game-based learning, learners arrive at their educational targets by playing games, which in short means learning via playing games. However, gamification has emerged entirely from the context of playing games. With gamification, games cannot therefore replace the learning process itself. Rather, it helps make learning a more participating activity and targets rather the overcoming of difficulties in learning over time (Codish and Ravid, 2014).

With the rapid development of cyber games and their penetrating the everyday lives of many young people, gamification becomes an essential issue for different study fields. Economic discourse is often used as a business strategy (Hamari et al., 2015). For pedagogy, it can present

an educational method or teaching instrument (Ranchhod et al., 2014). Psychologists examine gamification as a method of motivation (Sailer et al., 2017).

In the context of sports, gamification provides a possibility for various empirical sociological studies. Koivisto and Hamari (2019a) conducted a systematic literature review of comparitive studies related to physical activity gamification. Accordingly, it seems applicable for developing some of our ideas expressed in a few following paragraphs.

A strong current of publications devoted to gamification in the context of kinanthropology is related to health issues and healthy movement activities. Here can be mentioned some articles published in the field of sports medicine, health, and treatment (Gabele et al., 2019; Allam et al., 2015). The context of lifestyle elements and a sedentary life also presents quite a frequent topic for some authors (e. g. Broom and Flint, 2018; Gremaud et al., 2018; Martínez-Gonzales, 1999).

Gamification can be applied as an ambivalent instrument in the field of physical activity. It can sometimes be perceived as something which encourages a sedentary lifestyle (Peng, Lin, and Crouse, 2011). On the other hand, some location-based games (such as Pokémon Go) and exergames can support healthy kinds of active human movement.

Koivisto and Hamari (2019a, 106) also argue: "Beyond physical activity becoming a way to play games, intentional gamification further attempts to adopt the motivational facets of gaming and implementing them into pursuits with direct health outcomes in mind."

Here we can mention an essential link between studies devoted to the phenomenon of a "healthy lifestyle" and searching for instruments that can support improvements in this field. This focuses on monitoring physical activities via applications in some electronic devices (mobile phones, smartwatches, fitness trackers, etc.).

The gameful interventions for increasing physical activity are primarily applied in the same way as gamification in general (Koivisto and Hamari, 2019b). They present point-based mechanics and activity goals and performance rankings, or visualizations of one's performance. Some innovative affordances include real-world activity, e. g., "steps, being transformed into a game currency in a virtual world," or "duel competitions between individuals for engaging individuals in physical activity" (Koivisto and Hamari, 2019a, 109).

The gamification position within kinanthropology (or Sports Sciences) is also studied in social studies in sports and their possible relation to gamification. We argue that sociological and psychological investigations could be supported by studies of the philosophical background of gamification applied in the field of sport. Some authors speak about the concept of "meaningful gamification" (Deterding, 2011). This meaningfulness is often and primarily explained from psychological positions exploring theories of motivation (Nicholson, 2012).

In the philosophical discourse, we could examine gamification from different positions. There are many ways as to how to approach this phenomenon. We would like to provide some possible directions in a brief outline and to explain some selected possibilities within this article.

SOME POSSIBILITIES FOR FUTURE PHILOSOPHICAL INVESTIGATIONS OF GAMIFICATION

After 2010, the general technological developments in gamification became linked very closely to the IT-sphere. This trend is evident, and there are not many possibilities for regulating it. The philosophical discourse contains at least some potential to allow us to try to identify some problems via some selected paradigms. They can be interesting for those searching for sophisticated methods to approach this problem, which lends itself to a dangerously mechanistic understanding.

One of them is an ethical discourse that provides some instruments for preventing the most visible threats that present an evident public menace. In the context of the expansion of modern technologies, it is those which are related to producing weapons, genetic engineering and human cloning, deepfakes, disinformation activities, and similar phenomena that could be considered highly ethically problematic. However, some ethical rules can also be developed to take care of these problems or regulate them. Mainly, such rules are applied in the form of laws, moral norms, ethical board decisions, etc. This kind of prevention usually takes the shape of bans and prohibitions. This normative aspect of ethics is necessary, and it works in a regulative way, but it is suitable just for some cases.

Normative ethics is much more functional and efficient if applied practically than in the form of abstract philosophical thinking, which presents a more diverse space for interpretation and application than exact practical rules. In practice, we often face a functional problem that contains many contradictions. Decisions of some ethical boards can be effective and applicable to certain, specific, settings. Still, they are often instrumentalized and subordinated to various concrete orders (such as systems of law, political situations, or even business interests). The broader ethical principles that can be applied outside of these orders are not concrete and generally comprehensible enough to influence the determining mechanisms that shape social trends. That is why general social agreement is accepted when society feels the necessity facing a visible menace. This ethical approach is the most useful and efficient when there is generally a need to protect society from harm.

Concerning gamification, as it has been said, it arises as a part of technological developments, and we can consider it as an ambivalent instrument. We can find a lot of ethically troubling points here. While currently gamification's fundamental social impact is not generally understood as an urgent problem or danger that has to be solved, sharing data within different communities presents a visible outcome of using social networks (Facebook, or Instagram, especially). Via different gamification challenges leading to open competition in getting badges and other rewards, the process of sharing data could be permitted and indeed encouraged very strongly. Together with some instruments applied by artificial intelligence (like face recognition), the danger of accumulating the data obtained for some political, business, and other purposes increases (e.g., Oliveira, Ferreira & Allisson, 2020; Nweke et al., 2019). As such, the moral threat of gamification would become a problem to be solved by different ethical boards. It also mean that some administrative steps and regulative measures caused by gamification might change the face of gamification retroactively. For this reason, in the next future, gamification should, from the outset, be accepted as ethically problematic. We propose that for the philosophy of sport, gamification's ethical aspects will not be ignored or minimised in the future.

Besides ethics, there are other viewpoints from the philosophy of sport to which gamification is open. Some of them will be mentioned here just briefly. Undoubtedly they can be significant for the philosophy of sport, but we do not want to develop them within this article. One of these aspects is related to digitalization. Gamification is, at least in some concepts, often related to the virtual sphere and cyberspace.

The philosophy of sport is a rapidly developing kinanthropological discipline and is increasingly institutionalised through a variety of academic organizations (International Association for the Philosophy of Sport, British Philosophy of Sport Association, European Association for the Philosophy of Sport, etc.). *Sport, Ethics and Philosophy* is a respected journal that has been published since 2007. In 2016 a special issue entitled *Sport and Play in a Digital World* was published (2016, Vol. 10, Issue 1). This issue was wholly devoted to digital technologies in sport. We should repeat that gamification itself is not a part of digital games per se. It represents, rather, the removing of instruments from their original settings in order to facilitate their application

elsewhere. However, this technology was "born" in the "digital world," which is why it is interesting to follow the studies devoted to the digital sphere in the context of the philosophy of sport. The exact term "gamification" was not explicitly mentioned in any of the articles included in the special issue. However, some of the articles were focused on the ontological problems related to the phenomenon of gamification. Steven Conway examined the virtualization of sport from the Heideggerian position in his paper *An earthless world: the contemporary Enframing of sport in digital games* (Conway, 2016, 83–96).

The discussion about digitalization in the sphere of sport continues, even within the above mentioned journal. The very massive and visible phenomenon of e-sports draws together studies devoted to both the sphere of digital games and to the sphere of sports. Some authors argue that e-sports are not sports at all (Parry, 2019). It is difficult to anticipate the subsequent development in the terminological and theoretical discourses. Undoubtedly, if e-sports become a part of the Olympic Games in the near future, this institutional aspect will influence future academic studies. Considering Parry's position, all this broad area of e-sports might be outside the philosopher of sport's core interest. We will return to e-sports once again, in the context of play and games.

The social manifestations of gamification in sport and the cultural sphere can represent another exciting topic for investigations that combine sociological and philosophical approaches. We can identify some parallels between both the processes of gamification and sportification.

As Heere argues: "Sportification means to view, organize, or regulate a non-sport activity in such a way that it resembles a sport and allows a fair, pleasurable, and safe environment for individuals to compete and cooperate" (Heere, 2008, 21).

In a simplified explanation, we can propose that while gamification means adding game-like elements and principles in the non-game sphere, sportification means adding sport-like elements and principles in the non-sportive sphere.

Jirásek & Kohe emphasize some aspects of sportification such as "visualizations of one's performance" or in relations between sportification and "theatricality" (Jirásek & Kohe, 2015, 257). They treat their reference to the Renaissance principle of theatrum mundi in the case of sportification as an ontological viewpoint.

Examining the aspects of *theatricality* or *visualization of one's performance* can also be beneficial in the case of gamification. Sharing data, records, results, photos, and other attributes on social networks can be closely connected with using gamification instruments. For some users, presentations of their activities and sharing them within an internet community can be more important than carrying out the activities themselves. Psychologists can study this approach from the point of motivation, while sociologists can study this as a kind of social manifestation. For philosophers, it can be viewed as an ontological problem.

The spectrum of views that philosophy can look at in terms of the issue of gamification is undoubtedly much broader than this article can cover. Therefore, we have decided to focus on some selected ones, and to use them to show the potentiality that the phenomenon of gamification conceals.

GAMIFICATION AND PLAYING A GAME – A PARADOX OR A POSSIBILITY?

Discussions about three phenomena – play, game, and sport – have been published, over a significant period of time, in the field of the philosophy of sport. These discussions have initiated new ideas. They represent a philosophically beneficial activity, but they still have not arrived at a consensual concept. Merely the responses and reactions on Bernard Suits (*Utopia* and his other works) present a very long line of critical comments about the phenomenon of "play" (within

the *Journal for the Philosophy of Sport,* or recently within the special issue of *Sport, Ethics and Philosophy* devoted to Bernard Suits' legacy – Volume 13, issue 3–4).

Generally, play is understood as an unstructured activity that is creative and engaging. A game is an activity with a set of rules, and possibly equipment, and other specific attributes. Sports can be presented as a structured form of physical activity. Terminological and structural discussions about these phenomena are still frequent. Recently, some concrete and determining attributes of sport were described in the article as mentioned above by Jim Parry (2019). Parry defines "sport" (based on the concept of an Olympic Sport) as an "institutionalised, rule-governed contest of human physical skill" (Parry, 2019, 3). That is why he argues that e-sports are games, but they are not sports, for e-sports are not a test of physical skill.

Andrew Edgar, in his editorial (to a special issue devoted to e-sports), reminds us that this issue is still developing and it "…is posing exciting new challenges to which philosophers are responding with creativity and insight" (Edgar, 2019, 2). Although e-sports, as we tried to explain, are not related to gamification directly, for more complex considerations about gamification within the philosophy of sport, the question as to how much (or even whether) e-sports will continue to be studied by philosophers of sport plays an important role. We can expect increased interest in this field because of at least two reasons: digital technologies spread rapidly, and their application is interdisciplinary.

The general concepts of the "triad" of *play-game-sport* are fundamental for considerations of gamification within kinanthropology. However, what is very closely related to our point is understanding the phrase "playing a game". Here we are reminded of the well-known Suits' definition of playing games: "To play a game is to engage in activity directed toward bringing about a specific state of affairs, using only means permitted by specific rules, where the means permitted by the rules are more limited in scope than they would be in the absence of the rules, and where the sole reason for accepting such limitation is to make possible such activity" (Suits, 1967, 148).

Scott Kretchmar has recently provided a redefinition which begins with this description: "To play a game is to attempt, through effort, chance, or both, to solve a natural or constructed problem; where relationships between its means (lusory means) and ends (lusory goals) provide valid challenges…" (Kretchmar, 2019, 286). Within a shorter version, Kretchmar says: "To play a game is to attempt to solve a gratuitous problem" (ibidem).

In his response to Kretchmar, Alex Wolf-Root argues (in the article called *Too Much Playing Games*) that this definition is too broad. In his explanation, based on creating a free verse poem, he argues that creative activities like making poetry could be understood as playing a game according to Kretchmar's definition. Wolf-Root says: "We might be left with two distinct definitions, playing a game on Kretchmar's view and 'playing a game', say using the Suitsian view, that each capture real and important aspects of gameplay" (Wolf-Root, 2020, 268). For this reason, Wolf-Root proposes rejecting Kretchmar's definition.

We do not intend to decide who is right and do not want to follow this discussion in detail. However, we should explain why these ideas can be interesting in the context of gamification.

We can come back to the definition of gamification, which speaks about *adding game-like elements to the non-game settings*. And, as it also was said, gamification does not mean *playing games*. It presents using methods created for playing games for non-game purposes.

In this context, *the spirit of game* is lost because of the process of gamification, and just some instruments remain. However, there is another question. What about *"the spirit of playing"*? Is it also necessarily lost? Coming back to Kretchmar's description of playing the game as "attempting to solve a gratuitous problem," we can imagine the situation in which one game (the original one with the exact rules) finishes. Still, a new one (played differently) could begin.

This idea may be questioned by the definition of gamification itself (gamification is not a game).

On the other hand, this does not mean that any application of gamification elements must necessarily be deprived of playful attributes.

To illustrate these ideas, we would like to consider one concrete application of gamification – support for increased physical activity. In the next part of the article, we would like to focus on some endurance physical activities (like leisure running, cycling, or swimming), containing (in a model of non-elite movement activity for fun) some degree of spontaneity, liberty, joy, and playfulness. This is to raise the question as to what gamification can bring to this sphere.

GAMIFICATION – FOCUS ON MONITORING AND CHALLENGES IN THE FIELD OF ENDURANCE ACTIVITIES

To introduce the problem within endurance leisure sports, we must recall that some gamification instruments – based on specific game rules (badges, points, ratings) – are often used for scheduling physical activities. This scheduling is different from the previous methods of planning because it introduces some rigorous instruments that replace our responsibility for our sports schedules in the form of indoctrinated instructions. For this reason, gamification could, in some cases, result in a lower degree of playfulness.

The monitoring of physical activity represents a typical topic for studies devoted to gamification, generally. Some authors (e. g. Harris, 2018; Dadaczynski, Schiemann, & Backhaus, 2017; Walsh & Golbeck, 2014) pay attention to gamification aspects related to monitoring physical activity measured with some standard methods, like IPAQ (*the International Physical Activity Questionnaire*).

A broader expansion of investigations, based on monitoring physical activity through electronic devices, is to be expected. We can see that the sharing of the results on social networks is widespread. Developing relevant scientific studies is still limited because a great range of fitness trackers, smartwatches, or other electronic devices is produced for the practical purposes of leisure athletes. They prefer low costs, and highly exact results are not necessary for their everyday usage. That is why the most-used devices are not precise enough for scientific measures yet. However, technological developments are rapid in this sphere, and more exact devices should be produced in larger quantities in the near future.

With the massive expansion of devices monitoring our physical activity, many new possibilities for better motivation are emerging. We can apply some new interactive applications instead of our old (paper) training planners and turn them into effective instruments. Establishing short-term and long-term goals and searching for some challenges would constitute a substantial part of planning a while ago. What is the difference, and where should we place the division between the old and new methods?

The exact boundary cannot be delimited easily, but in general, it consists of giving up our responsibility for detailed planning. In the beginning, accepting some items does not seem to be a problem. It looks like we have the opportunity to adjust everything any time we want. However, it is easy and comfortable to be led by automatically established and, what is crucial, continuously adjusted goals. Thus, our effort can be focused on keeping to the instructions without any disturbing influences. We need not think, and we do not have the opportunity to hesitate.

Within the enlarged definition of gamification, not just game-like elements are being applied to non-game domains. Still, even game-like principles and systems (like rewards, quantifying player or user-like behaviour) also penetrate the spheres that are not game-like but *sport-like*

– fitness, endurance sports, etc. Here the parallel to the phenomenon of sportification can be recalled again.

A typical example of the previously committed behaviour of athletes can be presented by establishing the goal of a certain number of daily steps. Even an elementary device can automatically create a daily step count goal based on our previous activity levels. As we move during the day, the device shows our progress toward our daily goal. Undoubtedly, we are allowed to set a personalized step count goal instead of merely using the auto goal feature.

It presents a straightforward kind of a "game" – to accept the rules and "play" accordingly. Of course, the auto goal feature does not present a real danger for our authenticity, but this example can help us understand the point we wanted to display:

Although gamification does not mean playing games, *applying gameful thinking* presents an essential part of it. There much to be gained from our everyday activities for gameful people, or even for playful and ludic people. This ability is well articulated through the concept of "homo ludens", as described by Johan Huizinga (2016). We can see some good reasons why gamification has become an attractive and fashionable aspect of pure human playfulness. Many people who collect badges, postcards, stamps, and similar items do it because they are playful and find their activities interesting.

On the other hand, accepting rules also sometimes means adopting some mechanical structures which cannot be changed, examined, or questioned. As far as motivation and related ideas are concerned, we get closer to the "lusory goals" than "lusory means" if we use Kretchmar's distinction. From the ethical discourse, we are closer to the consequentialist position than the deontic one. If some instruments (like badges and points) are accepted just as indoctrinated goals, the instrumental approach to the world could be strengthened.

This issue can be seen via different philosophical concepts related to the question of authenticity. Concretely, we can mention instrumentality in the early Heidegger's works (Heidegger, 1997) or technologization in the late Heidegger's texts (1977). In the next section, we would like to recall Jan Patočka and his concept of three movements of human existence.

The last note of this section is connected with virtual settings and particularly in the context of gamification. Virtuality is often understood as the opposite of reality (or as an escape from reality). Thus it could be taken as something inauthentic (in the understanding of virtuality as a fiction/fictive, or even false human being). Escaping from reality into the virtual sphere presents a specific issue through the phenomenon of gamification. There are many philosophical aspects hidden in it.

One of them is included in the principle of the game. The notion of game itself contains some suggestion of escaping from natural settings into the world of fantasy and imagination. Obeying rules, sharing roles, and accepting a fictive background are all part of the game. In general, we often take this fact as something positive. We meet *"the playfulness of a game"* here again, remembering Kretchmar's words about our "attempts to solve a gratuitous problem". In this context, our ability to play is appreciable, and we profit from being in the "homo ludens" mode.

And, there lies the rub. If game-like elements were created to support our ability to play and if escape from reality presents a possibility, how are we to develop our playfulness; how is it possible that, in some cases, both the processes fail? As a result, we are drowned in the virtual world. Instead of a creative approach to physical activity, we fall into an automated mode in which everything is pre-arranged.

Can we identify a moment when we start "losing this game"? This question cannot be answered, generally. Athletes' approaches can be very individual. Undoubtedly, many athletes take it like this. They mechanically use simple instruments and do not need to think about it. It is clear that not all of them will appreciate a philosophical approach to this problem, but we believe

that for many of them, it can be beneficial. And, for this reason, it can be quite a good task for the philosophy of sport.

There are many opportunities for approaching this problem. Searching for some possible philosophical interpretation of this issue that can be understood by athletes, we can propose the hermeneutical approach. According to Hans-Georg Gadamer, hermeneutics aims not at explaining but at reaching an understanding (Warnke, 1987).

This approach can help to bridge a barrier between the practical world of sport and the philosophical perspective. Hermeneutics was involved in developing possible interpretations of the Bible, but later it was expanded and related to other significant texts. Generally, it is perceived as the *art of interpretation*. The hermeneutical circle contains not just the author and the text, but it also includes a reader. It presents a circular movement of understanding with repeating turns from the whole to the parts. This process can be effective in leading to a deeper understanding of the issue which the participants influence. Jirásek, Hurych, and Oborný (2019) describe some benefits of the hermeneutical method for athletes who do not read philosophical books but search for a deeper personal understanding. Thus they may come to find the activities they carry out more meaningful.

Hermeneutic interpretations can include the feelings and opinions of the participants. That is why, in the case of gamification, we must get closer to them and understand better what it is about gamification that they concretely consider to be a problem.

THE ONTOLOGICAL APPROACH BASED ON THE IDEAS OF JAN PATOČKA

The ontological discourse offers many different perspectives for considering gamification as a phenomenon. The ontological approach focuses on the meaningfulness and significance of the examined issue, which also provides some exciting viewpoints via the phenomena of authenticity or instrumentality. Here we can propose one selected point based on primarily a sociological distinction provided by Woodcock and Johnson (2018), which divides gamification into two different concepts. We offer to combine the original one with the philosophical approach to make an effect of synergy. It is not a profound study. We just want to display an example of one possible way as to how future studies could be developed.

Some sociologists perceive gamification as profoundly problematic because it represents "the capture of 'play' in the pursuit of neoliberal rationalization and the managerial optimization of working life and labour," as Woodcock and Johnson (2018, 542) argue. These authors remind us that "applying games and play to our ordinary lives can present a form of resistance against the regularity and standardization of everyday behaviour" (ibidem). In their article, the authors also distinguish between two types of gamification: *gamification-from-above* (involving the optimization and rationalizing of work practices by management); and *gamification-from-below* (a form of active resistance against control at work often represented by Autonomism and Situationism).

We can add that the former type of gamification is very close to business strategy, as Hamari et al. (2015) present. In the model presented by Woodcock and Johnson, *gamification-from-above* means an instrument that works through indoctrination. The role of managers here is to schedule tasks via systems of motivation different to the usual ones, and the recipients' position is relatively passive. They can just influence the rate of their participation in this "game", but usually, there are not so many possibilities for their active involvement. However, it is much more complicated in the real world than in the field of model construction.

Here we can mention Jan Patočka and his book called *Heretical Essays in the Philosophy of History*. Patočka speaks about three kinds of movement in human life here. The movement of acceptance represents a "rooting" into the world. "To this movement there belongs, not as a part but as its integrating core, a certain self-under-standing, understanding of our fundamental possibilities, which first makes it possible to sense, to encounter things as being in the world and at the same time to intervene in that world by movement" (Patočka, 1998, 157).

Some kind of *acceptance* could be observable in the concept of *gamification-from-above*. The main reason we mention Patočka's model of human existence here is that his concept can help us to understand the diversity of real situations that no model can fully cover. Patočka himself speaks about "self-under-standing", or "understanding of our fundamental possibilities" within the movement of acceptance. It means that he doesn't understand this movement as something just passive and simple. It can present an intense and sophisticated process that can contain and demand a robust intellectual effort. On the other hand, what is significant is that this kind of movement lacks active defence and aspects of self-transcendence. In this spirit, we can conceive of *gamification-from-above,* which can be received mechanically and in a passive mode, but not necessarily. There can be a deep understanding of the spirit through the scheduled game and the inner identification of some participants with the rules.

The second type proposed by Woodcock and Johnson, *gamification-from-below,* can be (in a simplified form) defined as an active resistance against control at work. Here we can recall Patočka's movement of defence. It is not strictly divided from the movement of acceptance. We have to accept the world, and we should learn a lot and understand a lot before we start defending our positions. The phenomenon of understanding is primarily anchored in the movement of acceptance. The movement of defence can be developed in different ways. (Intuitively, it is present even in the behaviour of a baby who doesn't like a person touching her.) However, Patočka sees all three kinds of movement in a complex way. Our explanation of the primary relations within the movement of defence (which can indeed be disputed) is that the higher legitimacy of it is connected with acceptance and a deeper understanding of the outer world and our being. Of course, anybody can defend himself in different ways, but that is not the determining point of Patočka's concept.

In our opinion, we can understand *gamification-from-below* in the context of the legitimacy of this resistance. Given this approach, we propose to analyze Patočka's concept of the movement of defence more in detail within possible future studies. It could help us understand the context of something that we can label as a "playful resistance" and which is hidden in *gamification-from-below*.

And, there is one more exciting point concerning the movement of defence. Patočka also calls it "movement of self-extension," or "self-projection into things" (ibidem). The phenomenon of self-extension can have many forms (self-education, building a career, a kind of conquest, etc.). It can also be perceived as enlarging our radius of action or expanding our sphere of influence. The playful resistance included in *gamification-from-below* can contain (besides a very personal aspect) a form of group-organized reaction to some indoctrinated settings, or even, in some cases, expanding this effort. This form of self-extension can lead back to *gamification-from-above*, in a paradoxical output where the old one is replaced by the new one on a different level.

Some electronic devices can present a phenomenon which could be metaphorically expressed as our "extended hands". It can help us to expand our sphere of influence (we have "longer hands" to reach), but there is a risk of dependence on these instruments. Thus "self-projection into things" can lead to a kind of dependence on instruments as a symptom of the inauthentic way of being. Here we can remember Heidegger's ideas about instrumentalization and technologization again.

The most significant movement for Patočka was the last one: the movement of the truth. Patočka also speaks about the movement of existence in a narrow sense (1998, 148). The movement of truth brings a possibility for a deeper understanding of our being. This movement includes a turn towards authenticity. The authentic position is related to accepting more responsibility for our behaviour. As Martínková (2006, 65) mentions: "Responsibility can no longer be placed on one's teachers, coaches and doctors, but on oneself."

The movement of truth represents a complex process. One of its attributes is also based on overcoming the "self-position". Kohák (1989, 33) emphasizes this attribute and speaks about the "self-transcendence movement". Thus one of the aspects of this movement can be seen in escaping from our egoistic interests and searching for some general profit. The backgrounds of the movement of truth could provide some space for considerations about *gamification-form-above* and *gamification-form-below* concerning responsibility for our behaviour in the context of the examining modes of authenticity.

Patočka's concept of three human movements presents a very sophisticated complex of ideas. We believe that in this complex, we can also find the point of contact with the hermeneutic method. It consists of a focus on a deeper understanding of the outer world.

We do not argue that our position is indisputable or that it is the only one that can be applied to the phenomenon of gamification. Here we want to provide some possible directions for future, more detailed, studies.

CONCLUSIONS

This article presents just a modest outline, in the form of an introduction to the problem of gamification from the philosophical perspective. Gamification is a phenomenon that has been frequently examined in the scientific literature over the last decade. Gamification in sport is monitored and studied from different positions (sociology, pedagogy, or management). On the other hand, not many works investigate gamification through philosophical discourse. For the philosophy of sport, some digital aspects of sport and problems of virtualization have already become exciting topics to study, but these studies were not focused on gamification directly.

This paper's point is to propose some opportunities through which philosophical approaches to gamification can be developed. As a process that influences the monitoring and scheduling of endurance sport activities, gamification can be exciting for practical reasons in both ontological and ethical discourses. The triad play-game-sport provides some space for philosophical investigations with respect to the relation between gamification and sportification. The sociological study by Woodcock and Johnson examined via Patočka's concept of three movements of human existence was included in the article mainly as an example to illustrate the great diversity of possible philosophical approaches.

We believe that gamification in sports will be considered more and more in future scientific investigations because many people use different electronic gadgets and applications based on diverse elements of gamification. The philosophy of sport shouldn't ignore this rapidly growing trend.

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The Impact of Slavia Praha's Takeover on Czech Football

Selçuk Özaydın

MEF University, Istanbul, Turkey

Abstract

Foreign ownership in European football has been rapidly increasing especially in the last two decades. Although the main interest for the foreign investors are the teams of major leagues such as English Premier League, Spanish La Liga or Italian Serie A, there are some occasional surprises. One of the surprises is the oldest football team in Czech football, SK Slavia Praha This study investigates the impact of Slavia's takeover on Czech First Division. First, a stochastic frontier analysis is conducted and efficiency scores are estimated. The results indicate that Slavia's athletic efficiency has improved significantly after the takeover. Later, the transfer activity in the league is investigated and concluded that it has increased greatly thanks to Slavia's additional funds allocated to transfers. Finally, the overall competitive balance in the league improved after the takeover despite Slavia's dominance in the league after the takeover.

Keywords: *Foreign Ownership, Czech First Division, Competitive Balance, Stochastic Frontier Analysis*

JEL CODE: Z20

INTRODUCTION

The latest rumors about the acquisition of Newcastle United by a group of investors led by the Saudi Public Investment Fund have stirred up the discussion regarding foreign ownership in European football. Foreigners have always been interested in the Premier League clubs which started with Fulham FC's takeover in 1997 with Mohamed Al Fayed (Fulham FC, n.d.). Although the Egyptian billionaire acquired Fulham FC and brought them memorable success, Abramovic's Chelsea was the first to go on a spending spree and transfer major stars. KPMG (2020) underlines that acquiring football clubs might provide the owners; political, economic, cultural and social power. Football clubs have become something more than extravagant toys for the rich in the last two decades due to the increasing revenues and worldwide recognition.

The first rich, to spend large sums on football clubs, were the Russian oligarchs however in the recent years, funds from the Middle and Far East have been rapidly flowing to European football due its ability to generate power in numerous ways. In the cases of Big 5, England, France, Germany, Italy and Spain, achieving success is costly for a foreign owner since clubs have more disposable income due to their high revenues and there are multiple teams owned by foreign investors hence the competition is fierce. In the case of smaller leagues such as the Czech First Division where revenues are lower, a foreign investor is more likely to succeed. In September, 2015, China Energy Company Ltd. (CEFC) bought the majority share of SK Slavia Praha which is the oldest football team in Czechia. Slavia was struggling with financial problems since their last title in 2009 (Xinhua, 2017). Despite the opposing views against the acquisition among fans, Slavia won two titles and 2nd place in the three seasons after the takeover.

This study investigates the impact of SK Slavia Praha's takeover on Czech First Division in a few critical angles. A period of 6-years is investigated between 13/14 and 18/19 seasons. Since the takeover was completed in the 15/16 season, the six-year period provides three year -pre and -post acquisition periods. First, using a stochastic production frontier, the athletic efficiency

scores of Czech First Division clubs are estimated. Later the competitive balance in the league is investigated using the measures from the literature and finally the transfer activity in the Czech First Division is examined thoroughly to observe how the takeover affected the transfer market.

Next section provides a theoretical background for the study which is followed by the methodology section. Forth section provides the results of the study whereas the fifth and sixth sections discuss the results and conclude the study.

1. LITERATURE SURVEY

Over the past couple of decades European football clubs have evolved into a corporate governance structure (Michie, 2000; Michie and Oughton, 2005). In Czech football, most of the clubs are owned by either wealthy Czechs or Czechs corporations with three exceptions. The first is FK Mladá Boleslav where a minority share of the club is owned city of Mladá Boleslav and the second is FC Opava where the 99% of the shares are owned by the city of Opava. The third and the newest is SK Slavia Praha after its takeover by CEFC in 2015 which is the first team to be acquired by foreign investors in Czechia (Bureš, 2019a; 2019b; 2019c).

Although foreign ownership is a new phenomenon for the Czech football, the impact of foreign ownership on football clubs have been subject to a number of studies. Wilson, Plumley and Ramchandani (2013) examine how different models of club ownership affect the financial and athletic performance of Premier League clubs and concluded that clubs owned by foreign investors perform better athletically. Rohde and Breuer (2016) investigate the financial impact of foreign acquisitions on English Premier League teams. Authors conclude that foreign investors increase team investment which results in a decrease in profits which coincide with Wilson and his colleagues' results. In another study, Rohde and Breuer (2018) investigate financial and athletic efficiencies of the English Premier League and French Ligue 1 clubs and revealed that teams owned by foreign investors have lower financial and athletic efficiency scores.

Stochastic production and cost frontiers have been used numerous times in the sports economics literature (Dawson, et al., 2000; Kern & Süssmuth, 2005; Frick & Simmons, 2008; Barros & Rossi, 2014) in efficiency estimation. Another popular approach for estimating efficiency is data envelopment analysis (DEA). Both approaches require inputs and outputs for estimating efficiency. The main focus of the literature has been the Big 5 however there are a few studies investigating the leagues outside the Big 5 such as Russian Premier League or Portuguese First League (Zelenkov & Solntsev, 2017; Ribeiro & Lima, 2012).

The literature on Czech football is not as comprehensive as the literature on the Big 5 and furthermore the research on the economics of Czech football is very limited. Šíma (2011) investigates how competitive balance has changed in Czech first division between the years 1970 and 2010 and conclude that there is a steady decline over the years. Procházka (2012) examines the financial structure and health of Czech football clubs and their compatibility with UEFA's Club Licensing and Financial Fair Play Regulations. He argues that Czech clubs are under the risk of bankruptcy. Racek and his colleagues (2015) conduct a survey to reveal Czech football fans' demand for football. There are also a number of studies investigating fan behavior and hooliganism in Czech football (Smolík, 2012; Scholz, 2016a; 2016b). There no studies investigating the efficiency of Czech football clubs or the impact of foreign ownership in Czech football.

2. METHODS

Data regarding the Czech First Division's transfer activity, squad market values and league tables are all gathered from the well-known German website Transfermarkt.com. Transfermarkt.com is often used in academic studies (Kern et al., 2012; Herm et al., 2014; Kirschstein & Liebscher, 2019) and has no credibility issues. First the methodology and the data used in the stochastic production frontier is introduced. Later the tools used in the investigation of competitive balance and the data regarding transfer activity are presented.

2.1 Stochastic Production Frontier

For estimating a stochastic production frontier, there is need for at least one input and one output. Aggregate market value of a team's players is used as the input. Market value is used as a proxy for talent and furthermore since market values are frequently updated based of factors like; age and performance, it captures multiple angles that are influential on team potential. As the output, points collected is used to measure the athletic performance.

Following Battese and Coelli (1995) a stochastic production frontier for panel data is:

$$Y_{it} = x_{it}\beta + V_{it} - U_{it} \quad (1)$$

where Y_{it} is the produced output, at time t for team i, x_{it} is a vector for input variables, β is a vector of unknown coefficients which are estimated, V_{it} is the error term and U_{it} the technical inefficiency in production.

The estimation of Equation 1 provides the technical inefficiency which can be specified as:

$$U_{it} = z_{it}\delta + W_{it} \quad (2)$$

where z_{it} is vector of variables causing inefficiency, δ is a vector of unknown parameters which are estimated and W_{it} is an error term.

The technical efficiency can be acquired by:

$$TE_{it} = \exp(-U_{it}) \quad (3)$$

For the case of Czech football teams, the production frontier is:

$$\ln Pts_{it} = \ln MV_{it}\beta + V_{it} - U_{it} \quad (4)$$

where Pts_{it} is the points collected in the end of the season and MV_{it} is the aggregate market value of a team's players.

Table 1 presents the summary statistics for the data used in the production frontier.

Table 1. Descriptive Statistics for Output and Input

	Obs	Mean	Std. Dev.	Min	Max
ln*Pts*	*96*	*2.35*	*0.57*	*1.34*	*2.64*
ln*MV*	*96*	*3.67*	*0.33*	*3.92*	*4.37*

2.2 Competitive Balance

Competitive balance is a fundamental area of research in the sports economics literature and numerous studies have been conducted. A comprehensive analysis of competitive balance measurement tools can be found in Özaydın and Donduran's study (2019). Out of the numerous options, the following three are chosen due to their ease of interpretability, popularity and explanatory power:

1) Range and Standard Deviation of Winning Percentage
2) Coefficient of Variation (CV) of Points
3) Gini Coefficient of Points

The winning percentage for a team is easy to compute and draws are counted as half wins. The range and the standard deviation of winning percentage enables the comparison of competitive balance between seasons. CV of points is simply the ratio of standard deviation of points to the mean of points in the end of a season therefore it's a value between 0 and 1. A higher CV indicates more competitive imbalance and vice versa. CV enables the investigation of competitive balance in a season and enables the comparison of different. Lastly, Gini Coefficient of points is used to evaluate the level of competition in the Czech First Division.

2.3 Transfer Activity

The transfer activity is relatively low in the Czech league when compared to the Big 5 or the other major leagues in Europe such as Netherlands, Portugal, Russia or Turkey. The lower revenues generated by the Czech teams reflect on their transfer activity. Table 2 provides the descriptive statics for Czech teams' transfer activity.

Table 2. Descriptive Statistics for Transfer Activity (million euros)

	Obs	Mean	Std. Dev.	Min	Max
T. Expenditure	96	0.68	2.22	0	16
T. Income	96	1.11	2.81	0	20.75
T. Balance	96	0.43	2.58	-10.95	15.8

3. RESULTS

Table 3 presents the estimation results of Equation 4 and as the results suggest market value is highly significant as expected and a 1% increase in market value increases the number of collected points by about 0.4%.

Table 3. Estimated Stochastic Production Frontier

Output ln*Pts*	
ln*MV*	0.41*** (0.00)
Constant	2.86*** (0.00)

Notes: Numbers in the parentheses are the standard errors, *** p<0.01, ** p<0.05, * p<0.1

There are 16 teams in the Czech top flight and nine of these have competed in all the six seasons in the investigated period. Using the results from the estimation of Equation 4, efficiency scores are predicted and presented for these nine teams in Table 4. For each team, athletic efficiency score and the league position in the end of each is season is presented. SK Slavia Praha and other two regular title contenders in the league, AC Sparta Praha and FC Viktoria Plzeň, are presented in the first three rows of the table.

Table 4. Efficiency Scores for Czech Teams – 13/14 – 18/19 Seasons

	13/14		14/15		15/16		16/17		17/18		18/19	
Team	**TE**	**Pos**	**TE**	**Pos**	**TE**	**Pos**	**TE**	**Pos**	**TE**	**Pos**	**TE**	**Pos**
SK Slavia Praha	0.696	13	0.839	11	0.926	5	0.943	1	0.865	2	0.907	1
AC Sparta Praha	0.934	1	0.907	2	0.901	2	0.858	3	0.754	5	0.827	3
FC Viktoria Plzeň	0.917	2	0.936	1	0.936	1	0.921	2	0.929	1	0.914	2
FC Slovan Liberec	0.926	4	0.808	12	0.943	3	0.872	9	0.916	6	0.896	6
FC Bohemians Praha 1905	0.857	14	0.926	8	0.915	9	0.834	13	0.916	7	0.849	11
FK Teplice	0.925	5	0.893	7	0.813	12	0.940	5	0.842	8	0.888	10
1.FC Slovácko	0.924	6	0.929	9	0.940	8	0.888	11	0.889	13	0.883	12
FK Dukla Praha	0.894	7	0.920	6	0.874	10	0.921	7	0.867	11	0.618	16
FK Mladá Boleslav	0.924	3	0.914	4	0.938	4	0.928	4	0.746	9	0.863	7

In the first three years the average efficiency scores for Slavia Praha, Sparta Praha and Viktoria Plzeň are 0.820, 0.914 and 0.930 respectively. Slavia was the least efficient of the three by far and they failed to win any titles. In the second three-year period, Slavia's average efficiency score increased to 0.905 whereas both Sparta and Plzeň's efficiency scores diminished. From period 1 to period 2 Slavia have managed to improve their efficiency significantly as well as winning two titles and a 2nd place.

Table 5 presents the competitive balance measured which were presented at Section 3.2.

Table 5. Measures of Competitive Balance

Season	Range of W%	Std Dev of W%	CV of Pts	Gini
18/19	0.567	0.153	0.332	0.174
17/18	0.517	0.144	0.318	0.168
16/17	0.550	0.159	0.346	0.184
15/16	0.650	0.171	0.377	0.205
14/15	0.617	0.154	0.348	0.176
13/14	0.550	0.153	0.342	0.167

The average scores in all measures are higher prior to SK Slavia Praha's takeover which indicates that competitive balance improved after the 15/16 season. The minimum of all measures other than the Gini coefficient are in the post takeover period. The lowest Gini was in the 13/14 season however it is just 0.001 lower than the 17/18 season.

Table 6. Transfer Activity in the Czech League

Team	Period 1		Period 2	
	Expenditure	Income	Expenditure	Income
League Total	10.36	28.61	55.23	78.26
AC Sparta Praha	2.93	11.2	24.64	44.41
FC Viktoria Plzeň	2.7	4.15	3.85	5.6
SK Slavia Praha	3.85	1.55	22.22	4.51

Table 6 presents the transfer expenditure and income figures for AC Sparta Praha, FC Viktoria Plzeň and SK Slavia Praha as well as the league total. The growing revenues in European football have affected the Czech first division as well and both expenditure and income have increased significantly in total. However, it should be noted that 90 % of the increase in expenditure from Period 1 to Period 2 belongs to AC Sparta Praha and SK Slavia Praha. In Period 2, 85 % of the total transfer expenditure belong to just two teams which are AC Sparta Praha and SK Slavia Praha. As a final note it should be mentioned that 86 % of SK Slavia Praha's expenditure in the first period was conducted in the winter transfer window in the 15/16 season which is right after the takeover. As mentioned earlier, the takeover was completed in September 2015.

4. DISCUSSION

In leagues such as the English Premier League or Spanish La Liga, multiple teams have been acquired by foreign investors in the recent past however Slavia is the only team in the Czech First Division with a foreign owner. As mentioned earlier, due to the lower revenues of the leagues outside the Big 5, a team is more likely to succeed with additional funds. Even though club owners are not allowed to inject funds into clubs anymore after the Financial Fair-Play regulations, owners are able to help their clubs' finances through sponsorships and commercial deals.

Among the nine teams presented in Table 4, FC Viktoria Plzeň has the highest average efficiency followed by 1.FC Slovácko and FC Slovan Liberec. Despite failing even to get in the top five in any of the seasons, 1.FC Slovácko is the second most efficient team in the investigated period. They have managed outperform themselves with a modest squad and avoided relegation. The impact of SK Slavia Praha's takeover on the team's performance is clearly visible on the efficiency scores which resulted two titles and a second place in three seasons. Slavia has definitely benefited from the takeover despite the initial opposition from the fans against the Chinese takeover. The new owners handled the opposition smoothly by making sure that supports were active in management and also by buying Slavia's stadium back from unknown agents in the Cayman Islands (Gosling, 2017).

Slavia's increasing competitive power improved the overall competitive balance in the league significantly as the results in Table 5 suggests. Before the 15/16 season, there were only two title contenders and the rest of the teams were competing for the other positions. As in all leagues the Czech league has its own giants however after the takeover a third giant has emerged. Although Slavia is the oldest football club in the Czech league and they have a number of championships, they have been struggling with financial troubles and their last title was in the 08/09 season. After the takeover, Slavia's attendance has also increased significantly. The average attendance for the three years before the takeover was about 7200 whereas the average after the takeover is about 12400 which is an increase more than 70 %. It should be noted the average attendance for

the league as a whole has increased only about 6 % so the increase in Slavia's average attendance is not a general trend in the league. The decrease in range and standard deviation of winning percentages, CV of points and Gini coefficient indicates the gap between the stronger and weaker teams in the league is also decreasing. Not only the title race but the whole league has become fiercer in Czech football in the recent years.

As Table 6 suggests, Slavia's expenditure has increased substantially after the takeover as expected. Although Sparta's expenditure increased more than Slavia's expenditure, it should be noted that Slavia has a negative transfer balance whereas both Sparta and Plzeň have positive transfer balances. Sparta has been financing their transfer spending through their transfer income. Perhaps an explanation for the improving competitive balance in the league can be made through the transfer activity. Major teams of the Czech league such as Sparta, Slavia and Plze are sources of players for teams from major leagues. Especially in the last decade, the transfer competition among the teams of Big 5 has become very fierce. They have been harvesting players from the smaller leagues of Europe. The major teams of smaller leagues are the first places to look for new talent for the Big 5. The giants of the Czech league have been losing their players to the major leagues therefore their competitive power increased hence the competitive balance in the league improved. Slavia has spent about 26 million Euros on transfer after the takeover and 60 % of the expenditure was spent on domestic transfers. Slavia generated more than 15 million euros of disposable income for the other teams in the league through their transfer expenditure. Thanks to their increasing transfer income, other clubs were able to conduct more transfer as well as improving their financial statuses. It can be concluded that Slavia's takeover was not only beneficial for Slavia but also beneficial for the whole league.

5. CONCLUSION

It is quite common in major leagues for a foreign investor to take over a team. Due to the increasing popularity and globalization of football, major teams have millions of supporters from all over the world. Although the profitability of investing in football is debatable in some cases, football brings popularity, reputation and respect. However, for the case of Slavia what the Chinese owners expect to gain is a matter of question. The rumors regarding a secret agenda have not been proven right or wrong so far.

Nevertheless, the takeover has significantly contributed to the Czech football. Firstly, the oldest and deep-rooted club of Czech football is salvaged from their debts and they are back at their glorious days. The fans showed their appreciation by filling the stands almost twice as much after the takeover and they witnessed Slavia winning titles. The impact of the foreign acquisition was extremely positive for Slavia. They have become much more efficient on the field and managed to win two titles.

Slavia was not the only one who benefited from the takeover. The overall competitive balance in the league improved and the number of teams competing for the title increased. How this improvement in the competitive balance affects the Czech football is yet to be investigated. Last but not least, the takeover did not just improved Slavia's finances. Through Slavia's transfer expenditure, other teams have earned significant transfer incomes.

The case of SK Slavia Praha sets and example that the road to the Champions' League might be shorter from the Czech or Danish leagues compared to the English or Spanish leagues. Taking over a major club of a smaller league could be a better way if the target is the Champions' League since competition is milder in smaller leagues when compared to the Big 5 or the other major leagues. Champions' League is watched by millions of fans every season and provides a huge

prize pool for the clubs. Chinese owners managed to achieve international recognition as well as acquiring several million euros as prize money.

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REPORT

STUDIA SPORTIVA 2021 /1

Early Dropout of Children and Youth from Sports – International Perspective and Societal Backgrounds

Michal Roček[1], Grzegorz Żurek[2], Dagmar Heiland Trávníková[1]

[1] Masaryk University Brno, Faculty of Sports Studies
[2] University School of Physical Education in Wroclaw, Department of Biostructure

Sport and physical activities of children are essential in forming their health, personality, society and other factors which affect their future life either directly or indirectly. Their life attitudes are shaped by experience, and one of domains that can be affected in them for ever based on positive or negative experience is physical activity and relation thereto. Significance and awareness of this societal problem currently lead to activities which are to support sports and physical movement of children and youth. Efforts focused on the prevention of early dropout of children from sports are in the interest of kinanthropological research studies, national children's sports support programmes where the issue often becomes part of political and programme statements of governments, civic and non-profit organizations and sports associations. In spite of all these efforts, however, we still face a massive dropout of children from sports, which is not replaced with an adequate alternative physical activity. Consequences of the negative, and sometimes even toxic experience with physical activity at early age lasts until adulthood, which brings a range of personal, health and social problems. Possibilities for reducing the phenomenon consist in systematic work dealing with the support and improvement of coaching procedures which will be focused more on the needs of children and diverted from the traditional perception of coaching education focused primarily on the needs of coaches, on the building of positive relationship with parents as partners in the process of physical education of children, and on extending the range of physical activities for children also in the environment of non-competitive sports.

ORGANIZATIONAL ACTIVITIES OF COMBATING THE "DROPOUT"

The fight against the dropout of children from sports and for the solution of this adverse phenomenon has given rise to various organizations and approaches across the society-wide spectrum, whose activities have been established in the following spheres:
1/ science;
2/ government institutions;
3/ non-profit organizations;
4/ cooperation of government, non-profit organizations and scientific institutions with sports federations and clubs.

We would like to highlight the theme as a resonant social problem on some specific examples from the particular domains and to mention concrete steps for its mitigation.

1/ The domain of science is represented primarily by research conducted by universities. In a majority of research studies, authors attempt to identify and describe processes leading to the early dropout of children from sports. Jeff Crane and Viviene Temple (2015) published an extensive overview including 43 studies about the reasons of dropped out adolescents and marginally children too. The studies mainly characterized the situation in Europe (53.6 %) and North America

(39.0 %). The research design of the included studies contained statements of informants from the ranks of young athletes, in five studies also parents and coaches.

The most frequently mentioned reasons for the early dropout of children from sports were: lack of joy, perception of insufficient physical competences, physical development (in this case connected with acceleration aspects when gymnasts were less successful due to growth and changes of their body). Other identified reasons were associated with the perception of negative feelings towards coaches or team as a whole, and other recorded constraints included time, financial cost of sports, or deficient equipment not allowing to achieve high performance. The last factor mentioned by respondents concerned injuries after which the athletes did not return to their sports.

A study which was focused on the phenomenon from the long-term perspective (Enoksen, 2011) showed that reasons for dropout from sports develop naturally in line with the historical, social and cultural development of the society. Thus, topical themes of early dropout from sports in the 1970s and 1980s included also military service and marriage, i.e. reasons hardly imaginable to contemporaries. Nevertheless, the main reasons still included factors of training and performance (early specialization, injuries), education and duties (school as a priority of young sportsmen), motivation aspects relating to the lack of education and social factors (Enoksen, 2011, p. 31–39).

A scale was gradually stratified characterizing reasons for the early dropout from physical activities or sports and identifying three main groups thereof (Crane & Temple, 2014; Witt & Dangi, 2018):

1) Intrapersonal constraints
2) Interpersonal constraints
3) Structural constraints.

The research design of these works was conceived traditionally in the form of questionnaire survey or semi-structured interviews of quantitative or qualitative character. The research sample consisted of coaches, sportsmen and parents but mainly only one of these groups was included in the research, which however brought some problems associated with the objectivity of assessing actual reasons for the dropout from sports. What a coach may seem and interpret as a lack of interest in the given sports discipline or laziness, an athlete can feel differently and his/her behaviour may be misinterpreted. These limitations of traditional research design were known to Lukáš Mařík (2020) who used a research design based on the principle of triangulation (parent – sporting child – coach) in his dissertation, thus being able to bring unbiased results from the perspective of young sportsmen as well as from the perspective of coaches and parents. It was really confirmed that the issue is very complicated and biased by the fact that each participant in the represented groups of respondents can see the situation through the prism of his/her role. As an example, we can mention the case of a handball playing girl who stated the main reason for leaving her sports club was that "*Some older schoolmates were making fun of me and laughed at* me". In the process of triangulation, her mother diagnosed the situation correctly by claiming that the sport and the particular sports club "*…did not make her (daughter) happy and she was going there just for us*". The coach then perceived manifestations of the young athlete as insufficient effort in the process of training: "*She did not do too well and she did not appear to have interest to do something with it either*". (Mařík, 2020, p. 54).

There is a number of research studies describing the phenomenon, which help to identify the problem but do not offer its solution. Therefore, it is important that the approach to the solution considers the above-mentioned levels and is targeted at the verification of theoretical procedures such as efforts for their implementation directly in educational activities of individual sports associations or clubs. However, a mere antagonistic approach is not enough (have fun, improve

sports skills, keep fit, excitement from the competition, be a part of the team, competition as such and physical activity itself).

2/ Government institutions promote the sports of children and youth, too, in effort to mitigate the impact of early dropout from physical activities or sports. Support at the highest or regional level comes from the European Union, from governments of various countries as well as from regions. One of main contributions of the European Commission to the issue and society-wide mitigation of its impact is implementation of the document White Paper on Sport (2007). The primarily social role of sports is highlighted in many sport and health promoting programmes, such as "*health enhancing physical activity – HEPA*", Public Health Programme 2007–2013, Programmes of Youth and Citizenship (collaboration of sports organizations, schools, civil society, parents and other partners at local levels) or Lifelong Learning Programme.

As an example of national programmes focused on the reduction of dropout, we can mention some activities of the Czech government such as the *Sport Concept for 2016–2025* focused on the continual education of coaches, enhancement of their skills and their application in practice. It s aim is to reduce negative factors such as: "*decline of spontaneous physical activities of children, longitudinal reduction of fitness in children and youth, increasing obesity, decreased level of movement literacy, low membership of organized sports as compared with the EU average, decline in expertise, non-existence of research in sports ...*" (Sport Concept for 2016–2025, https://www.msmt.cz/sport-1/koncepce-podpory-sportu-2016-2025).

In Poland, another member country of KidMove project, the dropout of children and youth from sports is an issue which is not being addressed at the legislative level. Thanks to the still high number of children who are physically active and involved in sports clubs, this phenomenon is not yet seen as a threat. Although there is quite a lot of talk about the growing reluctance of children and youth to take up sports (mainly due to electronic media), only a little is mentioned about how to prevent children and youth from giving up sports.

It should be pointed out, however, that large promotional efforts are still being made to promote an active lifestyle for children and youth. These activities are financed from both national and local government funds. A large and important activity was the plan to build playing fields in each municipality; it was implemented in 2012 and resulted in a good sports infrastructure (open sports grounds) in each Polish municipality.

3/ Another group dealing with the dropout of children from sports and physical activities is represented by non-profit organizations. An excellent example can be the American *Positive Coaching Alliance – PCA (https://positivecoach.org/)* which was established in 1998 and a mission of which is to create a positive example for how *coach with a double goal* can function. Such a coach can form the character of all persons who participate directly or indirectly in the processes taking place in the environment of physical activities and sports with a subsequent transfer into the "civil" lives of young athletes. This is after all also the motto of the organization which is to make persons attending physical activities *Better Athletes, Better People* thanks to the physical activities and specific approach of the believers of this philosophy. This however does not concern only the athletes themselves; the proposed practical procedures and recommendations concern and influence also the attitudes of parents, managers, viewers etc. In the course of time, the *PCA* ideas gradually spread to other continents, too. The organization is currently setting trends in the methods of coaching with the holistic approach and focus on the positive development of children and youth, their health and lifelong participation in physical activities. Similarly as in the *KidMove* project, *PCA* makes use of typical interconnection of science and implementation of experience from the long-term sport practice, realizing everything in the first line. *PCA* takes into account

the health as well as the physical and mental development of young athletes and cultivates their lifelong positive attitude towards sports. It strives to inspire and encourage the coaches as well as the managements of organizations. The portfolio of their activities is extensive and concentrated on video lectures, conferences, publication of professional literature and practical advice on their website. A today already classic title describing the *PCA* philosophy is *The Power of Double Goal Coaching*[1] (2010) by Jim Thompson, which is full of practical ideas and instruments that help the coaches succeed in achieving the two goals: to make their charges ready both for victory and for life outside the sports field. The author defined categories for this purpose, which are represented by acronyms for clear understanding and classified them into three main areas: a/ respect for sport – ROOTS: Teaching respect for Rules, Opponents, Officials, Team mates and Self; b/ defined how to achieve victory in sports "*through the ELM tree of mastership*" – Redefine 'winner' (ELM): Focusing on Effort, Learning skills and recovering from Mistakes; c/ enhancement of emotional aspect of physical activities in the form of encouraging, rewarding and promoting young athletes – Fill the emotional tank (E-TANK).

4/ The last group includes organizations permeating multiple spheres, thus creating an intersection focused on dropout mitigation. *The Association For International Sport for All – TAFISA* (http://www.tafisa.org/about-tafisa) is a global organization active on all continents, which promotes participation in sports and access to physical activities for everybody. The organization is aware of essential benefits of physical activities in the development of human potential at intellectual, physical, economic, social and emotional levels. It represents an alternative to performance and top-level activities in sports delivering a mission that even the movement for joy has its high price although a number of platforms offered are free of charge. *TAFISA* realizes that pressure for performance and sophisticated organization of sports, financial unavailability and other factors are obstacles, causes or consequences of neglected physical activity, and offers support through their programme called "*Play & Physical Literacy*". Their vision is to change the global attitude to physical activities and to do away with the threat of physical inaction. The significance of *TAFISA* follows out also from their strategic collaboration with other global institutions from the field of politics, health care, culture and sports.

International Council of Sport Science and Physical Education – ICSSPE (https://www.icsspe.org/) is an organization promoting education of coaches and other sports professions and public society awareness raising, whose activities have a very long tradition (since the 1950s). The goal of the organization is to cooperate across various sports industries, sports science and physical education practice. The Council associates a wide range of scientific and professional organizations in diverse sports industries, and creates opportunities for interdisciplinary collaboration between scientists and management structures in sports. Its mission makes use of the contribution of kinanthropological research and its applications in practice, all this with the support of partner organizations such as *UNESCO*, *WHO* and *IOC*.

Another example of applied innovations aiming at the education of certain professional groups is the *iCoachKids* project (https://www.icoachkids.eu/). This non-profit coach movement was established in 2016 and is focused on the enhanced education of coaches of children and youth worldwide. Based on the research and subsequent implementation of knowledge and procedures, the project innovates both formal and informal programmes for education and preparation of coaches. This also reflects the efforts of *ICCE* and *Leeds Beckett University* to direct the education of coaches towards the needs of target groups – children in this case. The project also deals with the integration of foreigners into local communities. The *iCoachKids* project

[1] In Czech published as: Thompson, J. (2017). Trénink2 : Výchova k úspěchu ve sportu i v životě. Praha: Mladá fronta.

has recorded a great success, attracting the attention and interest even of countries outside the European Union, international sports federations and multinational corporations from the field of health care and industries. Its only goal is to improve the education of coaches for children and youth throughout the world. The project is funded from the programme Erasmus+.

Another approach how to minimize the dropout is that of an independent Dutch institution which aims to enhance the role of sports in the society through education and awareness raising. In their case, a tool promoting physical activities is the *Knowledge Centre for Sport Netherlands–KCSportNL (https://en.kenniscentrumsportenbewegen.nl/).* This independent knowledge institute is strategically supported by the Ministry of Health, Social Care and Sports (*Ministerie van Volksgezondheid, Welzijn en Sport-VWS*). Already the name itself and sports sector integration together with health and social care indicate that sports and physical activities are understood in a societal context in the Netherlands. The institute deals not only with the issue of dropout, e.g. *14 factors to prevent dropout from sport*[2], but it strives also for other systematic solutions such as sports inclusion, increased participation of females in sports etc. One of concrete systematic approaches is represented by the document called *National Knowledge Agenda Sport and Exercise : From the steps to the podium*[3], which understands the issue of sport as a holistic society-wide topic.

International Association for Sport and Leisure Facilities – IAKS (https://iaks.sport/) is of a completely different focus. This non-profit organization was established in 1965 and deals with the exchange of ideas and procedures in planning, design and functionality of sports facilities at an international level. *IAKS* organizes international congresses, workshops, study trips and excursions around significant sports objects. It issues a professional journal named "*sb*", which ranks with the leading world magazines tackling architecture and innovations related to the sphere of sports. It is however not only about big sports centres, athletic halls, stadiums or swimming pools but members of the association also create backgrounds for leisure time physical activities such as playgrounds and facilities in the open, the aim of which is to encourage children to move and to prevent their physical inactivity. The organization is a recognized *IOC* collaborating with the International Paralympic Committee – *IPC* and awarding the most successful architectural projects.

While the other organizations touch on the dropout issue, perceiving it as an important item of their scope of programmes, the *KidMove* project (https://www.kidmove.eu/) directly focuses the negative phenomenon, offering solutions for its mitigation through the support of research. The project is being implemented with the help of the European Union (through the project *Erasmus+*) and attending organizations from academic and sports environments are from five countries: Finland, Austria, Netherlands, Poland and Czech Republic. Its main output are so-called *Good Coaching Practices*[4] informing about reasons and providing at the same time solutions that may help reduce the early dropout of children and adolescents from sports and physical activities. A very important feature of these solutions is that even if they are based on the procedures of scientific research, they are conveyed in a readable, clear and non-scientific form and made available to both experts and children's parents on the *KidMove* website. They involve four factors: motivation and support (self-esteem) of young athletes, their participation in physical activities on the basis of equal opportunities, co-creation of safe sporting environment, and collaboration in the development of coaching procedures focused on athletes (*Motivating and Empowering young Athletes, Enabling Participation and Equal Opportunities, Co-creating a*

[2] https://en.kenniscentrumsportenbewegen.nl/international-projects/keep-youngsters-involved/products-and-tools/

[3] https://www.kennisbanksportenbewegen.nl/?file=7184&m=1470909064&action=file.download

[4] https://www.kidmove.eu/wp-content/uploads/2020/09/2020-TAITO-59-KIDMOVE-Athlete-Centered-Coaching-Practices.pdf

Safe Sporting Environment, Collaboration in Developing the Athlete-Centered Coaching Practices). In some cases, the procedures are elaborated by means of acronyms for easier remembering, i.e. in the chapter *Seeking for the Ideal*, dealing with the approach of coaches to adolescent athletes. According to this approach, a knowledgeable coach should show interest – discuss with charges – build their self-esteem – ask them and listen to them (IDEAL: Show Interest – Discuss – Esteem – Ask – Listen). Nonetheless, this is far from being the only programme output because the programme also motivates, supports and educates coaches, parents and athletes by means of blogs, instructive videos and articles, focusing to a considerable extent junior athletes and younger age categories. In the context of *KidMove* project mission, adult persons participating in sports activities should not forget that sports should be fun for children. The atmosphere, entertainment, meeting friends, learning new skills, health care, solidarity and support are very important reasons for young athletes to attend sports activities.

The last of by us mentioned organizations which aims to eliminate the negative phenomenon of dropout from sports by means of improved approaches and education of coaches is *International Council for Coaching Excellence – ICCE* (https://www.icce.ws/). *ICCE* is a roofing organization associated with the research and promotion of enhanced coaching methodology. It combines political support from the European Union and the academic environment of Leeds Beckett University in northern England. *ICCE* is currently a leader in European research activities concerning the role of coaches in sports and coaching ethics. It also deals with the issues of equality and participation of females in sports. The Council is aware of demanding and specific roles of coaches and provides a newly conceived approach when the traditional model of education, originally focused on the needs of coaches, has been significantly transformed towards participants of physical activities and their specific needs. This has for example reflected necessity to focus education on issues concerning physically handicapped athletes, coaching of children, coaching of athletes whose results are not oriented on performance, physical activities of seniors etc. All these groups have specific goals and motivation for sports of physical activities, and this is why specific methods and means should be used in their coaching. Sports pedagogues should perceive it in this way and providing organizations should accommodate the mediation of these activities to their clients or athletes accordingly. As similar organizations, the *International Council for Coaching Excellence* publicizes results of their research activities on webinars, conferences, lectures and publications. One of their significant achievements is the publication of *International Sport Coaching Journal* and *International Framework for Coaching – Version 1.2*. (ICCE, ASOIF, & LBU, 2013). The latter provides a set of coaching principles on which the worldwide sports community can agree. The framework was created by *ICCE* in collaboration with the *Association of Summer Olympic International Federations – ASOIF* and *Leeds Metropolitan University – LMU*. The result of this collaboration is a universal platform which supports the development of coaches as well as sports available for all people. Together with the European Union, these two organizations participate also in other specific projects[5].

In this text we dealt with the negative phenomenon of the early dropout of children from sports. On the example of society-wide endeavour for its mitigation at various levels of public life we outlined possibilities for its identification and how to face it. "Dropout" is triggered and accompanied by diverse factors. We believe that the complexity and social importance of facing the phenomenon requires also a complex approach from professional and government structures. Science and scientific methods appear very effective in the characterization of factors accompanying this

[5] *iCoachKids* (https://www.icoachkids.eu/); *ParaCoach* (https://www.paracoach.eu/); *EDU:PACT* (https://edupact.eu/); *CoachForce21* (https://www.coachforce.eu/); *PEAK* (https://www.peak-coachingeu.com/)

phenomenon. Based on the best practices and by means of scientific work design, we can identify reasons triggering physical inactivity. On the example of research results triangulation we also pointed out subjective colour of assessing reasons (Mařík, 2020) leading to the dropout from sports. After the reasons have been determined, however, the mere antagonistic approach is not enough to eliminate the problem. It is not enough to just say that training units will take place for example in a more entertaining environment. It requires to design educational programmes for coaches and to equip them with the kind of specific knowledge and skills able to change the "traditional" inertial work of coaches. It is not only their problem but also responsibility of educators of coaches in individual sports disciplines and activities to teach them how to use the knowledge and skills in practice. Collaboration across scientific, government and non-profit sectors appears to be a very efficient model. This model, where the power and financial aid of government institutions are appropriately combined with scientific procedures focused on the characterization, identification and proposed solutions, is then subsequently brought to life by non-profit organizations and specific entities.

On the example of *International Association for Sport and Leisure Facilities* we could also see how architecture and urbanism can positively affect physical activities of youth. An example can be the athletic exploratorium in Odense, Denmark, directly encouraging to physical activities with its diversity and sensitive setting in the environment (Athletic Exploratorium, 2015). It shows that similarly as the design of school facilities, the issue of urbanism, too, can considerably influence the attitude to physical activities (Kohout & Mitáš, 2014; Kopcakova, J. et al., 2017).

The goal of the paper was not to present an exhaustive list of organizations and their programme scopes but rather to inform about the still ongoing fight for active participation of children in sports and physical activities.

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INTERNET SOURCES

Association for Sport and Leisure Facilities – IAKS, https://iaks.sport/
iCoachKids, https://www.icoachkids.eu/
International Council for Coaching Excellence – ICCE, https://www.icce.ws/
International Council of Sport Science and physical Education – ICSSPE, https://www.icsspe.org/
KidMove, https://www.kidmove.eu/
Knowledge Centre for Sport Netherlands–KCSportNL, https://en.kenniscentrumsportenbewegen.nl/
Positive Coaching Alliance – PCA, https://positivecoach.org/
The Association For International Sport for All – TAFISA, http://www.tafisa.org/about-tafisa

Address:
Masaryk University
Faculty of Sports Studies
Kamenice 5, 62500 Brno
Czech Republic
Tel. +420 549 497 226
e-mail: studiasportiva@fsps.muni.cz

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