ORIGINAL ARTICLE

Acute effects of speed-jumping intervention training on selected motor ability determinants: judo vs. soccer

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Abstract

Background and Study Aim: Judo and soccer are both representatives of complex sports where speed, power, superior motor skills, and excellent technical and tactical knowledge is of great importance. These factors strongly affect the final result of competitive performance. The purpose of this study was the effect of a short high-intensity specific speed-jumping training program on the improvement of the explosive power of lower extremities and simple, and complex responses between judo and soccer.

Material and Methods: Twenty-six athletes were divided into two groups: 13 judokas and 13 soccer players, participated in the experiment. They were tested pre- and post-implementation of the 4 weeks high-intensity specific speed-jumping training program which included various skips, bounds, hops, jumps in vertical, horizontal and mixed directions, sprints and groups of starts from lying positions on different signals: sound, visual and light. The pre- and post-experimental protocol included two horizontal jumps: standing long jump and standing triple jump, and one vertical jump – lateral ski jumps to indirectly assess lower-body power, maximal running velocity; a 20 m from standing and flying start sprint. Additionally, athletes underwent a simple and complex reaction time measurement. A one–way ANOVA and an independent t-test for establishing differences between those two groups were applied.

Results: The short-term speed-jumping intervention training significantly increased the explosive power of lower extremities, both vertical and horizontal jumping improvement and complex reaction times in judokas. The substantial differences between groups occurred in the 20 m sprint from flying and standing and lateral ski jumps.

Conclusions: Training in individual sports, such as judo, focused on improving dynamic capabilities (power and maximum speed combined with reaction time) and training in other sports, e.g., football (soccer), also focused on the dynamization of movement structures will bring similar results. In judo a short high-intensity specific speed-jumping training program could prove beneficial when intentionally used in the tapering phase with low volume and high-intensity training regime to increase explosive power and response time.

Key words: explosive power • motor skills • plyometrics • reaction time • response time • tactic • technique

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INTRODUCTION

Demands of the particular sport are being met by effective strength and conditioning programs that are designed to optimally prepare athletes [1]. One of the methods used regularly in those programs is the use of plyometric training, which seems to be an effective way to promote progressive improvements in the neuromuscular abilities, as well as to help in the injury prevention [2, 3]. One of the sports that regularly uses the abovementioned method is soccer, which represents an intermittent, highly-intensive, and complex sport that combines cyclic and acyclic movements for competitive success [4, 5]. Those movements consist of repeated explosive burst like sprinting, jumping, changing direction, and kicking actions [6, 7]. Movements as high speed running or sprinting are typical representatives of the concentric-eccentric movement, which are of great importance for soccer players [8]. Research shows that plyometric training can improve soccer player's overall physical performance [9] as it may increase the percentage of peak VO2 [10], muscle power, endurance [11] and improve the soccer kickball speed [12].

On the other hand, judo is considered a sport that is representative of eccentric/concentric movements but in different sequences and time frame from soccer, where the eccentric movement is frequently induced by the actions of the opponent. Judo, being considered an acyclic sport, represents a complex combat sport with intermittent high-intensity actions, which depend on a large number of factors, including motor skills, technique or tactic that affect the final result of competitive performance [13-15]. For this reason, it is essential to develop the motor skills such as strength, explosive power, speed, flexibility, balance, and coordination in addition to technical and tactical training specific to judo [15]. The successful performance in judo is tightly combined with the successful throwing technique, which means that judokas must be able to carry out technical elements with high power, high speed, and great motion control to maintain a high level of intensity during the entire competition [16]. A great number of judo throws consist of a rapid eccentric–concentric action to quickly get under the opponent's center of gravity and then executing the throw.

Therefore, the successful performance in judo relays on a high level of strength and explosive power from the upper and lower body. Research confirms that a good connection between the lower and upper body muscle kinetic chain is of great importance as the competition performance in judo correlates with the execution of counter movement jump with the arm swing, which represents the importance of this kinetic chain connection [17]. Plyometric intervention is at the forefront of the training models that are commonly applied to support strength and power development in judo [18]. Research shows that plyometric exercises with jumps tend to raise motor efficiency in the execution of maximum repetition during exercises [19], which can result in an increase in neural stimulation of the muscle and subsequently improve the production of power [20]. Plyometric intervention training has been shown to enhance neural stimulation to a level that will significantly increase the judokas performance in the first part of the special judo fitness test (SJFT), overall SJFT index [21] and anaerobic power [21, 22]. These types of modalities contribute the most to the development of physical performance [23].

Another crucial factor in judo and soccer, which increase the effectiveness of sports performance is simple and complex response time. According to the literature [24], the reaction capacity to external stimuli, also known as the velocity of a motor reaction or time of reaction (TR), is the time interval between the moment of the external signal presentation and the beginning of the proper muscular response. Also, an individual that can process the information faster and more correctly is more effective in achieving success in motor activity [25]. This variable can be divided into simple, discriminative, and choice reaction times [26]. It was reported that soccer players were faster in the simple response times when compared to judokas (335.24 ±50.60 ms vs 400.63 ±59.66 ms) [27]. The SRT is an especially relevant factor during the fight in judo when both judokas need to react within the shortest possible time [28]. It has been reported that a judo throw is being executed in between 300-500 ms [29]. Fast response time is of great relevance in judo since the need for optimization of judo fight relays on the pure technique execution, minimization of unwanted movements, which unnecessarily increases energy consumption and level of stimuli [22]. Therefore, explosive power for the dynamic position – preparation for attacks (implementation of a specific throw to the given situation) with integration of responses, intramuscular/intermuscular coordination, and correct timing are necessary for the effective application of techniques [30].

Judo – is a dynamic, high-intensity intermittent combat sport, invented by dr. Jigoro Kano in 1982, where a considerable number of different morphological dimensions alongside an excellent level of physical fitness physical conditioning and mental readiness plays a vital role in the final sport result [56].

Plyometrics – training utilizes the stretch-shortening cycle (SSC) by using a lengthening movement (eccentric) which is quickly followed by a shortening movement (concentric) [57].

Kumikata – the first phase of the fight to establish contact-grip (grip form or grip dispute) with your opponent's judogi (judo uniform), which represents a key technical and tactical component of the judo match to perform the throwing techniques [58, 59].

Kozushi – represents the first and critical phase of a throwing technique with the goal to perturb an opponent's balance and is performed several times during judo fight and training [60].

Motor skills – *plural noun* the ability of a person to make movements to achieve a goal, with stages including processing the information in the brain, transmitting neural signals and coordinating the relevant muscles to achieve the desired effect [61].

Motor skill – a skill for which the primary determinant of success is the quality of the movement that the performer produces [62].

Performance – *noun* the level at which a player or athlete is carrying out their activity, either in relation to others or in relation to personal goals or standards [61].

Technique – *noun* a way of performing an action [61].

Tactics – *plural noun* the art of finding and implementing means to achieve immediate or short-term aims [61].

Reaction time *noun* the interval of time between the application of a stimulus and The first indication of a response [61].

Reaction time – is the time from occurence of stimulus to

Some training modalities can result in acute short-term effects (AST) [21]. According to the literature [31], there is a close relationship between the ability of athletes to use dynamic overload (plyometric and speed) and stimuli orientation. This type of physical activity [32] is identified as post-activation potentiation (PAP) as a response to voluntary muscular activity, which can benefit an increase in strength performance. Researchers [21, 33] are stating that PAP seems to result in excitation of the central nervous system, which produces an increase in contractile function due to a heavy conditioning stimulus. The methodological strategy to apply some similar approach allowed to develop a training program called speed-jumping intervention training (SJIT). Therefore, we are examine the effect of a short high-intensity specific speed-jumping training program (plyometric, speed, responses and contrast exercises) on the improvement of the explosive power of lower extremities and simple, and complex responses in judo. This program involves the execution of dynamic maximum or sub-maximum intensity exercises, which are capable of initiating fast muscular strength potentiation [34-36]. Programmed training is based on findings recognizing that plyometric training, combined with speed training, improves the power and dynamic performance of all athletes. Hence, most of the program exercises are based on the implementation of the stretch-shortening cycle and the increase in movement speed [21].

The purpose of this study was the effect of a short high-intensity specific speed-jumping training program on the improvement of the explosive power of lower extremities and simple, and complex responses between judo and soccer.

MATERIAL AND METHODS

Participants

Twenty-six healthy male athletes were divided into two groups: judokas (n = 13; age 16.31 ±0.48), and soccer players (n = 13; age 16 ±0) participated in the study. The criteria for this selection were: age and practicing the respective discipline. The participants have been involved in regular training for a minimum of 3-4 years, were considered to be specialized for that particular sport, and healthy and in great condition. The athletes and their parents signed an informed consent and were informed of the protocol and procedures for the tests prior to the experiment. The study was approved by the Human Ethics Committee of the University School of Physical Education in Wroclaw, Poland.

Procedure

The experiment was carried out at the end of the school year during the competition season both for judo and soccer, in the morning, which corresponds to the regular athletes training routine. All subject during the week preceding the tests became acquainted with the procedure of doing the test exercises. At the same time, a group of judokas familiarized themselves with the training program. The testing procedure was done twice: before starting speed-jumping intervention training and after four weeks of implementation of the training program. Prior to the testing day, the subjects were instructed to be adequately fed, hydrated, and rested. Basic body measurements of height, weight, calculation of BMI, length of the lower extremity, and sitting height were made in accordance with the commonly used procedure of ISAK.

Before the testing, subjects performed 20 min standardized warm-up, including jogging, stretching, light jumping exercises, and speed drills. The testing battery comprised of two stages: jump testing and speed testing. During the first stage, each subject performed three different jumps, i.e. two horizontals: standing long jump (SLJ) and standing triple jump (STJ), and one lateral ski jump. Each jump was repeated three times with a 1-minute break in between. The best result was taken into further analysis. Break between first and second stage was 2 min. After that athletes performed the second stage of the testing, which included two sprints, run: i.e. 20 m from standing start and 20 m from flying start. For further calculations, the best result of each sprint was used. During the trial, each athlete was verbally encouraged to exert maximal effort in each test. The break between sprints was 3 minutes to avoid fatigue effects. The dependent variable was chosen to describe the link between physical attributes in competitive judo and soccer.

Motor ability measurement

To determine the level of maximum speed, two sprint tests were executed. The subjects performed two trials of maximum effort: 20 m from a standing start (stationary not rolling) and 20 m from a flying start. The sprints were performed on a track using the timing device. Two self-custom design light gates connected

first initiation of movement of the relevant segment of the body [62].

Response time – *noun* the time that it takes for someone to respond to a stimulus [61].

to timing system (SIMI) were placed at 0 m and 20 m marks. For the 20 m flying start, time starts as the participant passes the first timing gate and stops when he crosses the second gate at the finish line. The pick-up zone was 20 meters, which was suitable to reach the 20 m zone at maximum speed. Before speed testing, athletes performed a standardized warm-up routine of light jogging, stretching, skipping drills, and a few 10-20 m accelerations. The 2 sprints were separated by a 3-minute break to allow full recovery. For further analysis, the best time from each trial was chosen.

After completing sprints and a short warm-up, the subject performed power tests. The power of the lower extremities was assessed indirectly by horizontal and vertical jumps. Three jumping tests were used: standing long jump (SLJ), standing triple-jump (STJ) and one lateral movement – vertical ski jumps (VSJ) were executed [37, 38]. The ski jumps were performed (take-off and landing) from both feet, over a wooden strip (length 1 m, height 1cm, width 2 cm). On the signal, ("hop") athletes performed 12 jumps over the bar as fast as possible (measurement accuracy of 0.01 s). In horizontal jumps subjects were instructed to perform for maximal distance (length). Participants performed 3 trials, and the fastest or longest jump was taken for analysis. Breaks between each jump lasted about 1 minute and 3-4 minutes between different jumps. The reliability of the horizontal jumping tests was measured using the intraclass correlation coefficient (ICC). This indicated that the length for SLJ test (ICC = 0.95) and STJ (ICC = 0.93) reached high reliability. This high-reliability coefficient indicated that applied tests represent consistent vertical jump performance data among the participants. In turn, the ICC for the vertical ski jump reached lower value = 0.90. This may be as this type of jump required more familiarization time in order to be performed optimally.

Simple and complex response rates were executed by using the PNTR – program for testing the effects of receptor-motoric coordination [39]. During each trial, the participants were sitting on a chair in a comfortable position in front of a monitor and keyboard. The eyes were positioned about 50 to 70 cm from the monitor. To avoid the reflections of other sources of light, the monitor was optimally set in the room. After a short practice, athletes were able to execute a trial test (five pulses and then the proper test) 11 pulses. The final result is the average time after subtracting the highest and the lowest value. The trials were divided into:

- **simple response** – when a bright square appeared on the monitor, the subject had to push the "+" key as soon as possible with their thumb. A visual signal appeared 11 times at various time intervals (randomly selected);

- **complex response** – when a bright square appeared on the screen, the subject had to press the: Q, W, E, R, A, S, D, F keys. If the square appeared on the right-hand margin, one should push one of the U, I, O, P, H, J, K, L keys. If the square appeared in the middle of the screen, the space bar should have been pushed.

Speed-jumping intervention training protocol

The SJIT program was applied during a four weeks period to a group of 13 male judokas and 13 male soccer players at the end of the high school competition period. The judokas had completed a 4 weeks individual preparatory training program focused on general endurance and general strength development, before starting the SJIT program. The soccer players just finished their competitive season. The speed-jumping intervention program consisted of various skips, bounds, hops, jumps in vertical, horizontal and mixed directions, sprints and groups of starts from lying positions on different signals: sound, visual and light. These different types of exercises were assumed to develop speed, explosive power, and reaction and were divided into two modules: speed-oriented and jumping ones (Table 1).

Some exercises required to use additional equipment in the form of gymnastics benches and cones. During the experiment, a progressive overload of training was applied. It related to the complexity of movement and increasing the load (number of foot contacts, running meters, time execution), maintaining the maximum for the last two training sessions. The periodized manner of training allowed to avoid injury and adapt to neural stress. The exercises were divided into two independent modules, executed each other session – Monday and Thursday (Table 1). The subjects were familiar with most of the exercises. However, the reaction time exercises required better and more detailed explanation. It consists of three types of responses:

Table 1. Speed-jumping intervention training (SJIT) characteristics.

Exercises	Module 1			
	Session			
	1st	3rd	5th	7th
Speed intervention				
10 sec. power skip "A" in place	2 sets*	3 sets	2 sets	2 sets
Starts on a sound signal + 3 steps	3 reps†	3 reps	4 reps	4 reps
10 sec. power skip "C" in place	3 sets	3 sets	3 sets	4 sets
Starts on a visual signal + 3 steps	3 reps	3 reps	3 reps	4 reps
Squat jump	6r/2s‡	8r/2s.	6 r/3s	8r/3s 4
Starts on light signal + 3 steps	3 reps	4 rep.	3 reps	reps
15 m sprints	3 reps	3 reps	4 reps	4 reps

Exercises	Module 2			
	Session			
	2nd	4th	6th	8th
Jumping intervention				
Squat jump in place	6 r/2 s	8r/2s.	6 r/3s	8r/3s
Starts on a sound signal + 3 steps	3 reps	3 reps	3 reps	4 reps
Double leg side L/R cone jump	8 r/2s	10 r/2s	10 r/3s	12 r/3s
Starts on a visual signal + 3 steps	3 reps	3 reps	4 reps	4 reps
Jumping alternates step-ups (40 cm box)	10 r/2s	10 r/2s	12 r/2s.	12 r/3s
Starts on light signal + 3 steps	3 reps	3 reps	4 reps	4 reps
15 m power sprint bounding	3 sets	3 sets	4 sets	4 sets

2 sets* - mean 2 sets
3 reps† - mean 3 repetitions
6r/2s‡ - mean 6repetitions and 2 sets

• starts on a sound signal + 3 steps, where the subject is placed in a back-lying position (immobile on the back), on a sound signal (three whistles selected randomly from 5 attempts) starts/runs, trying to cover steps distance as soon as possible;

• starts on a visual signal + 3 steps, the subject is placed in a front lying position (immobile on the abdomen), on the visual signal (number 4 chosen at random from 5 attempts) starts/runs, trying to cover 3 m distance as soon as possible;

• starts on light signal + 3 steps where the subject is placed in a front lying position (immobile on the abdomen), on the visual signal (number 4 chosen at random from 5 attempts) starts/runs, trying to cover 3 m distance as soon as possible.

The subject performed all exercises in a dynamic manner (maximal effort) as much as possible.

Statistical analysis

Descriptive statistics (mean and SD) was calculated for all dependent variables. A one-way analysis of variance was used to examine the differences in sprinting speed, explosive jumping of lower extremities and, simple and complex response measurement tests between the two groups. Anthropometric characteristic differences were analyzed with independent samples

Table 2. Statistical characteristics and variation of mean values of somatic indicators in the soccer and judokas groups ($p<0.05$).

Feature	Soccer players (n = 13)			Judokas (n = 13)			t test	
	Means	SD	V	Means	SD	V	T	p
Age (year)	16.00	0.00	0.00	16.31	0.48	2.95	–2.31	0.0298
Body height (cm)	173.00	5.52	3.19	172.38	8.62	5.00	0.22	0.8302
Body mass (kg)	63.08	4.80	7.62	62.31	9.10	14.60	0.27	0.7898
Length of lower extremity (cm)	89.04	3.33	3.74	89.69	4.44	4.95	–0.42	0.6747
Sitting height (cm)	87.85	3.99	4.54	89.54	4.93	5.51	–0.96	0.3457
BMI	21.06	0.98	4.67	20.87	1.73	8.28	0.35	0.7325

t test. Statistical significance was set up p<0.05. The relationship between variables was determined using the Pearson product-moment correlation. Statistical power was determined to be >0.90 at the 0.05 alpha level.

RESULTS

Except for age (p = 0.0298), the athletes did not show differences in the somatic feature. The average BMI factor in each group was almost similar and was within the range constituting the type slender (Table 2).

The differences were observed in some motor ability measurements between the groups, especially in both 20 m sprint from flying and standing start (Table 3). Better results were achieved by soccer athletes (2.541 s vs. 2.835 s, respectively). The result was faster for about 0.40 s when compared to judokas. Average simple and complex response times in all groups were similar. The differences between the groups were also noticed in the ski jump. The soccer players reached better times, about 0.40 sec.

The one-way ANOVA for establishing differences between groups of athletes (Tab. 4) showed that the most significant differences in averages between judokas and soccer players compare pre- and post-test measurement occurred in the results of the 20 m run from the standing start and 20 m from the flying start (p = 0.0001). The lateral ski jumps also achieved significance between soccer players and judokas (p = 0.0001). The rest of the measured variable did not show significance between groups. The additional ANOVA analysis showed that judokas improved in all measured variables after four weeks of acute application of SJIT program. In turn, the soccer players reached in post-test improvement in jumping measurement.

DISCUSSION

The compared groups do not differ in the somatic indicators (body height and mass), despite the same calendar age, which showed statistical significance between groups (p = 0.0298). The judokas were older in an average of 3 months. Based on this analysis, we can assume that age needs to be taken into consideration when we evaluate motor ability [40], which is dependent on the task's implementation (movement structures). We know how much movement tasks differ in relation to each other: judo-soccer. However, research on an adolescent soccer players states [41] that the contribution of body size, maturity status, age, and years of performance experience to success in soccer-specific skills tests is relatively small (8-21%).

The 20 m sprint from standing or flying start is often applied as a maximum speed measurement

Table 3. Comparison of the pre-test and post-test physical indicators of the experimental group of Judo athletes.

Variable	Group	Before-training					After- training				
		Means	SD	V	Min	Max	Means	SD	V	Min	Max
Simple response time (sec)	Soccer	0.257	0.028	10.901	0.211	0.305	0.255	0.027	10.549	0.213	0.303
	Judo	0.260	0.024	9.089	0.228	0.310	0.256	0.030	11.886	0.221	0.338
Complex response time (sec)	soccer	0.409	0.053	12.875	0.342	0.498	0.407	0.053	13.039	0.342	0.496
	Judo	0.421	0.036	8.502	0.355	0.471	0.416	0.035	8.468	0.355	0.466
Lateral ski jumps (sec)	soccer	2.865	0.198	6.894	2.580	3.150	2.847	0.206	7.222	2.570	3.150
	Judo	3.232	0.325	10.067	2.780	4.050	3.183	0.326	10.233	2.710	4.000
Standing long jump (m)	soccer	2.239	0.077	3.433	2.100	2.400	2.272	0.076	3.342	2.180	2.450
	Judo	2.175	0.185	8.512	1.900	2.500	2.254	0.172	7.620	2.050	2.600
Standing triple jump (m)	soccer	6.978	0.473	6.779	6.050	7.750	7.008	0.466	6.647	6.100	7.750
	Judo	6.669	0.432	6.473	5.850	7.250	6.804	0.409	6.010	6.010	7.340
20 m from standing start (sec)	soccer	2.835	0.081	2.872	2.710	3.000	2.816	0.080	2.824	2.710	3.010
	Judo	3.195	0.187	5.865	2.920	3.480	3.128	0.198	6.345	2.820	3.400
20 m from flying start (sec)	soccer	2.541	0.071	2.808	2.460	2.690	2.525	0.089	3.515	2.420	2.710
	Judo	3.008	0.158	5.252	2.810	3.370	2.955	0.157	5.301	2.790	3.340

Table 4. Evaluation of the variation in mean values of physical fitness indicatorsbefore and after training (B1-B2) in groups (soccer-judokas), analysis of variance with repeated measurements, probabilities for post-hoc tests, LSD test, p-value

Variable	Main effects				Probabilities for post-hoc tests. LSD test. p-value			
	repetition		repetition×group		B1–B2		soccer–judokas	
	F	p	F	P	soccer	Judokas	B1	B2
Simple response time	2.32	0.1411	0.47	0.5016	0.5582	0.1322	0.7713	0.9152
Complex response time	35.54	0.0000	9.67	0.0048	0.0551	0.0000	0.4925	0.6301
Lateral ski jumps	92.68	0.0000	18.62	0.0002	0.0010	0.0000	0.0021	0.0042
Standing long jump	42.63	0.0000	7.55	0.0112	0.0133	0.0000	0.2414	0.7453
Standing triple jump	69.62	0.0000	28.12	0.0000	0.0418	0.0000	0.0895	0.2532
20 m from standing start	43.53	0.0000	14.21	0.0009	0.0570	0.0000	0.0000	0.0000
20 m from flying start	38.20	0.0000	10.65	0.0033	0.0501	0.0000	0.0000	0.0000

B1 – before training. B2 – after training

tool [42, 43]. The differences between groups to the detriment of judo in this test results from the fact that judo does not carry out this kind of movement in its skill specification. In judo, we can talk about maximum speed measurement in the initiation of the movement in grip fighting-kumikata, unbalancing the opponent-kozushi and maybe in one to three fast connected steps which allow to approach the opponent and initiate a direct throw. In contrast to judo, soccer players sprint for an average length of 17 m, and 96% of sprints are less than 30 m, with an average duration of less than 6 s and an occurrence of every 90 s [44]. According to the literature [45], almost half of the short sprints in soccer are less than 10 m, and often commence from a rolling start better known as the flying start. The vast majority of sprints performed in soccer take 6 s or less to complete, where the initiation of stating movement in judo takes only a hundredth of a second.

The lateral ski test represents more agility skill than jumping ability; therefore, this variable showed a significant difference between groups and differences between pre- and post-tests within each group. Some authors [46, 47] described the agility as the ability to change direction, stop, and start quickly. However, according to research [46, 48], fast straight running and agility tests assess specific qualities which do no transfer one to another. In our experiment, both groups improved this skill; however, according to the assumption, the soccer players got a better time. They completed 12 jumps in 2.87 s, whereas judokas in 3.32 s. The judokas reached the improvement after 4 weeks of special training, whereas soccer players stayed on the same level, which directly results from the specification of soccer training which was carried out at the same time. It can be assumed that the specification of the game and training: multiple starts, accelerations, different jumps, or shorts sprints with changes of direction contributed in itself to this improvement. It is known that the turns in soccer are inseparably connected with cutting movement, therefore they consciously use the lateral ski jump as a measurement for the level of agility [49]. No statistical significance in these two groups occurred between the standing long jump and standing triple jump both in pre- and post-test.

The result shows the great importance of the speed-jumping training on motor abilities of judokas. It was noted that the ability to perform complex motor tasks of a speed-explosive type in judo is significantly correlated to a number of victories and technical efficacy points [50]. Therefore, this kind of exercises can help to improve the specific judo coordination in selected throws, where the combination of power, speed and as well as coordinated movements of the ankle, knee, and hip are necessary [51]. In judo, an explosive execution of attacks and counter-attacks leads to the regular occurrence of rapid and sudden passage from eccentric to concentric muscle action [52]. Therefore, plyometric training should play a crucial role in judoka's physical preparation. Literature also states that for judokas, great emphasis should be made in increasing the maximal explosive [53] and maximal eccentric power [51] to increase their effectiveness. The result shows that plyometric training allows the muscle to make a rapid transition between the eccentric and concentric phases of the muscular action [54], which would benefit judokas in a quicker and more powerful attack

or counter-attack. Also, it increases the judokas complex response time, which is of great importance. This could potentially lead to the better decision-making process of attacks or countering the attacks from opponents that could lead to better overall success on competitions. This could also mean that a short high-intensity specific speed-jumping training program could prove beneficial when intentionally used in the periodization before the competitions in the tapering phase with low volume and high-intensity training regime.

The ANOVA analysis of the response time feature expressed that the simple reaction time can likely be explained by the ballistic character of the movements both by taking place during game and soccer training and in the judo fight. Some measurements of power of the lower limbs indicate that this movement structure lasted no longer than approximately 0.2 s. However, Bernstein's theory claimed that no correction of the movement could be made during the performance. This assumption suggests that the employed motor trials both during the competition movement and special design power training were executed at the level of simple reaction. It prompts us to seem that training in sports such as judo and soccer brings similar results.

At first glance, judo and football present completely different sports but both activities are characterized by very high variability of situations as well as the ability to quickly reorganize motion stereotypes in order to adapt to the new situation [55]. Comparable results could also be attributed to similarities in those two sports motor aspect. There is great importance for judokas and football players in need of strength endurance and as well as the explosive power to succeed in these two sports [55]. Because of the similarities of those two sports, we could use the elements from them in basic strength and conditioning of the transitional period in the annual training cycle in terms of psychological relief created by saturation with known daily training contents. These elements can also be used in the later stages of the preparatory as well as in the competitive period [55].

CONCLUSIONS

For the measurement of speed capacity, response time and lower extremity power the same type of test can be used to evaluate the motor ability potential and above all, the suitability of individual motor abilities in a given sport. In turn, it can be questionable whether the normative data derived for judokas can be relevant for soccer players and *vice versa*. This approach seems to be a credible tool. It appears that training in individual sports such as judo, focused on improving dynamic capabilities (explosive power, speed combined with enhanced response time) and training in other sport such as soccer also geared toward dynamization of movement structures will bring similar results. In judo, a short high-intensity specific speed-jumping training program could prove beneficial when intentionally used in the tapering phase with low time (also optimal number of repetitions of the respective exercises) and high-intensity training regime to increase explosive power and response time before the competition or during the competition period of cyclization.

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