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THE EVALUATION OF JU-JITSU TRAINEES' PHYSICAL FITNESS DEPENDING ON UTILIZATION OF ACROBATIC AND AGILITY EXERCISES IN TRAINING

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ABSTRACT

Purpose: The research aim is to provide an answer to the question whether including gymnastics exercises in a Ju-jitsu training positively influences trainees' general and special fitness. The research was preceded by a trainer survey conducted among Ju-jitsu trainers and instructors which enabled to distinguish two approaches to this issue. In the opinion of some trainers using gymnastics exercises in a Ju-jitsu training should positively influence the level of trainees' general and special fitness. In the other group of instructors, on the other hand, the opinion that there is no reason to recommend using such exercises in a Ju-jitsu training prevails.

Methods: The research has been conducted by means of physical fitness tests evaluating general fitness (EUROFIT physical fitness battery) and special fitness in Ju-jitsu. Research material included two groups consisting of 15 trainees aged 14-17 who represented sections trained by instructors having opposing views related to the presented issue.

Results: In the two groups it was the group whose training includes gymnastics exercises that obtained better results in 9 out of 11 tests which points to the rightness of opinions represented by trainers who are in favour of using gymnastics exercises in a Ju-jitsu training.

Conclusions: The profile of motor ability in Ju-jitsu and gymnastics shows a strong similarity in all areas of motor skills.

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INTRODUCTION

Ju-jitsu is the most versatile martial art originating in Japan, which for centuries has evolved to become a system comprehensively preparing an adept to fight both in a sporting arena

as well as in self-defense. Versatility of Ju-jitsu results from using multiple techniques, namely *atemi-waza*, *nage-waza*, *osaekomi-waza*, *kansetsu-waza* and *shime-waza* techniques (Sterkowicz, 1998, Ambroży, 2008).

The primary reason for taking up the issue of including gymnastics exercises in a Ju-jitsu training are significant differences in the approach to this problem adopted by Ju-jitsu trainers and instructors. On the basis of a trainer survey two separate systems of action can be distinguished. Whereas in one group of Ju-jitsu trainers and instructors the belief that there is no indication to use exercises typical for gymnastics in a training, trainers in the second group point to a correlation between using such exercises in a training and general and specialist fitness in Ju-jitsu.

General fitness is conditioned by the level of development and the level of motor skills, without attention being paid to motor abilities typical of a particular discipline. High level of physical condition signifies it. It is both an individual's motor potential and a basis for developing his or her special fitness.

Special fitness, on the other hand, is considered only with reference to specific motor skills which are characteristic for a particular discipline. Therefore, it is also determined by the level of the degree of technique mastery, which is measured by efficiency and effectiveness of task achievement set by a particular sports discipline. It is a kind of adaptation to motor challenges having a repeated structure and taking place in similar conditions (Drabik, 1992).

As far as the level of motor skills is concerned, Ju-jitsu places considerable demands on trainees. As a combat sport it is characterized by a high degree of complexity and any lacks in motor preparation can result not only in losing in a competition, but also in a serious injury. Ju-jitsu understood as a martial art does not make any compromises regarding the level of motor skills since suffering a defeat may be tantamount to permanent loss of health or death (Kalina, 2000).

On the basis of time and subject structure of a fight, as well as a characteristics of means used in it, it should be concluded that the level of the following motor skills and their compo-

nents plays a key role in special fitness in Ju-jitsu (Ambroży, 2008, Ambroży et al. 2014a):

1. strength abilities:
 - a) absolute strength (a fight without weight divisions);
 - b) relative strength (a fight with weight divisions);
 - c) general strength (performing techniques which engage a substantial number of muscles: *ukemi-waza* falls, *chugaeri-waza* rolls, a large group of *nage-waza* techniques etc.);
 - d) local strength (the influence of particular body segments on the effectiveness of technique performance: the strength of arms and shoulder girdle – hitting with upper limbs, *te-waza* throwing techniques; the strength of legs and pelvic girdle – hitting with lower limbs, *ashi-waza* leg throwing techniques, as well as all throws requiring lowering one's centre of gravity; the strength of stomach – throws involving hip rotation, weakening the attack by turning hips and changing the impact angle, protecting internal organs; the strength of neck muscles – protection against *shime-waza*);
 - e) explosive strength (lower and upper limbs attacks in fighting from a distance in standing positions; the phase of throwing techniques performance where a dynamic leg straightening enables to rise the opponent's centre of gravity);
 - f) static strength (the effectiveness of using holds limiting *osaekomi-waza* movements and *shime-waza* strangles in the course of ground fighting, but not only);
 - g) endurance (the ability to maintain an appropriate level of strength in the course of the whole fight);
 - h) power and speed skills (a general influence of power and speed predisposition on the effectiveness in a fight: kicks, counter-attacks, throws etc.);
2. endurance skills:
 - a) aerobic endurance (it is of huge importance in fights which lasts longer than 2 minutes; it is a basis for developing other forms of en-

- duration; it influences the effectiveness of restitution in the course of less intense parts of a fight);
- b) anaerobic endurance (a structure of a round in Ju-jitsu is based on short, but very intense anaerobic efforts separated by lower level efforts);
 - c) speed endurance (it is a component which is based on the ability to release energy by way of anaerobic processes and which determines an organism's resistance to tiredness caused by submaximal and maximal stimuli);
3. speed skills:
- a) reaction time (simple reactions: reacting quickly to a referee's commands; complex reactions: the ability to react quickly to an opponent's actions – using ducks, counter-attacks etc.);
 - b) pace of a particular movement (it influences the effectiveness of a blow or block that is used);
 - c) frequency of movement (it is significant when a sequence of movements consisting in a combination of various blows is used);
 - d) flexibility: a high level of flexibility enables to perform a series of techniques more effectively, especially kicks (*mae-geri, mawashi-geri, yoko-geri, ushiro-geri* etc.), punches (*oi-seiken-jodan-tsuki*), some leg throws (*tai-otoshi, uchi-mata, o-soto-gari* etc.), as well as techniques used in ground fighting (e.g. *sankaku-jime*);
 - e) coordinating motor skills: in the most general perspective these skills are a basis for mastering fighting techniques and using them effectively in a rapidly changing fight conditions, and even though each of their components exerts influence on it, it seems reasonable to highlight it (special role of the ability to maintain equilibrium, diversify and adapt movements).

THE AIM OF THE STUDY

The aim of this paper is to evaluate motor skills of Ju-jitsu trainees depending on using gymnastic exercises in a training. The research aim is a rationale for formulating the following questions resulting directly from the research procedure:

1. Does using gymnastic exercises in a Ju-jitsu training influence the level of trainees' general fitness?
2. Does using gymnastic exercises in a Ju-jitsu training influence
3. Should gymnastic exercises be used in a Ju-jitsu training in order to create a base for achieving better results in trainees in a leading discipline, e.g. Ju-jitsu?

These issues lead us to formulate a theoretical question, which results from a trainer survey, trainer and trainee experience as well as own research:

- Do profiles of motor skills in Ju-jitsu and in gymnastics show similarities? If the answer is yes, then in what areas of motor skills?

MATERIALS AND METHOD

Research on the level of general and special fitness in Ju-jitsu trainees was conducted in two sections: section 1 (the date of examination: 5 April 2014), consisting of 15 boys aged 14-17 and section 2 (the date of examination: 14 April 2014), also consisting of 15 boys aged 14-17. Apart from tests evaluating the level of components determining general and special fitness, measurements and the following data were recorded: height, body weight, age and training experience.

The research was preceded by a trainer survey conducted among Ju-jitsu trainers and instructors, which focused on a tendency to use in Ju-jitsu exercises taken from other sports disciplines, especially from gymnastics. This enabled to distinguish two groups representing two varying positions. Whereas the members of the first group highlighted their conviction about positive influence of gymnastics exercises used in Ju-jitsu on trainees' fitness, and consequently used them in a training of a many year's standing, starting from age 7 (such exercises were used in group I), members of the second group did not draw attention on the connection between using gymnastic exercises and the level of Ju-jitsu trainees' fitness,

and consequently did not use systematic programme based on using gymnastic exercises as supplementary measures (this approach was used in group II).

Before doing physical fitness test, a 15 minute warm up was performed in each group. Moreover, before doing a particular test the participants had been instructed on the way in which each exercise should be performed.

General fitness was evaluated by means of selected tests which make up EUROFIT physical fitness battery (Ambroży et al. 2014a):

1. Flexibility test – this test involves sitting on the floor with legs stretched out straight ahead and reaching forward ahead as far as possible (the so-called sit and reach).
2. Explosive strength test – standing long jump.
3. Static strength test – squeezing a dynamometer with maximum effort.
4. Sit up test (abdominal strength endurance) – performing as many sit-ups as you can in 30 seconds.
5. Functional strength test (shoulders and arms strength endurance) – a participant grasps a bar using an overhand grip and should attempt to hold this position for as long as possible.
6. Running speed and agility test – this involves a 10x5 m shuttle run with a maximum speed and changing the direction.

Special fitness was evaluated on the basis of the following tests (S. Sterkowicz, 1998, K. Sterkowicz, 2003, Ambroży et al. 2014b):

1. A test of speed (frequency) of upper limb strikes – a combination of two punches: left, straight punch (*Oi-seiken-jodan-tsuki*) and right, straight punch in the stomach (*Gyaku-seiken-chudan-tsuki*) performed 30 times in a fighting position.
2. A test of speed (frequency) of hip turns – time required to perform 30 hip turns in a fighting position.
3. Flexibility test – a maximum range (height of foot kick) when performing *Jodan-mawashi-geri* high kick. Three measurements of the

range of a dominant limb kick with a precision of 1 cm. Then the flexibility indicator was calculated:

$$\frac{\text{the flexibility indicator}}{\text{kick range [cm]}} = \frac{\text{height [cm]}}{\text{height [cm]}}$$

4. A test of speed (frequency) of lower limb strikes – performing 30 *Chudan-mawashi-geri* kicks on a sack/mattress held by a partner by a forward leg in a fighting position.
5. A test of technical fitness – a test of special motor fitness TSSR employing *Ippon-seoinage* throw.

The results have been presented by means of the following parameters of basic statistics:

- arithmetical mean,
- standard deviation.

Then, mean difference of the examined variables, obtained by trainees in both groups, have been calculated. The significance of results obtained by both groups have been checked. The results of the examined variables had a normal character (this distribution has been tested by means of Kolmogorov-Smirnov test) and that is why a student t-test for independent groups as well as Cochran-Cox have been tested to determine the significance of differences).

RESULTS

A general description of groups consisting of 15 participants, examined by means of the abovementioned fitness tests has been presented in Table 1 and 2.

Statistics	Age [years]	Height [cm]	Body weight [kg]	Training experience [years]
Arithmetical mean	15,8	169,733	63,2	5,667
Standard deviation	1,222	7,801	9,745	1,3
Variation coefficient	7,73%	4,60%	15,42%	22,93%
Minimal value	14	159	51	3
Maximal value	18	185	84	8
Median	15	171	62	6
Mode	15	176	63	6

Table 1. General description of trainees in group

As shown in Table 1, the average age of participants in group I is 15,8 years. Whereas the average height is 169,733 cm, the average body weight is 63,2 kg. Subjects' training experience is 5,667 years on average.

While the lowest variation coefficient among the examined features characterizes height (4,60%), the highest coefficient is training experience (22,93%).

Statistics	Age [years]	Height [cm]	Body weight [kg]	Training experience [years]
Arithmetical mean	16,267	171,267	63,4	5,6
Standard deviation	0,929	9,132	9,851	1,705
Variation coefficient	5,71%	5,33%	15,54%	30,44%
Minimal value	14	156	45	3
Maximal value	17	186	80	9
Median	17	173	65	5
Mode	17	186	65	5

Table 2. General description of trainees in group II

As Table 2 shows, the average age of participants in group II is 16,267 years. Whereas the average height is 171,267 cm, the average body weight is 63,4 kg. Subjects' training experience is 5,6 years on average. The lowest variation coefficient among the examined features characterizes height (5,33%), the highest coefficient is training experience (30,44%).

Table 3 presents a summary of average tests results in both groups, their standard deviations, mean differences and statistical significance of these differences.

	Test	Grup I		Grup II		Mean difference	Mean significance
			s		s		
General fitness	Flexibility	11,8	4,151	13,533	6,13	1,733	Insignificant
	Explosive strength	218,867	21,845	208,667	23,223	10,3	Insignificant
	Static strength	34,533	8,107	33,4	11,313	1,133	Insignificant
	Torso strength	30,2	1,939	28,6	3,593	1,6	Insignificant
	Functional strength	17,475	10,872	13,659	9,082	3,816	Insignificant
	Racing speed, agility	20,195	1,157	21,381	1,257	1,187	Significant
Special fitness	The speed of upper limb blows	14,287	1,672	19,7	2,869	5,413	Significant
	The speed of hip turns	19,436	3,046	19,193	2,709	0,243	Insignificant
	Flexibility indicator	0,938	0,049	0,928	0,034	0,01	Insignificant
	The speed of lower limb kicks	18,913	2,144	19,24	1,444	0,327	Insignificant
	TSSR	20,933	1,526	18,133	1,087	2,8	Significant

Table 3. A summary of average results in group I and II

As far as sit-ups are concerned (Table 3) the results obtained by participants in group I were worse than in group II by 1,733 cm on average. In case of the standing long jump test (table 3) participants in group I were better than participants in group II by 10,2 cm on average. They also obtained better results in the handgrip on a dynamometer test (table 2) by 1,133 kg on average. In the test evaluating abdominal strength endurance by means of performing sit-ups in 30 seconds (table 3) participants in group I obtained results better than in group II by 1,6 on average. In the functional strength test (table 3) participants in group I obtained better results than those in group II by 3,816 s on average. In the subsequent test which evaluated the 10x5 m shuttle running speed (table 3) subjects in group I obtained better results than subjects in group II by 1,187 s on average.

When it comes to the evaluation of special fitness, when performing a series of upper limb strikes (table 3) participants in group I obtained better results than those in group II by 5,413 s

on average. However, when performing 30 hip turns (table 3) participants in group I obtained worse results than participants in group II by 0,243 s on average. The flexibility indicator (table 3) in subjects in group I is higher than in group II by 0,01 on average. When performing 30 lower limb kicks (table 3) participants in group I obtained better results than those in group II by 0,327 s on average. When analyzing the number of *Ippon-seoi-nage* throws in the TSSR test (table 3) it has been found that subjects in group I obtained better results than subjects in group II by 2,8 on average.

SUMMARY AND DISCUSSION

Results obtained by trainees in tests differ both in case of general and special fitness. The conducted statistics analysis enabled to find the highest level of significance of differences in the test of speed (frequency) of upper limb strikes where the difference of the performance in the series of 30 kicks was 5,413 s for the benefit of group I), the TSSR test in which participants in group I performed 2,7 *Ippon-seoi-nage* throws more than in group II and the running speed and agility test in which in the 10x5 m shuttle run execution time in group I was on average shorter by 1,187 s than in group II. In all of these tests better results were obtained by trainees in group I that is the group in which gymnastic exercises were included in the training programme.

The least statistically significant differences have been observed in the test of speed of hip turns (subjects in group II performed 30 hip turns in a fighting position on average 0,243 s faster than subjects in group I) and in the static strength test (the strength which participants in group I gripped their hands on the dynamometers was higher by 1,133 kg on average than in group II).

Participants in group II (in whose training gymnastic exercises were not used) obtained better results than in group I only in two tests, namely in the flexibility test (sit and reach) and in the test of speed of hip turns. It is important to note that one of these test is in the group of tests whose results in the light of performed calculations are characterized as the least statistically significant. In case of other tests better results were obtained by subjects in group I. On this basis it can be concluded the group of factors influencing such a state of affairs includes the level of motor preparation, namely the level of particular motor skills and their components, described in detail in earlier sections and displayed in particular tests. It should also be noted that the average age in

group I was lower by 1,8 years than in group II. Despite this unfavourable disproportion, trainees in group I were able to obtain better results in the majority of tests.

The obtained tests results need also to be referred to the trainer survey conducted prior to the tests. Numerous opinions of trainers who believed that using gymnastic exercises in a Ju-jitsu training should exert positive influence on trainees' general and special fitness seem to be right. Therefore, the beliefs of instructors who oppose these opinions and state that there is no need to include gymnastic exercises in a Ju-jitsu training since there is no reason to believe that they will increase the level of general and special fitness can be disputed.

The analysis of literature (Sterkowicz, 1998, Ambroży, 2008, Kochanowicz, 1998, Sawczyn, 2000, Omorczyk, 2010, Ambroży et al. 2014a, Ambroży et al. 2014b) gives a clear picture of strong similarities between requirements Ju-jitsu and gymnastics trainees have to meet. These analogies are related to motor abilities (especially general and local strength, explosive strength, static strength, speed and strength abilities, but to some extent also their other components), endurance skills (mainly anaerobic endurance), speed skills (above all the speed of a particular movement performance and reaction time), flexibility (a significant influence of the flexibility level of the whole loco-motor system, from lower limbs, spine to upper limbs) and motor skills coordination (both Ju-jitsu and gymnastics are characterized by a high level of coordination complexity and particular components of motor skills coordination of key importance for this disciplines seem to be: the balance skill, the ability to vary and link movements).

CONCLUSIONS

When it comes to the application value of the research the following conclusions can be drawn:

1. Using gymnastics exercises in a Ju-jitsu training can positively influence trainees' general fitness, namely strength, endurance, speed and coordination skills.
2. Using gymnastics exercises in a Ju-jitsu training can positively influence trainees' special fitness, namely strength, endurance, speed and coordination skills.
3. Using gymnastics exercises in a Ju-jitsu training should be a common and recommended practice since it has been proven that it enables trainees to obtain better results.
4. Carrying out statistical calculations enabled to establish that only two of all obtained results (mean difference in results of the running speed and the speed of upper limbs strikes tests) are statistically significant. Nevertheless, in the majority of conducted physical fitness tests (except the flexibility test and the speed of hip turns test) trainees belonging to the group practicing gymnastic exercises obtained better results than trainees in the group whose training does not include such exercises.

The theoretical value of the conducted analysis can be summed up in the following way:

- The profile of motor skills in Ju-jitsu and gymnastics shows a similarity in all areas of loco-motor activity, that is in condition abilities (strength skills, endurance skills, speed skills, flexibility) and motor skills coordination.

The results obtained in the course of this paper should serve as a basis and encouragement for other authors to conduct further research since even though the subject of the correlation between gymnastics and Ju-jitsu has been addressed here and is interesting from a scientific perspective, it still needs to be thoroughly analyzed by means of empirical methods and conclusions have to be drawn. Such action will influence the increase of the theoretical qualifi-

cations of trainers and instructors, which in turn will positively affect the quality of training and enable trainees to obtain better results either in a sporting arena or in a defense fight.

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