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Muscle Strength and Technical Skills in 17–19-Year-Old Judoists

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Muscle Strength and Technical Skills in 17–19-Year-Old Judoists

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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Key words: *judo, muscle strength, techninical skills, throws*

Abstract

Background: *The aim of this study was to define the relationships between different kinds of muscle strength manifestations and technical skills (selected throwing techniques) in 17–19-year-old judoists.*

Material/Methods: *Results of measurements taken in 2006–2008 at the Physical Effort Lab in the Gdansk University of Physical Education and Sport were taken under consideration. 30 male judo athletes (17–19-year-old) participated in the study. They all were students of Comprehensive Sports School – with the judo profile and athletes representing clubs from Pomerania and Warmia-Masuria Provinces.*
An ergometric device "Concept 2 Dyno" was used in the measurements of isotonic strength and strength endurance. In the measurement of static strength an electronic dynamometer ERGO METER was used. To evaluate the level of technical skills (throws), the method of expert evaluation was used (coach evaluation).

Results: *Using regression analysis results, which revealed the most significant relationships between variables presented in percentage value, relation's topographies of particular types of muscle strength were created. They form an applicable, transparent and ready-to-use in training process form for coaches. They point to these elements of strength preparation on which the training process should be primarily focused and during measurement intervals as well.*

Conclusions: *Interpretation and synthesis of the results showed relationships of 10 technical skills (throws) with muscle strength in 17–19-year-old judoists in three out of four types: isotonic strength, strength endurance and static strength. These skills were included in hand throws – 2, foot – 1, hip – 3 and sacrifice – 4. Jump force remained with no significant relationships.*
The results of this study can be used in the training process of 17–19-year-old judoists. Following technical skills (throws) were characterized: tai-otoshi, seoi-nage, kosoto-gari, uki-goshi, tsuri-goshi, ushiro-goshi, tani-otoshi, osoto-makikomi, yoko-otoshi, yoko-guruma.

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Introduction

Physical fitness and its aspects in judo are a subject of frequent scientific considerations. Proper strength preparation in judo athletes is one of the elements influencing the level of a technical training process and enabling achievement of high sport results [1, 2, 3, 4, 5].

Judo training in practice means forming and enhancing technical and tactical skills and necessary complementary exercises. Results of the training process depend on the efficiency of usage of adequate forming methods, technical and tactical efficiency analysis and their synthesis [6, 7, 8, 9].

In view of the above, the aim of this study was to define the relationships between different kinds of muscle strength manifestations and technical skills (selected throwing techniques) in 17–19-year-old judoists.

Material and Methods

Results of measurements taken in 2006–2008 at the Physical Effort Lab in the Gdansk University of Physical Education and Sport were taken under consideration. 30 male judo athletes (17–19-year-old) participated in the study. They all were students of Comprehensive Sports School – with the judo profile and athletes representing clubs from Pomerania and Warmia-Masuria Provinces.

An ergometric device ”Concept 2 Dyno” was used in the measurements of isotonic strength. This devise defines the level of isotonic strength level of lower and upper limbs. The main element of this device is a fly-wheel with different levels of loads. Judo athletes were measured according to lower and upper limbs. The first task was to execute 4 dynamic push-outs of the device bar (in the case of upper limbs from flexed limbs in elbow joints to straightening) and pedals (in the case of lower limbs from flexed limbs in knee joints to straightening). The second task was to execute 4 dynamic pull-ups on the bar (in the case of upper limbs from the straightened position in elbow joints to the flexed position). Each subject performed tasks with the right upper extremity, the left upper extremity and with both upper limbs as well as with the right lower extremity, the left lower extremity and together with both lower limbs. During the measurement the following parameters were recorded: power, work, velocity, isotonic strength.

In the measurement of strength endurance an ergometric device “Concept 2 Dyno” was used. This device also defines the level of strength endurance of upper and lower limbs. The main element of this device is a fly-wheel with different levels of loads. All subjects had to perform 10 push-outs of the device bar (in the case of upper limbs from flexed limbs in elbow joints to straightening) and pedals (in the case of lower limbs from flexed limbs in knee joints to straightening). During the measurement the following parameters were recorded: 10 values of isotonic strength, power, work, and velocity.

In the measurement of static strength an electronic dynamometer ERGO METER was used. All subjects had to perform 6 test tasks, three for upper limbs and three for lower limbs. In the case of upper limbs the first task was based on the measurement of upper limbs together – upper limbs flexed (at 90º) in elbow joints; the device bar was held in the hands; in the exact time the subject had to hold static contraction of forearm flexors. The second task was based on the measurement of the right upper limb, flexed (at 90º) in elbow joints; the device bar was held in the hands; in the exact time the subject had to hold static contraction of the right forearm flexors. The third task was based on the measurement of the left upper limb, flexed (at 90º) in elbow joints; the device bar was held in the hands; in the exact time the subject had to hold static contraction of the left forearm flexors. In the case of lower limbs, the first task was the measurement of limbs together – lower limbs flexed (at 90º) in knee joints, feet laid on the platform; in the exact time the subject had to perform static contraction of the shank straightening muscles. The second task was the measurement of the right lower limb – the right lower limb flexed (at 90º) in knee joints, foot laid on the platform; in the exact time the subject had to perform static contraction of the shank straightening muscles. The third task was the measurement of the left lower limb – the left lower limb flexed (at 90º) in knee joints, foot laid on the platform; in the exact time the subject had to

perform static contraction of the shank straightening muscles. During the measurements the maximal level of static strength was defined.

To evaluate the level of technical skills (throws), the method of expert evaluation was used (coach evaluation). Each skill (throw), selected by judo coaches in an earlier executed diagnosis, was evaluated according to a scale (1–10, with one decimal place). Each error and incompatibility comparing to the model was adequately sanctioned with points, defined in a specially prepared evaluation sheet.

Statistica 5 software package was used in statistical analysis ($p \leq 0.05$).

Results

The main aim of statistical analysis of the relationships between muscle strength and technical skills (throws) among 17–19-year-old judoists was to define the level of determination factor in the regression analysis of dependent and independent variables (Table 1). In description and further analysis results $R^2 \geq 30\%$ were taken into consideration.

Tab. 1. Analysis of the relationship between muscle strength and technical skills (throws) among 17–19-year-old judoists (at correlation factor level $r > 0.5$) in a regression analysis

No.	Technical skill	Isotonic strength		Strength endurance		Jump force		Static force	
		variable	%	variable	%	variable	%	variable	%
1	tai-otoshi	power RLw	16.9	-		-	-	Fmax rel. NN	42.4
2	kibisu-gaeshi	power RLw	17.7	-		-	-	-	-
3	kouchi-gaeshi	-	-	-		-	-	-	-
4	kuchiki-taoshi	-	-	-		-	-	-	-
5	sukui-nage	-	-	-		-	-	-	-
6	seoi-otoshi	power RLw, velocity RRNN	27.6	-		-	-	-	-
7	uchi-mata-sukashi	power RLw, velocity RRNN	23.2	-		-	-		
8	morote-gari	-	-	-		-	-	Fmax rel. NN	22
9	ippon-seoi-nage	-	-	strength level maintenance factor RR	29.2	-	-	Fmax rel. NN	13.07
10	seoi-nage	-	-	strength level maintenance factor RR	36.9	-	-	Fmax rel. NN	23.3
11	okuri-ashi-harai	-	-	-	-	jump force RR	3.6		
12	osoto-otoshi	-	-	strength level maintenance factor NN	24.8	-	-		
13	hiza-guruma	-	-	strength level maintenance factor NN	11.1	-	-	Fmax rel. NN	14.8
14	kosoto-gari	-	-	strength level maintenance factor NN	32.4	-	-		
15	deashi-harai	-	-	-		-	-		
16	sasae-tsurikomi-ashi	-	-	average strength value NN	3.3	-	-	Fmax rel. NN	14.37
17	kouchi-gari	-	-	average strength value NN	3.2	-	-	Fmax rel. NN	15.3
18	osoto-gari	-	-	-		-	-	-	-
19	ouchi-gari	power RLw	10.2	-		-	-	-	-
20	uchi-mata	power RRw	29.3	-		-	-	-	-

No.	Technical skill	Isotonic strength		Strength endurance		Jump force		Static force	
		variable	%	variable	%	variable	%	variable	%
21	uki-goshi	-	-	strength level maintenance factor NN	35.2	-	-	Fmax NN. Fmax rel. NN. Fmax rel. NP	45.2
22	tsuri-goshi	velocity RRNNw, strength RLw, power RLw	38.9	-		-	-	-	-
23	hane-goshi	-	-	-		-	-	-	-
24	utsuri-goshi	power RLw	15.7	average strength value NN	3.3	-	-	Fmax rel. NN	26.7
25	ushiro-goshi	work RPd	31.2	-	-	-	-	-	-
26	koshi-guruma	-	-	-	-	-	-	-	-
27	tsurikomi-goshi	-	-	-	-	time cont. NN	26.5		
28	sode-tsurikomi-goshi	velocity RRw	24.9	-	-	jump force RR	2.7		
29	o-goshi	-	-	-	-	-	-		
30	harai-goshi	-	-	-	-	-	-	-	-
31	sumi-gaeshi	-	-	-	-	-	-	Fmax rel. RR	27.9
32	ura-nage	-	-	-	-	-	-	-	-
33	tomoe-nage	-	-	-	-	-	-		
34	tani-otoshi	-	-	strength level maintenance factor NN	36.1	-	-	Fmax rel. RR	17.2
35	osoto-makikomi	strength RLw	33.5	strength value of 1 repetition NN	31.5	-	-	-	-
36	yoko-gake	-	-	-	-	-	-	-	-
37	uchi-mata makikomi	velocity RRw	23.6	-	-	-	-	-	-
38	yoko-otoshi	-	-	strength level maintenance factor NN	33.8	-	-	Fmax rel. RR	12.4
39	yoko-guruma	-	-	strength level maintenance factor NN	36.04	-	-	Fmax rel. RR	19.5
40	soto-makikomi	power RPw	25.9	strength value of 1 repetition NN	27.9	-	-	-	-

***Legend**: RP – right upper limb; RL – left upper limb; RR – both upper limbs; NP – right lower limb; NL – left lower limb; N – both lower limbs; RRNN – upper and lower limbs together; W – push-out movement; D – pull-up movement*

Using regression analysis results, which revealed the most significant relationships between variables presented in percentage value, relationship topographies of particular types of muscle strength were created. They constitute an applicable, transparent and ready-to-use in training process form for coaches. They point to these elements of strength preparation on which the training process should be primarily focused and during measurement intervals as well. Figures 1–3 show topographies of relationships of independent (muscle strength parameters of different types) and dependent (technical skills) variables.

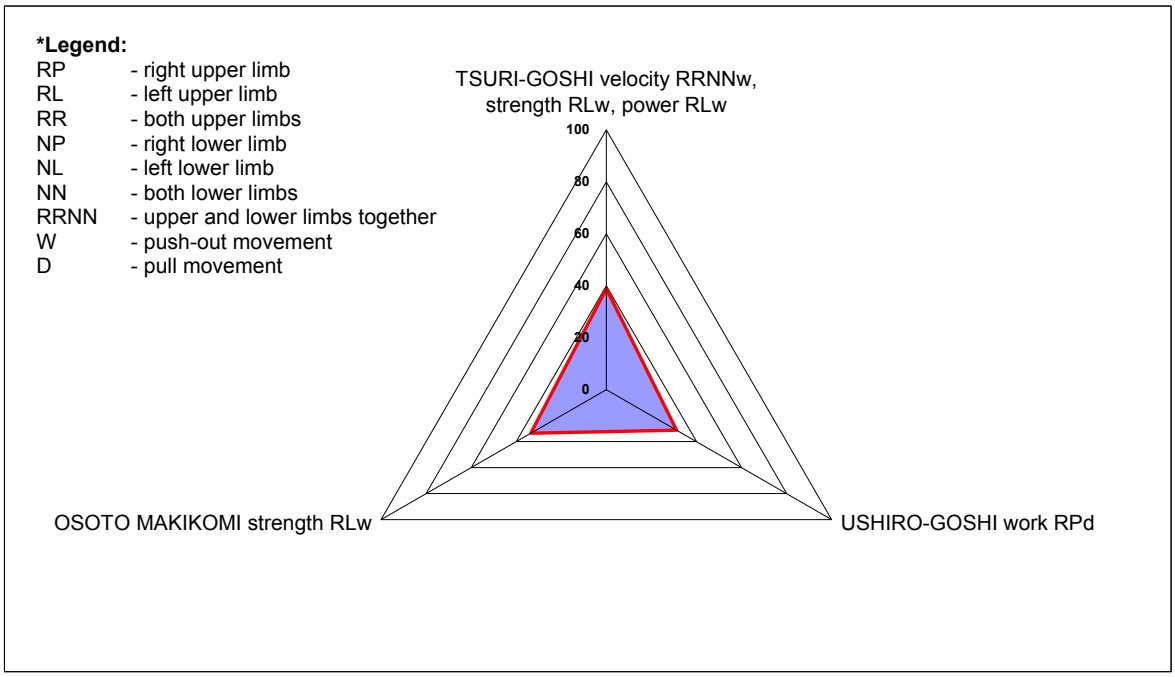

Fig. 1. Topography of isotonic strength in dependence of technical skills (throws) among 17–19-year-old judoists*

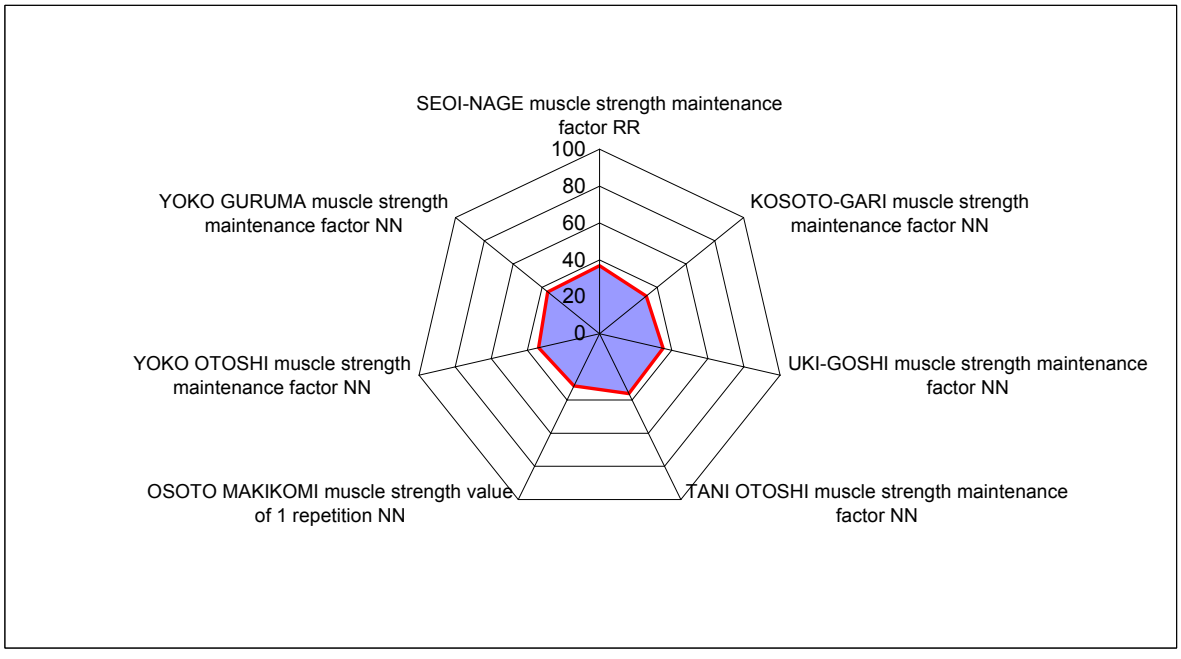

Fig. 2. Topography of strength endurance in dependence of technical skills (throws) among 17–19-year-old judoists*

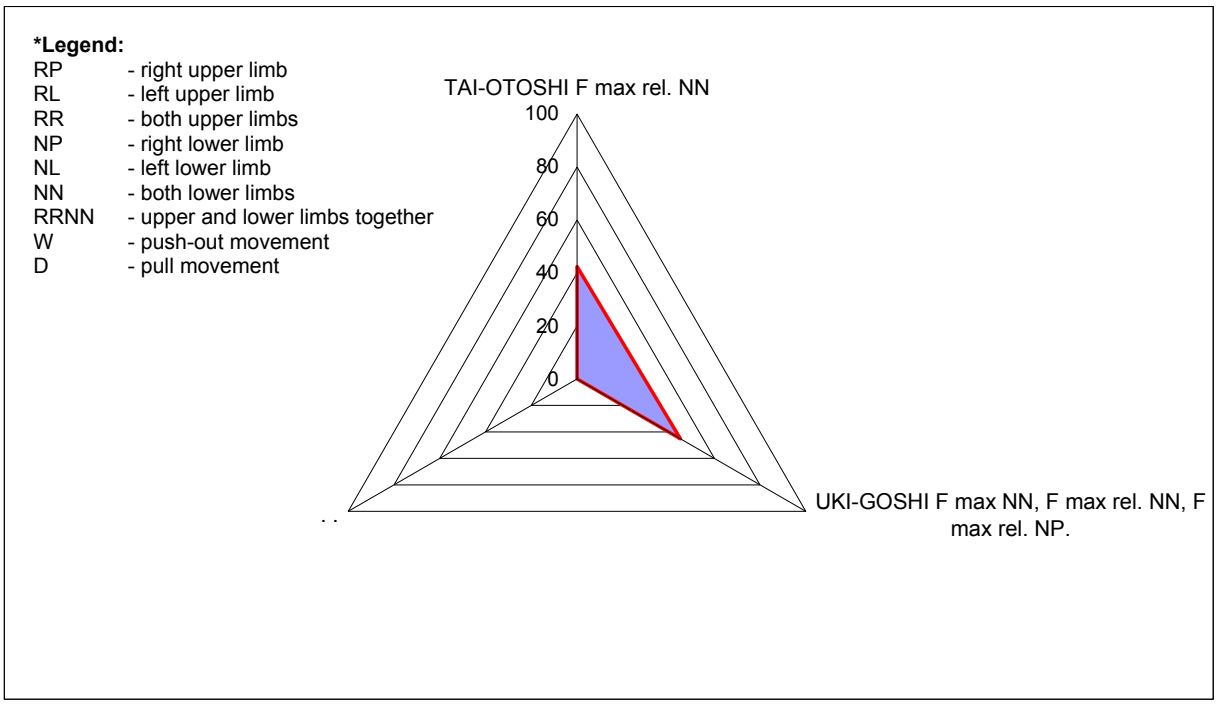

Fig. 3. Topography of static strength in dependence of technical skills (throws) among 17–19-year-old judoists*

Discussion

In the 40 analyzed technical skills in judo (throws) 25% was characterized by parameters of muscle strength, defined by the used methods.

Interpretation and synthesis of the results showed relationships of 10 technical skills (throws) with muscle strength in 17–19-year-old judoists in three out of four types: isotonic strength, strength endurance and static strength. These skills were included in hand throws – 2, foot – 1, hip – 3 and sacrifice – 4. Jump force remained with no significant relations.

Hand throws were characterized by parameters of static strength and strength endurance; foot throws by parameter of strength endurance; hip throws by parameters of isotonic strength, static strength and one of strength endurance; sacrifice throws by parameters of isotonic strength and 4 of strength endurance.

Seven throws: seoi-nage, kosoto-gari, uki-goshi, tani-otoshi, yoko-otoshi, yoko-guruma, osoto-makikomi showed relationships with strength endurance parameters. This was mainly strength endurance maintenance factor of lower limbs (kosoto-gari, uki-goshi, tani-otoshi, yoko-otoshi, yoko-guruma – foot, hip and sacrifice throws); one hand throw (seoi-nage) defined a relationship with strength endurance maintenance factor of upper limbs .

Significant in the training process relationships between technical skills (throws) and muscle strength in 17–19-year-old judoists appeared in two spheres of this condition ability: isotonic and static. Hand throws are characterized by static strength parameters, hip throws by isotonic and static strength parameters and sacrifice throws by parameters of isotonic strength.

This research is confirmed in other findings. Significance of different types of muscle strength in achieving high results in various sport disciplines were presented by numerous scholars [3, 10, 11, 12, 13, 14].

Conclusions

1. Particular groups of technical skills (throws) appeared in 17–19-year-old judoists, determined by different muscle strength parameters sets (profiles/characteristics). Interpretation and synthesis of the results showed relationships of 10 technical skills (throws) with muscle strength in 17–19-year-old judoists in three out of four types: isotonic strength, strength

endurance and static strength. These skills were included in hand throws – 2, foot – 1, hip – 3 and sacrifice – 4. Jump force remained with no significant relationships.

2. Based on muscle strength measurements and the training practice, the results of this study can be used in the training process of 17–19-year-old judoists. Following technical skills (throws) were characterized: tai-otoshi, seoi-nage, kosoto-gari, uki-goshi, tsuri-goshi, ushiro-goshi, tani-otoshi, osoto-makikomi, yoko-otoshi, yoko-guruma.

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