

The impact of an intensive two-year judo training at the dynamics of the morphological development in adolescents

Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Manuscript Preparation
- E Funds Collection

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Abstract

Background & Study Aim: Many empirical data provides evidence that the correct, long combat sports training stimulates biological, mental and social human's development. The research aimed is impact of systematic judo training on the dynamism of development processes in the youth during puberty.

Material & methods: The research was of semi longitudinal (2-years) character: it was first-age of the subjects: 13, then repeated after one year – age of the subjects: 14 and next done after another year – age of the subjects 15. One hundred sixty-two persons were studied: 88 females and 74 males; Research group: 8 females and 15 males practised judo, control group: 80 females and 59 males. Linear measurements to calculate the indices: RI, WHR, LLI, ULIWLI. Body weight of the subjects [kg] and body fat percentage evaluated using BIA method [FAT %] were measured.

Results: The descriptive statistics for females point to lower values of average morphologic factors of females training judo in comparison to control group. Contrasting, the average body mass, body fat percentage, as well as RI index for males practicing judo are higher comparing to the control group.

Conclusions: The spontaneous selection in judo practised prefers shorter females of lower body mass than in peers. Judo training has an impact on body mass gain in males in puberty. Biologically-conditioned body mass and height growth during puberty is to a great extent independent from stimuli used in judo training.

Key words: auxology • combat sports • anthropometric indexes • longitudinal observes

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Auxology – a term covering the study of all aspects of human physical growth.

Puberty – the process of physical changes where a child's body matures into an adult body capable of sexual reproduction.

INTRODUCTION

Puberty is a period in human's life, where the dynamism of both qualitative and quantitative changes is the greatest [1]. It encompasses growth processes i.e. the growth of body dimensions, mass and development, regarding perfection of cells, tissues and organs functions. The modifiers of this process are both endogenous as well as exogenous factors, which is the field of auxology – the science combining development anthropology and puberty age medicine [2]. Among the exogenous modifiers a significant role may be played by physical activity, especially when a young organism is subjected to above-standard workload related to practising sport professionally.

The requirements of modern professional sport ever more compel to the use of increased physical workload even in the case of children of several years of age. It is explained by the sensitivity to training stimuli at that age [3]. Therefore motor efficiency is tested in developmental context [4-6]. Consequently it inclines to assume that increased physical workload in the early stages of ontogenesis should, to some extent, have an influence of the rate and course of development. It may also bring about certain consequences such as definite effects on the process of development, as well as have an impact on the development of individual career in sports [7-9].

There have been conducted cross-sectional studies on the impact of judo training on somatic development of young people [10]. However, no studies of a continuous nature were executed. It supplied a reason to start the research presented below.

The research aim is impact of systematic judo training on the dynamism of development processes in the youth during puberty.

MATERIAL AND METHODS

The research was of longitudinal character: it was first carried out in the 1-st grade in Gymnasium (age of the subjects: 13), then repeated after one year (age of the subjects: 14), and next done after another year (age of the subjects: 15). One hundred sixty-two persons were studied: 88 females and 74 males; students of the 4th Gymnasium in Bytom, Poland.

Among the subjects 8 females and 15 females practised judo – they were students of a grade with a sports profile. These persons, apart from standard classes in physical education, practised judo in the following pattern: 1st grade 3-4 trainings a week; 2nd

grade 4-5 trainings a week; 3rd grade 5-6 trainings a week. Each class lasted on average 1.5x the unit of a regular. When the research began, only 1 female and 2 male subjects started judo training. The rest have already practised in the club: for 2.8 year for female and 3.5 year for male subjects on average. It was the experimental group (J).

The rest of the group of subjects (80 females and 59 males) constituted control group (C). The subjects from the control group were persons of varied level of physical activity, both practising various sport disciplines, as well as physically inactive.

The methodology of the research encompasses carrying out linear measurement: body height, the length of torso and limb as well as of waist and hips (cm). The data gathered was then used in order to calculate the following indexes:

Rohrer's index (RI) – using the model $RI = [\text{body mass [g]} / (\text{body height [cm]})^3] \times 100$

Waist to hip ratio (WHR): $WHR = \text{waistline [cm]} / \text{hipline [cm]}$

Lower limbs index (LLI): $LLI = (\text{average lower limbs length/body height}) \times 100$

Upper limbs index (ULI): $ULI = (\text{average upper limbs length/body height}) \times 100$

Waist length index (WLI): $WLI = (\text{waist length/height}) \times 100$

Furthermore, body weight of the subjects [kg] and body fat percentage evaluated using BIA method [FAT %] were measured. Soehnle electronic scales of ± 0.01 kg, 0.1% accuracy, according to the manufacturer, produced in Germany was used.

The statistical analysis encompassed descriptive analyses: calculation of average (x) and standard deviation (SD). Due to the fact that the distribution of the variables was similar to normal distribution, the level of diversification (p) was evaluated by the means of T test for variables independent in relation to groups (Statistica v.10), and statistically relevant level was set at $p \leq 0.05$.

The study has been conducted in accordance with ethical standards and was approved by the local Ethics Committee.

RESULTS

Descriptive statistics of morphologic measured were carried out first – the average (\bar{x}) and standard variation (\pm SD). The results for females are presented in Table 1.

Table 1. Descriptive statistics of morphologic factors of females: group J (n=8), group C (n=80)

Grade	I		II		III	
	J	C	J	C	J	C
Height [cm]	157.8 ± 9.0	160.0 ± 6.2	159.4 ± 7.3	163.0 ± 5.9	160.9 ± 7.5	163.7 ± 5.6
Weight [kg]	44.5 ± 8.3	54.0 ± 13.4	52.1 ± 7.8	55.9 ± 11.3	53.6 ± 9.5	58.7 ± 11.3
RI	1.22 ± 0.08	1.29 ± 0.26	1.28 ± 0.10	1.29 ± 0.25	1.28 ± 0.11	1.34 ± 0.26
WHR	0.78 ± 0.03	0.78 ± 0.05	0.75 ± 0.02	0.75 ± 0.06	0.74 ± 0.02	0.75 ± 0.11
FAT [%]	20.7 ± 2.3	24.7 ± 7.2	24.3 ± 1.5	24.9 ± 6.6	23.5 ± 3.3	24.9 ± 6.4
LLI	51.6 ± 0.9	53.3 ± 1.9	50.9 ± 1.0	52.6 ± 2.0	49.6 ± 1.1	50.8 ± 1.3
ULI	43.3 ± 0.9	44.4 ± 1.1	43.5 ± 0.7	44.1 ± 1.4	42.9 ± 1.6	44.2 ± 1.1
WLI	31.1 ± 1.8	31.1 ± 1.9	32.3 ± 1.8	31.4 ± 1.8	31.9 ± 1.4	31.8 ± 1.6

Descriptive statistics for males are presented in Table 2.

Table 2. Descriptive statistics of morphologic factors of males: group J (n=15), group C (n=59)

Grade	I		II		III	
	J	C	J	C	J	C
Height [cm]	159.9 ± 9.9	163.1 ± 8.8	169.6 ± 7.5	170.3 ± 7.9	172.7 ± 8.2	174.9 ± 5.5
Weight [kg]	53.0 ± 12.5	50.1 ± 9.1	63.8 ± 11.5	57.8 ± 8.4	67.7 ± 13.0	65.8 ± 9.0
RI	1.27 ± 0.1	1.15 ± 0.1	1.29 ± 0.1	1.17 ± 0.1	1.31 ± 0.2	1.23 ± 0.2
WHR	0.85 ± 0.04	0.83 ± 0.05	0.85 ± 0.05	0.80 ± 0.05	0.80 ± 0.05	0.80 ± 0.06
FAT [%]	15.9 ± 8.4	10.8 ± 6.4	18.9 ± 8.1	12.2 ± 6.5	16.2 ± 8.1	15.6 ± 6.9
LLI	52.9 ± 2.3	53.0 ± 1.2	51.5 ± 1.1	51.5 ± 1.6	50.8 ± 1.3	51.2 ± 1.2
ULI	45.5 ± 1.1	44.8 ± 1.1	44.8 ± 1.0	44.6 ± 1.4	44.8 ± 1.4	44.9 ± 1.2
WLI	32.0 ± 1.3	30.6 ± 1.6	30.5 ± 1.5	30.7 ± 1.4	31.2 ± 1.4	31.0 ± 1.7

Then examined the dynamics of morphological factors studied. Consequently, differences between given measurements were calculated and compared with T test for variables independent in relation to groups – the variation of parameters in groups practising judo (J) and the control group (C). The females results are presented in Table 3.

Table 3. The change of morphologic factors – females: group J (n=8), group C (n=80)

Variable	group	Study comparison					
		2-1		3-2		3-1	
		variation	p	variation	p	variation	p
Height [cm]	J	1.6	0.0556	1.5	0.1470	3.1	0.5470
	C	3.0		0.7		3.7	
Weight [kg]	J	10.8	0.1324	1.5	0.9985	12.3	0.1538
	C	1.9		2.8		4.7	
RI	J	0.06	0.0000*	0	0.3470	0.06	0.0088*
	C	0		0.05		0.05	
WHR	J	-0.03	0.9740	-0.01	0.8464	-0.04	0.8957
	C	-0.03		0		-0.03	
FAT [%]	J	3.6	0.0070*	-0.8	0.8810	2.4	0.1707
	C	0.2		0		0.2	
LLI	J	-0.7	0.9308	-1.3	0.5654	-2.0	0.5882
	C	-0.7		-1.8		-2.5	
ULI	J	0.2	0.2803	-0.6	0.9183	-0.4	0.0188*
	C	-0.3		0.1		-0.2	
WLI	J	1.2	0.0851	-0.4	0.8982	0.8	0.0260*
	C	0.3		-0.4		-0.1	

*p<0.05: statistically relevant differences

Table 4. The change of morphologic factors – males: group J (n=15), group C (n=59)

Variable	group	Study comparison					
		2-1		3-2		3-1	
		variation	p	variation	p	variation	p
Height [cm]	J	9.7	0.8999	3.1	0.3575	12.8	0.0947
	C	7.2		4.6		11.8	
Weight [kg]	J	10.8	0.7739	3.9	0.1145	14.7	0.0203*
	C	7.7		2.0		9.7	
RI	J	0.02	0.9915	0.02	0.5960	0.04	0.4292
	C	0.02		0.06		0.08	
WHR	J	0	0.1455	-0.05	0.2599	-0.05	0.8371
	C	-0.03		0		-0.03	
FAT [%]	J	3.0	0.9798	-2.7	0.2168	0.3	0.4538
	C	1.4		3.4		4.8	
LLI	J	-1.4	0.5437	-0.7	0.5773	-2.1	0.7773
	C	-1.5		-0.3		-1.8	
ULI	J	-0.7	0.3427	0	0.1926	-0.7	0.5804
	C	-0.2		0.3		0.1	
WLI	J	-1.5	0.0170*	0.7	0.2478	-0.8	0.0097*
	C	0.1		0.3		0.4	

*p<0.05: statistically relevant differences

The results for males are presented in Table 4.

A decision was made to compare the average of basic morphologic parameters. i.e. height and body mass with the results of other researchers: the population of Warsaw [11] and Upper Silesia [12]. The results are presented in Figures 1 and 2.

DISCUSSION

The descriptive statistics for females point to overall lower values of average morphologic parameters of females training judo in comparison to control group. The exceptions are only WHR and WLI indexes, where the average for judo and the control group are close (Table 1). In comparison to control group – the biggest body mass, FAT and RI indexes relate to the first study. It might suggest that small-built females in comparison to their peers are selected for practising this particular sport and probably undergoing the process of puberty later than their peers. On the other hand, the analysis of dynamism of these parameters show more rapid body mass gain, including fat tissue (statistically relevant differences) among females practising judo, comparing the result of the second study with the first one (Table 3). It resulted in statistically relevant differences, regarding Rohrer's index variation

between the second and first grade and consequently in the entire two-year period. Therefore, between the ages of 13 and 14 for females is the period when then impact of biological factors is at its peak and changes relating to the composition of the body and mass are to a great extent independent from judo trainings workload – at the age of 14 the variation of morphologic parameters in females between subjects practising judo and the control group was the smallest. The decrease of the fat tissue average for females training judo between the third and the second study, combined with lower comparing to the control group body mass increase, suggests that during that period training stimuli influence on the value of morphologic parameters relating to body mass increases. A confirmation of this assumption can be found by contrasting the study results with the studies carried out in Warsaw and Upper Silesia (Figure 1, Figure 2). The height for the female subjects practising judo examined was lower, whereas the height for the females from the control group was higher at all ages comparing to the average in Warsaw and Upper Silesia. In the case of body mass – the lowest average for females practising judo in the first study, came close to the average in Warsaw and Upper Silesia in the second study, to place lower than the comparative data in the third study. The relation, therefore, is in line with the comparison: judo group – control group.

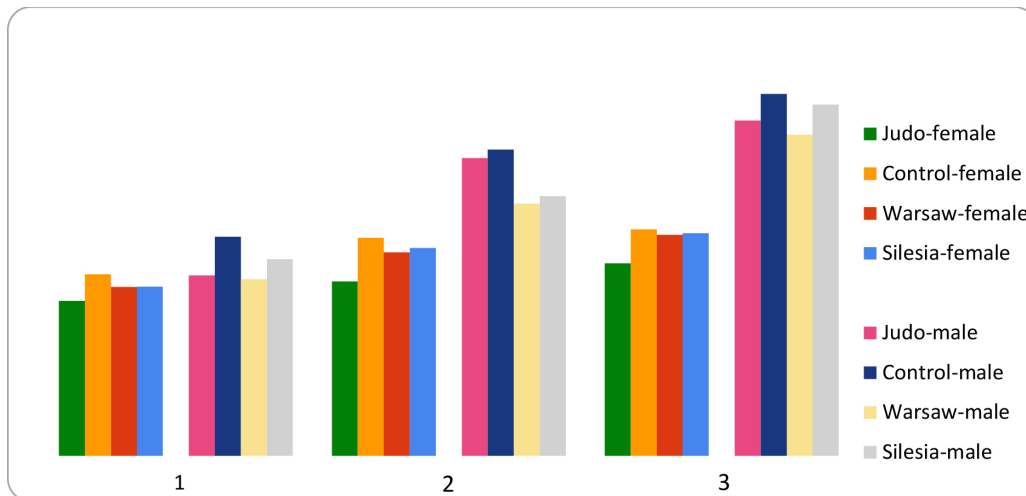


Figure 1. The height of the subjects – average comparison

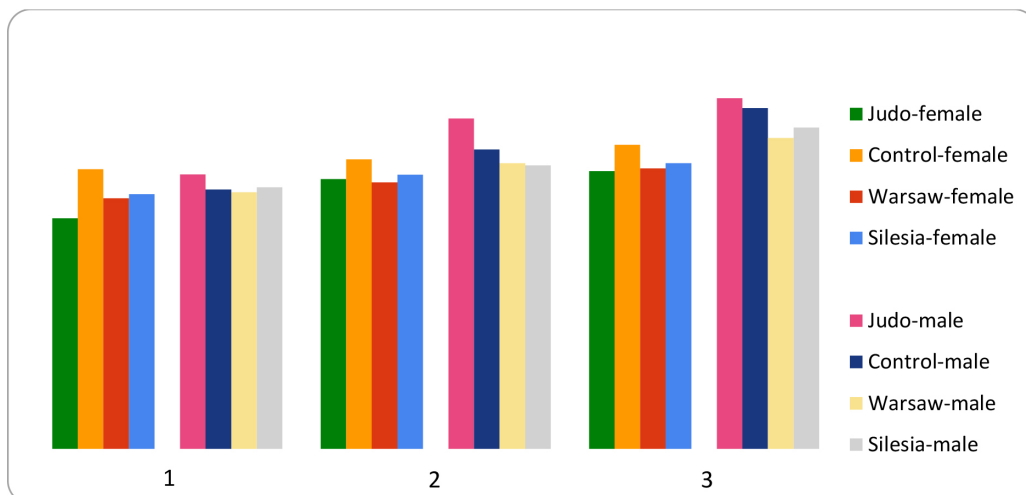


Figure 2. The body mass of the subjects – average comparison

Contrasting the males practising judo with the control group point to completely different tendencies than in females. The average body mass, body fat percentage, as well as RI index for males practising judo are higher comparing to the control group. Considering slightly lower average of body mass for the subjects practising judo it suggests much heftier body built in this group in comparison to the control group. It is confirmed by Rohrer's index comparison in all the three studies between the subjects practising judo and the control group, where the average for the first was considerably higher than in the case of the later. It would imply significant influence of judo training on the parameters relating to body mass from the early years of training in males. An important confirmation of this claim is the comparison of the body mass of subjects practising judo here and

the average in Warsaw and Upper Silesia, where the variations were even more significant (Figure 2). Yet, the comparison of the average of height of the male subjects with the before-mentioned studies point to similar level of the average (Figure 1).

It should be emphasised that the average analysis may point only to certain trends relating to analysed and contrasted variables. This knowledge seems desirable for choice and selection in sport training – the key issues in sport theory and practise [10,11]. Normative perspective, relating to average values, however valuable, cannot overshadow individual's development variability in regard to morphologic, physical capability, as well as interrelations between them and a number of psychological and exogenous variables. It should be added here that judo is a sport in which the

path to success is available for males and females of various morphological (body weight division) [12]. In comparison with other sports, where certain morphologic in a way condition achieving a champion level (e.g. basketball), it increases an almost unlimited number of levels of the freedom of development [13]. Not forgetting that sport is more than just 'player's biological functions' [14], these levels shall be reduced in the process of choice and selection, on the basis of solid knowledge. It increases the chances that the spontaneous and intuitive selection will be effective.

CONCLUSIONS

The spontaneous selection in judo practised prefers shorter females of lower body mass than in peers.

Judo training has an impact on body mass gain in males in puberty. Biologically-conditioned body mass and height growth during puberty is to a great extent independent from stimuli used in judo training.

COMPETING INTERESTS

Authors declare that we do not have any financial or personal relationships with other people or organisations that could inappropriately influence our paper.

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