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Influence of a programmed judo training on changes of anthropological features in children attending sports schools / Wpływ zaprogramowanego treningu judo na zmiany cech antropologicznych u dzieci uczęszczających do szkół sportowych

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This paper completes the follow-up of changes in motor and physiological abilities and anthropometric features during a three-year training cycle. The aim of the paper was to identify the effects of three-year judo training on changes of some anthropological features in judokas-boys. These changes were the result of a three-year long planned and programmed transformation process in the life span from 11 to 14 years of boys' age, that is during the period of their schooling from the fifth, to sixth, to seventh form of elementary school. The sample consisted of 17 boys who underwent the final testing after three years at the age of 14 (+/- six months). Those 17 judokas were tested both initially and at the end of the continuous three-year training program. The sample of variables was comprised of sixteen (16) tests for the assessment of anthropometric features and of motor and physiological abilities. The results obtained showed significant changes in judokas after a three-year organized training process. All motor and physiological abilities, as well as anthropometric features showed a statistically significant progress after the three-year training process. Upon analyzing the whole three-year training process it can be concluded that participation in judo program in adolescents significantly influences the positive development of all analyzed abilities and features.

INTRODUCTION

Judo in translation from Japanese means „Gentle way“. This name is defined with the structures of Judo which are performed without a real threat for a sportsmen's health. But if one considers everything judokas must pass for accomplishing good sport result, a more appropriate name would be „Thorny way“. For achieving these good results judokas must start with systematic and programmed training at early age.

Age for start with judo training is between 8 and 10 years, specialization should start with 15 and maximal results should be expected between 22 and 16 years [Degoutte *et al.* 2003].

One can notice that, for accomplishing good results, judokas must spend 14 to 16 years of hard training. This implies that at early age training process was made by its strict rules and principles. Most of previous research was made on population of judokas between 18 and 27 years old. Linear research of development of anthropological status of judokas at early age was rarely conducted.

Following the changes in motor and physiological abilities and anthropometric features during a three-year judo training cycle started as the part of science-research project “Observations of changes in anthropological status of children in wrestling sports”. As a result of this project it was noticed faster and better development of children incorporated in judo sport [Newton *et al.* 1997; Dopico 2002; Navarro 1998].

This paper presents final results in following motor and functional abilities and anthropometric characteristics during the three-year training period.

The aim of the paper was to identify the effects of three-year judo training on changes of some anthropometric features in judokas-boys. These changes were the result of a three-year long planned and programmed transformation process in the life span from 11 to 14 years of boys' age, that is during the period of their schooling from the fifth, to sixth, to seventh form of elementary school

METHODS

The sample consisted of 17 boys who underwent the final testing after three years at the age of 14 (+/- six months). Those 17 judokas were tested both initially and at the end of the continuous three-year training program. The control group was consisted of boys who have not participated in any organized training process except during the physical education class in elementary school.

The battery of 16 test items was used for the assessment of: anthropometric characteristics, motor abilities and functional abilities. The control group was tested only by the 11-test battery commonly used in elementary school PE teaching in the educational system of Croatia [Franchini *et al.* 1999]: anthropometric characteristics (ATV – body height, ATT – body mass, AOP – forearm circumference, ANN – upper arm skin fold); motor abilities: coordination (KUS – side steps, MPN – obstacle course backwards), flexibility (MPR – straddle seated forward bent), speed of movement (MTR – hand tapping), explosive power (MSD – standing broad jump), strength endurance of a dynamic type (MPT60 – sit-ups in 60 seconds) and functional abilities (F6 – 6 minute running). Experimental group obtained testing with additional five specific tests: coordination (ONT – ground agility), relative repetitive strength (SKL60 – push-ups in 60 seconds, ČUČ – squats), specific endurance (BAC2SKL – throw+2 push-ups in 90 seconds), strength endurance of a static type (MIV – bent arm hang).

Both groups were tested at the beginning of the fifth and at the end of seventh grade. The three year training program was designed and based on the children is judo sport schools program in Croatia. This program is suitable for preparation of young judoists for their first competitions. The main goal of this training design is that young judokas during the three years learn and perfect basic technical elements of judo (throws and ground holds). Work on coordination (basic and specific) dominate in this period of training followed by relative strength that implies the use of own body weight in basic forms of movement. The development of other abilities depends on sensible phases and specific characteristics of tested judokas. Flexibility, precision and balance drills were used without any limits and anaerobic functional abilities or the strength (except one mentioned above) were not present in a training program of children is judo sport schools.

The data were processed by the statistical software package Statistics for Windows, which is by means of *t*-tests for independent and dependent samples of subjects at the significance level of 0.05.

RESULTS

Tab. 1. Basic descriptive parameters of initial state of boys judokas / Podstawowe parametry opisowe początkujących dżudoków

VAR	Valid N	Mean	Minimum	Maximum	Std.Dev.	Skewness	Kurtosis
ATV	17	155,471	146,8000	169,200	5,8610	0,74789	0,44263
ATT	17	48,453	34,2000	69,000	10,3726	0,72681	-0,66531
AOP	17	22,159	18,5000	28,500	2,5899	0,79363	0,66267
ANN	17	12,824	5,0000	21,000	4,9904	0,34427	-1,06243
MPN	17	15,564	7,9000	21,090	3,3465	-0,17204	0,41973
MPR	17	55,941	35,0000	66,000	7,8060	-1,19775	1,89963
MSD	17	167,118	132,0000	206,000	16,9296	0,45359	1,21374
MTR	17	26,941	22,0000	32,000	2,8607	0,42996	-0,40220
MIV	17	20,831	1,0000	39,540	11,2503	-0,25596	-0,67477
MPT60	17	37,882	26,0000	48,000	5,9883	-0,23468	-0,63345
ONT	17	22,618	16,0333	27,300	3,7497	-0,63872	-0,98793
KUS	17	11,101	9,8667	13,067	0,8510	0,83937	0,31616
BAC90	17	12,000	10,0000	16,000	2,1213	0,89043	-0,52698
SKL60	17	16,941	6,0000	47,000	10,9114	1,56504	2,65593
CUC60	17	42,529	28,0000	52,000	7,0721	-0,76869	0,02633
F6	17	1072,353	790,0000	1300,000	126,5049	-0,15839	0,34035

VAR-variables, Valid N-number of entities, Mean-arithmetic mean, Std.Dev.-standard deviation

Table 1 presents standard descriptive parameters of boys judokas who underwent the three year training program at the beginning of this program.

Tab. 2. Basic descriptive parameters of boys judokas in final testing / **Tabela 2.** Podstawowe parametry opisowe chłopców džudoków w testach końcowych

VAR	Valid N	Mean	Minimum	Maximum	Std.Dev.	Skewness	Kurtosis
ATV	17	171,329	160,800	181,000	6,4381	0,010009	-1,22618
ATT	17	61,982	42,000	87,000	12,1151	0,534898	-0,28276
AOP	17	25,129	20,500	30,200	2,7633	0,131184	-1,03673
ANN	17	10,412	6,000	24,000	4,2288	2,147267	6,42853
MPN	17	11,783	7,070	18,500	3,2180	0,753171	0,00041
MPR	17	63,722	53,000	74,000	4,9073	-0,225236	0,91927
MSD	17	196,706	157,000	240,000	27,3787	0,105489	-1,08377
MTR	17	30,294	27,000	37,000	3,2358	0,791828	-0,61986
MIV	17	43,576	12,000	81,000	18,9643	0,029346	-0,44536
MPT60	17	47,294	30,000	57,000	7,8562	-0,783983	-0,16985
ONT	17	17,871	12,000	27,533	5,3527	0,417098	-1,40954
KUS	17	10,019	7,867	12,033	1,0710	-0,151488	0,03796
BAC90	17	14,059	10,000	20,000	2,8825	0,554643	-0,70995
SKL60	17	32,353	10,000	61,000	14,9078	0,242362	-0,51633
CUC60	17	52,294	41,000	61,000	5,1692	-0,280343	0,34675
F6F	17	1328,529	1029,000	1520,000	133,7615	-0,514569	-0,20244

VAR-variables, Valid N-number of entities, Mean-arithmetic mean, Std.Dev.-standard deviation

Table 1 presents standard descriptive parameters of boys judokas who underwent the three year training program at the end of this program.

Tab. 3. Mean values of participants on tests and their differences after one year training / Średnie wartości uczestników na testach i ich różnica po rocznym szkoleniu

VAR	Mean	Std.Dv.	N	t	df	p
1	2	3	4	5	6	7
ATV	154,429	5,6991				
ATVF	161,071	6,0738	17	-4,282	16	0,000572
ATT	46,259	9,7741				
ATTF	51,806	10,5597	17	-2,334	16	0,032954
AOP	22,053	2,3770				
AOPF	23,094	2,0744	17	-1,681	16	0,112103
ANN	13,824	6,3170				
ANNF	12,176	5,8227	17	1,376	16	0,187866
MPN	15,232	3,3094				
MPNF	13,518	2,7523	17	1,987	16	0,064294
MPR	54,882	8,3057				
MPRF	59,235	8,6134	17	-1,799	16	0,090852
MSD	167,647	15,6123				
MSDF	181,294	21,6182	17	-2,729	16	0,014873
MTR	27,196	2,9085				
MTRF	28,529	2,8748	17	-1,495	16	0,154457
MIV	17,994	11,1211				
MIVF	34,765	19,7350	17	-3,898	16	0,001279
MPT60	38,118	5,2307				
MPT60F	49,000	7,6893	17	-5,359	16	0,000064
ONT	22,630	4,1500				
ONTF	21,577	3,9684	17	1,651	16	0,118281
KUS	10,982	0,7317				
KUSF	10,196	0,9397	17	3,280	16	0,004714
BAC90	12,235	2,2229				

1	2	3	4	5	6	7
BAC90F	12,941	2,0454	17	-1,167	16	0,260341
SKL60	11,706	5,8712				
SKL60F	27,529	10,5955	17	-6,277	16	0,000011
CUC60	42,000	6,7268				
CUC60F	49,294	7,5974	17	-2,823	16	0,012239
F6	1118,235	84,9254				
F6F	1213,706	119,6232	17	-3,186	16	0,005742

VAR-initial result in variable, VARF-transitive result in variable, Mean-arithmetic mean, Std.Dv.-standard deviation, N-number of entities, t-t value, df- degrees of liberty, p-level of significance (0,05)

Table 3 shows the initial differences that occurred after one year training process. 12-year old judokas achieve statistically better results in 6 of 11 tests for assessment of motor abilities and in one test for assessment of functional abilities.

Tab. 4. Mean values of participants on tests and their differences after three year training / Średnie wartości uczestników na testach i ich różnica po 3-letnim szkoleniu

VAR	Mean	Std.Dv.	N	t	df	p
ATV	155,4706	5,860969				
ATVF	171,3294	6,438145	17	-13,9268	16	0,000000
ATT	48,45294	10,37257				
ATTF	61,98235	12,11514	17	-9,60927	16	0,000000
AOP	22,15882	2,589898				
AOPF	25,12941	2,763323	17	-7,96066	16	0,000001
ANN	12,82353	4,990432				
ANNF	10,41176	4,228753	17	2,296009	16	0,035523
MPN	15,56412	3,346457				
MPNF	11,78255	3,218004	17	6,101491	16	0,000015
MPR	55,94118	7,806012				
MPRF	63,72157	4,907264	17	-4,14604	16	0,000760
MSD	167,1176	16,92957				
MSDF	196,7059	27,37874	17	-6,80242	16	0,000004
MTR	26,94118	2,860738				
MTRF	30,29412	3,235829	17	-4,74383	16	0,000220
MIV	20,83059	11,25031				
MIVF	43,57647	18,96429	17	-5,50064	16	0,000048
MPT60	37,88235	5,988347				
MPT60F	47,29412	7,856245	17	-5,40706	16	0,000058
ONT	22,61765	3,749722				
ONTF	17,87078	5,352681	17	4,398378	16	0,000449
KUS	11,10098	0,850986				
KUSF	10,01853	1,070994	17	4,406249	16	0,000441
BAC90	12,00000	2,121320				
BAC90F	14,05882	2,882503	17	-4,34959	16	0,000497
SKL60	16,94118	10,91141				
SKL60F	32,35294	14,90780	17	-5,05720	16	0,000117
CUC60	42,52941	7,072108				
CUC60F	52,29412	5,169196	17	-5,84529	16	0,000025
F6	1072,353	126,5049				
F6F	1328,529	133,7615	17	-7,09311	16	0,000003

VAR-initial result in variable, VARF-final result in variable, Mean-arithmetic mean, Std.Dv.-standard deviation, N-number of entities, t-t value, df- degrees of liberty, p-level of significance (0,05)

The results in table 4 show statistically significant differences between two dependent groups of participants. Results in final measurement show statistically significant changes of anthropological status of the judokas who underwent the three year training process.

Tab.5. The results of *t*-tests for independent samples of subjects (non-athletes and judokas) at initial testing / Rezultaty testów *t* dla niezależnych próbek podmiotów (nie atletów i dżudoków) na testach początkowych

VAR	Mean J	Mean N	t	df	Valid NJ	Valid NN	p
ATV	155,471	151,1014	2,118088	85	17	70	0,037088
ATT	48,453	43,4777	1,696719	85	17	70	0,093409
AOP	22,159	21,3886	1,221804	85	17	70	0,225160
ANN	12,824	14,1714	-0,60126	85	17	70	0,549262
MPN	15,564	16,9529	-0,90096	85	17	70	0,370155
MPR	55,941	48,7500	2,900821	85	17	70	0,004737
MSD	167,118	163,2667	0,680137	85	17	70	0,498266
MTR	26,941	25,8262	1,183032	85	17	70	0,240095
MIV	20,831	24,1000	-0,67083	85	17	70	0,504143
MPT60	37,882	30,3143	3,758949	85	17	70	0,000312
F6	1072,353	992,6829	2,047296	85	17	70	0,043717

VAR-variables, Mean J-arithmetic mean of judokas, Mean N- arithmetic mean of non-athletes, t-t value, df-degrees of liberty, Valid NJ-number of judokas, Valid NN-number of non-athletes, p-level of significance (0,05)

Table 5 shows the differences between judokas and non athletes at the age of eleven, just before the three year training process started. Statistically significant changes occurred in variables: ATT – body height, MPR – straddle seated forward bent, MPT60 – sit ups in 60 seconds and F6 – 6 minute running.

Tab. 6. The results of *t*-tests for independent samples of subjects (non-athletes and judokas) at final testing / Rezultaty testów *t* dla niezależnych próbek podmiotów (nieatletów i dżudoków) na testach końcowych

VAR	Mean J	Mean N	t	df	Valid NJ	Valid NN	p
ATV	171,329	160,714	5,04622	85	17	70	0,000002
ATT	61,982	48,658	4,49477	85	17	70	0,000021
AOP	25,129	22,068	5,31013	85	17	70	0,000001
ANN	10,412	14,176	-1,91549	85	17	70	0,058641
MPN	11,783	15,368	-2,40825	85	17	70	0,018092
MPR	63,722	46,950	7,45442	85	17	70	0,000000
MSD	196,706	177,878	3,42674	85	17	70	0,000927
MTR	30,294	27,791	2,44783	85	17	70	0,016335
MIV	43,576	34,194	1,53269	85	17	70	0,128900
MPT60	47,294	36,054	6,11326	85	17	70	0,000000
F6F	1328,529	1110,581	4,76736	85	17	70	0,000007

VAR-variables, Mean J-arithmetic mean of judokas, Mean N- arithmetic mean of non-athletes, t-t value, df-degrees of liberty, Valid NJ-number of judokas, Valid NN-number of non-athletes, p-level of significance (0,05)

After the three year training process judokas were statistically significantly better than their non-athletic colleagues in nine out of eleven variables. There were no statistically significant changes only in variables ANN – upper arm skin fold and MIV – bent arm hang.

DISCUSSION

After analyzing given results one can conclude that judokas, after three year training period, have changed their anthropological status statistically significant. All tested abilities imply significant progress during observed period.

One can notice changes that took place in body height, body weight and forearm circumference, probably by influence of growth and development of children, but also reduction of upper arm skin fold. Increase of circumference of forearm in relation with reduction of upper arm skin fold implies growth in lean body tissue or muscle mass as the result of training process. One can confirm already known facts:

„Most dominant anthropometric characteristics for success in judo bout are volume and muscle mass“ [Leveritt *et al.* 1999].

Control group in the same period did not accomplish reduction in upper arm skin fold while the height, weight and forearm circumference enlarged. By given parameters one can presume that because of specific judo training in which judokas pay particular attention to reducing body fat in order to accomplish ideal proportion of muscular mass and subcutaneous fatty tissue.

„Sportsmen who are incorporated in sports such as wrestling or gymnastic have great percentage of lean body mass, which means that they by lower body mass have smaller percentage of body fat“ [Kraemer *et al.* 2006].

Although it wasn't mentioned in reference similar characteristics has judo which is structurally similar to wrestling.

In all variables for assessment of motor abilities one can notice statistically significant progress at the level of importance $p=0.01$. If the motor space is compared between experimental and control group one can notice that boys judokas accomplish statistically significant better results in two out of six variables at initial testing (table 5) and after three year training process at the final testing in five out of six variables for assessment motor abilities (table 6).

During the same project differences between 11 and 12 year old boys judokas were tested. Data in table 3. are the result of one year training process. After this period it can be noticed that judokas achieved progress in 7 out of 11 motor variables. After one year of training there is no statistically significant changes in coordination (MPN), flexibility (MPR), speed of movement (MTR) and specific endurance (BAC+2 SKL). If the data after one and three year training period are compared one can notice that the first year of judo training had the biggest influence on different aspects of strength: explosive power (MSD) and relative strength (MIV, SKL, MPT and CUC), and after the rest two year training boys judokas improved in all other variables. By following the mentioned data one can notice the dynamics of development of motor abilities during the three year of specific judo training at younger age. The plan and program for judo sport schools at this age (11–14) prescribes overcoming basic and specific ways of movement on the mat, learning hand, leg and hip throws and ground holds.

„Coordination is developed in two ways: by learning new, different structures of movement or performance of known movement structures in different conditions“ [Iglesias, Dopico 2004].

In spite of many new techniques, boys judokas learned in the first year of specific training, expected progress of coordination was not noticed. Significant progress in coordination occurred after three year training process. Statistically significant changes in the space of relative strength are conditioned by the structure of judo which demands engagement of entire body.

The strength has the biggest influence on result in judo bout [Leveritt *et al.* 1999].

Even the judokas at this age do not perform specific strength training because of it's contraindications that might occur, progress in strength happened because of practising specific judo techniques with specific judo methods such as uchi komi and nage komi in which all body muscles must be included.

Specific endurance was not improved during the first year of training process but after the three year training process one noticed the significant changes also in this aspect of motor abilities. It is well known that the specific training can't be the main goal of training process of judokas in the first years of their training but with constant improvement of their technical and tactic knowledge this ability also improved. Development of static strength after only one year of training (table 3) is explained with increase of stress because of use of grips which are first and basic condition for execution of every technical element in judo. Good and firm grip understand progress of static strength in hand, forearm, upper arm and shoulder region.

If the independent groups of 11 and 12 year old judokas are compared one can not notice any statistically significant difference [Sáez de Cosca *et al.* 2002].

One can conclude that young judokas even after one year long training process can expect improvement in static strength of arm and shoulder region.

Frequency of motion, estimated with test 15 seconds hand tapping, was improved only after three year training process. In this period of training it is necessary to conduct speed training as often as possible.

„For development of frequency of motion it is important adequate training till the age of 15. That is the time when the process of mielisation of nerve paths, which conduct nerve impulses, ends“ [Franchini 2001].

Flexibility of back and upper leg was statistically significant improved after three year of training, but even after the first year judokas had better results than the boys non-athletes.

„Dynamic, active flexibility is also important for judo sport and can have great influence on certain techniques in offence and defense. Hip and back mobility (especially lumbal part of back) play important role in judo sport“ [Leveritt *et al.* 1999].

Aerobic abilities are the basis for all other functional abilities. Already in the first year judo training had great influence on this ability and after the three-year training process statistically significant difference in test F6 is even bigger. Comparison between experimental and control group between initial and final testing showed improvement of difference in benefit of young judokas.

CONCLUSION

Upon analyzing the whole three-year training process it can be concluded that participation in judo program in adolescents significantly influences the positive development of all analyzed abilities and features. Structural, biomechanical, anthropometrical, motor and functional characteristics of judo imply that judo is sport of great complexity and that it can have strong influence on anthropological characteristics of young boys during the period of growth and maturation. Because of good progress in all tested abilities and characteristics it can be also concluded that the training process in judo sport schools is well planned and quality designed. Progress in technical and tactical knowledge can be the main goal for some other research.

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Słowa kluczowe: cechy antropologiczne, dżudocy, sportowe szkoły dżudo, proces transformacji

STRESZCZENIE

Niniejsza praca jest podsumowaniem badań nad motorycznymi i fizjologicznymi zdolnościami oraz cechami antropologicznymi młodych dżudoków w ciągu 3-letniego szkolenia. Celem pracy było zidentyfikowanie rezultatów szkolenia dżudo i procesów transformacji wśród 17 chłopców w wieku do 11 do 14 lat. Rezultaty testu składającego się z 16 elementów wykazały znaczne pozytywne zmiany w analizowanych zdolnościach i cechach.

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