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Differences in Anthropologic Characteristics between Kinesiologically Active and Inactive Female Students

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A B S T R A C T

On the sample of 156 female students in the first and the second year of the Faculty of Philosophy in Split, aged 18–20, we have analyzed the differences in certain dimensions of the anthropological system between the students who were or are still engaged in different aspects of sport activities and students who have never been engaged in any sport activities. To assess the anthropological status we used 15 tests, 4 out of which were used to assess morphological characteristics, 7 to assess motor abilities and 4 to assess personal characteristics. By multivariant analysis of variance, we established statistically significant differences on the level $p<0.05$ in a framework of anthropological variables defined in this way. By univariant analysis of variance, we established that students who have never been engaged in a sport have a statistically significant larger amount of sub-skin fat tissue, while the students who were or are still engaged in sport activities have statistically significant higher level of coordination of their whole body. We established no statistically significant differences in the variables for personal characteristics. The results of research reveal that sport engagement mostly contributes to differences in the morphological characteristics and motor abilities.

***Key words**: female students, morphology, motor abilities, kinesiologic activity, extraversion*

Introduction

In addition to energy, oxygen and water, muscle activity presents a biotic need of a man to maintain living[1,2]. A need to move is present in contemporary society also marked by hypokinesia, excessive nutrition and stress[3]. It is a well-known fact that hypokinesia at a child's age harms biological growth and development, health in adults, while, at an older age, inactivity can be fatal[4]. Physical activity naturally and interactively engages the systems and physiological processes in an organism, particularly the muscle, vascular and respiratory system[5,6]. However, positive influences can only be achieved by regular exercising and with weight loads appropriate to one's age, medical condition and the level of physical potential in an organism.

This effect is proportional to the extensity and intensity of the subject's exposure to kinesiologic activity. Regular performance of kinesiologic treatments will result in favorable modifications of various anthropologic system dimensions such as morphological characteristics, psychological characteristics, sociological features, cognitive, motor and functional abilities as well as medical condition[7,8], which in turn will reflect in the subject's efficient functioning also in non-kinesiologic conditions.

Starting from the importance of physical activity for improving anthropological status, the aim of the present study was to assess differences only in particular anthropologic system dimensions (anthropometric characteristics, motor abilities and personal characteristics) between female students previously or currently engaged in various forms of kinesiologic activity and those without such previous or current involvement.

The motor and psychomotor abilities are among the most complex and least investigated anthropologic status components. They are defined as the ability of performing motor activities efficiently relative to the basic physical parameters of time, space and force. These abilities are of great importance for success in kinesiologic activities and in daily life activities. Some motor abilities are more liable to genetic influences and others to social impact and kinesiologic transformation procedures[9,10].

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Thus e.g. some neuro-muscular abilities based on the mechanism for the regulation of stimulus intensity, such as the speed of single moves or explosive power, or the abilities based on the mechanisms for stimulus regulation, synergy regulation and tonus regulation, such as coordination or balance, can be influenced to a lesser extent, while the abilities based on the mechanisms for the regulation of stimulus endurance and energy regulation, such as repetitive or static power, can be influenced to a much larger extent[11–14].

Personality traits are relatively stable and largely genetically determined[15] components of the anthropologic status. The role of psychological properties in kinesiologic activities has been increasingly recognized, but at the same time, it has been discovered that by kinesiological activities one can, e.g. raise the level of frustration tolerance, improve psychological stability and adaption to stressful and emotionally demanding situations, increase motivation, self-motivation, positive emotions and cheerful temper, improve self-control and openness, and reduce anxiety[16,17].

Morphological characteristics that determine the built of the human body are to a large extent subjected to changes under the influence of kinesiological activities in bone, and particularly in muscle and fat tissue[18,19]. Under the influence of exercising, muscle tissue increases its volume (hypertrophy) and strength, which leads to a better capilarisation, to the increase of energy reserves in a muscle (glycogen, myoglobin, phospholipids, phosphates) and the concentration of minerals. The biggest changes happen with the reduction of fat tissue which happens only by long-lasting cyclical activities of moderate and medium intensity in aerobic work conditions. The best results in the reduction of fat tissue can be achieved by combining the mentioned activities and an appropriate diet[20,21].

Subjects and Methods

Subject sample

The study included 156 female students from the University of Split, School of Liberal Arts, aged 18–20 years. The sample involves all full-time female students in the second year of the Teacher Training College over a three-year period from 2007 to 2009, which are clinically healthy and capable of performing kinesiologic activities.

Study subjects were classified into two groups according to their involvement in kinesiologic activities: subjects neither previously nor currently involved in any form of self-initiative or organized recreation or sport kinesiologic activity, and subjects previously or currently engaged in some form of self-initiative or organized recreation or sport kinesiologic activity. Kinesiological engagement of the respondents has been determined by an anonymous survey on a binary scale.

Variable sample

Anthropologic status was assessed by 15 tests, including 4 tests to assess morphological characteristics, 7 tests for motor abilities, and 4 tests for personality traits. Eysenck's factor multidimensional personality questionnaire consisting of 90 questions was employed for assessment of personality conative traits. The advantages of this questionnaire are its economical quality, standard application, objectivity, practical use, and brief and simple instructions. Four prediction variables, i.e. conative factors were analyzed by the questionnaire: extraversion, psychoticism, neuroticism, and sincerity[15,22]. Answers were of two-item type, affirmative (answer yes) or rejecting the thesis (answer no). Personality testing was performed by a qualified psychologist, in line with ethical code of the Croatian Society of Psychologists.

Motor efficiency was assessed by 7 tests of basic motor abilities: standing long jump (MSDM) for assessment of explosive strength in terms of horizontal take-off, measured in centimeters; 20m run (M20M) for assessment of speed strength, measured in seconds; »Japan test« (MJAP) for assessment of agility in the aspect of speed of the change of course direction for 180 degrees, measured in seconds; polygon backward (MPOL) for assessment of whole body coordination in the aspect of speed of the change of course direction for 180 degrees, measured in seconds; forward bow (MRAS) for assessment of flexibility, measured in centimeters; hand tapping (MTAP) for assessment of hand movement frequency, measured by the number of repeating a movement over a 15-second interval; and sit-ups (MPTR) for assessment of the anterior trunk repetitive strength, measured by the number of repeating a movement over a 30-second interval. These are standard tests with tested metrical characteristics of validity, reliability, sensitivity and pragmatics which have been used for ages in the Republic of Croatia to evaluate motor ability[23], and most of them are the official tests to observe and evaluate Physical education classes in the school system in the Republic of Croatia[24]. The respondents did each test three times, and the best result was taken for the analysis. Three competent, authorized and agreed kinesiologists did the testing of motor abilities in all the students in a way that every year, on the same day, the same two kinesiologists did two tests, and the third one did three tests.

Morphological characteristics were assessed by the measures of body weight, body height, forearm circumference and forearm skinfold. All the mentioned measures are a part of the standard anthropometric measures according to IBP and they are presented by their responding units of measure with an accuracy of abbreviation to the first decimal place. The same competent kinesiologist did the measuring of all anthropometric characteristics in all the students, doing the measuring every year in one day. Each measuring was done three times, and the average result was taken for the analysis.

Data analysis

On descriptive analysis, the following parameters were calculated: arithmetic mean ($\overline{X}$); minimal and maximal result (MIN, MAX); standard deviation (SD); asymmetry coefficient (SKEW); and distortion coefficient (KURT). Kolmogorov-Smirnov test was used to test for distribution normality (MAXD).

Differences in anthropologic characteristics between the students engaged and those not engaged in kinesiologic activities were determined by multivariate and univariate analysis of variance.

Results

The basic descriptive statistics parameters of the motor, morphological and psychological space variables are presented in Table 1.

All variables showed normal distribution, without significant deviation from the normal distribution, thus being eligible for further multivariate analysis.

Comparison of the results obtained in study subjects with the results of motor ability testing performed in the age-matched population at large[22,25] and with standard values of motor abilities of high-school fourth-year female students[24] yielded no significant differences, i.e. the results recorded in the present study were consistent with the average values for this population in Croatia. There were no significant differences in morphological variables relative to previous studies either[26].

Comparison of the results recorded in our study population of female students with those reported for the population of female athletes[26–28] revealed the former to be characterized by a lower level of psychoticism and extraversion, as expected considering the specific demands associated with systematic training processes in sports and the fact that female athletes are more open to the environment than the general population[25,28]. Results of the analysis of variance are shown in Table 2.

Multivariate analysis of variance yielded statistically significant differences at the level of $p<0.05$ in the defined system of anthropological variables between the students that have never been involved in any form of kinesiologic activity and those previously or currently engaged in some form of kinesiologic activity. In the space of morphological variables, univariate analysis of variance produced a statistically significant difference only in the variable of subcutaneous adipose tissue.

In the motor space, as expected, the students not engaged in kinesiologic activities showed a lower level of most motor abilities, however, a statistically significant difference was only recorded in the variable for assessment of whole body coordination, where the students previously or currently involved in kinesiologic activities proved superior.

In the psychological space described by personality traits, there were no statistically significant differences between the students engaged and those not engaged in kinesiologic activities. Yet, greater differences were found in the variables of extraversion and sincerity in favor of the students previously or currently involved in sports activities, but not on the level of the statistic significance.

TABLE 1
BASIC DESCRIPTIVE AND DISTRIBUTION PARAMETERS OF VARIABLES (N=156)

Var	$\overline{X}$	Min	Max	SD	Skew	Kurt	MaxD
Body height	170.39	157.00	188.00	5.47	0.23	0.27	0.06
Body weight	61.00	47.50	96.50	8.18	1.48	3.33	0.11
Forearm circumference	22.89	13.00	28.50	1.90	–1.00	6.39	0.11
Upper arm skinfold	12.88	5.00	36.00	4.86	0.85	2.42	0.06
Standing long jump	176.69	135.00	240.00	16.47	0.11	0.78	0.05
Polygon backward	11.96	7.30	19.10	2.17	0.78	0.85	0.06
Forward bow	69.21	39.00	98.00	12.03	–0.14	–0.32	0.07
Sit-ups	23.96	13.00	40.00	4.20	0.62	2.28	0.11
Hand tapping	36.82	19.00	47.00	3.71	–0.78	3.37	0.11
20-m run	4.30	3.69	5.80	0.37	1.79	4.13	0.13
»Japan test«	18.39	15.02	22.94	1.49	0.34	–0.27	0.08
Psychoticism	3.66	0.00	12.00	2.41	0.71	0.47	0.12
Extraversion	15.23	2.00	21.00	3.25	–1.12	1.78	0.13
Neuroticism	10.10	0.00	22.00	4.40	0.39	–0.07	0.10
Sincerity	10.06	1.00	17.00	3.37	0.10	–0.46	0.13

Test = 0.13
$\overline{X}$ – arithmetic mean; Min – minimal value; Max – maximal value; SD – standard deviation; Skew – Skewness; Kurt – Kurtoses; MaxD – Maximal deviation of relative cumulative empirical frequency from relative cumulative theoretical frequency; Test – criterion value of the Kolmogorov-Smirnov test for testing the normality of distribution at the error tolerance level of 5%

TABLE 2
ANALYSIS OF VARIANCE (MANOVA/ANOVA)

Wilks' λ = 0.83	Rao's R=1.90	df 1=15	df 2=140	p=0.03
Variable	$\overline{X}_1$ (N=69)	$\overline{X}_2$ (N=87)	F	p
Body height	170.97	169.93	1.40	0.24
Body weight	61.55	60.56	0.56	0.46
Forearm circumference	23.22	22.63	3.77	0.06
Upper arm skinfold	14.22	11.83	9.80	0.00
Standing long jump	175.45	177.68	0.70	0.40
Polygon backward	12.41	11.59	5.68	0.02
Forward bow	67.57	70.52	2.32	0.13
Sit-ups	24.03	23.91	0.03	0.86
Hand tapping	37.10	36.60	0.71	0.40
20-m run	4.32	4.28	0.42	0.52
»Japan test«	18.42	18.36	0.07	0.79
Psychoticism	3.83	3.53	0.59	0.45
Extraversion	14.88	15.51	1.41	0.24
Neuroticism	9.90	10.25	0.25	0.62
Sincerity	10.49	9.71	2.07	0.15

Wilks' λ – Wilks' lambda value; Rao's R – Rao's value; df1/df 2 – respective values of the degree of freedom; p – significance level; $\overline{X}_1$ – arithmetic means first group (kinesiological nonactivity student); $\overline{X}_2$ – arithmetic means second group (kinesiological activity student); F – F values of statistical significance testing

Discussion and Conclusion

Multivariate analysis of variance revealed the kinesiologic activities to greatly influence the anthropologic status of persons involved in sports activities. Kinesiologic treatments and processes can considerably modify all aspects of the anthropologic status, such as health, sociologic, functional, mental, as well as motor, morphological and psychological components investigated in this study. The magnitude and structure of these changes depend on an array of factors, in particular intensity and extensity of physical exercise.

The students neither previously nor currently involved in sports activities had a considerably greater amount of subcutaneous adipose tissue than those with past or present history of sports activities. This is logical and consistent with the results of many previous studies[29]. Subcutaneous adipose tissue is inactive ballast tissue that represents a contraindication for the majority of sports activities and greatly reduces athlete performance, especially in energy demanding and time-consuming sports[30]. Therefore, in most sports disciplines, it is of great importance that the athletes have the least possible amount of subcutaneous adipose tissue. On the other hand, adipose tissue is efficiently reduced with regular involvement in kinesiologic activities, along with appropriate dietary regime. Reduction of adipose tissue can best be achieved by persistent and long-standing cyclic kinesiologic activities of aerobic type of low and moderate intensity. Thus, involvement in sports activities could be presumed to have contributed to the reduction of subcutaneous adipose tissue in this group of study students. Such an effect can have favorable impact on many other aspects of a person, such as health, sociologic, psychological and cosmetic domains.

Although the students not engaged in sports activities showed lower levels of most motor abilities, a statistically significant difference was only recorded in the variable assessing whole body coordination, where the students previously or currently engaged in sports activities proved superior. Whole body coordination is a motor ability of high relevance for performance in all kinesiologic activities, including mono-structural cyclic activities of a relatively simple structure. In the present study, this ability was measured by the polygon backward test, which requires rapid restructuring of the movement stereotype and maximal engagement of the mechanism for synergistic movement regulation. Some cognitive abilities such as spatial and temporal orientation, spatial factor and fast processing of kinesthetic information are also important for this test performance. Lower body dimensionality is also desirable, in particular in terms of the lowest possible amount of adipose tissue, which is characteristic of the individuals involved in kinesiologic activities. Although this ability is to a great extent genetically determined, it can still be maintained and promoted by target kinesiologic treatments, and probably it was the reason why differences between the students engaged and those not engaged in sports activities manifested most intensely in this ability. In addition, the students were most extensively involved in sports activities

in the form of sports games or esthetic movements, which are highly demanding in terms of coordination, which could therefore exert favorable effects on upgrading this particular ability.

Although there were no statistically significant differences in personality traits, some differences were observed in the variables of extraversion and sincerity in favor of the students previously or currently involved in sports activities. Most kinesiologic activities require high levels of dynamics, communicativeness, frankness, and cooperation with other participants. Constant confrontation with the opponent or physically demanding circumstances requires controlled and target impulsiveness and aggressiveness, readiness to accept the risk, and fast reaction in dynamic conditions. Therefore, kinesiologic engagement correlates positively with extraversion because kinesiologically active persons make communication and contacts more readily than physically inactive ones. Extraversion is one of the recognizable properties of individuals involved in kinesiologic activities[31,32]. In the literature, extraversion is defined by characteristics such as sociability, light-heartedness, predominance, activity and warmth, venturesome and lively spirit, and correlates significantly with pleasant emotions such as joy and happiness. Some studies show that extraversion is associated with the behaviors directed towards health[33], and to some objective physical symptoms. Accordingly, extraversion could be associated with blood pressure, epinephrine and norepinephrine secretion, and NK cell cytotoxicity[34].

The methodological aspect of this study did not allow for detection of the exact causes of the differences recorded in the variable of extraversion; however, it appears quite logical to attribute them to a combination of two factors. On the one hand, it could be postulated that these differences support the fact that extravert students with a predominant motor potential and emphasized need for movement were more frequently involved in sports activities than physically inactive and introvert ones; on the other hand, the intensive and frequent involvement in sports activities may be presumed to have resulted in a higher level of extraversion in physically active students. In addition, the students not engaged in sports activities were characterized by a higher level of insincerity as compared with the students involved in kinesiologic activities, but the difference was not statistically significant. Additional studies are warranted to test the thesis that involvement in kinesiologic activities contributes to sincerity and reduces the need of creating a false image of oneself by hiding some imperfections.

The recapitulation of the results of this research reveals that students engaged or previously engaged in kinesiological activities are superior in most of the anthropological features, in some even on the level of statistic significance. The results of research prove a thesis confirmed for a numerous number of times that kinesiological activities can positively influence the transformation of various anthropological features. However, the fact that some previous researches revealed even more significant differences in anthropological features between kinesiologically active and inactive entities[35] than this research, likely proves an insufficient kinesiological engagement of female students. It can be assumed that intensity and extensity of their kinesiological engagement was not on the level which could guarantee a more stressed and more global changes of their anthropological status on the whole. At the same time, this leads to a conclusion that in the future, we should give much more attention to the sport and kinesiological culture of the student population in Split.

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REFERENCES

1. MALINA RM, BOUCHARD C, BAR-OR O. Growth, Maturation, and Physical Activity. (Human Kinetics Book-Second Edition, Champaign, 2004). — 2. ABERNETHY B. The biophysical Foundations of Human Movement. (Human Kinetics Book, Champaign, 2005). — 3. WARBURTON DER, WHITNEY N C, BREDIN SDS. Canadian Medical Association, 6 (2006) 801. DOI: 10.1503/cmaj.051351. — 4. GALLAHUE, DL, DONNELLY FC. Developmental physical education for all children (Human Kinetics Book, Champaign, 2003). — 5. BORER KT. Sports Med. 20 (1995) 375. DOI: 10.2165/00007256-199520060-00004. — 6. CHENG YJ, MACERA CA, ADDY CL, SY FS, WIELAND D, BLAIR SN, Sports Med, 37 (2003) 521. — 7. BEEDIE CJ, TERRY PC, LANE AM, Journal of Applied Sport Psychology, 12 (2000) 49. DOI: 10.1080/10413200008404 213. — 8. ROWLAND TW, Sports Medicine, 10 (1990) 255. DOI: 10.2165/ 00007256-199010040-00004. — 9. BOMPA TO, Theory and methodology of training. The key to athletic performance. (Kenda/Hunt Publishing Company, USA, 1994). — 10. BEHM DG, BAMBURY A, CAHILL F, POWER K, Med Sci Sports Exerc, 36 (2004) 1397. DOI: 10.1249/01.MSS. 0000135788.23012.5F. — 11. LEES A, VANRENTERGHEM J, DE CLERCQ D, J Strenght Cond Res, 18 (2004) 787. DOI: 10.1519/00124278-20041 1000-00018. — 12. YOUNG WB, MCDOWELL MH, SCARLETT BJ, J Strength Cond Res, 15 (2001) 315. DOI: 10.1519/00124278-200108000-00009. — 13. ISLAM MM, NASU E, ROGERS ME, KOIZUMI D, ROGERS NL, TAKESHIMA N, Preventive Medicine, 39 (2004) 1148. DOI: 10.1016/j.ypmed. 2004.04.048. — 14. TODOROV E, JORDAN MI, Nature Neurosci, 5 (2002) 1226. DOI: 10.1038/nn963. — 15. EYSENCK H J, EYSENCK SBG, Psychological measure instruments: Eyscenk's scales of personality. (Naklada Slap, Jastrebarsko, 1994). — 16. HANIN YL, Emotions in Sports. (Human Kinetics, Champaign, 2000). — 17. SALMINEN S, LIUKKONEN J, HANIN YL, HYVONEN A, Pers Indiv Differ, 19 (1995) 725. DOI: 10.1016/0191-8869(95)00096-O. — 18. LOHMAN TG, Advances in Body Composition Assessment. (Human Kinetics Book, Champaign, 1992). — 19. MALOUSARIS GG, BERGELES NK, BARZOUKA KG, BAYIOS IA, NASSIS GP, KOSKOLOU MD, J Sci Med Sport, 11 (2008) 337. — 20. CATENACCI VA, WYATT HR, Nat Clin Pract Endoc, 3 (2007) 518. DOI: 10.1038/ncpendmet0554. — 21. MOORE MS, P Nutr Soc, 59 (2000) 193. DOI: 10.1017/S0029665100000215. — 22. EYSENCK, HJ, EYSENCK SBG, Manual of the Eysenck's Personality Questionnaire. (Naklada Slap, Jastrebarsko, 2003). — 23. PAVIĆ R, TRNINIĆ V, KATIĆ R, Coll Antropol, 32 (2008) 829. — 24. FINDAK V, METIKOŠ D, MRAKOVIĆ D, NELJAK B, Applied Kinesiology in Education – Norms. (Hrvatski pedagoško književni zbor, Zagreb, 1996). — 25. BRATKO D, Drus Istraz, 11 (2002) 623. — 26. ROGULJ N, NAZOR M, ČAVALA M, SRHOJ LJ, MIHALJEVIĆ D, Differences in personality traits in motor efficient and inefficient female students. In: Proceedings. (5th International Sci-

entific Conference on Kinesiology, Zagreb, 2008). — 27. ROGULJ N, NAZOR M, SRHOJ V, Personality traits of Croatian elite female handball players at different playing positions. In: Proceedings. (1st International Conference Contemporary Kinesiology, Kupres, 2006). — 28. ROGULJ N, SRHOJ V, NAZOR M, SRHOJ LJ, ČAVALA M, Coll Antropol, 29 (2005) 705. — 29. LASAN M, KATIĆ R, Coll Antropol, 24 (2000) 467. — 30. KATIĆ R, SRHOJ LJ, PAŽANIN R, Coll Antropol, 29 (2005) 711. — 31. DOUCET C, STELMACK RM, Pers Indiv Differ, 23 (1997) 775. DOI: 10.1016/S0191- 8869(97)00104-9. — 32. MARINOVIĆ M, Motivation and personality traits of sportsmen in different sports. In: Proceedings. (6th Annual Congress of the European College of Sport Science, Cologne, 2001). — 33. JERRAM K, COLEMAN PG, Brit J Health Psych, 4 (1999) 181. DOI: 10.1348/135910799168560. — 34. MILLER GE, COHEN S, RABIN BS, SKONER DP, DOYLE WJ, Brain Behav Immun, 13 (1999) 109. DOI: 10.1006/brbi.1998.0545. — 35. MARKUŠ D, ANDRIJAŠEVIĆ M, PRSKALO I, Odgojne Znan, 10 (2008) 349.

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RAZLIKE ANTROPOLOŠKIH ZNAČAJKI KINEZIOLOŠKI AKTIVNIH I NEAKTIVNIH STUDENTICA

S A Ž E T A K

Na uzorku od 156 studentica I i II godine Filozofskog fakulteta u Splitu, starosti 18–20 godina, analizirane su razlike u pojedinim dimenzijama antropološkog sustava između studentica koje su bile, ili su angažirane različitim vidovima sportskih aktivnosti i studentica koje nisu nikada bile angažirane sportskim aktivnostima. Za procjenu antropološkog statusa korišteno je 15 testova od kojih 4 za procjenu morfoloških karakteristika, 7 za procjenu motoričkih sposobnosti i 4 za procjenu crta ličnosti. Multivarijatnom analizom varijance utvrđene su statistički značajne razlike na razini p<,05 u ovako definiranom sklopu antropoloških varijabli. Univarijatnom analizom varijance utvrđeno je da studentice koje nisu nikada bile sportski angažirane imaju statistički značajno veću količinu potkožnog masnog tkiva, a studentice koje su bile, ili su angažirane sportskim aktivnostima imaju statistički značajno veću razinu koordinacije cijelog tijela. Statistički značajne razlike nisu zabilježene u varijablama crta ličnosti. Rezultati istraživanja ukazuju da sportski angažman najviše doprinosi razlikama u morfološkim karakteristikama i motoričkim sposobnostima.