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KVANTITATIVNE RAZLIKE U OKVIRU ANTROPOMETRIJSKOG PROSTORA KOD UČENICA SREDNJIH ŠKOLA

1. Introduction

Physical development of the individual is generally known to depend on the cumulative effects of both subjective and objective development factors. Naturally, the major of the subjective factors is that of the genetic code, whereas the objective factors are mainly influenced by the social, economic, geographic and climatic conditions as well as personal physical activity. Physical activities play an important part in the personal growth and development, which is manifested in a series of the organic systems and their functioning. The effect is most obviously and manifestly recorded with the musculature, the skeleton, the cardiovascular system and the respiratory system.

Following the core curriculum, classes in physical education at high school are meant to be one of the forms to carry out physical activities with the students. The students' achievements largely depend on more than one factor affecting the whole realization of the educational curriculum. Thus one of the essential factors appears to be the working conditions available in schools.

The subject of this research are female students at high school who regularly attend classes of physical education. The aim of the study is to determine the quantitative differences within the anthropometric space with the variables assessing the transversal dimension and the subcutaneous fatty tissue with female students attending their regular class activities held in different working conditions.

2. Work Methods

The research is conducted on three sub-samples of female students, i.e. it includes a total of 183 entities ranging in age from 15 to 16; who regularly attend classes in physical education at high school.

The schools included in the research are classified in accordance with the working conditions they provide for the educational curriculum, and regarding this the following sub-samples are defined:

- The first sub-sample consists of 49 entities attending classes in a school of bad working condition (this means a school only possessing outdoor playgrounds for handball, basketball and volleyball; there is no indoor sports facility and education is held in an improvised manner, in unsuitable premises).

- The second sub-sample consists of 63 entities attending classes in schools of approximately good working conditions (i.e. the schools possess outdoor playgrounds for handball, basketball and volleyball; there is an indoor sports hall which is either not

equipped or is reorganized into a gymnastic hall which is poorly equipped, without the necessary visual aids and without facilities for demonstrative training methods).

- The third sub-sample consists of 71 entities attending classes in a school of good working conditions (i. e. the school possesses outdoor sports playground facilities- a handball, a basketball and a volleyball playground; there are an indoor sports hall and a gymnastics hall equipped with visual aids and facilities for demonstrative training methods).

The general sample is tested by seven anthropometric measures, four of which treat the estimation of circular dimension: upper arm diameter (AONL), forearm diameter (AOPL), calf diameter (AOPK), and average stomach volume (ASOS); and three of the measures are variables treating the subcutaneous fatty tissue: upper arm skinfold thickness (AKNN), abdominal skinfold thickness (AKNS), and back skinfold thickness (AKNG). They are applied in accordance with International Biological Programme and following the description presented by Hristov (Христов,1992).

In order to assess if there are any differences between the students, regarding the working conditions in which the activities of physical education are held, the following methods are applied: univariate analysis of variance (ANOVA), t-test for treating the difference between the arithmetic means of sub-samples, and multivariate analysis of variance (MANOVA).

3. Results and Discussions

Having inspected table 1, which represents the results of the multivariate analysis of variance (MANOVA) of the applied variables for assessing the anthropometric characteristics, and evaluations obtained from processing the sub-samples, it is determined that there are significant differences between the sub-samples at the level of 0.05 worth in the whole analysed anthropometric space. On the ground of the results, Wilk's Lambda has a 0.77 worth which, together with Rao's F approximation worth of 3, 54 and the levels of freedom (Df1=14 and Df2=348), presents significance of the differences $Q=0.00$ (p level=0.00) of the whole analysed space.

Table 1. Multivariate analysis of variance of the anthropometric space

| Wilks' Lambda | Rao's R | df 1 | df 2 | p-level |
|---------------|---------|-------|--------|---------|
| 0,77 | 3,54 | 14,00 | 348,00 | 0,00 |

On the base of the applied univariate analysis of variance (ANOVA) in table 2, statistically significant difference is proved at the level of 0,05 worth with the variable of average volume of stomach only (ASOS). The differences with the rest of the variables are not statistically significant.

Table 2. Univariate analysis of variance of the anthropometric space for assessing the circular dimension and subcutaneous fatty tissue with female students attending class activities in different working conditions

| Variables | Group | X | SD | F | p-level |
|-----------|-------|-------|------|------|---------|
| AONL | 1 | 25,21 | 2,07 | 0,12 | 0,89 |
| | 2 | 25,11 | 2,64 | | |
| | 3 | 25,01 | 1,87 | | |
| AOPL | 1 | 24,43 | 2,24 | 1,41 | 0,25 |
| | 2 | 23,73 | 2,44 | | |
| | 3 | 24,03 | 1,88 | | |
| AOPK | 1 | 34,26 | 2,58 | 0,78 | 0,46 |
| | 2 | 33,73 | 3,10 | | |
| | 3 | 34,24 | 2,18 | | |
| ASOS | 1 | 76,82 | 6,47 | 9,60 | 0,00 |
| | 2 | 81,52 | 6,63 | | |
| | 3 | 81,18 | 5,57 | | |
| AKNN | 1 | 6,85 | 3,64 | 1,97 | 0,14 |
| | 2 | 8,12 | 3,83 | | |
| | 3 | 7,39 | 2,87 | | |
| AKNS | 1 | 12,55 | 5,56 | 1,38 | 0,25 |
| | 2 | 14,27 | 5,45 | | |
| | 3 | 13,52 | 5,34 | | |
| AKNG | 1 | 10,14 | 5,09 | 0,83 | 0,44 |
| | 2 | 11,27 | 4,77 | | |
| | 3 | 10,55 | 4,44 | | |

In order to establish the right sub-samples responsible for the differences, t-test for assessing differences within the arithmetic means of each variable are done considering each two sub-samples separately.

Inspecting table 3, it is obvious that considering the sub-sample attending class activities in bad working conditions and the sub-sample held in approximately good working conditions, statistically significant differences are determined with regard to the variable of average volume of stomach (ASOS), at the level of $Q=0.00$. With the rest of the variables between these two sub-samples, significant differences are not recorded.

Table 3. t-test between the sub-samples of students attending class activities in bad (1) and approximately good working (2) conditions

| Variables | Group | X | SD | F | p-level |
|-----------|-------|-------|------|------|---------|
| AONL | 1 | 25,21 | 2,07 | 0,22 | 0,82 |
| | 2 | 25,11 | 2,64 | | |
| AOPL | 1 | 24,43 | 2,24 | 1,55 | 0,12 |
| | 2 | 23,73 | 2,44 | | |
| AOPK | 1 | 34,26 | 2,58 | 0,95 | 0,34 |
| | 2 | 33,73 | 3,10 | | |

| | | | | | |
|------|---|-------|------|-------|------|
| ASOS | 1 | 76,82 | 6,47 | -3,76 | 0,00 |
| | 2 | 81,52 | 6,63 | | |
| AKNN | 1 | 6,85 | 3,64 | -1,79 | 0,08 |
| | 2 | 8,12 | 3,83 | | |
| AKNS | 1 | 12,55 | 5,56 | -1,64 | 0,10 |
| | 2 | 14,27 | 5,45 | | |
| AKNG | 1 | 10,14 | 5,09 | -1,20 | 0,23 |
| | 2 | 11,27 | 4,77 | | |

Table 4. *t*-test with the sub-sample of students attending class activity in bad working (1) conditions and that of students held in good working (3) conditions

| Variables | Group | X | SD | F | p-level |
|-----------|-------|-------|------|-------|---------|
| AONL | 1 | 25,21 | 2,07 | 0,54 | 0,59 |
| | 3 | 25,01 | 1,87 | | |
| AOPL | 1 | 24,43 | 2,24 | 1,08 | 0,28 |
| | 3 | 24,03 | 1,88 | | |
| AOPK | 1 | 34,26 | 2,58 | 0,04 | 0,97 |
| | 3 | 34,24 | 2,18 | | |
| ASOS | 1 | 76,82 | 6,47 | -3,95 | 0,00 |
| | 3 | 81,18 | 5,57 | | |
| AKNN | 1 | 6,85 | 3,64 | -0,91 | 0,37 |
| | 3 | 7,39 | 2,87 | | |
| AKNS | 1 | 12,55 | 5,56 | -0,97 | 0,33 |
| | 3 | 13,52 | 5,34 | | |
| AKNG | 1 | 10,14 | 5,09 | -0,46 | 0,65 |
| | 3 | 10,55 | 4,44 | | |

Inspecting table 4, it is obvious that considering the sub-sample of students attending class activities in bad working conditions and that of students held in good working conditions, statistically significant differences are recorded with regard to the variable of average stomach volume (ASOS) at the level of $Q=0.00$. With the rest of the variables between these two sub-samples, significant differences are not recorded.

Inspecting table 5, it is obvious that considering the sub-samples of students attending class activities in approximately good working conditions and those held in good working conditions, statistically significant differences are not recorded with neither of the treated anthropometric variables.

Table 5. *t*-test with the sub-sample of students attending class activities in approximately good working (2) conditions and that of students held in good working (3) conditions

| Variables | Group | X | SD | F | p-level |
|-----------|-------|-------|------|-------|---------|
| AONL | 2 | 25,11 | 2,64 | 0,24 | 0,81 |
| | 3 | 25,01 | 1,87 | | |
| AOPL | 2 | 23,73 | 2,44 | -0,78 | 0,44 |
| | 3 | 24,03 | 1,88 | | |

| | | | | | |
|------|---|-------|------|-------|------|
| AOPK | 2 | 33,73 | 3,10 | | |
| | 3 | 34,24 | 2,18 | -1,10 | 0,27 |
| ASOS | 2 | 81,52 | 6,63 | | |
| | 3 | 81,18 | 5,57 | 0,32 | 0,75 |
| AKNN | 2 | 8,12 | 3,83 | | |
| | 3 | 7,39 | 2,87 | 1,27 | 0,21 |
| AKNS | 2 | 14,27 | 5,45 | | |
| | 3 | 13,52 | 5,34 | 0,80 | 0,43 |
| AKNG | 2 | 11,27 | 4,77 | | |
| | 3 | 10,55 | 4,44 | 0,91 | 0,36 |

Researches of similar issue have been conducted by more authors, and some of them are the following: Kurelić, & coll. (1975), Kovač, Leskošek, & Strel (2007), Ma- jerić (2004) and Mitrevski (Митревски, 2009).

4. Conclusion

On the ground of the presented results, the following can be concluded:

Statistically significant differences exist between the sub-samples of students attending class activities in different working conditions with regard to the whole analysed anthropometric space.

Single statistically significant differences within the arithmetic means are re- corded with the variable of average stomach volume (ASOS). This difference is deter- mined between the sub-samples of students attending class activities in bad and in ap- proximately good working conditions, as well as between the sub-sample of bad and that of good working conditions.

With the rest of the variables for assessing the circular dimension and the vari- ables for assessing the subcutaneous fatty tissue that define the anthropometric space, statistically significant differences are not recorded.

5. Literature

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QUANTITATIVE DIFFERENCES WITHIN ANTHROPOMETRIC SPACE WITH FEMALE STUDENTS AT HIGH SCHOOL

The aim of this research is to determine the differences within anthropometric space with female students attending the regular class activity in physical education at school, the activities being held in different working conditions. Depending on these conditions the female students are divided into three (3) sub-examples, or the research includes a total of 183 entities. The analyses of results makes use of seven anthropometric parameters four of which treat the circular dimension and three treat subcutaneous fatty tissue. In order to determine differences between the three groups of female students according to the working conditions in class, the following analyses are used: univariate analysis of variance (ANOVA), t-test, and multivariate analysis of variance (MANOVA). The obtained data points at statistically significant differences between the groups within the whole space of anthropometric analysis. Arithmetic means are analysed between the groups with regard to all variables, and between the arithmetic means statistically significant differences are only determined with the variable of average volume of stomach (ASOS), whereas with the rest of variables statistically significant differences are not marked.

Key words: *parameters, working conditions, class in physical education, differences between the groups, analysis of variance (ANOVA), multivariate analysis of variance (MANOVA).*