

# SEMMELWEIS UNIVERSITY DOCTORAL SCHOOL



## COMPARATIVE STUDY OF PHYSIQUE AND PHYSICAL PERFORMANCE IN MEDICAL UNIVERSITY STUDENTS

by: Kálmán Kiss

Program director: prof. Péter Sótónyi, DSc

Adviser: prof. János Mészáros, Ph.D.

Opponents:

prof. Dr. János Gombocz Ph.D.

Dr. Ildikó Vajda Ph.D., associate professor

Head of Final Examination Committee: prof. Attila Nemes, DSc.,

Members of Final Examination Committee:

Dr. László Imrei Ph.D., physician-in-chief

Dr. Tamás Szabó CSc., director of NUSI

Dr. Márta Szmodis Ph.D., associate professor

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## **Introduction**

Results of the often used questionnaires and estimations by using various physical performances or assessments of body fat content in the same sample can often be markedly different. The observed differences can be related above all to the various subjective or doubtful components of the used procedures. It seems to be very important to follow two items of train of thought of Salbe and Ravussin (2000):

a/ These authors quantified the estimations as more accurate if they based on the joint evaluation of relative body fat content and cardio-respiratory endurance.

b/ The risk for the development of overweight and obesity-induced sicknesses is exponentially increased if the high body fat content relates with low cardio-respiratory endurance.

According the results of various statistics it is an unanimous opinion that in more than 50% of the adult population (62% females, 58 % males) of the developed societies the hypo-kinesis or hypo-activity are demonstrable (Ilyés, 2001; Ogden et al., 2004; Ross and Janssen, 2007). The observed prevalence is similar in our homeland too. The increase in the almost linear prevalence of risky body composition did not change during the past two decades and there is no reality to suppose that it reached the spike.

The relationship between hypo-kinesis, the consecutively very often developed overweight or obesity and the greater prevalence of evolving sicknesses is known by more than 2000 years. Among others the composition of Hippocrates (460-377 B.C.) is the following: "The sudden death is more often among the sluggard obese than in meagre athletes." The long-lasting overweight and/or obesity are risks (these are direct causes in unfavourable conditions) of many disorders. Because of the educational limits the summary of possible pathological functions cannot be our real task here.

It is a basic pedagogic principle that we should substantiate the adult lifestyle and practices in childhood. By the increasing distance between biological and social maturation it cannot be excluded that some of the habits (lifestyle patterns) may secure at the beginning of the 20s. The results of Szakály and associates (2007) can be evaluated as being both positive or negative. Positive experience of the authors is that many of such students has become physically active during the university studies, who refused rigorously not only the com-

petitive sports but the school physical education also at the time of high school studies. Unfortunately their negative experience is more significant and if it possible more grave. The physically active students have become hypoactive within four years after graduation. Consequently their body fat content increased significantly, and the physical and physiological performance decreased remarkably. The most often mentioned explanations (excuses) were: the employment activity, starting a family, constraint of buying flat or house. In addition to the significant “overfat”, irritableness, strain and high blood pressure were also reported as an accompanying symptom at the time of second investigation.

### **The aim of the study and hypotheses**

The main aim of this investigation was to compare the physique, weight-related body fat content (estimated by definite skinfold thicknesses) and physical performance of first and second year students studying at three different-educational-profile faculties of the universities. Our secondary aim was to characterise their lifestyle by indirect manner.

Since the statistical relationship between the physique characteristics, body composition and physical performance is significant in young adulthood too (Brodie, 1988), we wish to realise our aims by the answers of the following questions:

1. As one of the consequences of the obviously different-educational-profiles are there such differences between the body dimensions and physique characteristics of the students that can be related to their body composition and physical performance?
2. Are there significant differences between the statistical distributions, means and variability measures of nutritional status in the investigated three samples?
3. Are there any differences between the means of body composition attributes, and further is the relationship between physical performance and depot fat content statistically and human biologically the same level?
4. By a practical approach it is an important question that are the generally suggested (in a various handbooks) and more and more often used simple indices and anthropometric measures appropriate descriptors of nutritional status in young adulthood?

With reference to the between samples differences of the basic two body dimensions and physique characteristics (described by the metric and plastic indices) it is a necessity to devise both zero and research hypotheses. In our opinion no statistical or human biological differences can be supposed between the means of height, body mass, and physique attributes of the physically active and non-active samples.

According to the results of some relevant Hungarian publications (Mészáros and Szmodis, 1980; Farkas et al., 1986; Pechar and Mészáros, 1994; Csende et al., 1998), and also by the significant relationship between the physique and functional characteristics a moderately taller stature, lighter weight-related body mass, and moderately more linear physique can be supposed in the physically active (two hours physical activity as a mean) samples. This effect could be in operation, if we take into account both the aim and quality of regular physical activity by the side of its duration, thus the selection effects are in force. However, the body dimensions and body composition attributes characteristic for the top-athletes (Carter et al., 1982; Mészáros et al., 1999) cannot be supposed.

The statistical distribution of nutritional status characteristics depends in general on the sample size. The distribution of body mass index, relative weight and body fat content relative to body mass is standard normal in general (Szmodis et al., 2007). The statistical curtosity and/ or skinness are often characteristic if the sample size is relatively small and the habitual physical activity of the subjects is moderate. In our opinion no significant difference will be observed between the distribution patterns of the active and non-active samples, than again between the quality of greatest classes will be markedly different in the function of mean differences. It was supposed further that the consequences of conscious health-culture will appear among the studied variables of the samples, that is to say the comparison of the two non-active samples will result in markedly smaller relative body fat content and better physical performance in the groups of medical university students.

The statistical relationship between weight-related body fat content and the suggested simple indicators of the nutritional status is mediocre or strong in general. Nevertheless, there are some important limits and above all conditions of their general application. In our

supposition the linear correlations of these indicators with relative or absolute body fat content will be stronger in the groups of non-active students. These simple indicators could be suitable for the numerical expression of the status, but the high proportion of common variance (that cannot be related to the statistical relationship) these are not suitable for the qualification of the status. These indicators could be the character of a group or a sample, but in case of the individual the probability of false classification is definitely greater.

### **Subjects and methods**

The study group consists of first and second year students of faculties of General Medicine, Dentistry and Pharmacy of Semmelweis University Budapest (n = 875). The average physical activity level control group was recruited among the students of Technical University Budapest and University of Heavy Industry Miskolc (n = 631). The physically active subjects, as control group were the students of Faculty of Physical Education and Sports Sciences (Semmelweis University) (n = 650).

Body built was described by the suggestions of Conrad (1963). Nutritional status was estimated by the relative body fat content (calculated by the calliper-metric technique of Parízková –1961–), body mass index and abdominal girth. The physical performance capacity was assessed by the time of 800m run test.

The first step of statistical analysis was the calculation of means and variability measures by genders and years. Differences between the group means by variables were analyzed by F-test following one-way analysis of variance. In so far as, the year differences were not consistently significant the samples of first and second year students were merged. The joint and virtual differences between the newly created three groups were tested by discriminant analysis, namely by the Mahalonobis distances and the F-tests of the procedure. For the discriminant analysis only the direct variables were used. In case of significant differences the discriminating variables were determined.

The statistical relationship between the variables describing the nutritional status was analysed by linear correlation coefficients. The parallelism between the nutritional status characters and physical performance was tested also by correlation analysis. Differences between the statistical content of the linear correlation coefficients

were analysed following Z-transformation, and the common variances were also determined.

The sample differences in the statistical distribution of weight-related body fat content and body mass index were tested by  $\chi^2$ -test. According to the conventions in human biology the maximum level of random error was limited as being less than 5% in all statistical procedures.

### **We have found**

The aim of the study was to compare the physique, weight-related body fat content (estimated by definite skinfold thicknesses) and physical performance of first and second year students studying at three different-educational-profile faculties of the universities. Our secondary aim was to characterise their lifestyle by indirect means. Our conclusions were formulated with keeping the well-known limitations in view. By the results of the cross-sectional comparison we can conclude:

- a/ Neither among the female groups nor the male ones were consistent and significant between-year differences in the morphological (stature, body mass, BMI, relative body fat content) and functional (800m run) characteristics of the three studied young adult groups. This result, however, does not mean that the morphological development of 18-22-year-old youngsters has already been completed. In accordance with the relevant literature, for the demonstration of really moderate size and proportion changes following 18 years of age the cross-sectional arrangement of the study cannot be suitable. We should stress, however, the demonstration of these moderate changes were not among the aims of our study. These comparisons were made only in the interest of more easy and more clearly described comparison.
- b/ The human biological characteristics (body proportions, depot fat content) of the three groups differed significantly by the basic aims of the education varied above all along the regular physical activity levels of the students.

By the kinanthropometric evaluation, however, the observed non-consistent inter-sample differences were not large enough (moreover, they were significantly smaller than in the same comparison published in 1979) for explanation of the significant between-

sample differences in nutritional status and physical performance in every respect. Following the exclusion of the known modifying factors our conclusion is: Significant differences between the body fat content and physical performance of the studied groups can trace back to the differences between their lifestyle characteristics. According to the shown results, **the respective hypothesis** drawn in Chapter 1 **should be rejected**. By the human biological variables and indicators of the studied medical university students (both females and males) the consequences of conscious health-culture cannot be supposed.

- c/ Following the joint evaluation of direct and indirect characteristics (BMI, absolute and relative body fat content, lean body mass) of nutritional status in the three groups we can state. The absolute and relative body fat contents were significantly greater in the 2 non-active groups in spite of the statistically same absolute body mass means. On the basis of main goal of this comparison we emphasise that the mean depot fat of medical university students do not differ from those of technical university students. Thus, **the preliminary hypothesis should be rejected**.

The respective means were great irrespective of gender and the standard deviations were marked. The statistical distribution of nutritional characters was non-proportional in both non-active samples. The observed relative frequencies were greater in the right side of the curve. Thus, beyond the marked means the frequencies of overweight and obesity (determined on various bases) were great in both sexes, and those did not differ in essence from those of the non-university student population. The non-standard normal distributions can be related to the limited subject's number and those are evaluated as sampling error. The human biologically great depot fat content and the very moderate body weight-related lean body mass means are such factors that decrease the quality of life on one hand, but these states represent significant risk factors for the development of the overweight- and obesity-induced thicknesses. The relative body fat content and lean body mass means cannot be evaluated as being "top-athletic" characteristics or extremes. In our opinion the favourable fat range (18-20% for the women or the 13-15% for the males) would be not only reachable for every healthy youngsters.

The mentioned ranges are honestly expectable especially at the beginning of 20s. To meet the mentioned expectations are exclusively the function of decision and will-power.

d/ Nutritional status and body composition (in contrast with the earlier analysed morphological characteristics) are such environmental effect dependent (namely phenotypic) variables, that are direct and linear relationship with physical performances. Naturally there were no significant differences between the directions of signs, but the statistical contents of the coefficients were markedly different. The mean running performances in the physically active groups were clearly and significantly better than those of the non-actives. Nevertheless, the physical performance decreasing effect of the greater depot fat and/or lower active body mass was significantly stronger in the active samples. This consistent result, however, can be evaluated as paradox after a superficial qualification, because the strength of coefficients in this arrangement is not independent from the quality of performance. The qualification of this latter seems to be very difficult, because both the means and individual score were very weak. The definite depot fat amount can influence in significantly smaller level if the performance is originally moderate. Thus, we cannot state that the running performance means of the two non-active samples are weaker in a function greater body fat content exclusively. The reason is that in the determining majority the characteristic and definite inexperience (hypo-activity), which is also the function of lifestyle. **The respective hypothesis drawn, can be evaluated as being true.**

e/ There are some relatively new proposals in the practice of human biology for application of simple characters or indices for the description or qualification of the individual nutritional status. In accordance with the statements of some newly published comparisons, the body mass index and the abdominal girth were not appropriate and sensitive indicators of the individual nutritional status. Naturally, this statement does not relate for the biological content of extremely high or low body fat content, when the simple observation alone can be informative. The difference between the relative frequencies of BMI-based and relative body fat content-based qualifications was great, consequently the two

categorisation cannot be true at the same time. The BMI was consistently the more concessive clause, that is it classified less students into the two critical categories. The basic reason of discrepancy between the suggestions, practice and rapidly growing experience is obvious. Namely, biologically not the heavy body mass (it can be related often to greater proportion of loco-motor system), but the great proportion or absolute amount of subcutaneous or visceral fat should be evaluated as being critical. The newly developed and more valid procedures (ultrasound, CT, MRI, bio-impedance) momentarily are not suitable for the investigation of large samples. The circumspectly selected, consequently the valid and repeatable techniques require definitely more time for the investigation than the calculation of BMI or the measure of abdominal girth, but the extra time recovers with interest through the more accurate evaluation and classification. **The respective hypothesis drawn in Chapter 1 can be true without restriction.**

According to the sown results, it is out of question that body composition and physical performance of our students fail to come about the theoretical expectations. The momentary state and the possibly developing (during the coming years) consequences give the grounds of the necessity of interferences at institutional level. The necessary modifications need both theoretical and practical bases. The possibility of theoretical substantiation (the introduction of favourable effects of regular physical activity –not the sports training–) are available though the great number of disciplines appearing in the present programs. One side of the practical promotion could be the increase of prestige of physical education, concretely the recognition of student performance by official credits. The mentioned two modification require neither the changes of timetables nor extra financial background. The other side of the possible solution the reform of physical education programs. The students who basically refuse regular physical activity hardly suffer the traditional structure, content and loading of physical education. According to the great number of practical experience prove, that such students are significantly more active and it is important they are more co-operative if the type of physical activity was chosen by them. These types of activities (namely the modern sport or fashion activities), however,

could be very effective tools in the hands of well-prepared physical education teachers and coaches.

### Scientific publications of Mr. Kálmán Kiss

#### Publications in journals

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3. Vajda I., **Kiss K.**, Mavroudes M., Prókai A., Zsidegh M., Mészáros Zs. (2008): Az állóképesség fejlődése alsó tagozatos leányoknál. *Magyar Sporttudományi Szemle*, **9**: 3. 34-37.
4. **Kiss K.**, Fodor Á., Mavroudes M., Osváth P., Mészáros Zs., Zsidegh M. (2008): Egyetemisták tápláltsági állapota és futóteljesítménye. *Magyar Sporttudományi Szemle*, **9**: 4. 45-47.
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7. Mészáros, Zs., **Kiss, K.**, Szmodis, M.B., Zsidegh, M., Mavroudes, M., Mészáros, J. (2009): Effects of attending elevated level school physical education in 7-to-11-year-old boys. *Acta Physiologica Hungarica*, **96**: 3. 349-357.
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female medical university students. *Acta Physiologica Hungarica*, **96**: (közlésre elfogadva).

10. Osváth, P., Mészáros, Zs., Tóth, Sz., **Kiss, K.**, Mavroudes, M., Ng, N., Mészáros, J. (2009): Physical and physiological performances in 10-year-old obese boys. *Acta Physiologica Hungarica*, **96**: (közlésre elfogadva).

#### Abstracts

1. Mészáros Zsófia, Zsidegh Miklós, Kiss Kálmán, Polydoros Pampakas, Mike Mavroudes, Mészáros János (2009): Túlsúly, elhízottság, obesitas és állóképesség 8-13 éves fiúknál. *Magyar Sporttudományi Szemle*, **10**: 2. 40.
2. Zsidegh Miklós, Mészáros Zsófia, Polydoros Pampakas, Kiss Kálmán, Mészáros János (2009): Elhízott és normál testzsírtartalmú fiúk szomatikus és motorikus fejlődése. *Magyar Sporttudományi Szemle*, **10**: 2. 64.