8th LUMEN International Scientific Conference Rethinking Social Action.
Core Values in Practice | RSACVP 2017 | 6-9 April 2017 |
Suceava – Romania

Rethinking Social Action.
Core Values in Practice

The Relationship of Body Composition and Aerobic Exercise Capacity

Cristian Florian SAVU*, Constantin PEHOIU, Silviu Andrei BADEA

https://doi.org/10.18662/lumproc.rsacvp2017.72

How to cite: Savu, C. F., Pehoiu, C. & Badea, S. (2017). The Relationship of Body Composition and Aerobic Exercise Capacity. In C. Ignatescu, A. Sandu, & T. Ciulei (eds.), *Rethinking Social Action. Core Values in Practice* (pp. 786-794). Suceava, Romania: LUMEN Proceedings
https://doi.org/10.18662/lumproc.rsacvp2017.72

© The Authors, LUMEN Conference Center & LUMEN Proceedings.
Selection and peer-review under responsibility of the Organizing Committee of the conference

This is an Open Access article distributed under the terms of the Creative Commons Attribution-Noncommercial 4.0 Unported License, permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited

©LUMEN Proceedings

8th LUMEN International Scientific Conference
Rethinking Social Action. Core Values in Practice |
RSACVP 2017 | 6-9 April 2017 | Suceava – Romania

The Relationship of Body Composition and Aerobic Exercise Capacity

Cristian Florian SAVU[1]*, Constantin PEHOIU[2],
Silviu Andrei BADEA[3]

Abstract

Determining multifactorial phenomenon, the physical heritage also depends on hereditary and environmental conditions, in particular economic and social. To this body it is very responsive and therefore physical development can be regarded as an accurate indicator of health. Today, the food supply occurs frequently too extensive consequences such overload the body with fat and overweight installation. Also in the modern world it is confused with the new aesthetic conceptions, new trends in fashion, with frequent exposure to stress and bad habits (smoking, alcohol, drugs). In this context it may occur body homeostasis disorders or abnormal weight decrease or counterclockwise, bulimia and body fat overload. Regulation of body weight requires permanent control of the main constituents of body lean mass and fat mass, which is dependent evolution of nutrition and physical activity. Keeping an optimum composition is one means of improving and maintaining health. The aerobic capacity is an important component of physical fitness because it reflects the overall capacity of the respiratory and cardiovascular systems to cope with a prolonged and vigorous exercise. In terms of health, the high level of cardiorespiratory fitness is associated with decreased risk for certain diseases such as hypertension, coronary heart disease, obesity, diabetes, certain malignancies etc. Fight against nutritional disorders can't be achieved only under physiological adaptation mechanisms of the body. Adaptation theory is based on physiological reasoning. Thus, we believe that differences between individuals arise from

[1] PhD candidate, Assistant Valahia University of Targoviste, Faculty of Humanities, Department of Physical Education and Sport, Romania, e-mail savufcristian@yahoo.com, 0040722359419.
[2] Professor PhD, Valahia University of Targoviste, Faculty of Humanities, Department of Physical Education and Sport, Romania, e-mail: cpehoiu@yahoo.com, +40742019638/+40245206105.
[3] PhD candidate, Assistant Valahia University of Targoviste, Faculty of Humanities, Department of Physical Education and Sport, Romania, e-mail silviu_a_badea@yahoo.com, 0040722200979.

https://doi.org/10.18662/lumproc.rsacvp2017.72
Corresponding Author: Cristian Florian SAVU
Selection and peer-review under responsibility of the Organizing Committee of the conference

This is an Open Access article distributed under the terms of the Creative Commons Attribution-Noncommercial 4.0 Unported License, permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited

mutations or adaptations to particular climatic or geographic conditions that influenced survival at a time.

Keywords: weight, adjustment, nutrition, physical effort, aerobic, consumption.

1. Introduction

The normal body composition is that which allows the weight to remain within acceptable limits, which implies a poor weight adapted to one's own lifestyle depending on the profession, a certain type of physical activity, and a fat mass that meets the minimum health risk. Aerobic capacity is an important component of physical fitness because it reflects the global ability of respiratory and cardiovascular systems to cope with prolonged and sustained physical effort [3].

2. Problem Statement

Although the notion of ideal weight is circulating at the population level, it is important to note that this does not actually exist because the normal weight oscillations within a few days may exceed a few kilograms, and the normal weight can't be reported only in number. These changes are directly related to body mass regulation mechanisms, whose influence can extend over a week or even two. For example, we can talk about hydration, food of the previous days, intestinal transit, diuresis, etc., which are important factors depending on which the weight of the human individual varies [1, 2].

Body composition becomes abnormal whenever the lean mass, fat mass, the amount of water in the body, the weight becomes too small or too high, relative to age, waist, gender. Body composition can also become abnormal due to inappropriate dietetic manipulations, eating disorders (anorexia, bulimia), repeated stress and psychological problems, too much physical activity and prolonged physical activity, various diseases. Physical activity along with basic metabolic activity and thermogenesis are considered components of energy expenditure [6, 8].

As a variable factor from individual to individual, depending on intensity and duration, physical activity involves the contraction of muscle groups for the production of which various sources of energy (alactacid anaerobes, lactobacil anaerobes, aerobes) are used at different times with a different yield. As a rule, when talking about physical activity, two static and dynamic categories are referred to. The effects of static physical activity

consist mainly in toning and hypertrophy of the muscles, while dynamic physical activity improves the transport of oxygen to the tissues, allowing the burning of fats as well. Lipids, unlike carbohydrates, can't be used by the muscle cell in the absence of oxygen (anaerobiosis). Therefore, in order to lose fat during physical activity, the body must be well trained in endurance. In individuals with severe obesity (BMI over 35 or 40% fat mass), physical exercise (excepting water) is contraindicated before decreasing body weight relative to the risk of premature joint pain (especially joints Bearing - knees especially). The muscle mass, from the point of view of the structure of the human body, represents a qualitative component of the motor system, with the greatest influence on the possibilities of effort in terms of the efficiency of the energy consumption [7, 9].

From this point of view, the influence of body weight on cardio-respiratory fitness is based only on the lean mass, the fat mass having no positive effect in this relationship. Thus, the reduction or excess of body fat should not lead to a reduction in maximum oxygen consumption, exercise aerobic capacity and fat mass should be considered as distinct entities [5].

3. Research Questions/Aims of the research

Although there are different views on the role they play in the human body's homeostasis, the aerobic exercise capacity and the body composition (the lean mass and the fatty mass) of these two parameters is frequently encountered. This is because the weak mass is the most important correlated parameter from the theoretical perspective with VO_2 max, but it is unclear whether the effect of the fat mass on the maximum oxygen consumption is either added or independent. The purpose of the study is to determine the influence of body weight and body composition on aerobic exercise capacity (aerobic fitness), which is a factor whose importance is maximized when the concept of functional and health capacity is taken into discussion.

In order to achieve the proposed goal, a transversal correlation study was carried out during the academic year 2012-2013, with a group of 57 persons aged between 20-23 years - the average age being 21.5 years.

From the point of view of gender, the sample of subjects was made up of 32 male persons, 56.14%, respectively 25 female subjects, 43.86% of the total. The sample of subjects consists of students in a specialized degree program, being admitted to the faculty on the basis of a natural and artificial medical-biological selection (admission examination, respectively medical visit) with a high physical activity regime, their participation in the practical

activities (athletics, basketball, handball, football, gymnastics, swimming) from the structure of the educational plan, those being mandatory.

4. Research Methods

In this study, we used the method of scientific documentation, the pedagogical observation, the test and measurement method, the statistical mathematical processing (arithmetic mean, the standard deviation coefficient of variability, the Bravais - Pearson correlation coefficients) and the graphic representation method [4, 10]. The tests and measurements were carried out under the same conditions at the beginning and end of the academic year 2012-2013. Using this method, it was intended to obtain data on two anthropometric indicators (body weight and height), on the basis of which the body mass index, namely the body composition and the determination of the aerobic effort capacity, were calculated by using two tests (Ruffier - physical fitness test - and Harvard - a test to determine the functional status of the cardiovascular system). Interpretation of data obtained from these measurements was performed according to the scales in Tables 1 and 2.

Table 1. Interpretation values of effort capacity

Crt. No.	Harvard Test	Interpretation	Ruffier Test	Interpretation
1.	< 54	Unsatisfactory	> 15	Unsatisfactory
2.	54-67	Below average	10 – 15	Satisfactory
3.	68 – 82	Average	5 – 10	Average
4.	83 – 96	Good	0 – 5	Good
5.	>96	Excellent	< 0	Very good

Table 2. Interpretation of body mass index – UN (2003)

Value IMC kg/ m^2	Interpretation
< 18,5	Hypoponderal, weak
18,5 < 24,9	Normal
25 < 29,9	Overweight
30 < 34,9	Moderate obesity
35 < 39,9	Severe obesity
> 40	Morbid obesity

We used bioelectric impedance to determine body composition. This technique measures the speed of movement of electric currents that cross the superficial soft tissues of the human body at a certain moment so as to

obtain a percentage of the weight of the body fat compared to that of the bones and the muscles taking into account the weight, Age and gender affiliation of the subject. Depending on these last parameters the optimal percentage of body fat changes significantly, in our case the data obtained being compared with those in Table 3.

Table 3. Values of the normal fat percentage of men and women aged 20-39 years

Crt. No.	Genre	Adipose tissue (%)			
		Low	Normal	High	Very high
1	Male	5% -10%	11%-19%	20%-25%	26%-50%
2	Woman	5% -21%	22%-31%	32%-36%	37%-50%

5. Findings

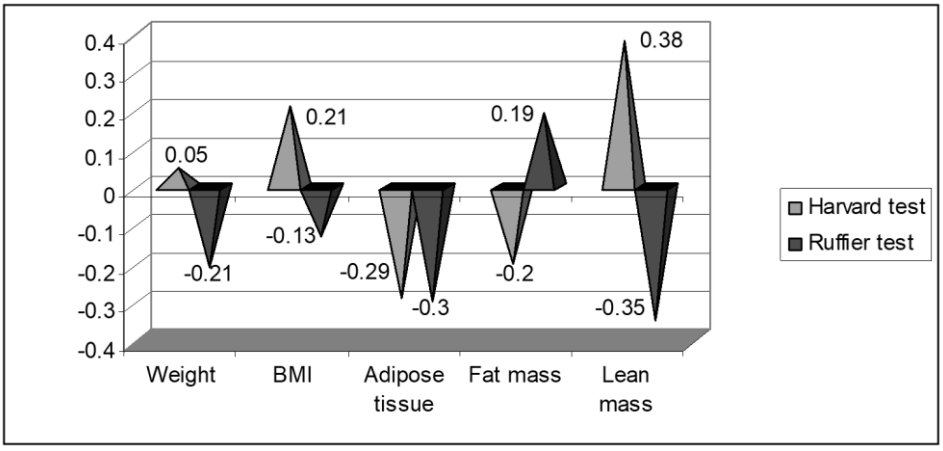
Regarding anthropometric weight and waist indicators, consider for the subjects included in the study, please note that they did not undergo significant changes during one year. For the first, the average was 66.7 kg (the minimum weight being 48.8 kg and the maximum of 84.6 kg respectively), corresponding to an average coefficient of variation (CV-13.9%). At the end of the study, the mean weight was 65.7 kg (the minimum weight being 48.3 kg and the maximum of 84.1 kg respectively), corresponding to a very good coefficient of variability (CV-9.4%). As for the second indicator, it was 175 cm for the beginning and the end of the study, the range of variation of the individual values ranging between 158 cm and 192 cm, representing a very good homogeneity (CV-4.8%).

Based on the above anthropometric data, the baseline values (minimum, average and maximum), calculated for Body Mass Index (BMI), were 19.55, 21.78 and 22.95 Kg / m^2, also within the weight normality range (18-25 kg / m^2). According to the mean BMI, a coefficient of variation (CV) of 11.3% was calculated, demonstrating that the sample of subjects had a good homogeneity compared to the intervals presented in the literature. At the end of the study, the same indices had values of 19.35 kg / m^2, 21.45 kg / m^2 and 22.81 kg / m^2, and the scattering of the results was low, as demonstrated by the value of the coefficient of variability, 8.3%, corresponding to a very good homogeneity. Starting from the fact that there is no ideal weight but just fitting into a weight normality, based on the individual BMI calculation, it was found that of the total of 57 subjects, only three former combat sports practitioners, were initially found outside the normal weight range, according to the results (BMI 25.71-25.95 kg / m^2), being considered as overweight. Of the three subjects, two belong to the female genotype, with weight values of 70 kg / 165 cm and 71 kg / 166 cm

respectively, and one male with a weight of 79.5 kg / 175 cm height, which is 5.26 % of the total subjects enrolled in the study. Determination of body composition by the electrical impedantometry method led to the conclusion that at the beginning of the study, for the sample of subjects, the average adipose tissue percentage was 18.2% initially and 17.6% at the end of the boys and 23.1% at the beginning of the study and 22.2% at the end of the study for girls, the values situated within the normality range (11-19%, respectively 20-24%, see Table 3).

Regarding the mean mass and fat mass, they initially were 11.8 kg and 54.9 kg respectively, the fat mass variability coefficient having a much larger spreading (CV = 27.9%, poor homogeneity) compared to the low mass (17.1% good homogeneity). At the end of the study, for the same indicators, the average values were 10.8 kg and 54.9 kg, the coefficient of variability in both the fat and the low weight, the values (19.5% and 12.3% respectively) being within the area of a good homogeneity. The values calculated for the target indicators reflect the degree of muscle mass development, generally increasing in all components of the sample, previously involved in intensive physical activities, and the amount of adipose tissue varying according to the constitutional type of each subject.

The aerobic efforts of the subjects were determined using the Harvard and Ruffier tests. Harvard test scores led to an initial baseline of the 86.2 physical fitness index reflecting, according to the data in Table 1, a good level of aerobic effort adaptation of the cardiovascular device, which is maintained at the end of the study, but the average recorded value of the same index of 90.3 shows a substantial improvement in subjects' adaptation to aerobic effort, approaching the excellent mark.



Graph 1. Bravais - Pearson correlation coefficients for the tested parameters across the sample studied

In the case of the Harvard test, the degree of dissemination of the results is low and the value of this indicator (9.8%) brings the sample of subjects to the area of a very good homogeneity. For the Ruffier test, based on the initial and final data processing corresponding to the same index, an average of 4.8 or 4.1 was obtained, which also corresponds to a good level of cardio-respiratory fitness, according to the intervals included in Table 1.

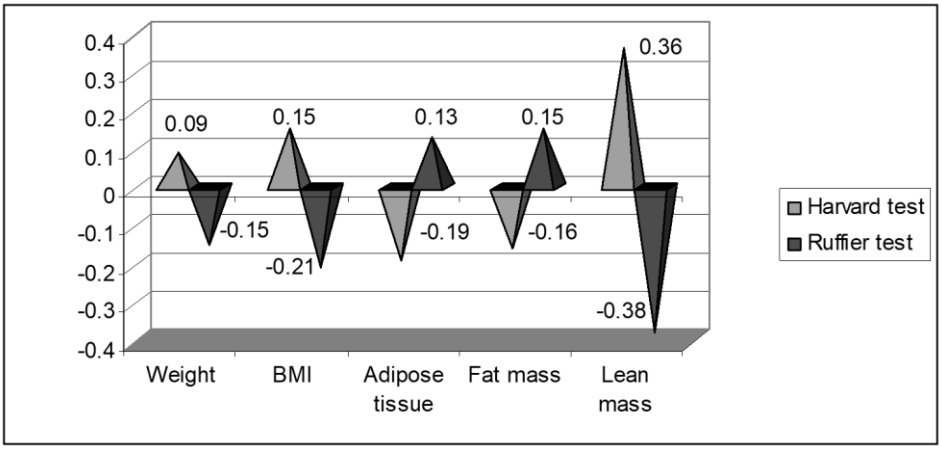
From the point of view of the Bravais-Pearson correlations between the tested parameters, there is a practical interest in the values of the aerobic exercise capacity determined by the application of Harvard and Ruffier tests and the body composition indicators. This, on the one hand, at the level of the whole sample of subjects and, on the other hand, was studied for each gender category of the respective female and male. Graphs 1-3 show in a suggestive way the above-mentioned elements, the correlation between the results obtained from the application of the two tests can be considered as close to absolute value, the difference being given by the variation of the different scaling and interpretation ranges - in the case of the test Ruffier's best values are negative, while for the Harvard test the values sometimes correspond to superior, positive aerobic capacities.

Regarding the entire sample level, it was found that there is a better correlation between the low mass and the values calculated on the basis of Harvard (0.38) and Ruffier (-0.35) test results, which means that aerobic exercise possibilities are first dependent Of the lean mass, with the secondary weight being the fat mass (0.19 and -0.2) and the body fat proportion (-0.29 and -0.3 respectively). At the same time, we notice the inverse correlation of body weight in the case of Ruffier test results (Graph 3). As a consequence, it can be argued that an objective analysis of the aerobic exercise capacity, at least in the case of people with a high physical activity, can also be made from the body composition perspective, taking into account the muscle mass that actually represents the substantial part of the weak mass.

6. Discussions

The results of the study indicate that the maximum level of oxygen consumption (indirectly assessed) is relatively independent of the body fat mass. It can be assumed that people with deviations from the weight curve (with the weight outside the normal range) should not have lower values of the aerobic capacity of effort towards the normoponderal persons. The aerobic exercise capacity, however, depends on the weight of the body only by reference to the lean mass. In other words, the difficulties associated with

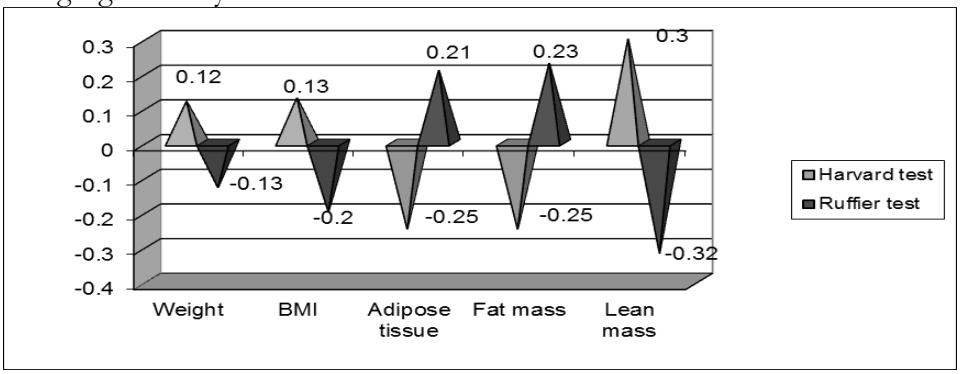
performing an intense physical exercise are more related to the lack of development of the muscular system than the overload of the body with fat. If there is an excess of fat in the body, however, there may be disturbances related to the mechanical overload of the bearing joints, especially during dynamic effort.



Graph 2. Bravais - Pearson correlation between exercise of aerobic capacity and the body composition of boys

It is noted that for boys there is the same type of correlation between body composition and aerobic exercise capacity, the order of magnitude being similar to that obtained for the whole lot ($p \leq 0.05$). It is, however, remarkable for the results of the whole group that the lower values of the correlations between the percentage of adipose tissue and the cardio-respiratory fitness.

The explanation for this may be done considering the constitutional distribution of adipose tissue to the male sex, with normal body fat values being significantly lower than of female ones.



Graph 3. Bravais - Pearson correlation between exercise of aerobic capacity and the body composition of girls

For the sub-sample of girls, the situation is not very different from the whole lot and the boys sub-sample respectively.

There is, however, a very slight reduction in the correlation coefficients between the lean mass and the aerobic exercise capacity, with the almost invisible increase in the correlation between the fat mass and the same aerobic exercise capacity ($p \leq 0.05$). Thus, from a physiological point of view, female sex stores fat more easily, as the muscle mass is less developed, and fat is better represented, with a specific distribution (especially in the area of the pelvis and thighs).

7. Conclusions

In conclusion, we can say that there is an influence of body weight and body composition on aerobic exercise capacity (aerobic fitness), which is a factor whose importance is maximized when the concept of functional and health capacity is discussed.

Higher body composition management by eating adjustment and exercise can greatly improve the quality of life, slow down the aging process, and increase overall body resistance to various forms of internal or external aggressions.

References

[1] Bota C. Fiziologie. Bucureşti: Editura Globus. 2000.
[2] Demeter A. Fiziologia efortului sportive. In: Drăgan I., Medicină sportivă aplicată. Bucureşti: Editura Editis. 1994.
[3] Drăgan I. Medicina sportivă aplicată. Bucureşti: Editura Editis. 1996.
[4] Epuran M. Metodologia cercetării activităţilor corporale. Bucureşti: Ed. Fest. 2005.
[5] Georgescu L. Fiziologia educaţiei fizice. Craiova: Editura Universitaria. 2002.
[6] Goran M., Fields G.R., Hunter S.L., Herd S.L., Weinsier R.L. Total body fat does not influence maximal aerobic capacity. International Journal of Obesity (2000) 24: 841-848.
[7] McArdle W. et al. Exercise Physiology, Energy, Nutrition and Human Performance, Fourth ed. USA: Williams & Wilkins.1996.
[8] Moody D.L., Kollias J., Buskirk E.R. Evaluation of aerobic capacity in lean and obese women with four test procedures. J Sports Med 1969; 9: 1-9.
[9] Rowland T.W. Effects of obesity on aerobic fitness in adolescent females. AJDC 1991, 145: 764 - 768.
[10] Simion Ghe. Metodologia cercetării activităţii omului în mişcare. Pitesti: Editura Universităţii din Piteşti. 1998.