Studii şi Cercetări Ştiinţifice 2019, **20** (4), pp. 627 – 638
Chimie şi Inginerie Chimică, Biotehnologii, Industrie Alimentară

Scientific Study & Research
Chemistry & Chemical Engineering, Biotechnology, Food Industry *ISSN 1582-540X*

ORIGINAL RESEARCH PAPER

STUDY REGARDING THE USE OF HYPOCALORIC - HYPOLIPIDEMIC AND HYPOGLUCIDIC DIET AND PHYSICAL EXERCISE TO DECREASE BODY MASS IN ADULTS OVER 50 YEARS OLD

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Received: July, 19, 2019
Accepted: December, 04, 2019

Abstract: Today's society, with its fast pace and growing stress, leads to a complex motivation for the modern person's need for exercise. For the middle age adults (50-60 years old), the stimulation of their metabolism through physical effort has become a habit imposed also by changes in their lifestyle. This paper started from the hypothesis stating that the systematic practice of physical exercise under the form of fast pace walking, doubled by an adequate diet can contribute to one's weight loss and improve one's health, especially their blood pressure. This research represents a case study conducted on a over 50 years old male, former professional athlete. The experiment was based on two independent variables: nutritional and motor, with initial and final measurements. The final blood test results emphasize the beneficial role played by exercise and a balanced diet in regulating the human body. Basically, there was a shift from a pathological level to an almost normal state of health. The motor analysis shows that the optimal markers of energy consumption are, besides distance, the average pace and speed; thus, the authors are able to say that the exercise performed by the subject while fatigued did not have any effect on his body mass loss.

Keywords: *adults, body mass, diet, physical exercise*

INTRODUCTION

Middle age, besides being a part of the genetic program of an individual's ontogenesis, is an emotional and mental state. Considering the biological changes occurred at this age, the experts have constructed several theories concerning the life rate, cellular theories, and theories stating that aging and death are genetically programmed [1].
The first theories, referring to the life expectancy, have three versions.
The first one claims that there is a genetically determined quantity of energy, the second that the number of calories available to the body through feeding influences the duration of life. This version is supported by studies conducted on a Japanese population that eats approximately 60 % of an average Japanese meal, and that counts 40 times more elderly people who have reached the age of 100 than the rest of the Japan population [2]. The third version of this first theory refers to the hormonal regulation of the stress adaptation system. The latter, of course, does not cause aging, but stress resistance decreases with age and leads to diseases such as atherosclerosis, diabetes, hypertension, and cognitive deficit.
The cellular theories present the irreversible processes in the cell biology, with other three versions: the first refers to the regeneration degree that is different in the cells of an adult individual (20 times) compared to the ones of a fetus (40-60 times) [2], which limits the life of the individual. Another theory states that certain proteins in the human cell (the collagen) interact and produce molecules that link each other to make the body more rigid [1]. The third version refers to the free radicals in the cells, which, produced during metabolism, due to high chemical reactivity, would cause cell destruction, thus degrading the functionality of the organs.
Physically and physiologically, the middle age adults (as this is the age studied in this paper) feel changes in their entire body. There are modifications in their skin, hair, and muscle mass. The vital functions also go through significant changes. The cardiovascular system is affected by a decrease in the elasticity of blood vessels and modifications in the heart muscle. The respiratory system is affected by the decrease in the vital capacity (the quantity of air that can be inhaled in the lungs) [1]. The nervous system also presents structure modifications, highlighted by CT scans, MRIs and PET scans; not in the least, the immune system decreases, thus increasing the individual vulnerability toward diseases.
From another point of view, the energy need of the body is divided to maintain the basic metabolism, which includes the energy required for breathing, blood circulation, intestinal contraction, maintaining the muscle tone, and for performing muscle or intellectual work. Besides this, the external temperature and the digestion of food lead to the stimulation of metabolism [3]. The body needs energy to cope with the increasing number of daily life activities. The muscle work is performed using the intermediary metabolisms that release energy [4]. The potential energy of food is transformed in energy both for work and in caloric energy [5-6]. A sedentary person, 70 kilograms weight has a total metabolism of approximately 100 Cal·hour^{-1} [7]. If that person stands up, the metabolism is increased by 10 %. A low intensity physical exercise can increase the basic metabolism [8] by 20-60 %, a moderate one, by 100-200 %, and an intense physical exercise raises the energy level to values that are 10 times higher than the ones recorded during complete rest (Table 1).

Table 1. *Quantity of energy for a person under normal circumstances*

Work level	Calorie needs (units)	
	Men	Women
Complete rest	1800-1900	1600-1800
Sedentary person	2200-2400	2100-2200
Light work	2400-3050	2500
Tiring work	3300-3800	3000
Very tiring work	4150-6500	-

Today's society, with its fast pace and growing stress, leads to a complex motivation for the modern person's need for exercise [9]. For the middle age adults (50-60 years old), the stimulation of their metabolism through physical work has become a habit imposed also by changes in their lifestyle. The stress and health issues that occur at this age need for a person to lead a balanced lifestyle [10-13], from all points of view: physically, mentally, and dietary. The physical exercises performed daily or at least three times per week have positive effects in preventing/improving certain disorders, but also in maintaining the person's optimism and positive attitude.

A current issue is weight control. The American College of Sports Medicine recommends exercising 150 minutes per week at a moderate pace. Related to this aspect, the indications regarding the exercise differ when the aim is to lose weight or to improve one's health. If both represent the goal, then a nutritionist or dietitian must also intervene [12].

The personalized diet represents a scientific means to meet the desired goals [14]. A diet that does not consider the influence of cooking on the content of nutrients in the foods will never be successful [15]. Weight loss is achieved by burning several of calories that is higher than the one consumed.

The prescription of a diet must consider the nutritional, energetic, sensory, biological, and hygienic value of foods [16] (Figure 1).

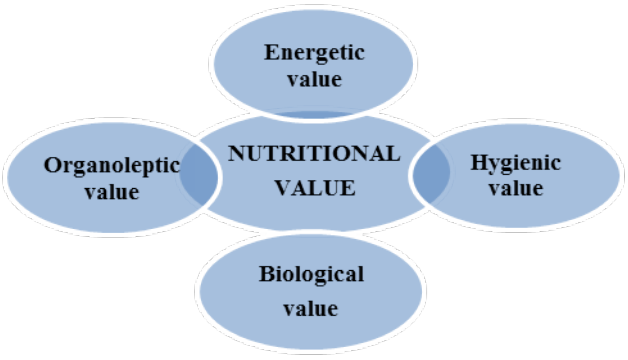


Figure 1. *Nutritional value of foods*

The ratios in these values give in the end the satiety index of a food. This is important when the diet aims to decrease, maintain, or increase the body mass [17-18]. The scientific literature states that foods that are a part of a diet become functional foods [19-20], if they prove to have beneficial effects in the prescribed quantities [21-22].

Considering the statements above, this study aimed to improve the health and decrease the body mass of a middle aged (58 years old) male adult by making him go through a hypocaloric, hypolipidemic and hypoglucidic diet, combined with moderate physical exercise.

MATERIAL AND METHODS

This paper started from the **hypothesis** stating that *the systematic practice of physical exercise under the form of fast pace walking, doubled by an adequate diet can contribute to one's weight loss and improve one's health, especially one's blood pressure.*

The research is a case study conducted between July 24 and October 24, 2019, on an over 50 years old male subject, former professional athlete with muscular sequelae that prevent him from practicing any other type of exercise except fast pace walking.

From a medical standpoint, he was diagnosed with mitral valve prolapse, essential hypertension, and thyroidectomy. The substitution treatment consists of Eutirox 150 units and Concor 5 mg. The average weekly blood pressure value at the beginning of the study was of 160/100 mmHg.

The experiment was based on two independent variables: **nutritional** and **motor**, with initial and final measurements.

The nutritional variable was conceived as a diet, based on the initial results of the blood tests. The blood tests showed an increase in the cholesterol, the gamma-glutamyltransferase, and the glycemia over the normal high values. The patient had a BMI of 32.1 (class II obesity), with a weight of 104.5 kg, and a height of 170 cm.

The subject followed a hypocaloric, hypolipidemic and hypoglucidic daily diet consisting of 3 main meals and 2 snacks.

The diet contained 160 g of protein, 70 g of lipids, and 150 g of carbohydrates. After 14 days, a weight loss of 3 kg was observed, the number of kilocalories being reduced to 1800, and the number of lipids to 50. At the same time, the number of proteins was increased to 2 g·kg body^{-1}·day^{-1} and the number of carbohydrates to 180.

The tested initial biochemical markers were: Albumin, Magnesium, Lactate Dehydrogenase (LDH), Alkaline phosphatase (ALP), Phosphorus (IP), Creatine phosphokinase (CPK), Calcium, Uric acid, HDL-cholesterol, Gamma-glutamyltransferase (GGT), Triglycerides, Glucose, Aspartate aminotransferase (GOT), Total proteins, Blood urea nitrogen, Alanine aminotransferase (GPT), Total bilirubin, Amylase, Creatinine. The blood tests analyses were performed at the medical laboratory of the Moinesti Emergency Hospital.

The motor variable consisted in a systematic program of physical exercise, specifically walking over a distance over 8 km, covered by the subject 5 times per week. Two routes were used, according to the subject's location, one in Bacau, at an average height of 33 m and one in Slanic Moldova, at an average height of 126 m.

The length of the route was established through three challenges - the moment in which the subjective feeling of fatigue appeared, and the heart rate went over 140 beats per minute. The physical activity was performed usually in the evening, when the outside temperature was comfortable enough.

The authors recorded 65 physical activities with a total duration of 82 hours and 522 km overall. The authors have measured: the distance, the average speed, the maximum speed, the caloric consumption, the number of steps, the ascendant pace, the descendant pace, the highest point reached, the lowest one, the heart rate and blood pressure.
The data was recorded with a mobile phone application - Sports Tracker. Sports Tracker was originally a software tool for the Symbian Series 60 phones that allowed the user to track their route, speed, timings and energy expenditure; the application was continued by Sports Tracking Technologies Ltd as *Sports Tracker*. This experiment used Sports Tracker version 4.12.6.
Sports Tracking for running and cycling offers GPS and powerful maps, tracking everything from burnt calories to speed and average altitude. Sports Tracker for Android comes with social features in addition to award-winning GPS tracking capabilities, making it the most feature-packed, easy to use fitness app available, giving voice feedback during training.

RESULTS AND DISCUSSIONS

The analysis of the progress of the main biochemical markers highlights a significant balancing in all of them, in the end being closer to the average reference values. There was, however, a decrease in the calcium level under the reference value, caused probably by a diet that was poor in lactose, but also by the energy consumption demanded by the physical effort (Table 2).

Table 2. *Initial and final values of the biochemical markers*

Analyses	**Initial**	**Reference values***	**Final**
Albumin	3.8	3.8-5.1 g·dL^{-1}	3.8
Mg	1.8	1.86-2.2 mg·dL^{-1}	2.0
LDH	291	230-460 Ul·L^{-1}	303
ALP	59	53-128 Ul·L^{-1}	85
IP	2.7	2.5-4.5 mg·dL^{-1}	2.8
CPK	148	56-244 Ul·L^{-1}	150
Calcium	***8.10***	***8.5-10.2 mg·dL^{-1}***	***7.0***
Uric acid	5.10	3-7.5 mg·dL^{-1}	4.8
HDL cholesterol	45	31.4-73.8 mg·dL^{-1}	49
GGT	**148**	**16-73 Ul·L^{-1}**	**53**
Triglycerides	85	50-130 mg·dL^{-1}	57
Glucose	**124**	**60-100 mg·dL^{-1}**	**85**
GOT	25	10-27 Ul·L^{-1}	19
Total proteins	7.20	6.7-8.3 g·dL^{-1}	6.9
Blood urea nitrogen	26	8-20 mg·dL^{-1}	18
GPT	26	0-33 Ul·L^{-1}	20
Total bilirubin	0.18	0.2-1 mg·dL^{-1}	0.8
Total cholesterol	**230**	**125-210 mg·dL^{-1}**	**198**
Amylase	47	25-72 Ul·L^{-1}	34
Creatinine	**1.01**	**0.6-1 mg·dL^{-1}**	**0.9**

**Evaluation of the Dimension XL clinical chemistry system*

Out of the 20 studied markers, in 4 of them there was a significant drop, getting them within the reference values, as one can see in Figure 2.

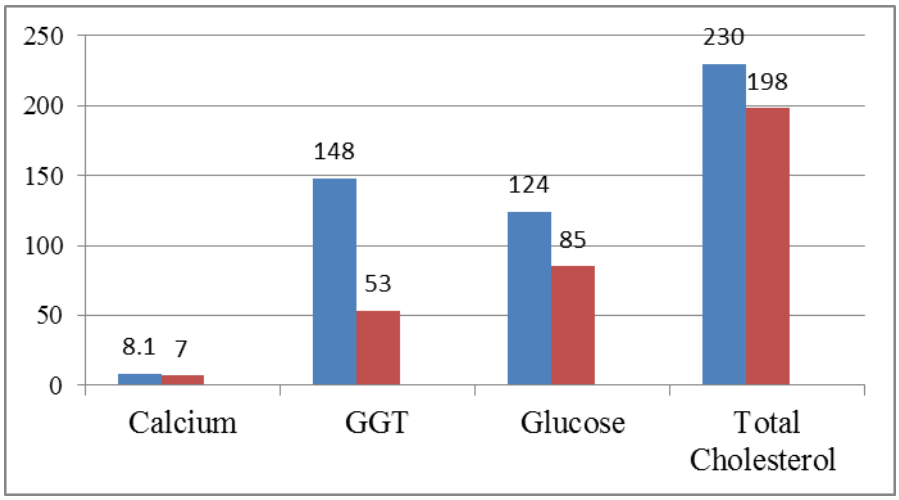
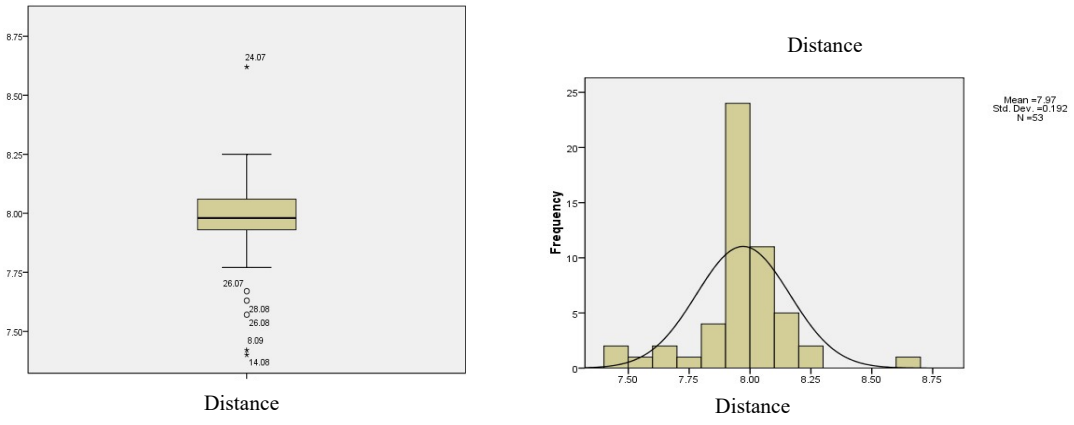


Figure 2. *Four markers getting within the reference values at the end of the study*

The total cholesterol recorded a 13.92 % decrease, the glycemia decreased by 31.46 %, and the gamma-glutamyltransferase (GGT) recorded a 64.19 % decrease.
Regarding to the other 16 markers, there was a shift of the final values toward the average reference values, showing an overall balanced state.
The cholesterol results must also be noted, in the case of which the literature speaks of two ways of decreasing it - diet and medicine therapy; in this case, there was a fortunate association of exercise and diet.
The statistical analysis of the recorded data for the **motor variable** was performed using the SPSS software. For an easier representation of the data for this variable, box plots and histograms (Figures 3(a),(b) - 7(a),(b) were used, for the variables: *covered distance, average speed, calories burned, step count, and pace.*



a **b**

Figure 3. *Box plot (a) and histogram (b) of the motor variable distance*

The authors recorded 65 physical activities with a total duration of 82 hours and 522 km overall.

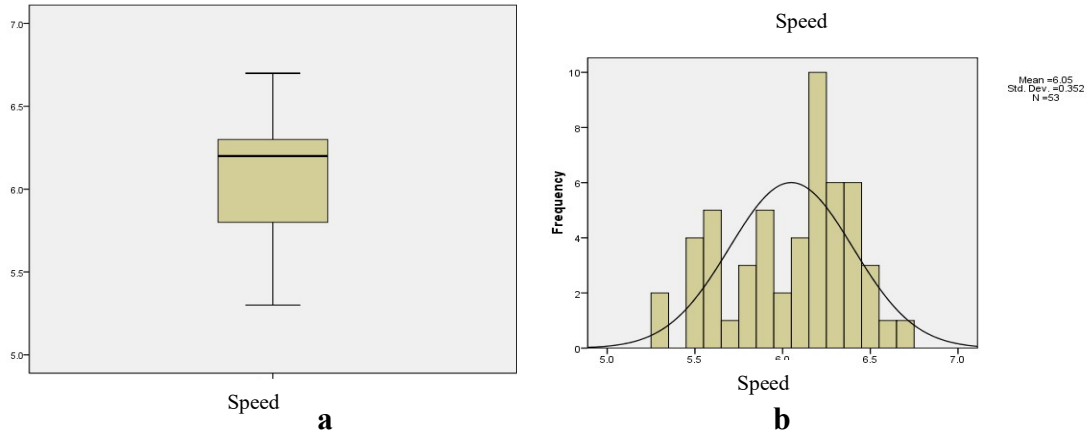


Figure 4. *Box plot (a) and histogram (b) of the motor variable average speed*

The average speed recorded over the 65 physical activities had a value of 6.04 km·h^{-1}, with a range of 1.4 km·h^{-1}, in which the maximum value was 6.7 km·h^{-1} and the minimum, 5.3 km·h^{-1}.

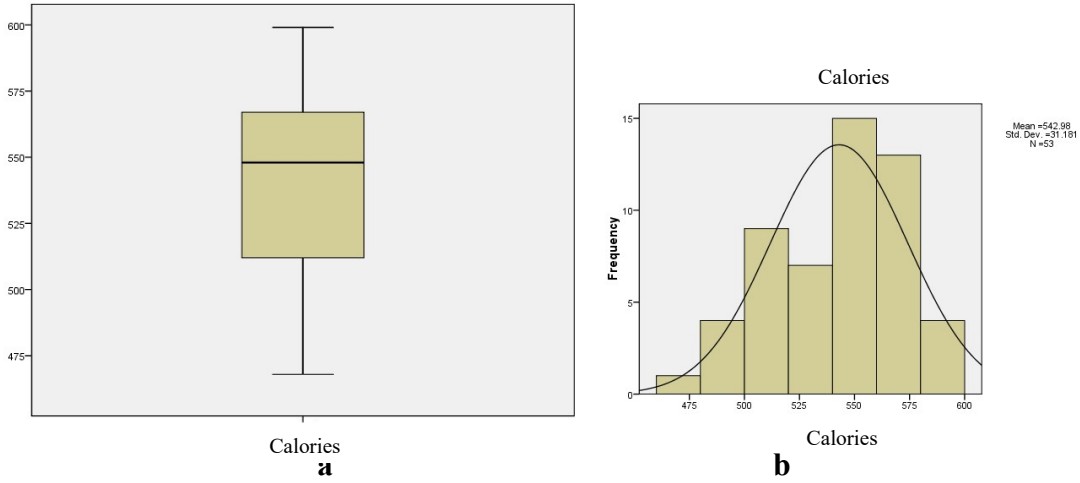
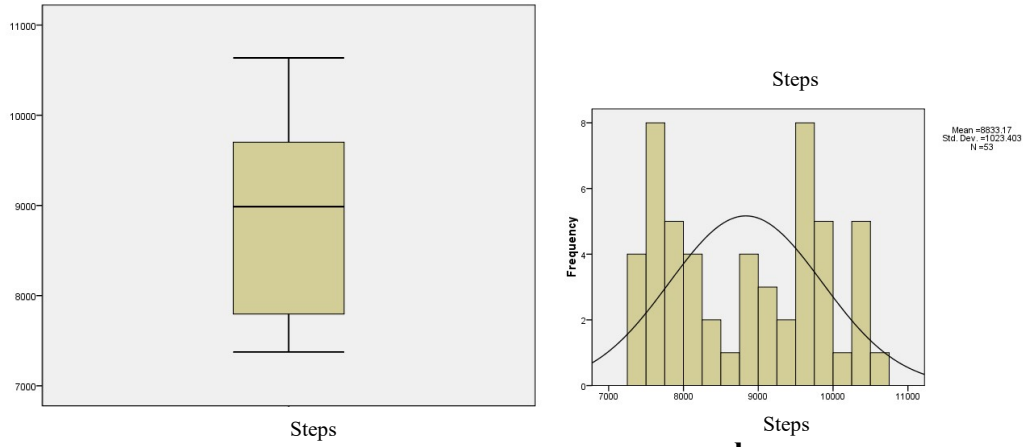


Figure 5. *Box plot (a) and histogram (b) of the motor variable calories burned*

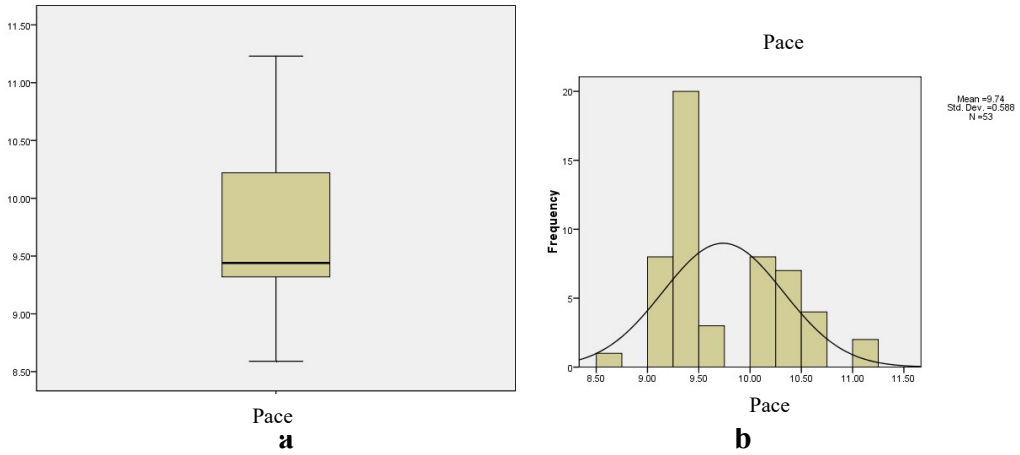
Over the course of the activities, the authors recorded an average value of 542 Kcal and a range of 128 Kcal. The maximum value, recorded in the last month of the study, was 596 Kcal and the minimum, 468 Kcal, recorded in the second week of the program.



a **b**

Figure 6. *Box plot (a) and histogram (b) of the motor variable step count*

The step count analysis records the highest range - 3261 steps, with a maximum of 10636 steps, a minimum of 7375, and an average of 8833 steps.



a **b**

Figure 7. *Box plot (a) and histogram (b) of the motor variable pace*

The statistical markers: mean, median, standard deviation, variance, skewness, kurtosis, range, minimum, maximum, and Q1, Q2, Q3 were used to interpret as correctly as possible the figures 3-7 shown above. The values of the enumerated markers are presented in Table 3.

Table 3. *Values of statistical markers*

		distance	Speed_m	calories	steps	pace
N	Valid	53	53	53	53	53
	Missing	0	0	0	0	0
Mean		7.9717	6.049	542.98	8833.1 7	9.7366
Median		7.9800	6.200	548.00	8987.00	9.4400
Std. Deviation		.19162	.3523	31.181	1 023.403	.58848
Variance		.037	.124	972.250	1047354.605	.346
Skewness		-.430	-.436	-.307	.034	.672
Std. Error of Skewness		.327	.327	.327	.327	.327
Kurtosis		3.905	-.741	-.639	-1.435	-.288
Std. Error of Kurtosis		.644	.644	.644	.644	.644
Range		1.22	1.4	131	3261	2.64
Minimum		7.40	5.3	468	7375	8.59
Maximum		8.62	6.7	599	1 0636	11.23
Percentiles	25	7.9250	5.800	511.50	7777.00	9 3150
	50	7.9800	6.200	548.00	8987.00	9 4400
	75	8.0600	6.300	567.50	9701.00	10 2350

Because the second objective of this study was to decrease the adipose tissue through exercise, the authors wanted to know which of the recorded motor markers correlate the most with the number of calories burned, knowing that the latter plays and important role in fat burning. For this, the simple regression data was analyzed - the influence of average speed, step count, and pace on the number of calories burned, by testing the regression equation in SPSS. The results show that the calories burned are influenced greatly by average speed and pace. There was no positive correlation between the step count and the average speed, or between the step count and the calories burned.
Table 4 presents the SPSS regression model with the three coefficients for the average speed and calories burned, and Figure 8 shows the correlation between average speed and calories burned.

Table 4. *The SPSS regression model for average speed and calories burned*

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.800	.640	.633	18.889

The independent variable is speed_m.

ANOVA

	Sum of Squares	df	Mean Square	F	Siq.
Regression	32360.165	1	32360.165	90.695	.000
Residual	18196.816	51	356.800		
Total	50556.981	52			

The independent variable is speed_m.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Siq
speed_m	70.818	7.436	.800	9.523	000
(Constant)	114.600	45.057		2.543	014

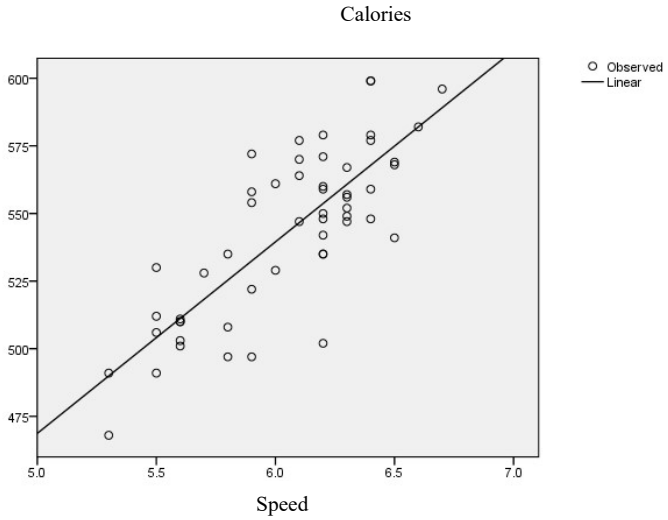


Figure 8. *Correlation between average speed and calories burned*

As one can see, there is a good relation between the number of calories and average speed.
Table 5 presents the SPSS regression model with the three coefficients, for pace and calories burned, while Figure 9 shows the relationship between calories burned and pace.

Table 5. *The SPSS regression model for pace and calories burned*

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.816	.666	.659	18.198

The independent variable is pace.

ANOVA

	Sum of Squares	df	Mean Square	F	Siq.
Regression	33666.723	1	33666.723	101.656	.000
Residual	16890.258	51	331.182		
Total	50556.981	52			

The independent variable is pace.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Siq.
pace	-43.238	4.288	-.816	-10.082	000
(Constant)	963.975	41.830		23.045	000

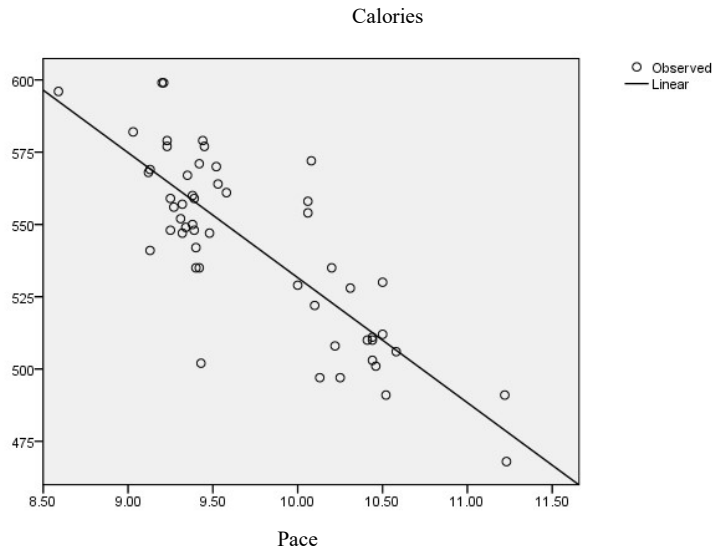


Figure 9. *Correlation between pace and burned calories*

As one can see, there is a good relation between the number of calories and pace.

CONCLUSIONS

The analysis of the results allows the formulation of the following conclusions:
The final blood test results emphasize the beneficial role played by exercise and a balanced diet in regulating the human body. It can be said that the loss of 18 kg of body mass meant losing adipose tissue, which has led to a drop in the average blood pressure, from an initial value of 160/100 mmHG to 130/70, and an average heart rate value of 65 beats·minute^{-1}. In short, there was a shift from a pathological level to an almost normal state of health.
The motor analysis highlights positive correlations between calories burned and average speed, as well as between pace and calories burned, which proves that the optimal markers for energy consumption are, besides distance, the pace and average speed; thus, one can say that the activities performed below the fatigue threshold have no effect on the body mass, the success being real only in the situations where the subject is out of his comfort zone, this confirming the role played by fatigue in the progress of sports training.
Another condition for success is the systematic practice of physical exercise, in order to allow the body to benefit from the cumulative effect of fatigue. The authors would like to note that over time body weight does not vary linearly, being dependent on the ingested quantity of liquids and the recovery speed, meaning the speed with which the muscle toxins are eliminated.
The authors believe also that the step count marker, used currently by a high number of applications, is not a valid marker of effort, being influenced by external factors such as step length, work, altitude, etc., factors that are not taken into consideration by these applications.

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