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THE EFFECTS OF A PHYSICAL ACTIVITY PROGRAM ON BODY COMPOSITION AND PHYSICAL CONDITION IN THE OVERWEIGHT ADULT

Bianca Mădălina PAPP *
Student, University of Oradea, Faculty of Geography, Tourism and Sport 1st University Street, Oradea, 410 087, Romania, e-mail: bianca.papp@yahoo.com

Carmen ŞERBESCU
University of Oradea, Department of Physical Education, Sport and Physical Therapy,1st University Street, Oradea, 410 087, Romania, e-mail: carmen_serbescu@yahoo.com

Tudor CACIORA
Student, University of Oradea, Faculty of Geography, Tourism and Sport,1st University Street, Oradea, 410 087, Romania, e-mail: tudor.caciora@yahoo.com

Adriana BAIDOG
University of Medicine and Pharmacy of Oradea, Municipal Clinical Hospital "Dr G. Curteanu", Nephrology Department, 12 C. Coposu street 12, Oradea, Romania, e-mail: bejusca@yahoo.com

Varodi Mihaela OLĂU
Ph.D. candidate, University of Oradea, Faculty of Geography, Tourism and Sport 1 University Street, Oradea, 410 087, Romania, e-mail: oradeanu_miha@yahoo.com

Abstract: The main purpose of the study is to analyse the effects of a physical activity programme on the body composition and physical condition of the overweight adult. Starting from the assumption that, with the decrease of the period of time available for physical activities combined with an erratic eating, the overweight/obesity phenomenon associated with increased risk factors for cardiovascular diseases has become an important issue which the contemporary society is facing. Therefore, the organised physical activity adapted to the needs of each individual seems to be the most viable solution for the improvement of the general health. The study has been carried out on two subjects, a 21 year old male and a 45 year old female, for a period of three months in which they followed a 60 minutes/day, 7 days/week physical activity programme, accompanied by minor changes in their eating habits. In order to establish the efficiency of the training programme, the subjects underwent a series of measurements with the purpose to determine their body composition and stamina both at the beginning, as well as at the end of the three months of physical activity. The results obtained prove that only through the introduction of an aerobic physical activity and muscle toning programme may the health and physical condition reported to the state of health be improved both at the young adult as well as in middle aged subject.

Key words: physical activity, obesity, health, bodily composition, physical activity, eating

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* Corresponding Author

INTRODUCTION

Obesity is presently seen as a disease which characterizes the beginning of the third millennium (Navarro et al., 2017). Recent studies have shown that approximately 2.1 billion people in the whole world suffer from obesity or are overweight (Smith and Smith, 2016), 40% of them being adults (Tseng et al., 2018). These figures must be considered an alarm for the whole of humanity concerning the magnitude this modern disease is reaching. Obesity is mainly associated with an erratic lifestyle, unhealthy eating and the lack of physical activity, nevertheless it may have several causes, among which chronic diseases and genetic causes are most commonly met. Independent on the motives which lay at the foundation of weight gain over the admissible limits, one thing is certain, i.e. the negative effects obesity has on the state of health, such as: diabetes, cardiovascular diseases, different types of cancer, hypertension, etc. (Tseng et al., 2018).

To combat obesity, improve physical conditions and health, the most effective prophylactic and/or therapeutic intervention is physical activity. Physical activity has a role in both the improvement of the physical condition in relation to the health of obese and overweight people as well as in a prophylactic context in the case of healthy population (Corbin and Lindsey, 1984 cited by Șerbescu, 2008). In order to maintain and improve our health all we need is our own body to start moving every day, systematically and methodically, respecting the human physiology (Dejardin, 2008). Moreover, scientific proof certifies that those people who are more active from a physical point of view present a lower risk of getting sick (Kassirer si Angell, 1998).

Both obesity as well as physical activity in order to lose weight and maintaining the state of health does not represent any new study issue. Obesity is an issue which has been quite studied in the past few years, both in what the causes are concerned as well as the effects it has on the overall health of adults (Flegal et al., 2016; Inoue et al., 2018; Yumuk et al., 2015; Powell et al., 2015; Ștef et al., 2019) and children as well (Lobstein et al., 2015; Gupta et al., 2012; Van Cleave, 2010; Waters et al., 2019; Geserick et al., 2018; De Bont et al., 2019). Some studies have been carried out in order to observe the effects regular physical activity has on the composition of the body and the physical condition (Șerbescu et al., 2006; Nagy et al., 2016; Battaglia et al., 2016), and the mood of the participants (Ilieș et al., 2018; Tătar et al., 2018) or in fighting obesity (Baidog and Herman, 2018; Whooten et al., 2018; Wiklund, 2016; Hills et al., 2011).

The results of regular physical activity together with a proper and healthy eating lacking in fat have on the composition of the body are well known (Chin et al., 2016; Ferry et al., 2014), therefore rarely these two key elements in the weight loss process are separately analysed. The present study sets to determine whether physical activity plays an independent role or not in the weight loss process of overweight or obese people.

MATERIALS AND METHODS

PARTICIPANTS

The study was carried out on two participants. They were selected according to a series of indicators such as age, gender, weight, profession, etc.

Subject 1 (S1) is a 21 years old male student weighing 98.5 kg with a BMI of 30.12 being classified as a class I obese. The subject does not have any hereditary-collateral pathologic antecedents. Has a sedentary lifestyle, lacking in physical activity and based on a hyperlipidic diet comprising carbonated drinks and fast food.

Subject 2 (S2) is a 45 years old female, economist, weighing 76.2 kg with a BMI (28.43) which exceeds a little the admissible limits (Jensen et al., 2013) therefore the subject is considered to be overweight. The subject does not have any hereditary collateral pathological antecedents, physical deficiencies and personal pathological antecedents. The body weight exceeding the admissible limit is due to the sedentary lifestyle, lack of physical activity and erratic eating.

ASSESSMENT OF PARTICIPANTS

The anthropic-physiometric assessment of the subjects was carried out through measurements of the main anthropic-physiometric indicators (i.e. height, weight, circumferences, corporal composition) in accordance to the standard procedures (Marfell-Jones et al., 2006).

Weight measurement was carried out with an analogic scale which had an error range of ±0.1 grams. The weighing was carried out in kilograms and hundreds of grams, in the morning after defecation and urination.

The body height was measured with the height measurer between the vertex and the plantar plate. The subjects kept an orthostatic position with the M1 articulations extended, a straight spine and the heels united; the vertical rod of the height measurer touches the heels, the cleftal and spine aligned with the scapula. (Cordun, 2009).

The Body Mass Index (BMI) was determined considering the age, sex, height and bone constitution using the following formula: $BMI=\frac{\text{weight (kg)}}{\text{heigh (m)}^2}$. The results were compared with the scale of normal BMI values according to age in order to classify the subjects and the risk of illness due to excess weight.

The thickness of the subcutaneous fat (subcutaneous folds) was measured in millimetres, using body fat caliper. The measurements were carried out only on the right side of the subjects, while for a better accuracy they were repeated three times, the final value being considered the average value of the three. The subcutaneous fold was measured on the abdomen, biceps, flank, subscapular and on the thigh. The measurements were carried out both at the beginning as well as at the end of the physical activity period.

The values obtained following the measurement of the subcutaneous fold were used to determine the optimum body composition and weight of the subjects, using formulas developed by the National Center for Sports and Exercise Medicine (Drăgan, 2002): *adipose tissue (%)* = (the sum of all five plies (mm) x 0.15) + 5.8 + BD (m^2) – *where BD = body surface calculated with the help of the Du Bois nomogram (Du Bois and Du Bois, 1916 cited by Șerbescu, 2008)*; *the real adipose tissue (kg)* = real body weight (kg) x adipose tissue (%); *real weak mass (kg)* = real body weight (kg) – adipose tissue (kg); *optimum weak mass (kg)* = real body weight (kg) x 75%; *optimum adipose tissue (kg)* = optimum weak mas x 25% (female)/15-17% (male); *optimum body weight (kg)* = optimum weak mass + optimum adipose tissue.

The perimeters were measured in centimetres using a tape measurer. The dimensions of the perimeter of the chest, waist, abdomen, both arms, relaxed and contracted, both fore arms, both thighs and calfs all in a state of relaxation and contracted. These procedures were carried out both at the beginning of the programme as well as at the end.

The estimation of the daily *dietary calorie's consumption* was carried out through an analysis over a seven day period. During this period the daily calories intake was estimated taking into consideration the table comprising the caloric content of each food. The daily calories intake has been established for a menu considering the three main dietary principles (carbohydrates, fats, proteins) carrying out a characterisation of the diet depending on the recommended percentage of nutrients.

The estimation of the maximum oxygen consumption (VO_{2max}) was carried out using the Astrand test (Astrand and Ryhming, 1954). A 40 cm ladder was used for males and a 33 cm one for females. The duration of the physical effort was 6 minutes; the intensity of the aerobic effort was submaximal for each subject (600 kgm/min - S1, 500 kgm/min - S2), the rhythm of the climb was given by a metronome. The prediction of the maximum oxygen consumption (VO_{2max}) was established considering the heart frequency measured for the last 15 seconds of each minute, multiplying the value by 6 and respectively by 4 (Heyward, 1998), the results being compared with the Astrand-Ryhming nomogram.

The motric assessment consisted in the appreciation of the articular mobility, muscle force, balance coordination and effort capacity by finalising the trials comprised in the Hettinger

motric test battery. There is a score comprised between 1 and 10 for each exercise, the maximum score being 100 points; the scores which exceed 65 points are considered to be good scores (Sbenghe, 1987).

TRAINING PROGRAMME

The physical activity programme was carried out on a period of three months, between the 1st of March and the 1st of June 2019. During this period, the subjects underwent a daily 60 minutes training programme. The type of training was chosen based on the assessment of the subjects which was carried out before the start of the programme, as well as on the recent research in this field. It seems that the aerobic training (AT) is the optimum type of training in order to lose weight and reduce body fat (Stasiulis et al., 2010); while a physical activity programme based on AT is required for the increase of weak mass for overweight or obese adults (Willis et al., 2012). Therefore, the training programme was created mainly of AT combined for superior results with upper body toning exercises. The intensity of the physical effort was determined based on the VO_{2max} and it is comprised between 50 and 85% of its total value. The sequence of the exercises during the training sessions follows a pre-set order for the entire implementation period of the programme: preparing the body for effort (10 – 13 minutes; with the increase of the cardiac flow up to 120 bpm); the fundamental part, which comprises: intense walk/running (30 minutes); climbing - descending stairs (10 minute); abdominal-lumbar-pelvic muscle toning exercises (15 minute); effort recovery which consists in a 5 - 8 minute stretching session.

Due to the deficient physical condition of the subjects, the programme was divided into two steps (i.e. one month and a half for each step). the differences between the two steps is the vigorous walking in step 1 and running in step 2, while the increase of the intensity of the exercise involves climbing and descending stairs as well as the number of repetitions for each toning exercise.

RESULTS AND DISCUSSIONS

Following the careful examination of the dietary habits of the subjects for the week comprised between the 22nd of February and the 28th of February 2019, the total amount of calories consumed was determined and therefore a characterisation of the diet based on the recommended percentages of the main nutrients was developed. During this period, S1 ingested an average of 2326.2 kcal/day, respectively 16283.4 kcal/week. Therefore, his diet is considered to be hypoglucidic, hyperlipidic and hyperproteic. S2 consumed an average an average of 2356.8 kcal/day, namely 16497.6 kcal/week, with a diet in which the main nutrients are found in quantities considered to be normal (table 1).

Table 1. Calories and main nutrients intake for the two subjects

Indicators	Subject 1			Subject II		
	Energetic value	Percentage of major nutrients	Recommended percentage of nutrients	Energetic value	Percentage of major nutrients	Recommended percentage of nutrients
Total calories/week	16283.4 kcal			16497.6 kcal		
Total calories/day	2326.2 kcal			2356.8 kcal		
Glucids/day	1030.4 kcal	44.29%	55%	1242.8 kcal	52.73%	55%
Lipids/day	801.9 kcal	34.47%	30%	777.6 kcal	32.99%	30%
Proteins/day	367.6 kcal	15.84%	15%	321.6 kcal	13.64%	15%

Before the start of the actual training programme, minor changes in the diet of the two subjects were taken into consideration. Therefore, the dietary changes of S1 were represented by the elimination of sweet carbonated drinks and snacks. Considering this change, the average

amount of calories consumed per day decreased by 700 kcal/day; this is a sure and sustainable way of losing weight according to the American Center for the Control and Prevention of Diseases. Due to a normal and balanced diet in relation to the recommended percentage of nutrients, the changes brought to the diet habits of S2 were less severe, the reduction occurring for the quantity of carbonated drinks (a reduction of approximately 400 kcal/day).

In the first step of the programme, due to the lack of physical condition, the subjects were not able to maintain a constant running pace for the whole 30 minutes, therefore the aerobic training consisted in intense walking. Based on the VO_{2max} of 1.8 l/min it was estimated that the value of the intensity of the effort for S1 must be comprised between 0.9 – 1.53 l/min, meaning a speed of 4 – 5.9 km/h and a consumption of 4.5 and 7.65 kcal/min. The total calories consumption for S1 during the 30 minutes of intense walking was an average of 68.4 kcal. S2 with a superior VO_{2max} (1.9 l/min), the value for the intensity was also increased (0.95 – 1.61 l/min), consuming between 4.75 – 8.05 kcal/min for a speed comprised between 5.6 – 7.2 km/h. The total calories consumption for S2 for the whole 30 minutes of intense walking was an average of 52.9 kcal (Table 2).

Table 2. Calories burnt by the two subjects during the training programme

First stage of training								
Indicators / Exercises	Subject I				Subject II			
	Duration (min)	Kcal consumed	Kcal consumed per training	Kcal consumed per week through training	Duration (min)	Kcal consumed	Kcal consumed per training	Kcal consumed per week through training
Walking	30	68.4	306.2	2143.2	30	52.9	235.8	1650.6
Stairs	10	132.2			10	101.3		
Toning	15	105.5			15	81.6		
Second stage of training								
Indicators / Exercises	Subject I				Subject II			
	Duration (min)	Kcal consumed	Kcal consumed per training	Kcal consumed per week through training	Duration (min)	Kcal consumed	Kcal consumed per training	Kcal consumed per week through training
Running	30	267	517.2	3620.5	30	210	403.6	2824.9
Stairs	10	138.6			10	107.2		
Toning	15	111.7			15	86.4		

The training which consists of climbing and descending stairs, S1 burnt 132.2 kcal for the 10 minutes of intense continuous effort, while S2 burnt only 101.3 kcal.

The toning training consisted in exercises for the strengthening of the abdominal-lumbar-pelvic muscles. By carrying out this type of exercises S1 burnt 105.5 kcal during 15 minutes of intense effort, while S2 only 81.6 kcal.

The average amount of burnt calories for a training session for both subjects was 306.2 kcal for S1 respectively 235.8 kcal for S2. This brings forward an induced a deficit of approximately 2143.2 kcal per week for S1 and 1650.6 kcal for S2.

An intermediate assessment was carried out at the end of the first step. It has been observed a substantial increase in the VO_{2max} of both subjects (Table 4), the training intensity increasing in accordance. S1 improved the VO_{2max} from an initial value of 1.8 l/min to 2.18 l/min, managing to run with a constant speed comprised between 4.8-6.4 km/h, the calories consumption being of 8.9-11.3 kcal/min. The total calories burnt in the 30 minutes of running increased with 198.6 kcal (from 68.4 to 267 kcal) for S1. The VO_{2max} for S2 increased from 1.9 l/min to 2 l/min, managing to maintain a constant running pace comprised between 5.8 and 7.5 km/h, with an average calories consumption of 7-9.1 kcal/min. The total amount of calories burnt during the 30 minutes of running increased with 157.1 kcal (from 52.9 to 210 kcal) for S2.

The increased intensity for the stairs exercise determined an increase concerning the calories burnt by the two subjects. Therefore, S1 burnt 138.6 kcal during 10 minutes of intense continuous physical effort, while S2 burnt 107.2 kcal.

An increase of the calories consumed was observed as well during the abdominal-lumbar-pelvic muscles toning exercises, due to the increase in the number of repetitions and intensity. The duration of the exercise remained 15 minutes, S1 burning 111.7 kcal while S2 increased the amount of calories burnt to 86.4 kcal.

The average amount of calories burnt per training session in the second step by the subjects was 517.2 kcal for S1, respectively 403.6 kcal for S2; a considerable increase for both subjects has therefore been observed since the beginning of the programme. This leads to a calorie's deficit of approximately 3620.5 kcal (with 1477.3 kcal more than the 1st step) per week for S1 and respectively 2824.9 kcal (with 1174.3 kcal more than the 1st step) for S2 (Table 2).

In what the measured perimeters are concerned, they were the object of a series of measurements both at the beginning as well as at the end of the training programme. An improvement of the pre-existent situation was observed for both subjects during a final assessment, in the sense that all the perimeters taken into consideration for the measurements underwent functional improvements and decreased in dimensions.

Taking into account the case for S1 there has been a cumulated loss of 21 cm. The largest loss was noticed in the abdominal area where the perimeter dropped with 5 cm (from 101 to 96 cm), followed by the chest (- 4cm; from 112 to 108 cm) and the thighs (- 3.5 cm for the left thigh; - 2.5 cm for the right thigh). S2 lost 29.5 cm of the total value of all 10 measured perimeters. The greatest deficit was recorded in the abdominal area, its dimension decreasing with 10 cm (from 99 to 89 cm) followed by the chest and waist (both losing 5 cm).

Following the physical effort of the past three months the amount of adipose tissue has considerably decreased for both of the subjects. In order to determine this indicator, the subcutaneous fat was measured using a body fat caliper, both at the beginning and the end of the programme. The folds for S1 recorded a drop of 11.5 mm (from 132 to 120.5 mm). The major drops in the quantity of adipose tissue were recorded on the abdomen (- 4 mm; from 33 to 29 mm), the thigh (- 4 mm; from 35 to 31 mm) and the flank (- 2 mm; from 23 to 21 mm). For S2 the overall amount of the folds dropped with 10 mm (from 136 to 126 mm). Most of them occurring in the abdominal area (- 4 mm; from 30 to 26 mm), followed by the thigh (- 2.5 mm; from 37 to 34.5 mm) and flank (- 2 mm; from 24 to 22 mm) (table 3).

After three months of continuous and systemic practice of physical exercises, the final results have shown an net improvement of all the parameters taken into consideration at the beginning of the study (weight, BMI, body composition, VO_{2max}); all these being associate with a more pleasant physical aspect and an improved quality of life.

The body weight of S1 suffered a significant drop from 98.5 kg at the beginning of the training programme to 89.8 kg at the end of the programme. Meaning that there has been a total weight loss of 8.7 kg in three months namely 2.9 kg per month, a superior loss to the optimum loss of 1.8 kg/month (Jensen et al., 2013). The real adipose tissue decreased with 4.02 kg (from 27.38 kg initially to 23.36 kg in the end), meaning approximately 1.74% of the total. The value of the BMI also recorded a decrease from the initial values which exceeded 30, by the end of the programme it was 27.46. Even if the subject didn't reach the optimum BMI value of 24 according to the height weight and age, going therefore from first class obesity to overweight. Together with the decrease of all the values the effort capacity of S1 increased. It was therefore observed from the VO_{2max} value which increased with approximately 0,6 l/min (from 1.8 l/min initially to 2.4 l/min in the end) and the superior results obtained during the final Hettinger test, compared to the one at the beginning of the programme (97 final points, compared to 95 initial points) (figure 1 and table 4).

Table 3. The dimensions of the perimeters and of the cutaneous folds of the two subjects before and after the physical activity programme

Indicators	Subject I		Subject II	
	Initial values	Final values	Initial values	Final values
Thoracic perimeter (cm)	97	95	98	93
Abdominal perimeter (cm)	101	96	99	89
Basin perimeter (cm)	112	108	110	105
Left arm perimeter (cm) (relaxation - contraction)	35 - 36.5	34 - 37	29 - 29	29 - 29
Right arm perimeter (cm) (relaxation - contraction)	35 - 36.5	34 - 37	29 - 29.5	29 - 29
Right forearm perimeter (cm) (relaxation - contraction)	30 - 30.5	29.5 - 31	23 - 23.5	23.5 - 24
Left thigh perimeter (cm) (relaxation - contraction)	66.5 - 68	63 - 65	62.5 - 63	58 - 60
Right thigh perimeter (cm) (relaxation - contraction)	66.5 - 68	64 - 66	62.5 - 63	58 - 60
Left calf perimeter (cm) (relaxation - contraction)	45 - 45.5	44 - 45	37.5 - 37.5	37 - 37
Left calf perimeter (cm) (relaxation - contraction)	44 - 45	44.5 - 45	37.5 - 37.5	37 - 37
Abdominal folds (mm)	33	29	30	26
Flank folds (mm)	23	21	24	22
Subcapular folds (mm)	26	25	25	23.5
Thigh folds (mm)	35	31	37	34.5
Biceps folds (mm)	15	14.5	20	20
Folds sum (mm)	132	120.5	136	126

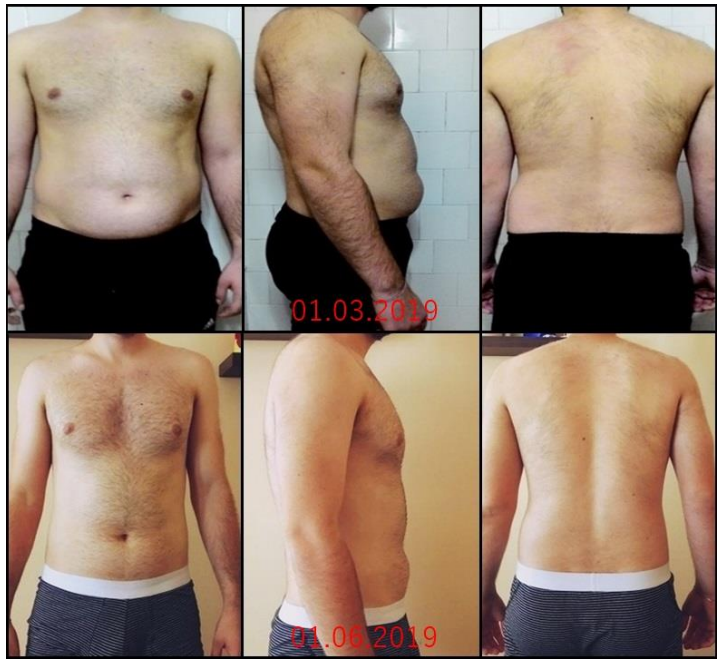

Figure 1. Subject 1 at the beginning and at the end of the physical activity programme

During the three months of training, the body weight of S2 decreased from 76.2 kg to 69.7 kg. Taking into account the 6.5 kg lost during the period and approximately 2.16 kg each month, S2 also exceeded the average value of 1.8 kg/month considered to be the optimum weight loss (Jensen et al., 2013). The adipose tissue dropped with 2.9 kg (from 28.37 kg initially to 25.46 kg in the end), representing 1.56% of the total; maintaining above the normal limits of 25%. The BMI dropped from an initial 28.43 to 26, reaching the end of the programme a level bellow the optimum value of 27, the subject situated as normal considering this indicator. The effort capacity indicated by the VO_{2max} increased with approximately 0,3 l/min (from 1.9 l/min initially to 2.2 l/min in the end). The considerable improvement of the stamina and physical performances of S2 during the programme are highlighted by the results obtained at the Hettinger test, namely 84 points in the end compared to 81 points initially (table 4).

Table 4. The values of the weight, body composition and VO_{2max} of the two subjects before and after the physical activity

Indicators	Subject I			Subject II		
	Initial values	Optimal values	Final values	Initial values	Optimal values	Final values
Real body weight (kg)	98.5	85.6	89.8	76.2	71.4	69.7
BMI (Body Mass Index)	30.12	<24	27.46	28.43	<27	26
Real fat tissue (%)	27.8	16	26.06	28.05	25	26.49
Real fat tissue (kg)	27.38	11.81	23.36	28.37	14.28	25.46
Real weak mass (kg)	71.12	73.87	66.44	54.83	57.15	51.24
VO2max (l/min)	1.8	3.2 - 3.6	2.4	1.9	1.7 - 2.1	2.2

CONCLUSIONS

The present study carried out over a period of three months and having as subjects' people of different ages and gender considered the analysis of the effects a regular physical activity programme might generate on the body composition of adults. Taking into consideration the bleak forecast of an alarming increase of obesity in the near future, such programmes seem to be a sine-qua-non tool for weight loss and the reduction of fat with the increase of muscle mass. The results obtained during the study justify us to state that the state of health, respectively physical condition related to health, may be improved for both a young adult as well as for a middle aged person, independent on the gender, with just minor changes in their diet and with the introduction in everyday life of a 60 minutes physical activity aerobic and muscle toning programme, based on the assessment and prescription of all the determined components.

REFERENCES

Åstrand, P. O., & Ryhming, I. (1954). A nomogram for calculation of aerobic capacity (physical fitness) from pulse rate during submaximal work. *Journal of applied physiology*, 7(2), 218-221.

Baidog, A. & Herman, G.V. (2018). The influence of Sports and Physical Activity on the Metabolic Syndrome: A Systematic Review. *Analele Universităţii din Oradea. Facicula Educaţie Fizică şi Sport*, 28, 39-45.

Battaglia, G., Bellafiore, M., Alesi, M., Paoli, A., Bianco, A., & Palma, A. (2016). Effects of an adapted physical activity program on psychophysical health in elderly women. *Clinical interventions in aging*, 11, 1009-1015.

Chin, S. H., Kahathuduwa, C. N., & Binks, M. (2016). Physical activity and obesity: what we know and what we need to know. *Obesity Reviews*, 17(12), 1226-1244.

Corbin, C., & Lindsey, R. (1984). *The ultimate fitness book*, Leisure, New York, USA.

Cordun, M. (2009). *Kinantropometrie*, Editura CD PRESS, Bucharest, Romania.

de Bont, J., Casas, M., Barrera-Gómez, J., Cirach, M., Rivas, I., Valvi, D., ... & Vrijheid, M. (2019). Ambient air pollution and overweight and obesity in school-aged children in Barcelona, Spain. *Environment international*, 125, 58-64.

Dejardin, P. (2008). Prevention du vieillissment. *Kinesitherapie scientifique*, 491, 5-10.

Drăgan, I. (2002). *Medicina sportivă*, Editura Medicală, București, Romania.

Ferry, B., Gavris, M., Tifrea, C., Serbanoiu, S., Pop, A. C., Bembea, M., & Courteix, D. (2014). The bone tissue of children and adolescents with Down syndrome is sensitive to mechanical stress in certain skeletal locations: a 1-year physical training program study. Research in developmental disabilities, 35(9), 2077-2084.

Finkelstein, E. A., Khavjou, O. A., Thompson, H., Trogdon, J. G., Pan, L., Sherry, B., & Dietz, W. (2012). Obesity and severe obesity forecasts through 2030. *American journal of preventive medicine*, 42(6), 563-570.

Flegal, K. M., Kruszon-Moran, D., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2016). Trends in obesity among adults in the United States, 2005 to 2014. *Jama*, 315(21), 2284-2291.

Geserick, M., Vogel, M., Gausche, R., Lipek, T., Spielau, U., Keller, E., ... & Körner, A. (2018). Acceleration of BMI in early childhood and risk of sustained obesity. *New England Journal of Medicine*, 379(14), 1303-1312.

Gupta, N., Goel, K., Shah, P., & Misra, A. (2012). Childhood obesity in developing countries: epidemiology, determinants, and prevention. *Endocrine reviews*, 33(1), 48-70.

Heyward, V. H. (1998). *Advance Fitness Assessment & Exercise Prescription*, The Cooper Institute for Aerobics Research, Dallas, USA.

Hills, A. P., Andersen, L. B., & Byrne, N. M. (2011). Physical activity and obesity in children. *British journal of sports medicine*, 45(11), 866-870.

Ilies, D. C., Buhas, R., Ilies, M., Ilies, A., Gaceu, O., Pop, A. C., ... & Baias, S. (2018). Sport activities and leisure in Nature 2000 protected area-Red Valley, Romania. *Journal of Environmental Protection and Ecology*, 19(1), 367-372.

Inoue, Y., Qin, B., Poti, J., Sokol, R., & Gordon-Larsen, P. (2018). Epidemiology of obesity in adults: latest trends. *Current obesity reports*, 7(4), 276-288.

Jensen, M. D., Ryan, D. H., Apovian, C. M., Ard, J. D., Comuzzie, A. G., Donato, K. A., … & Yanovski, S. Z. (2013). 2013 AHA/ACC/TOS Guideline for the Management of Overweight and Obesity in Adults. *Circulation*, 129(25 suppl 2), S102–S138.

Kassirer, J. P., Angell, M. (1998). Losing Weight - An Ill-Fated New Year's Resolution. *New England Journal of Medicine*, 338(1), 52–54.

Lobstein, T., Jackson-Leach, R., Moodie, M. L., Hall, K. D., Gortmaker, S. L., Swinburn, B. A., … & McPherson, K. (2015). Child and adolescent obesity: part of a bigger picture. *The Lancet*, 385(9986), 2510–2520.

Marfell-Jones M, Olds T, Stewart A, & Carter L. (2006). International Standards for Anthropometric assessment. *International Society for the Advancement of Kinanthropometry (ISAK).* South Africa: Potchefstroom.

Nagy, K., Șerbescu, C., & Ciobanu, D. (2016). The efect of a physical activity program of the health related fitness and quality of life on a female student group from Oradea, Romanian. *Journal of Physical Therapy*, 21 (37), 50-58.

Navarro, E., Funtikova, A. N., Fíto, M., & Schröder, H. (2017). Prenatal nutrition and the risk of adult obesity: Long-term effects of nutrition on epigenetic mechanisms regulating gene expression. *The Journal of Nutritional Biochemistry*, 39, 1–14.

Powell, K., Wilcox, J., Clonan, A., Bissell, P., Preston, L., Peacock, M., & Holdsworth, M. (2015). The role of social networks in the development of overweight and obesity among adults: a scoping review. *BMC Public Health*, 15(1), 996.

Sbenghe, T. (1987). *Kinetologie ptofilactică terapeutică și de recuperare*, Editura Medicală, București, Romania.

Serbescu, C., Flora, D., Hantiu, I., Greene, D., Laurent Benhamou, C., & Courteix, D. (2006). Effect of a six-month training programme on the physical capacities of Romanian schoolchildren. *Acta Paediatrica*, 95(10), 1258–1265.

Smith, K. B., & Smith, M.S. (2016). Obesity statistics. *Primary Care: Clinics in Office Practice*, 43(1), 121-135.

Stasiulis, A., Mockienė, A., Vizbaraitė, D., & Mockus, P. (2010). Aerobic exercise-induced changes in body composition and blood lipids in young women. *Medicina*, 46(2), 129.

Steff, M., Verney, J., Marinau, M., Perte, S., Pereira, B., Bryant, E., ... & Thivel, D. (2019). Toward a Romanian version of the Three-Factor Eating Questionnaire-R21 for children and adolescents (CTFEQ-R21): Preliminary psychometric analysis and relation with body composition. Developmental period medicine, 23(1), 45-53.

Șerbescu, C. (2008). *Condiția fizică a școlarului mic*, Editura Universității din Oradea, Oradea, Romania.

Tătar, C. F., Herman, G.V., & Pețan, P. (2018). Sport and physical activity engagement in Romania. *Geosport for Society*, 8(1), 40-50.

Tseng, E., Zhang, A., Shogbesan, O., Gudzune, K. A., Wilson, R. F., Kharrazi, H., ... & Bennett, W. L. (2018). Effectiveness of policies and programs to combat adult obesity: a systematic review. *Journal of general internal medicine*, 33(11), 1990-2001.

Van Cleave, J. (2010). Dynamics of Obesity and Chronic Health Conditions Among Children and Youth. *JAMA*, 303(7), 623.

Whooten, R. C., Perkins, M. E., Gerber, M. W., & Taveras, E. M. (2018). Effects of Before-School Physical Activity on Obesity Prevention and Wellness. *American Journal of Preventive Medicine*, 54(4), 510–518.

Wiklund, P. (2016). The role of physical activity and exercise in obesity and weight management: Time for critical appraisal. *Journal of Sport and Health Science*, 5(2), 151–154.

Willis, L. H., Slentz, C. A., Bateman, L. A., Shields, A. T., Piner, L. W., Bales, C. W., … & Kraus, W. E. (2012). Effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. *Journal of Applied Physiology*, 113(12), 1831–1837.

Yumuk, V., Tsigos, C., Fried, M., Schindler, K., Busetto, L., Micic, D., & Toplak, H. (2015). European Guidelines for Obesity Management in Adults. *Obesity Facts*, 8(6), 402–424.

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