O R I G I N A L   A R T I C L E

# The evaluation of body composition and anthropometric measurements of males aged 18-25 years, based on the regularity of physical exercise

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**Summary.** There were 200 participants in total, on a voluntary basis in the study.  Of these participants, 100 were male students aged 18-25 years who exercised regularly and vigorously, and 100 were male aged 18-25 years who did not participate in any physical activity. The measurements of BMI, body fat composition, hip-to-waist ratio, and skinfolds measured at nine different anatomical areas of their bodies (pectoral, biceps, triceps, subscapular, abdominal, suprailiac, thigh, midaxillary and the medial part of the leg) using skinfold caliper were recorded in the Excel format. It was determined that there was a significant difference ($p<0.05$) between the BMI of those who exercised regularly and of those who did not, and that there were significant differences ($p<0.05$) between muscle weights, hip-to-waist ratio, body fat composition, total body water, and basal metabolic rates of the participants who exercised regularly and of those who did not. It was determined that the total body water was increased in the subjects who exercised regularly due to increased muscle weight and mass, their hip-to-waist and body fat ratios were lower, and basal metabolic rates were higher when compared to the non-exercisers. It was also determined that there were significant differences ($p<0.05$) between the two groups regarding of skinfold caliper measurements at nine different areas. When the data from the study, which is the first to include nine different anatomical regions, was evaluated, it was concluded that the sedentary lifestyle influences the onset of obesity and it can be partially treated with physical activity.

**Key words:** anthropometric measurement, regular exercise, athlete, physical activity, obesity

## 1. Introduction

Exercising can be defined as making a habit of performing physical activity on a regular basis, which is important for overall health (1). With the recognition of the relationship between a sedentary lifestyle and chronic disorders, the tendency to exercising is continuously increasing.

The World Health Organization defines sports or exercises as any physical movement produced by the skeletal muscles, requiring energy consumption (2). The increased prevalence of obesity, which is due to the improvement of socioeconomic conditions in developing and developed countries and the subsequent withdrawal from an active lifestyle, brings about many

chronic disorders with it (3). It is known that exercising has positive impacts on obesity, coronary heart disease, hypertension, diabetes, arthritis, osteoporosis, dyslipidemia, depression, cancer, muscles, bones, and joints (4-6).

The most commonly used measure for overweight and obesity is the Body Mass Index (BMI), a simple index to classify overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m2). Body mass index (BMI) is a measure of body fat based on height and weight that applies to adult men and women (6).

Body composition is defined as the relative weight ratio of fatty and fat-free tissues of the body (2), whereas anthropometry is measurement of physical parameters

**Table 1.** Classification of Overweight and Obesity by Body Mass Index (BMI) (7)

| Body Weight | BMI (Kg/M²) | Morbidity Risk |
|---|---|---|
| Underweight | <18.5 | Low (Clinical Problems High) |
| Healthy Weight | 18.5-19.9 | Middle |
| Recommended | 20.0-24.9 | Mid |
| Overweight | ≥25:00 | Lightweight |
| Pre-Obese | 25.0-29.9 | High Mid-Lightweight |
| Obese | ≥30.00 | High |
| Obese Class I | 30.0-34.9 | Very High |
| Obese Class III | 35.0-39.9 | Very High |
| Obese Class III | ≥40 | Extremely High |

(height, weight, circumferences, etc.) of individuals with different ages, genders, and nutritional status and determination of the body composition (fat and muscle tissues) (8,9). Anthropometric measurements are important for the evaluation of development and growth, the determination of the amount of lean tissue (muscle tissue) and fatty tissue, and also because it is an indicator of fat distribution in the body. The measurement of body weight, height, mid-upper arm circumference (MUAC), head circumference (HC), waist circumference, and hip circumference are commonly used anthropometric methods (9). Anthropometric data from adults is a good indicator for the evaluation and recognition of health status and diet, disease risk, and the comparison of different body types by comparing measurements from various regions of the body (6, 10). The purpose of our study was to investigate the presence and tendency to obesity together with the wellness status of 18-25-year old male individuals by comparing the body composition and anthropometric measurements to the reference values according to their status of regular exercise and to determine reference values for mildly overweight, overweight, skinny or underweight individuals.

## 2. Material and Method

There were 200 participants in total, on a voluntary basis in the study. Of these participants, 100 were male students aged 18-25 years from Police Vocational School of Higher Education who exercised regularly and vigorously, and 100 were male university students aged 18-25 years who do not participate in any physical activity. The study was conducted after the obtainment of the permission dated 06/11/2014 and No.: E.1459 from the Bitlis Eren University Ethical Committee. At least one day prior to the measurements, the participants were informed about the measurement process, and the measurement devices were introduced. The participants signed a "Voluntary Consent Form." For both groups, the BMI, body fat ratio, hip-to-waist ratio, and skinfolds from nine different anatomical areas of their bodies (the pectoral, biceps, triceps, subscapular, abdominal, suprailiac, thigh, midaxillary and the medial part of the leg) using skinfold caliper were measured and recorded in Excel format.

### 2.1. Anthropometric measurements
#### 2.1.1. Measurement of height
Measurements were made by using a Harpenden stadiometer (ADE/Hamburg MZ10020) ultrasonic height measurement unit with 0.1 cm accuracy (11) parallel to the floor at the level of the crown of the head, and without any clothes or accessories that might affect the measurements.

#### 2.1.2. Measurement of Body Mass Index (BMI), Body Fat Composition, Hip-to-Waist Ratio, Total Body Water, Basal Metabolic Rate (BMR)
Measurements were performed with InBody230 (MW160) Bio-Impedance Body Analysis Machine with the participants not wearing anyclothing except for shorts, at least 12 hours after the last meal, and at a state of rest.

#### 2.1.3. Skinfold Thickness (SFT) measurement
The thickness of skin was measured using special callipers named Holtain Skinfold Calipers (Holtain, Crymch, Dyfed, UK) on nine different anatomical regions of the body (12) (pectoral, biceps, triceps, subscapular, abdominal, suprailiac, thigh, midaxillary and the medial part of the leg) on the dominant side of the body.

The measurement of skinfold thickness was done by holding the skin and subcutaneous fat with the

thumb and index finger (13), pulling it in the direction of the fold and away from the muscle tissue. The value on the skinfold indicator was recorded in millimeters. This process was done in all subjects by a single person to minimize the chance of error.

### 2.1.4. Bi-iliac, bitrochanteric, and biacromial diameter measurements

Measurements were done using Holtain Harpenden Anthropometer measurement device (14), subjects wearing nothing but shorts.

## 2.2. The Physical Activity Status
### 2.2.1. Moderate-level physical activities

These activities are accompanied by small increases in heart and respiratory rates. Paced walking, dancing, gardening, low-intensity swimming and biking are considered moderate-level physical activities (15). To be able to consider this type of activity as regular, it must be done at least 5 times a week and 30 minutes a day.

### 2.2.2. Moderate-severity activities

This is the type of activity that requires moderate physical exertion and causes a small increase in respiration, performed for at least 10 minutes at a time (15).

### 2.2.3. Vigorous physical activities

This level of physical activity requires immense physical effort and produces prominently increased respiration. These activities are performed for more than 10 minutes at a time (15). The participants of this study performed vigorous exercise on a regular basis.

### 2.3. Statistical analysis

All data were statistically analysed using STATGRAPHICS Centurion XVI (Version 16.2.04), STATGRAPHICS plus 5.1 (Statpoint Technologies, Warrenton, VA, USA), or SPSS v21 (IBM Corp., Chicago, IL, USA) and means ± SD were calculated for every parameter measured.

## 3. Results

### 3.1. Demographic characteristics

The BMI distributions and means of BMI, age, and height of the exercising and non-exercising participants of the study were given in Table 2.

### 3.2. Body Mass Index, Body Fat Ratio, Hip-to-Waist Ratio, Muscle Mass, Total Body Water, Basal Metabolic Rate (BMR) Analysis Results

In the study, it was determined that there was a significant difference ($p < 0.05$) between the BMI of exercising subjects and non-exercising subjects and the mean BMI value of exercising subjects was lower.

It was determined that there was a significant difference ($p < 0.05$) between the exercising and non-exercising subjects regarding muscle mass, hip-to-waist ratio, body fat ratio, total body water, and basal metabolic rate. It was determined that, due to increased

**Table 2.** The exercising and non-exercising participants of the study; means of BMI, age, and height avarage

| Avarage | Regular Exercise | | Not Regularly Exercising | |
|---|---|---|---|---|
| BMI | 22.66±1.90 | (n=100) | 23,57±1.77 | (n=100) |
| Age | 21.04±1.58 | (n=100) | 20.90±1.52 | (n=100) |
| Height | 178.86±5.74 | (n=100) | 177.64±5.23 | (n=100) |

| BMI (kg/m²) | Regular Exercise participants (n) | Not Regularly Exercising participants (n) | Total |
|---|---|---|---|
| 18.5-19.9 | 10 | – | 10 |
| 20.0-24.9 | 80 | 82 | 162 |
| 25.0-29.9 | 10 | 18 | 28 |
| General Total | 100 | 100 | 200 |

**Table 3.** Regular exercise status of groups; body fat ratio, hip-to-waist ratio, muscle mass, total body water, basal metabolic rate (BMR) analysis values (*n:200*)

| Measurement Parameters | Exercise Situation (F-value) |
|---|---|
| Body Mass Index (BMI) | 0.2394 * |
| Percentage Body Fat (PBF) | 0.5937 *** |
| Waist-Hip Ratio (WHR) | 0.5183 *** |
| Muscle Weight | 0.4338 *** |
| Total Body Water | 0.3656 *** |
| Basal Metabolic Rate (BMR) | 0.2394 *** |

*0.01<P<0.05      *** P<0.001*

muscle weight and mass, the total amount of water in the body was higher, the hip-to-waist and body fat ratios were lower, and basal metabolic rates were higher in the subjects who regularly exercised when compared to the non-exercisers.

### 3.3. Skinfold thickness analysis results

It was determined from measurements of the nine different anatomical areas using skinfold caliper that there was a significant difference (p<0.05) between the exercising and non-exercising subjects.

### 3.3. Bi-iliac (Navel), Bitrochateric (Hip), Biacrominal (Shoulder) Diameter Analysis Values

It was also determined that the differences between the bi-iliac, bitrochanteric and biacromial di-

**Table 4.** Regular exercise status of groups; skinfold thickness measurements analysis values (*n:200*)

| Measurement Parameters | Exercise Situation (F-value) |
|---|---|
| Pectoral | 0.4070 *** |
| Subscapula | 0.4209 *** |
| Biceps | 0.4919 *** |
| Triceps | 0.5033 *** |
| Suprailiac | 0.4932 *** |
| Abdomen | 0.5292 *** |
| Middle Axillary | 0.4132 *** |
| Femur | 0.2578 *** |
| Leg Medial | 0.5159 *** |

*** P<0.001*

**Table 5.** Regular exercise status of groups; diameter measurements analysis values (*n:200*)

| Measurement Parameters | Exercise Situation (F-value) |
|---|---|
| Bi-iliac (Navel) Diameter | 0.0619** |
| Bitrochateric (Hip) Diameter | 0.1743** |
| Biacrominal (Shoulder) Diameter | 0.1690** |

*** P>0.05*

ameters of the exercising subjects and non-exercising subjects were not significant (p>0.05).

## 4. Discussion

Regularly performed physical exercise ensures that the muscles, bones, joints, and cardiovascular system function optimally (17). With exercise, the respiratory, digestive, excretory, and skeletal systems can be maintained in the ideal condition (18). Individuals who remain sedentary for too long can lose their mobility and may suffer from poor health. Systematic sports activities have a definite positive effect on the body composition (19). The body is mainly composed of fat tissue, bones, muscle tissue, other organic material and extracellular fluids. The body composition can be divided into fatty and fat-free masses (20). The fat-free mass involves muscles, bones, water, nerves, blood vessels and other organic material. The fatty mass can be classified as subcutaneous fats, stored fats, and essential fats (21).

The results of the study indicate that in the exercising individuals, BMI, the body fat and the hip-to-waist ratios are lower, and therefore, exercise reduces fatty mass in the body, the BMI, and the obesity risk. It is also shown that muscle mass and total body water is higher in exercising subjects when compared to non-exercising ones; therefore, it can be suggested that exercise increases muscle mass, strength, speed, and endurance (22). While the body fat mass decreases, the muscle mass and endurance improve in individuals who exercise regularly. Besides, a sedentary lifestyle can lead to energy input and output imbalance, and thus, may lead to increased prevalence of obesity.

It was determined that the BMR of the regularly exercising individuals were higher than those who did

not (3) and the exercise-related increase in muscle mass elevated the BMR. Another study has found that the aerobic metabolic capacity increased in subjects who participated in exercises such as walking, running, gymnastics, swimming, and ball games (22).

Significant differences (p<0.05) were found between the exercising and non-exercising individuals regarding skinfold thicknesses measured with a skinfold caliper from nine different anatomical regions (pectoral, biceps, triceps, subscapular, abdominal, suprailiac, thigh, midaxillary and the medial part of the leg). It was shown in conducted studies that exercise reduces fatty mass, particularly leading to a reduction of the subcutaneous fat thickness in the abdominal region (10, 13, 23-24,).

Similar to this study, Kayıhan et al. (25) have found significant differences between exercising and non-exercising individuals. However, in contrast with this study, the studies performed by Twisk et al. (26) and Düzgün (27) have indicated that the differences between their exercising and non-exercising groups regarding subcutaneous fat thickness were insignificant. This may be a result of differences in the intensity and frequency of the workouts, and the number of participants in the studies.

Even though no significant differences were discovered between the bi-iliac, bitrochanteric, and biacromial diameters of the exercising and non-exercising groups measured by Holtain Harpenden Anthropometer, this might be associated with the low number of participants and the similarity of BMI in the two groups. A study conducted with a higher number of participants with wider ranges of BMI and age groups can better address this issue.

**To conclude:** The research done until now have proven that exercise improves the cardiovascular and respiratory systems, the musculoskeletal system, hypertension, diabetes, being overweight or obese, cholesterol, mental clarity, psychological balance, stress, and cancer (10).

➢ Today, obesity is a disorder leading to a great financial loss all over the world. This problem can be taken under control by providing better living conditions, healthy nutrition, and step-by-step improved lifestyle changes.

➢ Although the regularly exercising group in this study included male students from Police Vocational School of Higher Education, exercise is not limited to certain age and vocational groups, only. People from every age group, background, and occupation should be informed with the importance of regular exercise and be provided with regular courses if necessary. It should not be forgotten that exercise can prevent many health problems and exercise should not be considered as treatment, but a preventive measure for obesity and related disorders.

➢ In this study, we have once again proven that, in the treatment of obesity, it should be aimed to increase the energy expenditure through regularly performed exercise, activity, and sports, in addition to the restriction of energy input.

## Acknowledgments

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