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Determination of Adductor Pollicis Muscle Thickness in Overweight or Obese Young Women

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Abstract: The Adductor Pollicis Muscle Thickness (APMT) value is the numerical value obtained by measuring the thickness that contains components such as tissue, skin, nerve and adipose tissue by means of a caliper. A new anthropometric measurement technique, APMT, is promising for clinical use in conditions such as obesity and malnutrition. In this study, it is aimed to compare APMT measurement with other anthropometric measurements in overweight-obese and normal weight female individuals. Healthy female individuals living in Sivas, between the ages of 18-25, overweight-obese and with normal weight were included in the study. APMT measurements were taken from both the right and left hands of the participants. The measurements were repeated twice and the average of the measurements was taken. The study sample was divided into normal weight and overweight-obese groups. A total of 46 individuals were included in the study by including 23 women in the groups. While obese individuals constitute 15.2% of the sample; overweight individuals constitute 34.8%. While APMT-R was 15.37±1.90, APMT-L was 15.04±1.78 mm in individuals with normal weight; APMT-R was 17.10±2.81 and APMT-L was 16.69±22.75 mm in overweight and obese individuals. APMT and APMT index values measured on both the right and left hands were found to be higher in overweight-obese individuals than in individuals with normal weight ($p<0.05$). In the study, it was revealed that APMT and APMT index measured in the right and left hands showed a moderate positive correlation with BMI ($p<0.05$). It was observed that the correlation between APMT thickness and other anthropometric measurements was higher in overweight and obese individuals. The results obtained from the study show that the increase in weight, muscle and adipose tissue affects APMT values. Anthropometric measurements and APMT values correlate with each other. Therefore, APMT measurement is a feasible method in different age groups and in different clinical situations because it is easy and applicable.

Keywords: Adductor pollicis muscle thickness, antropometric measurements, muscle Mass, obesity.

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1. INTRODUCTION

Nutritional status is an indicator of how much of an individual's physiological nutritional needs are met (Hammond 2019). Evaluation of healthy and unhealthy individuals in the society in terms of nutrition; Identifying and diagnosing nutritional risks is essential for planning appropriate nutritional interventions. Anthropometric measurements used in the evaluation of nutritional status and determination of body composition are considered by researchers as a very important component (Uyar 2013).

Anthropometric measurements are important in terms of diagnosing malnutrition and reflecting protein and fat reserves in various parts of the body. Anthropometric measurements are frequently used in clinical practice because of their ease of application and low cost. In general, skeletal muscle mass is measured quickly and easily through anthropometric measurements such as upper middle arm muscle circumference (UMAMC) and upper middle arm muscle area (UMAMA) (Lameu et al. 2004a).

The idea of using the place called "Adductor Pollicis Muscle Thickness" (APMT) between the thumb and forefinger in determining the nutritional status of individuals by taking the measurement alone was first put forward by Lameu et al in 2004. Measurement of APMT; It is in the form of determining the thickness of the whole textural structure together with the skin, subcutaneous adipose tissue, muscle and other components. When determining the place to be measured, it was accepted that the metacarpal bones of the thumb and index fingers formed the two sides of a triangle, and the line to be drawn between the metacarpophalangeal joints at the end of these bones formed the base of the triangle. The bisectors of this imaginary triangle are drawn with a compass and their intersection points are marked. While the individual to be measured was in a sitting position, the measurement was taken with a caliper so that the wrist standing at the tip of the kneecap was 90 degrees to the homolateral lower extremity (Lameu et al. 2004b).

The method described above has been accepted as a standard in studies investigating the relationship between APMT and nutritional status (Heymsfield et al. 1982; Lameu et al. 2004a). In the studies, APMT measurement was performed only in the dominant hand (the hand used for daily work or writing). The reason for this is based on the idea that the muscles here, which are used more and more developed, will atrophy faster in the presence of malnutrition (Pereira et al. 2018). Because of these features, the measurement of this thickness has the potential to be used in clinical malnutrition screening by comparing or using other anthropometric measurements (Lew et al. 2016). Various scientific studies have shown that APMT measurement can reflect the total muscle mass in the body (Gonzalez et al. 2010; de Oliveira et al. 2012). APKT measurement emerges as an auxiliary anthropometric measurement in the clinic. When we examine the literature, there are studies in which APKT measurement is used in intensive care patients, cancer patients and postoperative patients (Ghorabi et al. 2016; Valente et al. 2016; Valente et al. 2019).

In this study, it is aimed to compare APMT measurement with other anthropometric measurements in overweight-obese and normal-weight female individuals. Normal weight and obese female individuals were included in the study and it was examined whether the APKT measurement changed in a smaller population. This study was conducted as a pilot study and was designed to form the basis of a more comprehensive study that included all age groups and all BMI groups. With the results of the study, it is thought that APMT measurement can be used in the clinic and in the evaluation of nutritional status.

2. MATERIAL AND METHODS

2.1. Study Design

The study was planned as a cross-sectional study and included between 18-25 years of age, living in Sivas, healthy female individuals with a normal weight and overweight-obese. Anthropometric measurements in the study were carried out by researchers who are specialist dietitians. In this study, APMT measurements of the dominant and non-dominant hands of the participants were taken separately and thus, the bias that could occur depending on the dominant or non-dominant hand was tried to be prevented. The measurements were repeated twice and the average of the measurements was taken.

2.2. Antropometric Measurements

The weight measurements of the participants were measured with a digital weighing instrument with an accuracy of ± 0.1 kg. The height measurement was made by means of a portable height meter that can be calibrated (with an accuracy of 20-205 cm±1 mm). The height measurement was recorded standing upright, facing straight ahead, and the upper part of the ears and the outer corner of the eyes were in a line parallel to the plane (Frankfort plane). Body mass index (BMI) was calculated by dividing weight (in kilograms) by the square of height (in meters) (WHO, 2019). Caliper was used to measure APMT and triceps skinfold thickness (TST). It has the feature of measuring the subcutaneous fat layer of the calipers used with an accuracy of ±0.2 mm. TSK measurement; The distance between the tip of the acromion protrusion of the scapula and the olecranon prominence of the ulna was measured while the elbow was flexed at 90 degrees and the midpoint was marked. The measurement was recorded 1 cm below the marked point with the individual standing upright and the arm hanging freely. Skinfold thickness (ST) values were measured while individuals were standing upright and with their shoulders and arms relaxed. A total of 2 measurements were taken at 2 min intervals to allow the tissue to recover. The ST values to be used in the study were calculated by taking the average of these 2 values (Heyward and Wagner 2004).

Upper mid-arm circumference (UMAC) measurement was performed using a non-flexible tape measure by marking the midpoint of the distance between the tip of the acromion process of the scapula and the olecranon process of the ulna. Upper middle arm muscle circumference (UMAMC) measurement, UMAC and TST values were found; calculated by means of the formula UMAMC = UMAC -- (π x TST). Upper middle arm area (UMAA); calculated with the formula UMAA = $UMAC^2/4\pi$. Upper middle arm muscle area (UMAMA); It has been determined as UMAMA = $UMAMC^2/ 4\pi$. Adductor Pollicis Muscle Thickness Index (APMTI); It was obtained by dividing the APMT value measured in millimeters (mm) by the height in meters (m) (Ghorabi et al. 2014).

Statistical analysis

The data obtained from our study were evaluated with the SPSS 23.0 program. The normality of the data was evaluated with the Mann Whitney U test. Independent sample t test was used for two independent groups in normally distributed data. Normally distributed data are shown as $\bar{x}$±SD, non-normally distributed data are shown as median. The state, direction and degree of the relationship between continuous variables were analyzed using the Pearson correlation coefficient. $p<0.05$ was considered statistically significant.

3. RESULTS AND DISCUSSION

The study sample was divided into normal weight and overweight-obese groups. A total of 46 individuals were included in the study by including 23 women in the groups. Obese individuals constitute 15.2% of the sample and overweight individuals constitute 34.8%. The mean weight of the sample was 64.13±12.72 kg, the average height was 1.6±0.48 m, and the mean BMI was 25.02±4.61 kg/m2. When the weight and BMI status of the groups are examined; in the overweight-obese group, mean weight was 72.86±11.87 kg (range: 58.6-103.8 kg), mean BMI was 28.61±3.8 kg/m2 (range: 25.12-38.59 kg/m2); in the normal weight group, the mean weight was 55.41±5.56 kg (range: 46.45-67 kg), and the mean BMI was 21.43±1.47 kg/m2 (range: 18.61-24.46 kg/m2). It was determined that the right hand of all individuals included in the study was dominant.
Table 1 shows the mean and standard deviation values of the TST, UMAC, UMAMC, UMAA, UMAMA, right and left hands of the individuals' APMT and APMT index, and the lowest and highest values of anthropometric measurements according to the groups. A statistically significant difference was found between APMT, APMT index and other anthropometric measurements between overweight-obese and normal-weight individuals.
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Table 1. Adductor Pollicis Muscle Thickness and Other Anthropometric Measurements of Individuals by Group.

Anthropometric Measurements	Normal Weight Group x̄±SD	Normal Weight Group Min-Max	Overweight-Obese Group x̄±SD	Overweight-Obese Group Min-Max	Test Statistics p
APMT (mm-right hand)	15.37±1.90	11.60-18.90	17.10±2.81	12.20-22.70	0.019**
APMT (mm-left hand)	15.04±1.78	11.30-18.10	16.69±22.75	12.30-21.15	0.020**
APMİ(mm/m^2-right hand)	9.58±1.24	6.99-11.96	10.73±1.74	7.87-14.04	0.013**
APMİ (mm/m^2-left hand)	9.37±1.13	6.81-11.76	10.46±1.69	7.69-13.78	0.012**
TST (cm)	1.54±0.33	0.92-2.27	2.47±0.47	1.54-3.20	0.001*
UMAC (cm)	24.13±1.48	21.00-27.00	29.59±33.16	25.40-36.00	0.001*
UMAMC (cm)	19.27±1.15	17.67-22.18	21.81±2.47	17.93-27.68	0.001*
UMAA (cm^2)	46.52±5.69	35.11-58.04	70.48±15.42	51.37-103.18	0.001*
UMAMA (cm^2)	29.67±3.65	24.87-39.17	38.34±8.89	25.59-61.00	0.001*

* $p < 0.01$, ** $p < 0.05$

In the study, when the correlation relationship between BMI and APMT, APMT index was examined; It has been revealed that there is a positive correlation between BMI and right hand APMT mean r=0.608 (p=0.001), and left hand APMT mean r=0.550 (p=0.001). A positive correlation was found between the mean of the right hand APMT index, r=0.592 (p=0.001) and the mean of the left-hand APMT index, r=0.549 (p=0.001).
When the relationship between APMT and other anthropometric measurements of normal-weight individuals is examined; APMT and APMT index measured in the right and left hands were found to be positively correlated with each other (p<0.01). While APMT and APMT index measured from the right hand were not found to be associated with TST, UMAC, UMAMC, UMAA and UMAMA (p>0.05); it was found that APMT measured on the left hand showed a positive correlation with UMAC, UMAMC, UMAA and UMAMA (p<0.05). On the other hand, it was revealed that the APMT index measured on the left hand showed a positive correlation only with UMAMC (p<0.05). It was determined that TST, which is one of the other anthropometric measurements taken from individuals with normal weight, showed a positive correlation with UMAC and UMAMC (p<0.01). The correlation relationship between APMT and other anthropometric measurements of normal-weight individuals is shown in Table 2.

Table 2. Correlation Relationship Between Adductor Pollicis Muscle Thickness and Other Anthropometric Measurements of Normal Weight Individuals.

	APMT-R (mm)	APMT-L (mm)	APMİ-R (mm/m^2)	APMİ-L (mm/m^2)	TST (cm)	UMAC (cm)	UMAMC (cm)	UMAA (cm^2)	UMAMA (cm^2)
APMT-R (mm)	-	r=0.867 p=0.001*	r=0.972 p=0.001*	r=0.866 p=0.001*	r= -0.118 p=0.592	r=0.201 p=0.357	r=0.366 p=0.086	r=0.196 p=0.370	r=0.350 p=0.102
APMT-L (mm)	r=0.867 p=0.001*	-	r=0.820 p=0.001*	r=0.965 p=0.001*	r=0.106 p=0.630	r=0.451 p=0.031**	r=0.482 p=0.020**	r=0.452 p=0.030**	r=0.474 p=0.022**
APMİ-R (mm/m^2)	r=0.972 p=0.001*	r=0.820 p=0.001*	-	r=0.881 p=0.001*	r= -0.204 p=0.352	r=0.095 p=0.668	r=0.307 p=0.154	r=0.087 p=0.693	r=0.288 p=0.182
APMİ-L (mm/m^2)	r=0.866 p=0.001*	r=0.965 p=0.001*	r=0.881 p=0.001*	-	r=0.002 p=0.992	r=0.330 p=0.124	r=0.421 p=0.045**	r=0.328 p=0.126	r=0.410 p=0.052
TST (cm)	r= -0.118 p=0.592	r=0.106 p=0.630	r= -0.204 p=0.352	r=0.002 p=0.992	-	r=0.632 p=0.001*	r= -0.103 p=0.640	r=0.614 p=0.002*	r= -0.094 p=0.668
UMAC (cm)	r=0.201 p=0.357	r=0.451 p=0.031**	r=0.095 p=0.668	r=0.330 p=0.124	r=0.632 p=0.001*	-	r=0.706 p=0.001*	r=0.999 p=0.001*	r=0.712 p=0.001*
UMAMC (cm)	r=0.366 p=0.086	r=0.482 p=0.020**	r=0.307 p=0.154	r=0.421 p=0.045	r= -0.103 p=0.640	r=0.706 p=0.001*	-	r=0.721 p=0.001*	r=0.999 p=0.001*
UMAA (cm^2)	r=0.196 p=0.370	r=0.452 p=0.030**	r=0.087 p=0.693	r=0.328 p=0.126	r=0.614 p=0.002*	r=0.999 p=0.001*	r=0.721 p=0.001*	-	r=0.728 p=0.001*
UMAMA (cm^2)	r=0.350 p=0.102	r=0.474 p=0.022**	r=0.288 p=0.182	r=0.410 p=0.052	r= -0.094 p=0.668	r=0.712 p=0.001*	r=0.999 p=0.001*	r=0.728 p=0.001*	-

* p <0.01, ** p <0.05

When the relationship between APMT and other anthropometric measurements of overweight and obese individuals was examined; APMT and APMT index measured in the right and left hands were found to be positively correlated with each other (p<0.01). While APMT and APMT index measured on the right hand were found to be positively correlated with TST, UMAC, UMAMC, UMAA and UMAMA (p<0.05); it was found that the APMT and APMT index measured on the left hand showed a positive correlation with TST, UMAC, and UMAA (p<0.05). It was determined that TST, which is one of the other anthropometric measurements taken from overweight and obese individuals, showed a positive correlation with UMAC and UMAA (p<0.01). The correlation relationship between APMT and other anthropometric measurements of overweight and obese individuals is shown in Table 3.

Table 3. Correlation Relationship between Adductor Pollicis Muscle Thickness and Other Anthropometric Measurements of Overweight and Obese Individuals.

	APMT-R (mm)	APMT-L (mm)	APMİ-R (mm/m^2)	APMİ-L (mm/m^2)	TST (cm)	UMAC (cm)	UMAMC (cm)	UMAA (cm^2)	UMAMA (cm^2)
APMT-R (mm)	-	r=0.084 p=0.001*	r=0.980 p=0.001*	r=0.895 p=0.001*	r=0.520 p=0.011**	r=0.673 p=0.001*	r=0.545 p=0.007*	r=0.669 p=0.001*	r=0.547 p=0.007*
APMT-L (mm)	r=0.084 p=0.001*	-	r=0.847 p=0.001*	r=0.981 p=0.001*	r=0.497 p=0.016**	r=0.528 p=0.010**	r=0.375 p=0.078	r=0.521 p=0.011**	r=0.361 p=0.090
APMİ-R (mm/m^2)	r=0.980 p=0.001*	r=0.847 p=0.001*	-	r=0.887 p=0.001*	r=0.436 p=0.038**	r=0.631 p=0.001*	r=0.542 p=0.007*	r=0.629 p=0.001*	r=0.545 p=0.007*
APMİ-L (mm/m^2)	r=0.895 p=0.001	r=0.981 p=0.001*	r=0.887 p=0.001*	-	r=0.425 p=0.043**	r=0.500 p=0.015**	r=0.383 p=0.072	r=0.495 p=0.016**	r=0.370 p=0.083
TST (cm)	r=0.520 p=0.011**	r=0.497 p=0.016**	r=0.436 p=0.038**	r=0.425 p=0.043**	-	r=0.646 p=0.001*	r=0.222 p=0.309	r=0.639 p=0.001*	r=0.231 p=0.289
UMAC (cm)	r=0.673 p=0.001*	r=0.528 p=0.010**	r=0.631 p=0.001*	r=0.500 p=0.015**	r=0.646 p=0.001*	-	r=0.887 p=0.001*	r=0.999 p=0.001*	r=0.890 p=0.001*
UMAMC(cm)	r=0.545 p=0.007*	r=0.375 p=0.078	r=0.542 p=0.007*	r=0.383 p=0.072	r=0.222 p=0.309	r=0.887 p=0.001*	-	r=0.891 p=0.001*	r=0.998 p=0.001*
UMAA (cm^2)	r=0.669 p=0.001*	r=0.521 p=0.011**	r=0.629 p=0.001*	r=0.495 p=0.016**	r=0.639 p=0.001*	r=0.999 p=0.001*	r=0.891 p=0.001*	-	r=0.895 p=0.001*
UMAMA (cm^2)	r=0.547 p=0.007*	r=0.361 p=0.090	r=0.545 p=0.007*	r=0.370 p=0.083	r=0.231 p=0.289	r=0.890 p=0.001*	r=0.998 p=0.001*	r=0.895 p=0.001*	-

* p <0.01, ** p <0.05

Assessment of nutritional status is an important table showing the ratio of meeting the physiological nutrient needs of individuals and reflecting the health status of the individual. One of the important methods used in the assessment of nutritional status is anthropometric measurements (Hammond 2019). The APMT value is a numerical value obtained by measuring the layer containing components such as tissue, skin, nerve and adipose tissue through the caliper. This thickness contains minimal adipose tissue. This distinctive feature makes APMT the only place in the body that can be directly measured by caliper as a muscle component. Anthropometric measurements are frequently used in the clinic due to their practical application, low cost and advantages such as being an invasive technique (Lameu et al. 2004b). A new anthropometric measurement technique, APMT, is promising for clinical use in conditions such as obesity and malnutrition. In the study, APMT measurement, which can be detected easily and quickly, the measurements can be easily repeated, and the cost is relatively lower than other anthropometric measurement methods, was used. APMT values were compared in overweight and obese and normal weight young women.

In this study, APMT-R was 15.37±1.90 mm and APMT-L was 15.04±1.78 mm in individuals with normal weight; APMT-R was 17.10±2.81 mm and APMT-L was 16.69±22.75 mm in overweight and obese individuals. In the findings obtained from the study, APMT and APMT index values measured in both the right and left hands are higher in overweight-obese individuals than in individuals with normal weight. In another recent study, it was shown that APMT value is higher in obese individuals. In the study, it was shown that APMT value was 17.6±3.1 mm in women with normal weight, 19.9±2.9 mm in overweight women and 22.9±3.8 mm in obese women (Bielemann et al. 2016). In another study in which women were the sample, the mean BMI was found to be 27.1±6.2 kg/m^2 and the mean APMT was 14.0±3.6 mm (Barreiro et al. 2018). In a study involving adolescents aged 14-19 years, APMT measurement in women was found to be 18.0 mm (de Lima Pereira et al. 2021). In another study, APKT measurement in the dominant hand of women aged 18-29 was found to be 19.4±3.10 mm (Gonzalez et al. 2010). The findings of our study are similar to the results of other studies. According to the results of the study, weight gain leads to an increase in APMT.

In this study, it was revealed that the APMT and APMT index measured in the right and left hands showed a moderate positive correlation with BMI. In a study that included both women and men, APMT was found to be moderately correlated with lean mass and lean mass index (Bielemann et al. 2016). In another study that included post-menopausal and young women, it was found that APMT showed a positive correlation with lean mass (Barreiro et al. 2018). In a study of adolescents, in women, APMT measurement showed moderate correlation with lean mass, lean mass index, and body fat mass. However, no correlation was found between BMI and APMT (de Lima Pereira et al. 2021). In a study involving healthy adults, it was found that APMT measured on both hands and weight and BMI correlated (Gonzalez et al. 2010). In a study conducted in the pediatric age group, it was determined that APMT measurement was associated with nutritional status, BMI and arm muscle circumference (Vallandro et al. 2019).In a study that included both women and men, it was revealed that APMT measurement increased with increasing BMI value (Cortez et al. 2017). In a study conducted with elderly individuals, it was revealed that there is a weak correlation between BMI and APMT. In the study, the mean BMI was found to be 26.93± 5.75 kg/m^2 (de Seabra Trevisan et al. 2021). Similar results were obtained in another study. It was determined that there was a weak correlation between APKT measurement and other anthropometric measurements (Cobero et al. 2012). In another study, right and left-handed APMT and anthropometric measurements of individuals with anorexia nervosa were performed before and after treatment. Parallel to the increase in weight and BMI in individuals after treatment, there was an increase in APMT in both the right and left hands (Soto-Célix et al. 2019). The results obtained from our study show parallelism with the results of other studies. Increases in body muscle and fat mass affect APMT.

4. CONLUSION

Anthropometric measurements and APMT measurements show correlation with each other. Therefore, APMT measurement can be applied in different age groups and in different clinical situations because it is easy and applicable. APMT measurement emerges as a new anthropometric measurement in the prediction of both obesity and malnutrition. There is a need to reveal new studies by measuring APMT in different age groups and clinical situations.

Ethics Committee Approval
N/A

Peer-review
Externally peer-reviewed.

Author Contributions
All authors have read and agreed to the published version of manuscript.

Conflict of Interest
All authors declare that they have no conflict of interest.

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