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# Adductor pollicis muscle thickness has a low association with muscle mass in hospitalized patients.

## El espesor del músculo aductor del pulgar tiene una baja asociación con la masa muscular de individuos hospitalizados.

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**Abstract**
**Introduction**: The adductor pollicis muscle thickness (APMT) is located between two bony structures allowing movement of the thumb. It has been proposed that APMT can be used as a new technique for evaluating muscle mass and, thus, be used in clinical practice as a predictor of muscle mass loss. The purpose of this study was to associate the APMT (alone or plus weight) with muscle mass of hospitalized individuals.
**Methods**: We evaluated 106 hospitalized patients aged 18 to 95 years old, of both sexes. The APMT measurement and anthropometric parameters of upper and lower members, adiposity (fat mass and waist circumference), and muscle mass (kg) were performed. Muscle mass was calculated by Lee et al.'s equation and fat mass by Durnin and Wormersley's.
**Results:** APMT was positively correlated with muscle mass (r = 0.61; p<0.05). Additionally, after multiple regression analysis, it was noted that APMT explained 37% of the variance in muscle mass (Beta = 0.609, $R^2$ = 0.370, p= 0.000). Furthermore, APMT increased the prediction of muscle mass by 1.77% when used in addition to weight, which explained 70.1% of the variances in muscle mass.
**Conclusion:** Compared with weight, APMT showed a lower association with muscle mass. Therefore, in individuals who can ambulate, weight is a better predictor of muscle mass than APMT.

**KEYWORDS**
*Malnutrition; adductor pollicis muscle; anthropometry.*

**Resumen**
**Introducción:** El espesor del músculo adductor pollicis (EMAP) se localiza entre dos estructuras óseas que permiten el movimiento del pulgar. Se ha propuesto que el EMAP puede ser utilizado como una nueva técnica para evaluar la masa muscular y, por lo tanto, ser utilizado en la práctica clínica como un predictor de la pérdida de masa muscular. El propósito de este estudio fue asociar el EMAP, solo o junto con el, con la masa muscular de los individuos hospitalizados.
**Material y métodos:** Se evaluaron 106 pacientes hospitalizados de entre 18 a 95 años de edad, de ambos sexos. Se llevaron a cabo la medición EMAP y los parámetros antropométricos de los miembros superiores e inferiores, la adiposidad (masa grasa y la circunferencia de la cintura), y la masa muscular (kg). La masa muscular se calculó con la ecuación de Lee y cols y la masa grasa con la de Durnin y Wormersley.

**Resultados y discusión:** EMAP se correlacionó positivamente con la masa muscular (r = 0,61; p <0,05). Además, después del análisis de regresión, se observó que EMAP explicó 37% de la varianza en la masa muscular (Beta = 0,609, $R^2$ = 0,370, p = 0,000). Por otra parte, EMAP aumentó la predicción de la masa muscular mediante el 1,77% cuando se utiliza el peso, lo que explica el 70,1% de las variaciones en el masa muscular.
**Conclusiones:** Por lo tanto, llegamos a la conclusión de que en comparación con el peso, EMAP mostró una menor asociación con la masa muscular. Por consiguiente, en individuos que pueden deambular, el uso del peso es un mejor predictor de la masa muscular que EMAP.
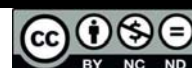
# Introduction:

Malnutrition is a problem that affects 20 to 60% of hospitalized patients and is associated with higher morbidity and mortality [1-4]. Furthermore, many hospitalized patients already show signs of malnutrition and are often not early diagnosed by health professionals [5], increasing the risk of falls and reducing the ability to perform daily activities during the period of hospitalization and after hospital discharge [6].

The assessment of the nutritional status of hospitalized patients is also important in the monitoring of clinical evolution and recovery of health, because it allows the monitoring of patients at risk or who already require specialized nutritional therapy [7]. Since muscle mass loss is one of the major causes of mortality among hospitalized patients [3, 4], practical parameters that are associated with muscle mass can be useful for the nutritional assessment of hospitalized patients.

The adductor pollicis muscle thickness (APMT) is located at the apex of an imaginary angle formed by the extension of the thumb and the index finger. The use of APMT appears to be an objective method, low-cost and minimally invasive, which allows the implementation of a practical assessment of the nutritional status of the individual [8] and it has been proposed that this measure can be used in clinical practice as a predictor of muscle mass loss [8-10]. Adductor pollicis muscle thickness could be used as a new technique for the assessment of muscle mass quantity in hospitalized patients; however, it is not clear whether this measure is strongly associated with muscle mass or can replace other anthropometric parameters that are already used, such as body weight, which is also associated with muscle mass and/or undernutrition [11, 12].

Therefore, the aim of the present study was to associate the APMT (alone or plus weight) with the muscle mass of hospitalized individuals.

# Methods:

## Subjects

We evaluated 106 patients older than 18 years (18–95 years), both sexes (64.15% male), admitted in the wards of the Medical Clinic and Surgical Practices of a University Hospital in Uberlandia, MG, Brazil. A transversal study was conducted and the individuals were recruited by convenience sample. The study population was composed of all individuals admitted to the hospital who were able to join the study at the period of evaluation. All subjects signed an informed consent form and the project was approved by the Ethics Committee of the Federal University of Uberlandia (protocol 069123/2013).

The individuals included in the sample were over 18 years of age, able to respond to the questions asked by the researchers, able to walk and had agreed to sign the informed consent form. We excluded bedridden patients and those who did not meet the search criteria, or who could not perform any of the anthropometric assessments, such as weight, height and APMT.

## Anthropometric Assessment

A trained nutritionist performed all the anthropometric measures, which consisted of measuring: current weight, height, body mass index (BMI); arm, waist, thigh and calf circumferences; and triceps, biceps, supra and subscapular skinfolds. The mean of three measurements of circumferences and skinfolds was considered as the final measure. The current weight was obtained using a Líder® portable balance, with a maximum capacity of 200 kg. For height, a portable stadiometer (Welmy®) was used. For circumference measurements we used a stretchable tape measure and for skinfold measures an adipometer (Lange®) with a scale of 0–60 mm and an accuracy of 1.0 mm was used. These measurements were performed on the right side of the patient following the methods classically described [13]. For the evaluation of fat mass, the equations proposed by Durnin and Wormersley (1974) were used [14]. The value of muscle mass was obtained by equation of Lee et al., 2000 [15] that included height and skinfold-corrected upper arm, thigh, and calf girths.

## Adductor Pollicis Muscle Thickness (APMT)

The APMT (mm) measurement was performed with the individual sitting or lying down, with the dominant hand (right or left). A Lange® caliper was used exerting a continuous pressure of 10 g/mm$^2$ to pinch the adductor pollicis muscle at the apex of an imaginary angle formed by the extension of the thumb and the index finger. The mean of three measurements was considered as the APMT measure [9]. Inadequate values were considered below 12.5 mm for men and 10.5 mm for women [9].

### Statistical Analysis

The tests were performed using the STATISTICA 6.0 software. Data were described as mean $\pm$ SD. For comparison of individuals, according to APMT classification, an unpaired student t-test was applied. We tested the normality of the sample using the Shapiro–Wilk test. To correlate the APMT and weight with muscle mass a crude and adjusted Pearson's correlation (sex and age) was used. Linear regression analysis was performed to evaluate the association of APMT and/or weight with muscle mass. The results were discussed based on a significance level of $p < 0.05$.

# Results:

The main causes of hospitalization were gastrointestinal diseases (25.5%), trauma (22.6%), urinary system diseases (19.8%), cardiovascular diseases (16.0%), and others. Regarding BMI, it was observed that 8.5% (n = 9) of participants were underweight, 33.0% (n = 35) were of normal weight, 36.8% (n = 39) were overweight, 18.9% (n = 20) were obesity class I, and 2.8% (n = 3) were obesity class II. It was noted that 22% of women and 11% of men showed inadequate APMT.

Individuals with inadequate APMT showed a lower weight, height, BMI, and muscle mass (kg). No differences were observed in age and body fat mass (%) when compared with individuals with adequate APMT (Table 1).

| Table 1. Demographics and anthropometric measurements of individuals according to APMT classification. | | |
|---|---|---|
| | Adequate APMT (n = 91) | Inadequate APMT (n = 15) | p |
| Age (years) | 51.07 ± 17.5 | 60.2 ± 15.0 | 0.058 |
| Weight (kg) | 72.8 ± 15.9 | 54.1 ± 11.4 | <0.001 |
| Height (m) | 1.67 ± 0.10 | 1.60 ± 0.11 | 0.021 |
| Body Mass Index (kg/m²) | 26.1 ± 4.8 | 21.5 ± 5.7 | 0.001 |
| APMT (mm) | 16.9 ± 3.5 | 9.2 ± 1.8 | <0.001 |
| Muscle Mass (kg) | 25.4 ± 9.6 | 19.3 ± 3.5 | <0.001 |
| Body Fat (%) | 22.7 ± 9.7 | 21.6 ± 13.1 | 0.685 |

APMT = Adductor pollicis muscle thickness; APMT Inadequate (< 12.5 mm for men and < 10.5 mm for women)

The APMT was positively correlated with muscle mass (r = 0.61; p < 0.05) (Figure 1) and after adjustments for sex and age remained significant (r = 0.48; p<0.05). Furthermore, weight was strongly correlated with muscle mass (r = 0.84; p < 0.05) (Figure 2).
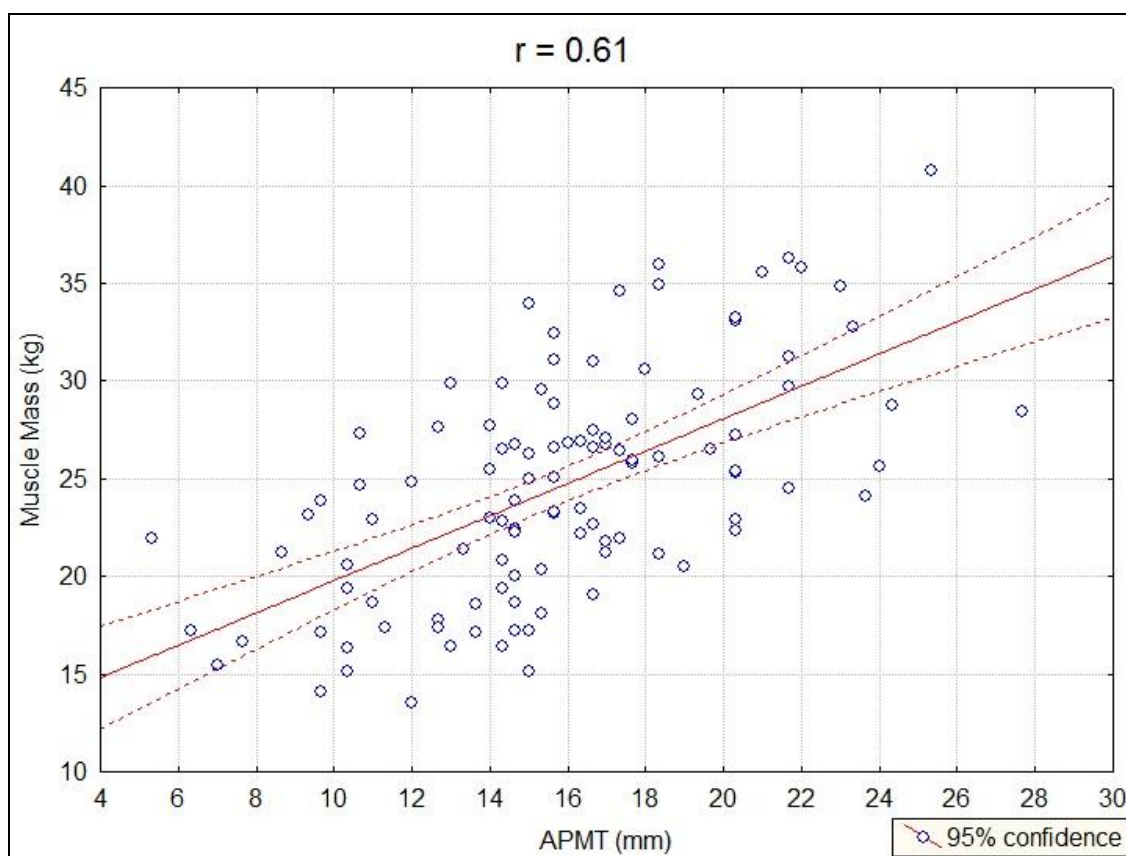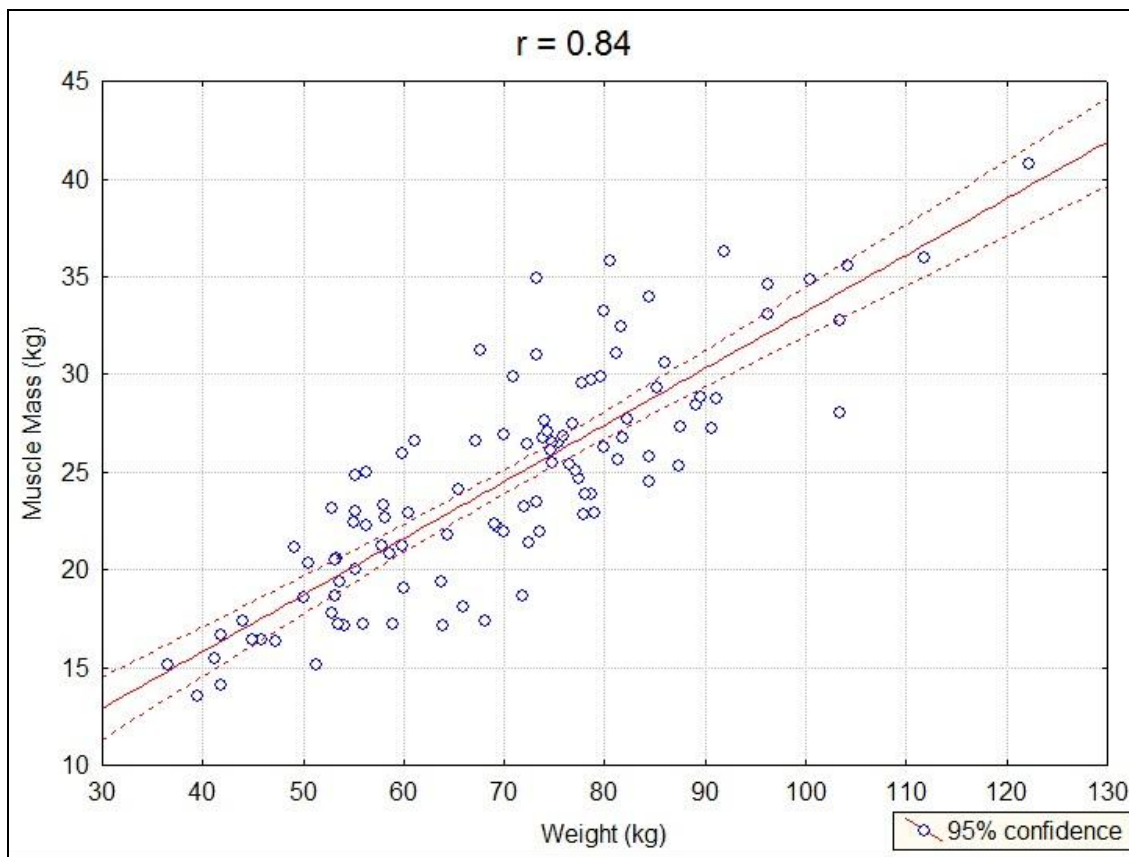


**Figure 1.** Correlation of APMT and muscle mass. p<0.05

**Figure 2.** Correlation of weight and muscle mass. p<0.05

After linear regression analysis, it was noted that APMT explained 37% of the variance in muscle mass (Beta = 0.609, $R^2$ = 0.370, p= 0.000) (Table 2). Additionally, weight showed a prediction of 70.1% of estimation of muscle mass; and weight plus APMT explained 71.89% the muscle mass (Figure 3).

| | β | R2 | B | Standard error of B | t | p |
|---|---|---|---|---|---|---|
| **Table 2.**Linear regression coefficients of prediction of muscle mass by adductor pollicis muscle thickness in hospitalized patients. | | | | | | |
| Intercept | | | 11.50 | 1.731 | 6.646 | <0.001 |
| APMT (mm) | 0.609 | 0.370 | 0.828 | 0.105 | 7.820 | <0.001 |

APMT = Adductor pollicis muscle thickness
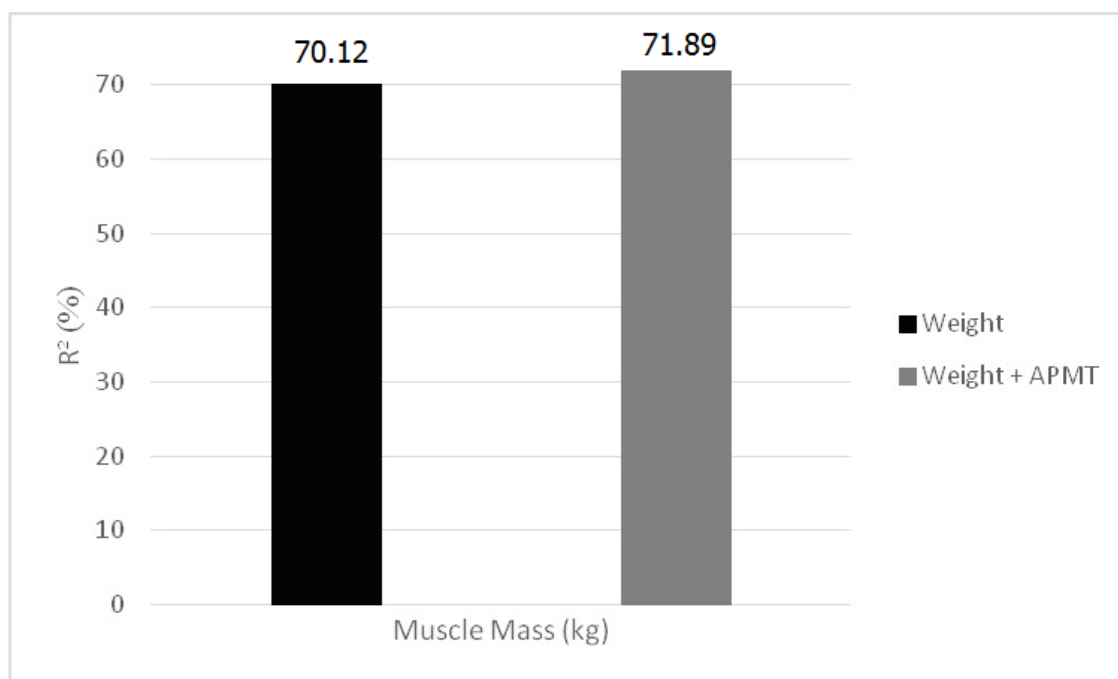
**Figure 3.** Coefficients of determination ($R^2$) of adductor pollicis muscle thickness in the prediction of muscle mass. APMT - adductor pollicis muscle thickness.

## Discussion:

The main finding of our study was that APMT showed a low association with muscle mass when compared with weight. The APMT explained 37% of the variance of muscle mass, whereas weight explained 70.1% of the variances in muscle mass, and the addition of APMT increased this prediction by 1.77%. Based on our data, the utilization of weight would be a better predictor of muscle mass than APMT in hospitalized patients in cases where the evaluation of body mass is possible, for example, individuals who can ambulate. However, in bedridden patients for whom the measurement of body weight is difficult, the APMT could be used in clinical practice as a predictor of muscle mass, but data interpretation would need to be treated cautiously, since this parameter has a low association with muscle mass.

Recently, Bieleman et al. (2015) [16] evaluated the association of APMT with lean mass in free-living adults. It was found that APMT predicted 19–26% of lean mass, whereas BMI explained 48-–59% in males and female, respectively. When BMI plus APMT were evaluated an increase of 3–4% in the estimation of lean mass was noted. These results are in agreement with our data, despite differences of approximately 10% in the power of predictions when using APMT or weight (our study) compared using APMT or BMI (Bieleman et al.'s study). These differences can be explained by the different methodologies and parameters. Bieleman et al. used DXA and evaluated lean mass, whereas in our study anthropometry was used and muscle mass was evaluated. Additionally, we evaluated hospitalized patients, some of whom presented diseases that cause malnutrition, and Bieleman et al. analyzed healthy free-living adults. Besides these differences, both studies showed that the use of body weight can be a better muscle mass or lean mass predictor than APMT.

Another important finding in the present study was the positive correlation between APMT and muscle mass. Considering that there are some confounding factors related to muscle mass, the analysis were also adjusted for age and sex. It is known that women and older individuals present lower muscle mass [17], which could be reflected in the associations between APMT and muscle mass in our data, mainly because we evaluated individuals of both genders and aged from 18 to 95 years old. However, even after adjustments, the correlation remained significant, showing an association between APMT and muscle mass independently of sex and age. It is important to note that APMT showed a moderate correlation, whereas weight was strongly correlated with muscle mass, which confirms that body weight could be a better muscle mass predictor than APMT.

The individuals of the present study showed a low prevalence of inadequate APMT, however there is still no consensus on proposed values of normality for the APMT, because there are few studies proposing an APMT cut-off [9, 18]. In our study the cut-off used was based on Lameu et al., 2004 [9], who conducted a research evaluating 421 healthy individuals and observed mean values of APMT of 12.5 mm for men and 10.5 mm for women. Gonzalez et al. (2010) [18], evaluating 300 healthy patients ,established higher mean values of APMT (26.1 mm for men and 19.8 mm for women). Both studies evaluated healthy individuals, who can present higher APMT values than hospitalized patients, so new studies proposing an APMT cut-off for hospitalized patients are necessary.

It is important to emphasize that our data must be extrapolated to a hospitalized population whose major cause of hospitalization was gastrointestinal diseases, trauma, among other causes, which directly interferes with the feeding routine and may influence muscle mass loss [19, 20], therefore, our results cannot be generalized to a specific disease population. Further studies should be carried out associating APMT with muscle mass in healthy individuals or those with other causes of hospitalization.

The present study had some limitations. The muscle mass was estimated by anthropometry, a method whose limitation is already known [21], and more studies are necessary regarding estimating muscle mass using other methods (e.g. DXA). However, the equation of Lee et al. used in the present study has been previously validated [15], which strengthens and supports our data.

# Conclusion:

Therefore, we concluded that compared with weight, APMT showed a lower association with muscle mass. Hence, in individuals who can ambulate, the use of weight is a better predictor of muscle mass than APMT.

# Author's contribution:

CDB participated in collection of the data and wrote the manuscript, BVCC collaborated in the collection and interpretation of the data, PCN and LTR wrote and collaborated in the interpretation of the data, EPO carried out the conception and design of the study, participated in the interpretation of the data, wrote, and contributed with the revision of the manuscript

# Conflict of interest:

None.

# Acknowledgement:

# References

1. White JV, Guenter P, Jensen G, Malone A, Schofield M. Consensus statement of the academy of nutrition and dietetics/american society for parenteral and enteral nutrition: Characteristics recommended for the identification and documentation of adult malnutrition (undernutrition). *J Acad Nutr Diet*. 2012;112:730-738
2. Cobêro FE, Gomes MCB, Silva AP, Bernardi JLD, Mclellan KCP. A medida do músculo adutor do polegar está associada com indicadores antropométricos de avaliação de massa magra e de massa gorda em pacientes hospitalizados. *Nutrire*. 2012;37:174-182
3. Waitzberg DL, Caiaffa WT, Correia MITD. Hospital malnutrition: The brazilian national survey (ibranutri): A study of 4000 patients. *Nutrition*. 2001;17:573-580
4. Puthucheary ZA, Hart N. Skeletal muscle mass and mortality - but what about functional outcome? *Crit Care*. 2014;18:110
5. Pereira RA, Caetano AL, Cuppari L, Kamimura MA. Espessura do músculo adutor do polegar como preditor de força de preensão manual nos pacientes em hemodiálise. *J. Bras. Nefrol*. 2013;35:177-184
6. Wall BT, Dirks ML, Loon LJCv. Skeletal muscle atrophy during short-term disuse: Implications for age - related sarcopenia. *Ageing Res Rev*. 2013;12
7. Pasquini TAS, Neder HD, Araújo-Junqueira L, De-Souza DA. Clinical outcome of protein-energy malnourished patients in a brazilian university hospital. *Braz J Med Biol Res*. 2012;45:1301-1307
8. Lameu EB, Gerude M, Campos AC, Luiz RR. The thickness of the adductor pollicis muscle reflects the muscle compartment and may be used as a new anthropometric parameter for nutritional assessment. *Curr Opin Clin Nutr Metab Care*. 2004;7:293-301
9. Lameu EB, Gerude MF, Corrêa RC, Lima KA. Adductor policis muscle: A new anthropometric parameter. *Rev. Hosp. Clin*. 2004;59:57-62
10. de Oliveira CM, Kubrusly M, Mota RS, Choukroun G, Neto JB, da Silva CA. Adductor pollicis muscle thickness: A promising anthropometric parameter for patients with chronic renal failure. *J Ren Nutr*. 2012;22:307-316
11. Gariballa S, Alessa A. Sarcopenia: Prevalence and prognostic significance in hospitalized patients. *Clin Nutr*. 2013;32:772-776
12. Soenen S, Chapman IM. Body weight, anorexia, and undernutrition in older people. *J Am Med Dir Assoc*. 2013;14:642-648
13. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Human kinetics books 1988:1-55
14. Durnin JVGA, Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness: Measurements on 481 men and women aged from 16 to 72 years. *Br J Nutr*. 1974;32:77-97
15. Lee RC, Wang Z, Heo M, Ross R, Janssen I, Heymsfield SB. Total-body skeletal muscle mass: Development and cross-validation of anthropometric prediction models. *Am J Clin Nutr*. 2000;72:796-803
16. Bielemann RM, Horta BL, Orlandi SP, Barbosa-Silva TG, Gonzalez MC, Assuncao MC, Gigante DP. Is adductor pollicis muscle thickness a good predictor of lean mass in adults? *Clin Nutr*. 2015
17. Janssen I, Heymsfield SB, Wang Z, Ross R. Skeletal muscle mass and distribution in 468 men and women aged 18–88 yr. *J Appl Physiol*. 2000;89:81-88

18. Gonzalez MC, Duarte RRP, Budziareck MB. Adductor pollicis muscle: Reference values of its thickness in a healthy population. *Clin Nutr.* 2010;29:268-271

19. Kalyani RR, Corriere M, Ferrucci L. Age-related and disease-related muscle loss: The effect of diabetes, obesity, and other diseases. *Lancet Diabetes Endocrinol.* 2014;2:819-829

20. Jeejeebhoy KN. Malnutrition, fatigue, frailty, vulnerability, sarcopenia and cachexia: Overlap of clinical features. *Curr Opin Clin Nutr Metab Care.* 2012;15:213-219

21. Brodie D, Moscrip V, Hutcheon R. Body composition measurement: A review of hydrodensitometry, anthropometry, and impedance methods. *Nutrition.* 1998;14:296-310