Nutritional assessment of hospitalized patients: Comparison of real and estimated anthropometric measures

Evaluación nutricional de pacientes hospitalizados: Comparación entre medidas antropométricas reales y estimadas

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ABSTRACT

The assessment of the nutritional status of hospitalized patients is fundamental to the establishment of the diagnosis. For bedridden patients, however, it is not possible to determine simple measures, such as weight and height, which are the most widely used variables for nutritional assessments. Objective: Compare real and estimated anthropometric measures in hospitalized patients. Methods: A cross-sectional study was conducted with adult (>18 years of age) and senior patients (>60 years of age) admitted for clinical or surgical treatment in the general surgery infirmary of Governador Paulo Guerra Restauração Hospital. Data (sex, age, clinical diagnosis, real weight, real height, body mass index, knee height and arm circumference) were collected using nutritional follow-up charts and tabulated using Excel 2016. Statistical analyses were performed in SPSS® version 21.0. Results: One hundred and twenty patients participated in the study (median age: 55 years). Most were adults (73.3%) and women (53.3%). The mean differences in weight between the estimated and real measures were statistically significant (p=0.000), with an overestimation of this variable. Regarding height, the estimated values differed significantly from the real values in both men and women (p<0.000) and the difference was larger among the seniors (mean: -0.072). No significant difference was found between the real and estimated body mass index (p=0.44). Conclusion: In the comparison of methods for estimating weight and height to real measures, a tendency was found to overestimate these body measures.

Keywords: Anthropometrics; Body Height; Nutritional assessment; Nutritional status; Weights and body measures.
INTRODUCTION

The prevalence of malnutrition in the hospital environment has been intensively studied in the last twenty years. Studies carried out around the world have shown that the prevalence varies between 20 and 50% of inpatients. According to the Brazilian Hospital Nutritional Assessment Survey (IBRANUTRI), about 48.1% of hospitalized patients in the public health network had hospital malnutrition. Changes in nutritional status, especially in hospitalized patients, compromise immunity and functional capacity, negatively interfering with recovery.

The assessment of the nutritional status of hospitalized patients is essential to establish a diagnosis on which the adequacy of nutritional therapy will be based. Thus, the screening aims to characterize the nutritional status and identify patients at risk. One of the most important factors that contribute to the health and a proper functioning of the body is nutrition. In this sense, nutritional assessment is extremely important to improve treatment aiming to decrease the number of complications during hospitalization and hospitalization time, in addition to reducing hospital costs.

Despite its importance in monitoring and treating patients, the measurement of weight and height is not always possible, especially in critical patients, the elderly, bedridden patients, or those with bone diseases who cannot walk. In this situation, formulas to estimate the patient’s weight and height were created in order to provide this data indirectly.

The World Health Organization recommends using estimated measurements for bedridden patients or those with some amputated limb. Estimated weight and height measurements are routinely used in clinical practice for nutritional assessment. However, the accuracy and precision in hospitalized patients is unknown, as anthropometric assessment can be hampered by changes in body composition, impaired mobility, polytrauma, edema and ascites. Therefore, the objective of this study is to compare real and estimated anthropometric measurements in hospitalized patients, using the Chumlea formula for adults and the elderly, considering the wide use of this in clinical practice.

METHODOLOGY

We conducted a cross-sectional study analyzing nutritional monitoring files of a nutrition and dietary service. Participants were patients admitted to the General Surgery Clinic of the Hospital Restauração Governador Paulo Guerra, Recife, PE, Brazil. All adult (>18 years old) and elderly (>60 years old) patients admitted for clinical and surgical treatment, admitted from July to November 2019 and who underwent nutritional status assessment during this period were included. We excluded patients with peripheral edema, ascites or anasarca, limb amputation or paralysis, or those on dialysis and those whose anthropometric assessment was performed in the postoperative period.

We collected data on sex, age, clinical diagnosis, real weight, real height, body mass index (BMI), knee height (KH), and arm circumference (AC). Real weight was measured using a digital scale with a precision of 50 g and capacity for 200 kg (Welmy W200A Led). Height was measured using a stadiometer attached to the scale. Nutritional diagnosis was determined by BMI, obtained by dividing weight by squared height. The classification is according to the cutoff points proposed by the World Health Organization for adults and by the Pan American Health Organization for the elderly.

The arm circumference (AC) was measured in the arm against the peripheral venous access (PVA), as part of the hospital’s nutritional assessment protocol. A percentage of adequacy between 90 and 110% was classified as normal weight. The knee height (KH) was measured with the patient sitting in a supine position or with the feet resting on the floor or bed. The knee height measurement was performed in relation to floor or bed height from the external bone point just below from the patella (tibia head) up to the surface. Two measurements were made with an inextensible measuring tape, on the skin and the measured body region was adjusted to an accuracy of 0.1 cm.

Using data of AC and KH, the estimated weight was obtained using the predictive formulas Chumlea et al for adults and Chumlea et al for the elderly;
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men = [64.19 - (0.04 x age) + (2.02 x knee height in cm)] and women = [84.88 - (0.24 x age) + (1.83 x knee height in cm)]16.

The patients included in the study met the criteria proposed by Chumlea for calculating estimated measures. Real weight and height measurements were obtained simultaneously with the measurements, arm circumference and knee height, used in the calculation of the predictive formulas. Using the estimated weight and height data, the estimated BMI was obtained. It is used to determine nutritional status considering the same cutoff points for adults and the elderly as described for real BMI.

Data were tabulated using the software Excel 2016 and statistical analyses were performed using SPSS®, version 21.0 (SPSS Inc., Chicago, IL, USA). The results were presented as tables with their respective absolute and relative frequencies. The normal distribution of variables was performed using the Kolmogorov Smirnov test. Continuous variables were presented as mean and standard deviation or median and interquartile range for normal and non-normal variables, respectively. Chi-square association tests, paired t test, and Pearson correlation test were performed. The Bland-Altman test was used to assess the agreement between two different methods of measuring the quantitative variables weight and height. The linear regression test was used to assess the proportion bias in the distribution of differences. For the analysis of interobserver agreement of the anthropometric variables (weight, height and BMI) measured, the Kappa Test was performed. A 5% significance level was considered to reject the null hypothesis.

Data collection began after approval by the Ethics Committee of the Hospital da Restauração Governador Paulo Guerra, according to the Resolution of the National Health Council no. 466/12, under CAAE no. 10418919.5.0000.5198.

RESULTS

The final sample consisted of 120 patients. The median age was 55 years (minimum 19 - maximum 84 years). The majority were adults (73.3%) and females (53.3%). By assessing frequencies by sex, 56% of women had a clinical diagnosis of cholelithiasis. For males, the main clinical diagnosis was neoplasia (53.6%). Table 1 shows data according to demographic, clinical, and nutritional variables.

| Sex (n= 120) | n | %  |
|--------------|---|----|
| Female       | 64 | 53.3|
| Male         | 56 | 46.7|

| Age (n= 120) |    |      |
|--------------|----|------|
| Adults       | 88 | 73.3 |
| Elderly      | 32 | 26.7 |

| Clinical diagnosis (n= 120) |    |      |
|----------------------------|----|------|
| Perforation by stab/gunfire | 4  | 3.3  |
| Neoplasm                   | 41 | 34.2 |
| Cholelithiasis             | 46 | 38.3 |
| Hernia                    | 12 | 10.0 |
| Non-surgical pathologies*  | 17 | 14.2 |

| Nutritional status according to real BMI (n= 100) |      |
|---------------------------------------------------|------|
| Malnutrition                                      | 14   |
| Eutrophic                                         | 34   |
| Overweight                                        | 52   |

| Nutritional status according to estimated BMI (n= 120) |    |
|-------------------------------------------------------|----|
| Malnutrition                                         | 23 |
| Eutrophic                                            | 34 |
| Overweight                                           | 63 |

*Choledocholithiasis and acute pancreatitis.
The average differences between estimated and real weight and height measurements were statistically significant ($p<0.001$). This indicates overestimation of weight and height. Figure 1 shows the agreement analysis between the real and estimated weight measurements. There was a proportional bias in the distribution of differences with a tendency for concentrated values below or above the average ($p=0.023$). Figure 2 shows the analysis of agreement between the measurements of real height and estimated height. A similar distribution was found between the differences with a trend of values close to the mean ($p=0.092$). Despite this, comparisons between real and estimated BMI were statistically equal ($p=0.44$), not compromising the final nutritional diagnosis. The most frequent nutritional diagnosis was eutrophy for males (24.41±5.71 x 23.10±5.59) and overweight for females (27.45±6.07 x 29.07±6.23). The results are similar regardless of the use of real or estimated data for calculating the BMI, showing a substantial agreement when analyzed using the Kappa test ($k=0.635$).

Table 2 shows the comparison of means, standard deviation, and significant difference of real measurements of weight, height, and calculation of real and estimated BMI.

Upon correlating real weight with estimated weight (Pearson’s correlation test), only males did not show a statistically significant difference ($p=0.717$). This suggests that there is a great possibility that the estimated data correspond to the real measurements for this demographic. By comparing females and stratifying between adults and the elderly, both showed a significant difference ($p<0.001$). For females, the average difference between weight was -7.18±7.59 kg.

Regarding height, the estimated measurements differed significantly ($p<0.001$) from the real ones for men and women. This variation was even greater among the elderly (average of -0.072).

**Table 2.** Comparison between real and estimated weight, height and BMI of patients admitted to a referral hospital in the city of Recife, PE, Brazil, 2019.

| Mean±Standard deviation | Mean difference | $p^*$ |
|-------------------------|-----------------|------|
| Real weight (kg)        | 66.36±16.69     | -3.96| <0.001 |
| Estimated weight (kg)   | 70.33±18.25     |      |       |
| Real height (m)         | 1.60±0.09       | -0.04| <0.001 |
| Estimated height (m)    | 1.64±0.08       |      |       |
| Real BMI (kg/m²)        | 26.02±6.07      | -0.24| 0.44  |
| Estimated BMI (kg/m²)   | 26.26±6.62      |      |       |

*Paired t test ($p<0.05$).
DISCUSSION

Most of the sample consisted of adult women. They were overweight according to the real BMI and diagnosed with cholelithiasis. Female sex is an unmodifiable risk factor for cholesterol gallstones. It manifests particularly during the fertile period because of hormonal influences. The predominance is in overweight patients, a characteristic and diagnosis we found in the sample.

Comparing the real and estimated weight using the Chumlea formula, which considers the parameters of arm circumference and knee height, we observed overestimated values. There was no significant difference only for males. For females, the mean difference was -7.18±7.59 kg. Melo et al. found similar results, i.e., overestimation of the real body weight in comparison with several weight estimation formulas. The average difference was -3.35±3.37 kg. Only the formula for adult men showed no significant differences compared to the real weight of adult men. This result is similar to that of Oliveira et al. In addition to their use for determining nutritional needs and dietary prescription, weight and height are important for calculating the supply of medications and sedatives, dialysis treatment, water supply, and calculation of cardiac function indexes. If the values are underestimated, malnutrition and its complications may occur. On the other hand, if the measures are overestimated, there will be an overload in the supply of energy and medicines, which may cause hyperglycemia, hepatic steatosis, cardiac arrhythmias, edema, and respiratory failure.

Regarding estimated height, all correlations showed a tendency towards overestimation compared to real height. The average difference was -0.039 cm. The greatest mean difference was in elderly males (-0.072 cm). The results found in our study are different from those of Melo et al. The Chumlea formula in their study was the only one that underestimated height compared to the real height.

Even though elderly patients in our study showed height overestimation when assessed by knee height, it is important to note that elderly individuals often have spinal deformity. This makes it difficult to apply anthropometry. Therefore, it leads to wrong height measurements if using only a stadiometer. It is well defined in the scientific literature that the measurements of long bones do not suffer postural interference from aging and that, for this reason, they are better predictors of the real height value in comparison to other bone segments.

Although we observed significant differences between real and estimated weight and height, the comparison between real and estimated BMI did not show any differences in the classification of the final nutritional diagnosis. This result can be justified by the tendency to overestimate both estimated measurements.

One of the limitations of our study was the use and comparison of only one estimate to estimate weight and height. We did not consider other references found in the literature, however, we tested a formula widely used in clinical practice, verifying the tendency to overestimate the results, with similar values only for adult men, possibly related to the smaller number of patients in the sample for the evaluation of the height parameter. In addition, the number of samples at the time of correlations was low. Few studies in the literature had the same objective as this study. However, the results obtained may be used to guide clinical practice.

CONCLUSION

By comparing the methodologies for estimating weight and height with real measurements, there was a tendency of methods to overestimate these body measurements. The only measurement that showed no significant difference was estimated weight for males.

Although there was no difference in the final nutritional status, most nutritional recommendations consider calories and proteins per kilogram of body weight, requiring the professional’s careful evaluation when using estimated weight. In addition, more studies are needed to validate the existing equations according to the profile of the studied population and to evaluate their applicability.

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