

Comparative Analysis between Anthropometry and Subjective Methods in Nutritional Evaluation in Cancer: A Systematic Review

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Abstract This study aims to evaluate the anthropometric indicators used in cancer patients, comparing them with one another and with the subjective methods of nutritional assessment. Methodology: A search was made in January 2018 in the databases Medline (PubMed), Latin American and Caribbean Literature in Health Sciences (Lilacs) and Scientific Electronic Library Online (Scielo), with the descriptors oncology, cancer, evaluation, anthropometry, adults, elderly and malnutrition. Results: A total of 10 articles were included in this review. All of them used body mass index (BMI) to diagnose malnutrition; however, fewer malnourished individuals were identified by this method. In addition to BMI, the most used anthropometric indicators were arm muscle circumference, tricipital skinfold and arm perimeter, used in most articles, being the most malnourished identified by it. As for subjective methods, fewer malnourished patients were tracked when compared to perimeters and folds. Conclusion: It is concluded that the arm perimeter is the most anthropometric indicator use in tracking of malnutrition in cancer patients, considering the prevalence.

Keywords: oncology, malnutrition, bmi, adult, elderly

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1. Introduction

Cancer is considered an important public health problem in the world [1]. According to the National Cancer Institute (INCA), about 600,000 new cases of cancer will be discovered in Brazil in the biennium 2018-2019 [1]. The estimate of the World Health Organization (WHO) is that by 2030 about 17 million deaths will occur worldwide as a result of the disease [2]. It is estimated that 10 to 20% of deaths of individuals with cancer can be attributed to malnutrition and not to the malignancy of the disease itself [3]. Prevalence of malnutrition in these patients has been reported in the literature in a range of 20 to more than 70%, with differences related to the age, type, location and stage of the disease [4].

Malnutrition may result from low ingestion, disease or advanced age (over 80 years), isolated or in combination [5]. In individuals with cancer, it may be considered of the type related to the chronic disease with the presence of inflammation [5] being a catabolic condition characterized by inflammatory response, including anorexia and tissue degradation, triggered by an underlying disease leading to loss of appetite, reduced food intake, weight loss, and

muscle catabolism [6].

Patients with cancer are more likely to develop malnutrition, which results in decreased functional capacity, worsening of the clinical picture and less response to treatment, making recovery difficult [7,8]. In view of such data, it is necessary to have an early diagnosis and the monitoring of nutritional status in these patients in order to favor the best prognosis [9].

The screening of malnutrition in these individuals is fundamental, but there is still no specific tool to be used in this population [10]. However, it is possible to perform nutritional screening of the patient and identify risk or presence of malnutrition through information such as weight loss and reduction of food intake [10]. Although the use of subjective methods for nutritional assessment is ideal, some anthropometric indicators can be used to complement the nutritional diagnosis [11]. Some of them are percentage of weight loss (%WL), body mass index (BMI), arm perimeter (AP), tricipital skinfold (TSF), arm muscle area (AMA) and calf perimeter (CP) [11].

Given the high prevalence of malnutrition in a hospital setting, it is essential to track and treat it to avoid other complications, which in combination, may lead to the patient death [12]. Therefore, the objective of this systematic review is to evaluate the anthropometric

indicators used in cancer patients, comparing them with one another and with the subjective methods of nutritional assessment.

2. Materials and Method

This is a systematic review based on the recommendations Preferred Reporting Items for Systematic Reviews (PRISMA) [13], based on the following guiding question "what is the best anthropometric indicator used in clinical oncology practice to diagnose malnutrition?". This question was formulated according to the PICO strategy, which represents an acronym for Patient (adults with cancer), Intervention (use of anthropometric indicators), Comparison (anthropometry and subjective methods) and Outcomes, (malnutrition) [13]. In order to achieve the objective of this article, a bibliographic survey was carried out in the databases Medline (PubMed), Latin American and Caribbean Literature in Health Sciences (Lilacs) and Scientific Electronic Library Online (SciELO).

The descriptors used (DeCS and Meshs) in Portuguese, English and Spanish were oncology, cancer, evaluation, anthropometry, adults, elderly and malnutrition, combined with Boolean OR and AND operators. The filters *Humans*, *Full text* and *published in the last 10 years* were used in

Pubmed database. The search for articles was carried out in January of 2018, by pair of researchers.

The steps of inclusion and exclusion of the works (Figure 1) started from an initial identification of the articles in the databases, with a reading of the title. After the exclusion by title, duplicate papers were excluded. Subsequently, the abstracts were read and then continued the reading of the text in full.

Inclusion criteria were original articles in English, Portuguese or Spanish that used anthropometry in adult and elderly oncology patients to assess nutritional status. We excluded articles that assessed malnutrition only by subjective methods. The anthropometric indicators were compared among themselves and with the subjective methods.

3. Results

Initially, 99 studies were identified. After deleting duplicates and reading titles and abstracts 40 of these were selected for full reading. After the reverse search 3 articles were included. Finally, 3 studies were excluded because they only used BMI and 9 because they presented data on average, both cases making comparison impossible. In total, 10 studies met the eligibility criteria and integrated this review (Figure 1).

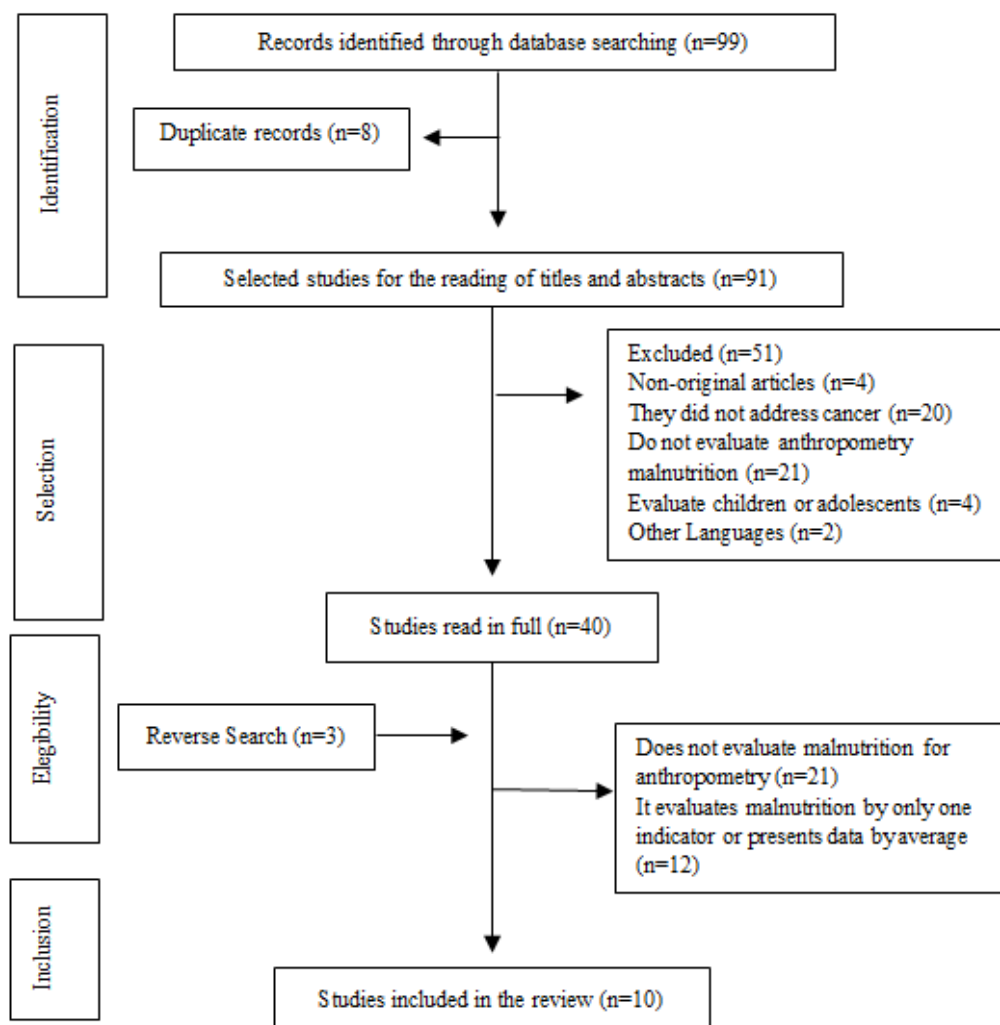


Figure 1. Flowchart of article selection based on PRISMA recommendations

Table 1. General characteristics of studies with anthropometry in cancer patients.

Reference/ Location / Year	Sample	Objective	Study outline	Anthropometric Indicators Used
Merhi, Aquino ¹⁸ Brazil, 2017	300 cancer patients, men and women.	To investigate the relationship between nutritional status through anthropometric indicators and the clinical results during hospitalization using the multiple correspondence analysis technique.	Cross-sectional study	BMI, AP, AMC and TSF
Barata et al. ¹⁹ Portugal, 2016	234 cancer patients, men and women.	To evaluate the nutritional status through anthropometric indicators.	Cross-sectional study	BMI, AP, AMC and TSF
Cunha et al. ²¹ Brasil, 2015	173 cancer patients, men and women.	To evaluate the agreement between anthropometry and subjective evaluations	Cross-sectional study	BMI, AP, AMC, TSF, cAMA, %AT and %MM
Santos et al. ²³ Brasil, 2015	96 elderly men and women. cancer treatment.	To compare the nutritional diagnosis obtained by the ASG-PPP with the anthropometric measurements and to evaluate the agreement between the methods used in the detection of malnutrition.	Cross-sectional study	BMI, AP, AMC, TSF, WP, HP, AMA, cAMA, AFA and CP
Silveira et al. ²² Brasil, 2014	40 oncological patients, men and women with indications for digestive surgery	To evaluate the nutritional status of the AGS and FPM and to compare the diagnostics.	Cross-sectional study	BMI, AP, TSF, %WL, AMC and HGS
Santos et al. ²⁴ Brasil, 2014	96 elderly men and women on cancer treatment	To analyze the clinical, sociodemographic and nutritional profile through anthropometric indicators.	Cross-sectional study	BMI, AP, AMC, TSF, WP, HP, cAMA, AFA, CP and AMA
Schutte et al. ²⁷ Brasil, 2014	51 male and female patients with hepatocellular carcinoma	To evaluate the prevalence of malnutrition through anthropometric indicators.	Prospective study	BMI, %AT and %MM
Brito et al. ²⁸ Brasil, 2012	27 cancer patients, men and women.	To evaluate the nutritional profile through anthropometric indicators and to relate to the type of neoplasia.	Cross-sectional study	BMI, AMC, cAMA, TSF.
Bites et al. ²⁰ Brasil, 2012.	30 male and female patients with colorectal cancer.	To evaluate the anthropometric profile.	Cross-sectional study	BMI, AP, AMC and TSF
Sommacal et al. ²⁶ Brasil, 2011	32 cancer patients, men and women.	To identify the methods of pre-operative nutritional evaluation that can diagnose malnutrition.	Prospective study	BMI, AP, AMC and SCF.

BMI: body mass index, AP: arm perimeter, AMC: arm muscle circumference, TSF: tricipital skinfold, cAMA: correct arm muscle area, %AT: percentage of adipose tissue, %MM: percentage of muscle mass, WP: waist perimeter, HP: hip perimeter, AMA: arm muscle area, AFA: arm fat area, CP: calf perimeter, %WL: percentage of weight loss, HGS: hand grip strength, SCF: subscapular cutaneous fold.

Table 2. Prevalence of malnutrition (%) according to anthropometric indicators and subjective methods in studies with cancer patients

Reference	BMI	Perimeters	Folds	AMC	TSF	AMA	AFA	WP	Subjective Method
Merhi, Aquino ¹⁸	22% (65)	AP 39% (117)	*	*	*	*	*	*	SGA 27% (80)
Barata et al. ¹⁹	57% (128)	AP 84% (189)	*	75% (168)	*	*	*	*	*
Cunha et al. ²¹	15% (26)	*	*	*	*	*	*	%MM 64% (110) %AT 51% (85)	PG-SGA 24% (42) SGA 25% (44)
Santos et al. ²³	29% (28)	AP 45% (43) CP 24% (23)	TSF: 61% (59)	38% (36)	*	39% (37)	34% (33)	*	PG-SGA 44% (42)
Silveira et al. ²²	15% (6)	AP 25% (10)	TSF 15% (6)	45% (18)	38% (15)	*	*	*	SGA 38% (15)
Santos et al. ²⁴	29% (28)	AP 45% (43) PP 24% (23)	TSF: 61% (59)	38% (36)	*	39% (37)	34% (33)	*	PG-SGA 44% (42)
Schutte et al. ²⁷	33% (17)	*	*	*	*	*	*	24% (12)	MNA 37% (19)
Brito et al. ²⁸	22% (22)	*	TSF: 73% (73)	68% (68)	*	90% (90)	*	*	PG-SGA 59% (59)
Bites et al. ²⁰	3,3% (1)	AP 60% (18)	TSF: 60% (18)	*	*	*	*	*	*
Sommacal et al. ²⁵	17% (5)	AP 24% (7)	TSF: 86% (25) SCF: 66% (19)	7% (2)	*	*	*	*	*

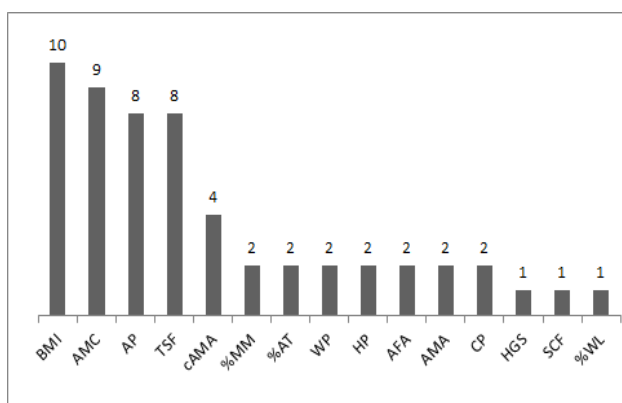
BMI: body mass index, AP: arm perimeter, AMC: arm muscle circumference, TSF: tricipital skinfold, AMA: arm muscle area, AFA: arm fat area, WP: waist perimeter, SGA: subjective global assessment, %MM: percentage of muscle mass, %AT: percentage of adipose tissue, PG-SGA: patient-generated subjective global assessment, CP: calf perimeter, MNA: mini nutritional assessment, SCF: subscapular cutaneous fold.

* anthropometric indicators not used in the article.

The year of publication of the articles included ranged from 2011 to 2017, with nine national and one international studies. The age of participants was diverse, with the largest number of participants over 65 years old. Oncological patients without type discrimination were evaluated in seven studies. The other evaluated gastric, hepatic or colorectal cancer. All evaluated men and women without distinction (Table 1).

All studies used BMI adopting the World Health Organization (WHO) criteria [14,15] and other anthropometric data were classified according to Frisancho [16,17].

In addition to the BMI, the most used anthropometric indicators were arm muscle circumference (AMC), arm perimeter (AP) and tricipital skinfolds (TSF), with three studies using only these indicators [18,19,20]. Figure 2 shows the indicators used in the selected studies, with their respective absolute values.



Legend: BMI: body mass index, AMC: arm muscle circumference, AP: arm perimeter, TSF: tricipital skinfold, cAMA: correct arm muscle area, %MM: percentage of muscle mass, %AT: percentage of adipose tissue, WP: waist perimeter, HP: hip perimeter, AFA: arm fat area, AMA: arm muscle area, CP: calf perimeter, HGS: hand grip strength, SCF: subscapular cutaneous fold, %WL: percentage of weight loss.

Figure 2. Frequency of use of the anthropometric indicators in the 10 articles of this review

Cunha et al. [21] in addition to AMC, AP and TSF also used the corrected arm muscle area (cAMA). Only one study used hand grip strength (HGS) and Percentage of weight loss (% WL) associated with BMI, CP, TSF and AMC [22].

Santos et al. [23] and Santos et al. [24] used the largest number of anthropometric indicators, such as BMI, arm perimeter, arm muscle circumference, triceps skinfold, waist circumference, hip perimeter, corrected arm muscle area, arm fat area, calf perimeter and arm muscle area.

In addition BMI, Sommacal et al. [25] used arm circumference, arm muscle circumference, triceps skinfold, and subscapular cutaneous fold classified by Blackburn et al. [26].

One study combined BMI with body composition [27], while Brito et al. [28], in addition to BMI, also evaluated triceps skinfold, arm muscle circumference and corrected arm muscle area, respectively. Table 2 shows the comparison between the prevalence of nutritional risk or malnutrition evaluated by different anthropometric indicators and subjective methods.

The prevalence of malnutrition diagnosed by BMI varied from 3.3% to 57%, which is the indicator that showed the lowest value compared to the others in all the

selected studies. The largest difference between this anthropometric indicator was 17% to 86% of malnourished patients according to TSF [2]. In one study, this percentage was higher for BMI than for another method (33% for BMI and 24% for bioelectrical bioimpedance analysis (BIA)).

The highest prevalence of malnutrition was detected by AMA [28] (90%), followed by TSF [25] (86%) and AP [19] (84%). Compared to AMA, 22% of malnourished patients were detected by BMI, 68% by AMC and 73% by TSF [28]. Regarding the study that showed the highest value for TSF, the other indicators presented 17% (BMI), 24% (perimeters), 66% (subscapular cutaneous fold) and 7% (AMC) [25]. In the article that tracked 84% of malnourished patients by AP, the percentages were 57% and 75% for BMI and AMC, respectively [19].

The hand grip strength was used in only one study, in which 38% of the malnourished subjects were identified, compared to 15% (BMI and TSF), 25% (perimeters) and 45% (AMC) [22]. AFA reported a prevalence of malnutrition of 34% in the two studies that were used [23,24].

Regarding the subjective methods, PG-SGA presented values of prevalence of malnutrition superior to the BMI [21,23,24,28] and AFA [23,24]. The data obtained in the comparison of this subjective method with AMC, TSF and AMA were controversial. Evaluated in four studies, two studies indicated larger values compared to AMC [23,24] and three demonstrated smaller data regarding TSF [23,24,28]. As for AMA, PG-SGA presented higher values in two manuscripts [23,24] and lower in another [28]. Compared with AFA, PG-SGA diagnosed more malnourished in two studies [23,24]. Finally, the values were the same for PG-SGA and HGS [22].

The percentage of malnutrition demonstrated by the SGA was higher than the BMI and lower than the AP (27%, 22% and 39%, respectively) [18]. Regarding the MNA, this percentage was 37%, which was higher than the BMI (33%) and WP (24%).

4. Discussion

The anthropometric indicators that proved to be the best in screening for malnutrition in cancer patients were arm perimeter (AP) and tricipital skinfold (TSF), considering the prevalence. The arm perimeter is widely used, since it is possible to calculate the arm muscle circumference and arm muscle area [15] in combination with the triceps skinfold [15], which has a good correlation with the total muscle mass [29]. However, in the studies which allowed the comparison between AP and AMC only one [22] showed more malnourished patients diagnosed by AMC, the others with more frequency by AP [19,25] and TSF [23,24]. Skinfolds, in general, are more prone to errors. For Heyward and Stolarczyk (2000) there is a variability of up to 9% of the measurements obtained from the errors of the evaluators. Moreover, the type of adipometer used, and even the time at which the fold (menstrual period, for example) is measured, may interfere with the result [30]. Thus, the arm perimeter is a good indicator alternative to be used in the malnutrition screening in these patients because it is a simple measure to obtain, low cost and less

prone to error in relation to the folds [31].

The calf perimeter, used in only two studies that evaluated only the elderly, showed little accuracy in the diagnosis of malnutrition when compared to BMI, AP, TSF, AMC, AMA, AFA and PG-SGA [23,24]. According to the World Health Organization, this measurement is the most sensitive regarding changes in muscle mass in the elderly, but in these studies, it was the least sensitive in relation to malnutrition [32]. This result may be due to the presence of common swellings in these patients as a side effect of chemotherapy [33] or even the inactivity inherent to hospitalized patients.

Likewise, the BMI also showed a smaller percentage compared to the others. The underestimation of malnutrition by this index can be explained by the presence of edema or ascites, caused by the decrease of albumin in cancer patients. The BMI considers only the weight without discounting the water retention, which does not occur in subjective methods [33].

Oliveira, Aarestrup [34] observed that two patients were classified as obese by BMI, while triceps skinfold, arm perimeter and arm muscle circumference showed cachexia. Whenever possible it is recommended that BMI be used in combination with other methods, so that the chances for a mistaken diagnosis be minimized [35]. The Nutritional Risk Screening tool (NRS-2002), for example, uses BMI as one of the criteria to classify nutritional risk, associated with the severity of the disease, loss of weight and changes in food intake. It is recommended that a diagnosis should be based on at least three criteria, emphasizing the importance of the combination between different anthropometric indicators [36].

In general, when compared to objective methods, PG-SGA and MNA presented to be better indicators of malnutrition. This is justified by the combination of a number of measures in these subjective methods. In addition, they use other information such as weight loss, change in food intake, functional capacity, gastrointestinal symptoms, among others. However, PG-SGA compared to the anthropometric indicators that proved to be the best predictor of malnutrition, presented a value close to CP and lower than TSF.

SGA was not a good method to be used in cancer patients, unlike PG-SGA and MNA. PG-SGA is more specific for cancer patients compared to SGA, as it includes a list of symptoms of increased nutritional impact, patient screening, and a focus on medical and nutritional care [37]. The MNA includes nutritional data such as food consumption and anthropometry; and health-related quality of life data, such as functional capacity, mental health, diseases, prescription drugs, and subjective assessment related to nutrition and health in general [38].

Another alternative used was the biochemical evaluation, mainly evaluation of serum albumin, transferrin and total lymphocyte counts, which was sensitive to the diagnosis of malnutrition in the study, where up to 69% were diagnosed malnourished by these parameters, compared to only 17% by BMI [25]. C-reactive protein (CRP) is also used because it is common in the routine of these patients. In a study performed with malnourished oncology patients, they had higher CRP concentrations [39]. However, caution should be exercised in this diagnosis, since low albumin and high CRP in these patients reflect a picture of

inflammation, not of malnutrition necessarily [40,41]. Therefore, evaluating biochemically requires caution and may not be a reliable alternative of aid in nutritional monitoring.

There is no method that is a reference for the accurate diagnosis of malnutrition in cancer patients. These patients are already at nutritional risk because of the catabolic state the disease causes. Therefore, it is important to track the highest number of malnourished, because in this case, it is more worrisome a malnourished classified as eutrophic than a eutrophic classified as malnourished. Thus, the best anthropometric indicator or subjective method to be used is the one that has the highest prevalence of malnutrition classified by it [7,9,10].

One limitation of this study is the non-standardization of the use of anthropometric indicators and subjective methods in the studies. Each article used different anthropometric indicators, making it difficult to compare them.

5. Conclusion

The anthropometric indicators used for the evaluation of a cancer patient should be carefully chosen in order to ensure the outcome by optimizing the response to applied nutritional therapy [42]. There is no referential method, so the best way to reduce random errors is the combination of several indicators to assess the nutritional status of a patient [39]. It was concluded that the arm perimeter (AP) is the best anthropometric indicator in the tracking of malnutrition in cancer patients.

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