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CUT-OFF POINTS FOR BODY MASS INDEX TO CLASSIFY THE NUTRITIONAL STATUS IN ELDERLY

PONTOS DE CORTE DO ÍNDICE DE MASSA CORPORAL PARA CLASSIFICAR O ESTADO NUTRICIONAL EM IDOSOS

PUNTOS DE CORTE DEL ÍNDICE DE MASA DEL CUERPO PARA CLASIFICAR EL ESTADO NUTRICIONAL EN ANCIANOS

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The objectives of this systematic review were to assess what the cutoff points for BMI classification are, which the most used is and its applicability in population studies with elderly. From the VHL database, the descriptors used for the search were body mass index, nutritional and elderly status. We found 492 articles, and of these 21 were excluded due to duplication, resulting in 471. Only 24 met the inclusion criteria. In total, four distinct references were found to classify the cutoff points for BMI: Lipschitz, World Health Organization, Nutrition Screening Initiative and the Pan American Health Organization. The cutoff point for body mass index most widely used in the literature is the classification recommended by WHO. BMI is used in order to assess nutritional status, co-factors associated with health; and relate their values and classification with risk of morbidity and mortality.
Descriptors: Body Mass Index; Nutrition Status; Elderly.

Os objetivos desta revisão sistemática foram verificar quais são os pontos de corte para a classificação do IMC, qual é o mais utilizado e a sua aplicabilidade em estudos populacionais com idosos. A partir da base de dados BVS, os descritores utilizados para a busca foram índice de massa corporal, estado nutricional e idoso. Foram encontrados 492 artigos, e desses 21 foram excluídos por duplicação, resultando em 471. Apenas 24 atenderam os critérios de inclusão. No total, foram encontradas quatro referências distintas para classificar os pontos de corte do IMC: *Lipschitz*, *World Health Organization*, *Nutrition Screening Initiative* e Organização Pan Americana de Saúde. O ponto de corte do índice de massa corporal mais utilizado pela literatura é a classificação recomendada pela *WHO*. O IMC é utilizado com o intuito de avaliar o estado nutricional, associar com co-fatores de saúde; e relacionar seus valores e classificação com risco de morbimortalidade.
Descritores: Índice de massa corporal; Estado nutricional; Idoso.

Los objetivos de esta revisión sistemática fueron determinar cuáles son los puntos de corte para la clasificación del IMC, que es el más utilizado y su aplicación en estudios de población con edad avanzada. Desde la base de datos BVS, los descriptores utilizados para la búsqueda fueron índice de masa corporal, estado nutricional e anciano. Se encontraron 492 artículos, y de éstos 21 fueron excluidos por la duplicación, lo que resulto en 471. Sólo 24 cumplieron los criterios de inclusión. En total, se encontraron cuatro referencias distintas para clasificar los puntos de corte del IMC: Lipschitz, Organización Mundial de Salud, Nutrition Screening Initiative. El punto de corte del índice de masa corporal más utilizado en la literatura de la Organización Panamericana de la Salud es la clasificación de la OMS. El IMC es utilizado con el fin de evaluar el estado nutricional, co-factores asociados con la salud; y relacionar sus valores y la clasificación con riesgo de morbimortalidad.
Descriptores: Índice de masa corporal; Estado nutricional; Ancianos.

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INTRODUCTION

Data from the Brazilian Institute of Geography and Statistics show that Brazil has 23.5 million people aged 60 years old or older[1]. With the significant increase of elderly in absolute numbers as well as the average of years of life, this population is highlighted in epidemiological studies, especially when evaluating determinants for chronic noncommunicable diseases and their nutritional status[2].

In a study conducted in southern Brazil, it was found that the prevalence of the diseases that constitute the metabolic syndrome (hypertension, diabetes mellitus, central obesity and dyslipidemia) were higher in those patients of both sexes who were overweight[3]. In this sense, the identification of the nutritional status of the elderly has been highlighted in the literature due to its importance and risk relation to chronic diseases[2,4,5].

The 2008/2009 Household Budget Survey data indicated that, while the prevalence of overweight increased from 60 years old on, it decreased in age groups over 75 years of age, and underweight was diagnosed[6]. Maintaining an adequate nutritional status in the elderly individual is not an easy task, due to the constant presence of chronic noncommunicable diseases, use of drugs, physiological changes associated with age that can interfere with appetite resulting in malnutrition, in addition to socioeconomic conditions. Nutritional problems are associated with increased morbidity, higher rates of mortality, susceptibility to infections and negative impact on quality of life for seniors[7].

Anthropometric measures are important to evaluate the risk of morbidity and mortality and body composition, but few of them are applicable to a large number of individuals. Among these measures, body mass and height are essential to calculate the Body Mass Index (BMI). This index measures the nutritional status, also, is the most used because it is simple, inexpensive, non-invasive, rapid implementation and easy measurement[8], especially in population-based studies.

On the other hand, it is still lacking in the literature consensus on the most appropriate cutoff point for BMI to classify the nutritional status of the elderly. In aging there are physiological changes such as loss of muscle mass, increased abdominal fat[9], and in general, the elderly have more body fat than younger adults[10].

National surveys such as the National Survey on Health and Nutrition (*Pesquisa Nacional sobre Saúde e Nutrição - PNSN*) and the Household Budget Survey of Brazil (*Pesquisa de Orçamento Familiar do Brasil - POF 2008-2009*) used the criteria recommended by the World Health Organization (WHO), but there are criticisms about the use of the same cutoff points to classify malnutrition or overweight in adults and elderly, as changes in body composition, associated with the aging process, should be analyzed[11]. Thus, it is believed that using cutoff points that are proposed for adults to classify the nutritional status of the elderly, would not take into consideration the physiological changes of aging.

In this sense, the objectives of this review were to verify what the cutoff points for the classification of BMI are, which the most used is and its applicability in population studies with elderly.

METHOD

This study is a systematic review, performed from the selection of original articles on the topic: nutritional status of elderly.

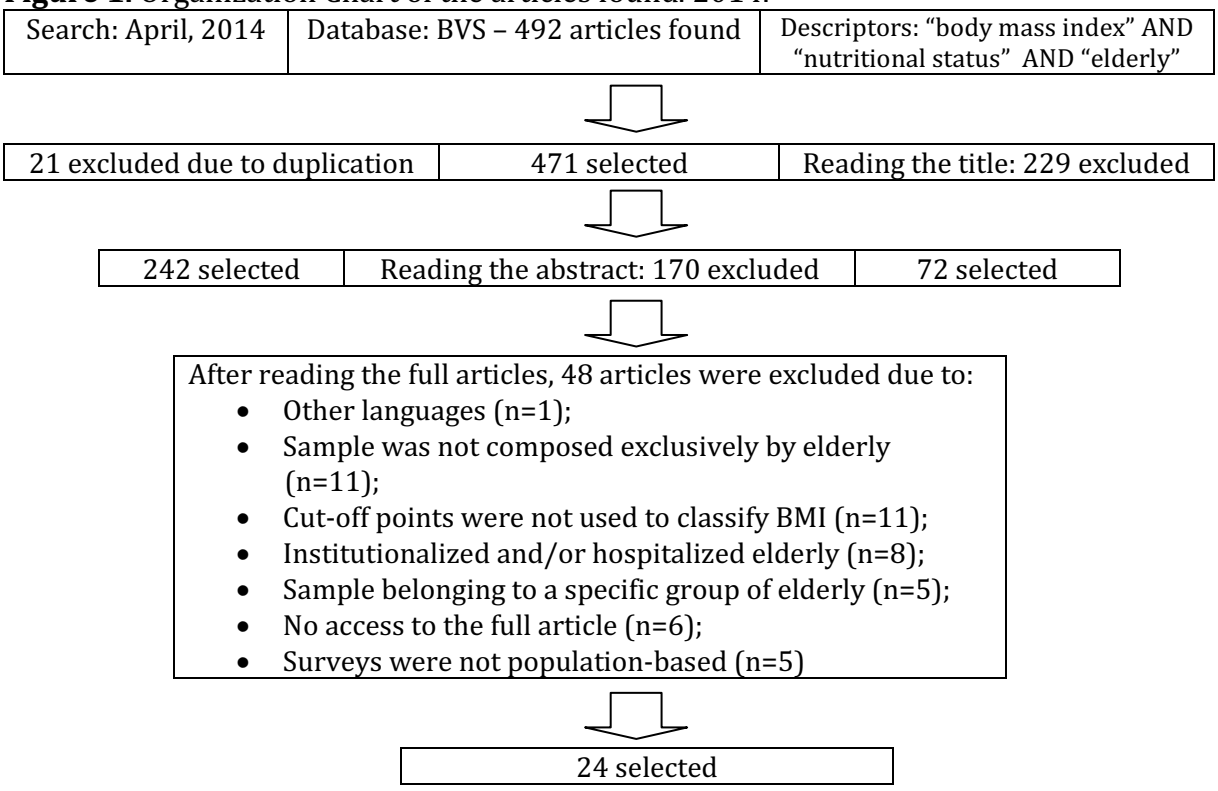
In April 2014 we collected and analyzed publications in duplicate related to the topic of interest by researchers simultaneously. The search was

performed through the Virtual Health Library (VHL) database. The descriptors used were "body mass index", "nutritional status" and "elderly". It is used the logical operator AND to combine the terms used during the search for publications.

Exclusion criteria were: (a) studies that were not performed exclusively with the elderly (≥ 60 years old); (b) articles published more than five years ago; (c) that are not population-based surveys; (d) sample with institutionalized or hospitalized elderly; (e) sample of elderly belonging to any particular group (e.g. fragile, with cancer, physical limitations); (f) using the BMI continuously (g) reviews; (h) articles that are not in English, Portuguese and Spanish languages.

Initially there was a reading of the titles and abstracts of the articles found in the search. Then the selected articles were obtained in full and examined according to the exclusion criteria, as Figure 1.

Figure 1. Organization Chart of the articles found. 2014.



For the analysis of the studies, the following aspects were considered: year of publication; age and sex of participants; total sample; objective; design; operational definition for the nutritional status; cutoff points for BMI and its reference; place of data collection; which was analyzed based on the cutoff points used to classify the sample; and main results analyzed from the BMI classification.

RESULTS

After the survey, 492 articles were found, and of these 21 were excluded due to duplication, resulting in 471. Subsequently 229 were excluded by reading the title and 170 the abstract. After full reading of 72 articles on the nutritional status of the elderly, according to the exclusion criteria, only 24 were selected (Figure 1). Of these, 37.5% (n=9) were published in 2012, 83.3% (n=20) had a cross-sectional design, 70.83% (n=17) considered the age group ≥ 60

years old, 62 5% (n=15) were performed in Brazil (Table 1).

Table 1. Characteristics of studies on nutritional status of elderly. 2014.

Authors	Year	Design	Age	Sample	Place
Andrade et al.	2009	Cross-sectional	≥ 60 years old	887	Vitória/Brazil
Silveira et al.	2009	Cross-sectional	≥ 60 years old	596	Pelotas/Brazil
Amirkalai et al.	2010	Cross-sectional	≥ 65 years old	221	Tehran/Iran
Reyes et al.	2010	Cross-sectional	≥ 60 years old	157	Morelia/Mexico
Mastroeni et al.	2010	Cross-sectional	≥ 60 years old	218	Joinville/Brazil
Tribess et al.	2010	Cross-sectional	≥ 60 years old	265	Jequié/Brazil
Ahn, s. et al.	2011	Cross-sectional	≥ 65 years old	1143	USA
Ferreira et al.	2011	Cross-sectional	≥ 60 years old	304	Botucatu/Brazil
Freitas et al.	2011	Cross-sectional	≥ 60 years old	100	Matarazzo and São Miguel Paulista/Brazil
Nascto. et al.	2011	Cross-sectional	≥ 60 years old	621	Viçosa/Brazil
Sales et al.	2011	Longitudinal	71-81 years old	1035	Bambuí/Brazil
Silva et al.	2011	Cross-sectional	≥ 60 anos	13943	Brazil
Sirola et al.	2011	Longitudinal	Média de 73 years old	1125	Finland
Ahn, s. et al.	2012	Longitudinal	≥ 60 years old	3.591	China
Andrade et al.	2012	Cross-sectional	≥ 60 years old	833	Vitória/Brazil
Cheserek et al.	2012	Cross-sectional	≥ 60 years old	128	East Africa
Fares et al.	2012	Cross-sectional	≥ 60 years old	787	Antônio Carlos and Lafaiete Coutinho/Brazil
Lee et al.	2012	Cross-sectional	≥ 65 years old	2948	Thailand
Perera et al.	2012	Cross-sectional	≥ 60 years old	437	District of Colombo/Sri Lanka
Silva et al.	2012	Cross-sectional	≥ 60 years old	1441	Bambuí/Brazil
Siqueira et al.	2012	Cross-sectional	≥ 60 years old	262	Bambuí/Brazil
Soares et al.	2012	Cross-sectional	≥ 60 years old	235	Vitória de Santo Antão/Brazil
Boscatto et al.	2013	Cross-sectional	≥ 80 years old	134	Antônio Carlos/ Brazil
Hsiao et al.	2013	Longitudinal	≥ 75 years old	449	Pennsylvania/USA

It was observed a total of four classifications of cutoff points for BMI, as follows: Lipschitz[12], World Health Organization (WHO)[13], Nutrition Screening Initiative[14] e Pan American Health Organization(PAHO)[15] (Table 2).

The review showed that of the 24 articles, 37.5% (n=9) used the cutoff points for BMI according to the classification recommended by the World Health Organization; 29.2% (n=7) of the articles do not mention and/or the cut-off point reference used to classify BMI is unknown (Table 2).

In 12.5% (n=3) two different classifications were used to compare and verify the best cutoff point for BMI[8,16,17].

The Table 2 demonstrates the applicability of the BMI in each study according to the adopted cutoff point.

It was observed that BMI is used in order to assess the nutritional status, particularly for under and overweight, and associated with health co-factors; also relating its values and classification with risk of morbidity and mortality.

Table 2. Characteristics of the studies as for methodological criteria. 2014.

Authors	Year	Cutoff point and classification for BMI *	Reference cutoff point for BMI	Applicability of BMI
Andrade et al.	2009	Underweight: < 18.5 Normal: 18.5 – 24.99 Overweight: 25 – 29.99 Obesity: ≥ 30	WHO, 1995	To determine the nutritional status.
Silveira et al.	2009	Underweight:< 18.5 Normal weight: 18.5- 24.9 Overweight: 25 – 29.9 Obesity: ≥ 30 Lipschitz: Low weight: < 22 Normal weight: 22 - 27 Excesso weight: > 27kg/m^2	WHO, 1998 and Lipschitz, 1994	To compare the results (factors associated with obesity) through two different cut-off points for BMI.
Amirkalai et al.	2010	Considered malnutrition BMI <24	Not mentioned	BMI is secondary to compare the scores of mini nutritional assessment (MNA).
Reyes et al.	2010	Malnutrition: < 20 Normal weight: 20 -25 Overweight: > 25	Not mentioned	To compare the nutritional status through MNA with the resultant of anthropometric parameters (BMI).
Mastroeni et al.	2010	Underweight: ≤ 23 Normal weight: 23< BMI < 28 Pre-obesity: 28 ≤ BMI ≤ Obesity: ≥ 30 Overweight: ≥ 25 (WHO)	OPAS, 2001 and WHO, 2000	To verify the nutritional status and compare the best BMI classification according to their cut-off points.
Tribess et al.	2010	Underweight: <18.5 Normal: 18,5 - 24,9 Overweight: ≥ 25	WHO, 1998	To verify the nutritional status.
Ahn et al.	2011	Normal weight: 18.5 – 24.9 Overweight: 25,0 – 29.9 Moderate obesity: 30- 34.9 Severe obesity: ≥ 35	WHO, 1998	To determine the relationship between BMI and health.
Ferreira et al.	2011	Underweight: ≤ 23 Normal: 23<BMI<28 Pre-obesity: 28≤BMI<30 Obesity: ≥30	OPAS, 2001	To classify the elderly in obese and non-obese and compare the associated factors.
Freitas et al.	2011	BMI≤ 28; Between 28 and 30 Between 30 and 35 BMI >35	Not mentioned	To classify and verify the nutritional status. It uses these cutoff points, but does not classify them.
Nascto. et al.	2011	Underweight: < 22 Normal weight: 22-27 Overweight: > 27	Lipschitz, 1994	To evaluate the nutritional status.
Sales et al.	2011	Excess weight: ≥ 27	Lipschitz and Nutritional Screening Initiative	To determine the nutritional status, focusing on excess weight.
Silva et al.	2011	Underweight:<18.5 Normal: 18,50≥IMC≤24.99 Overweight: 25.00≥IMC≤29.99 Obesity: ≥30.00	WHO, 1995	To verify the prevalence of excess weight (overweight and obesity).
Sirola et al.	2011	Malnutrition: < 21	Not mentioned	BMI uses that cutoff point as a criterion for the diagnosis of frailty.
Ahn et al.	2012	Normal weight : 18.5 – 24.9 Overweight: 25.0 – 29.9	WHO, 1998	To analyze factors associated with excess weight

		Obesity: ≥ 30		(overweight and obesity).
Andrade et al.	2012	Underweight: < 18.5 Normal: 18.5 – 24.99 Overweight: 25 – 29.99 Obesity: ≥ 30	WHO, 1995	To determine the amount of elderly classified with overweight and obesity, and from this classification, to associate with other variables.
Cheserek et al.	2012	Underweight: < 18.5 Normal: 18.5 – 24.99 Overweight: 25 – 29.99 Obesity: ≥ 30	WHO, 1995	To determine the nutritional status.
Fares et al.	2012	Underweight: < 22.0 Normal weight: 22.0 ≤ IMC ≤ 27.0 Excess weight> 27.0	Nutrition Screening Initiative, 2002	To verify the nutritional status.
Lee et al.	2012	< 17; 17-19; 19-21; >21	Not mentioned**	To verify the chances of malnutrition.
Perera et al.	2012	Underweight: < 18.5 Normal weight: 18.5 – 24.9 Overweight: > 25	WHO	To evaluate the nutritional status.
Silva et al.	2012	Underweight: < 18.5 Overweight; ≥ 24.99	WHO, 1998	To verify the nutritional status (malnutrition and overweight).
Siqueira et al.	2012	Not mentioned.	Lipschitz, 1994	To classify the nutritional status and to verify how some variables can influence the calculation and classification of BMI.
Soares et al.	2012	Underweight: ≤ 22; Normal weight: > 22 e < 27 Overweight: ≥ 27	Not mentioned	To verify the nutritional status.
Boscatto et al.	2013	Underweight: < 22.0 Excess weight: > 25	Nutrition Screening Initiative, 2002	To verify the nutritional status focusing on malnutrition and overweight.
Hsiao et al.	2013	Underweight: < 18.5 Normal: 18.5 – 24.9 Overweight: 25 – 29.9 Obesity: ≥30.	Not mentioned	To verify the prevalence of obesity and to examine associations with risk factors and standard diet.

*BMI = Body Mass Index in kg/m²
** does not mention the classification, only proposes these cutoff points according to the Mini Nutritional Assessment.

DISCUSSION

It was observed that most of the articles analyzed adopted the cutoff point of the World Health Organization to classify BMI[18-23], and used it in order to determine and assess the nutritional status, both overweight as malnutrition, and possible factors associated with these nutritional conditions. The others[24-26] used BMI to classify the nutritional status and relate it with morbidities.

According to the WHO[13] the use of BMI is appointed to investigate the association between nutritional status and the risk of morbidity and mortality, both underweight and overweight bring different implications. The causes of death associated with low BMI are tuberculosis, obstructive pulmonary disease, lung and stomach cancer; and causes associated with a high BMI: cerebrovascular diseases, cardiovascular diseases, diabetes and colon cancer among men.

Two articles have adopted the classification proposed by Lipschitz [27,28]. Both evaluated the nutritional status,

however Siqueira et al.[27], in addition to classify the nutritional status of the elderly, verified how some variables can influence the calculation and classification of BMI. Other studies [2,29] that have adopted the classification of the Nutrition Screening Initiative also used it in order to verify the nutritional status of the elderly. But with different focuses: one in malnutrition and overweight[2] and the other to associate with factors that might be related to the nutritional status of this population[29]. On the other hand, the PAHO classification was verified in a study[30] in order to classify the elderly in obese and non-obese and compare the factors associated with this nutritional status which is one of the main risk factors for hypertension, cardiovascular disease, type 2 diabetes and osteoarthritis[31].

Another research[17] compared results of factors associated with obesity through two different cutoff points for BMI (WHO and Lipschitz) and which one would be suitable for anthropometric classification of obesity, on the "look" of public health, definitions and advances in research, suggested that the cutoff point of obesity more sensitive to Brazilian elderly population would be BMI> 27kg/m^2, or the Lipschitz classification. Study performed with Brazilian elderly[16], and adopting the same cut-off point recommended by Lipschitz and Nutrition Screening Initiative, aiming to check the nutritional status of the elderly and classifies them overweight, stressed that differences in birth cohort in anthropometric measurements of older elderly, in a near future, may influence the higher prevalence of overweight in male elderly.

Mastroeni *et al.*[8] in order to provide demographics of elderly residents in Joinville, adopted the classification of PAHO and WHO to verify the nutritional status depending on the cutoff point adopted for BMI. They found that both men and women were characterized as eutrophic when they adopted the PAHO classification, in contrast to the classification of WHO in which prevalence of overweight in both sexes was observed.

Of the articles that did not mention the reference cut-off points to classify BMI, three used the Mini Nutritional Assessment (MNA) together with BMI to diagnose the nutritional status[32-34]. Cervi *et al.*[35] state that BMI cannot be used as a single estimate of the nutritional status of the elderly, since it must take into account the specific changes of aging, loss of muscle mass and fat accumulation; in addition to separately analyze the different age groups comprising seniors.

Three other studies mentioned the cut-off points to classify the nutritional status, but without citing the reference to such classification. They had as main objective to determine the prevalence of obesity, to examine associations with risk factors and eating habits[36-38]. Only one study used the BMI classification as one of the criteria to diagnose the fragility [39].

The cutoff point that should be adopted to classify BMI will depend on the purpose of the research; that is, if the intention is to correlate the BMI and morbidity and mortality, the most recommended are the cutoff points proposed by the World Health Organization and the Pan American Health Organization. On the other hand, the cutoff points of Lipschitz and Nutrition Screening Initiative are suitable to classify the nutritional status with strong focus on malnutrition, which is also common in older people and is associated with significant adverse health effects[31].

It is important to note that BMI values are related to both the morbidity and mortality and the nutritional status. This relationship depends on the cut-off point used, taking into account the recommendation of each reference. And the researches end up using for

assessment of nutritional status, the relationship with underweight (malnutrition) and overweight (obesity risk).

CONCLUSION

It can be concluded that although there is no consensus about a specific cutoff point for the elderly, the cutoff point of the World Health Organization has been the most used in the last five years in population studies for the elderly in order to evaluate only the nutritional status and/or with other health co-factors. Thus, using the same cutoff point may help in comparing the results obtained in the various epidemiological studies.

It stands out as limiting the considerable number of articles that did not provide complete methodological data, restricting the analysis about the cutoff points to classify BMI and its references in relation to selected articles containing all information.

It was observed that there have been few studies published in the last five years related to the nutritional status in the elderly. Among the strengths of this review we highlight the care with the data collection, which was performed in duplicate to minimize possible faults in the search, using reliable database.

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CONTRIBUTIONS
Talita Inácio Martins was responsible for study design, data collection, interpretation and text editing. **Joilson Meneguci** assisted in the survey and analysis of publications in duplicates. **Renata Damião** was responsible for the idea; was guiding this review and participated in the correction of the Article.