Relationship between hand grip strength and nutritional assessment methods used of hospitalized patients

Relação entre a força do aperto da mão e métodos de avaliação nutricional em pacientes hospitalizados[1]

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ABSTRACT

Objective

This study verified the association between hand grip strength and body mass index, subjective global assessment and nutritional risk screening 2002.

Methods

This cross-sectional study calculated the body mass index, measured hand grip strength and administered the subjective global assessment and nutritional risk screening 2002 to 118 patients hospitalized at the University Hospital of the *Universidade Federal de Santa Catarina, Florianópolis*, Brazil. Hand grip strength was compared with the reference values for the Brazilian population according to gender and age. The statistical analyses included the Student's t-test or Mann-Whitney test and multiple linear regression. The results were considered significant when $p<0.05$.

Results

The prevalences of nutritional risk or malnutrition according to body mass index, global subjective assessment, nutritional risk screening 2002 and hand grip strength were 3.5%, 50.9%, 33.9% and 35.6%, respectively.

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Malnourished individuals according to body mass index had, on average, 11.0kg less hand grip strength than the nourished individuals (p=0.008). There was no association between hand grip strength and the subjective global assessment (malnourished individuals had -2.8kg; p=0.078) and nutritional risk screening 2002 (malnourished individuals had -1.5kg; p=0.352).

Conclusion

Hand grip strength was associated with body mass index but not with the subjective global assessment or nutritional risk screening 2002.

Indexing terms: Nutritional assessment. Nutritional status. Hand strength. Body mass index. Inpatients.

RESUMO

Objetivo

Verificar a associação da força do aperto da mão com o índice de massa corporal, a avaliação subjetiva global e o rastreamento de risco nutricional 2002.

Métodos

Estudo transversal com 118 pacientes internados no Hospital Universitário da Universidade Federal de Santa Catarina, Florianópolis, Brasil. Foi calculado o índice de massa corporal e foram aplicados a avaliação subjetiva global, o rastreamento de risco nutricional 2002 e a força do aperto da mão. Esta última foi comparada aos valores de referência da população brasileira, segundo sexo e idade. Para análise estatística, foi utilizado o teste t *Student ou Mann-Whitney e regressão linear múltipla, considerando uma significância estatística de p<0,05.*

Resultados

A prevalência de risco nutricional ou desnutrição pelo índice de massa corporal, avaliação subjetiva global, rastreamento de risco nutricional 2002 e força do aperto da mão foi de 3,5%, 50,9%, 33,9% e 35,6%, respectivamente. Os indivíduos, identificados como desnutridos pelo índice de massa corporal, tiveram, em média, 11,0kg a menos na força do aperto da mão do que os nutridos (p=0,008). Não houve associação da força do aperto da mão com a avaliação subjetiva global (desnutridos tiveram -2,8kg; p=0,078) e com o rastreamento de risco nutricional 2002 (desnutridos tiveram -1,5kg; p=0,352).

Conclusão

A força do aperto da mão foi associada com o índice de massa corporal, mas não com avaliação subjetiva global ou com o rastreamento de risco nutricional 2002.

Termos de indexação: *Avaliação nutricional. Estado nutricional. Força da mão. Índice de massa corporal. Pacientes internados.*

INTRODUCTION

An ideal method for assessing the nutritional status of patients should include dietary intake, nutritional requirements, functional status and body composition[1]. However, in the absence of a gold standard, scientists tried to identify new methods capable of accurately diagnosing malnutrition[2-4]. Many tools have been used; however, their validity is still controversial[5].

In clinical practice and in the hospital setting, Body Mass Index (BMI)[6], Subjective Global Assessment (SGA)[7] and Nutritional Risk Screening 2002 (NRS 2002)[8] are frequently used while Hand Grip Strength (HGS) is often reported as an indicator of functional capacity[9].

Body Mass Index indirectly assesses nutritional status and depends on weight and height. It is a simple index and an easy-to-use method, commonly used for classifying malnutrition, overweight and obesity[6].

The Subjective Global Assessment is a clinical nutritional assessment method developed by Detsky *et al*.[7]. It investigates clinical history and includes a subjective physical examination. It is

considered a simple, inexpensive and easy-to-use technique, and provides important nutritional information[2].

The Nutritional Risk Screening 2002 is used for determining the risk of malnutrition by assessing the severity of the disease, BMI, percentage of weight loss and food intake. Hence, malnutrition and/or severe disease may indicate the need of nutritional support[8].

Hand Grip Strength is determined by dynamometry. It is a noninvasive, simple and quick method that can be used in clinical and epidemiological studies[10,11]. It may be useful for the assessment of nutritional status[11-13], since malnourished patients present lean mass depletion and low muscle strength[10,11].

Given the importance of scientific evidence proving the efficiency of HGS for assessing nutritional status, the objective of this study was to verify its association with BMI, SGA and NRS 2002 in hospitalized patients.

METHODS

This is a cross-sectional study of patients aged ≥19 years of the University Hospital of the *Universidade Federal de Santa Catarina* (HU/UFSC) hospitalized between July 2010 and July 2011. Patients unable to understand instructions and communicate, pregnant or breastfeeding women and those with amputated or atrophied limbs were excluded.

The project was approved by the UFSC Human Research Ethics Committee under protocol n° 333/08, and all participants signed an informed consent form before the interview and assessment of their nutritional status.

The patients' clinical data were obtained from their hospital records. All nutritional status assessments were done on the same occasion. The researchers were previously trained for ensuring the reliability of the nutritional status assessment and data collection.

Hand grip strength

Hand grip strength was measured using a hydraulic hand dynamometer Saehan® model SH 5001 (*Saehan Corporation - Yangdeok-Dong*, Masan, Korea) with a capacity of 90kg.

The evaluation was done with the patient seated, with hips and knees at 90° of flexion, adducted shoulder close to the trunk, flexed elbow at 90° with the forearm in neutral position (between pronation and supination) and wrist between 0° and 30° of extension and 0° and 15° of ulnar deviation[12].

A pretest was done allowing the participant to become familiar with the apparatus. The researcher verbally instructed the participant to exert maximum palmar prehension three times and the highest value was used[12]. HGS was evaluated on the arm side without vascular access. The results were compared with the reference values for the Brazilian population[11] and the patients were classified as malnourished when their HGS was below the tenth percentile[11].

Body mass index

Weight (kg) and height (m) were determined as recommended by the World Health Organization[14]. BMI was calculated by dividing the weight by the square of the height. Patients were classified as malnourished[6] when BMI <18.5kg/m², normal weight when 18.5kg/m²≤BMI≤24.9kg/m², overweight when 25.0kg/m²≤BMI≤29.9kg/m² and obese when BMI≥30kg/m². For the statistical analysis, the patients were classified as malnourished (BMI<18.5kg/m²) or nourished (BMI≥18.5kg/m²).

Weight and height were measured using an electronic scale with stadiometer (Welmy, W300, *Santa Bárbara D'Oeste, São Paulo*, Brazil).

Subjective global assessment

The Subjective Global Assessment was done as recommended by Detsky *et al*.[7], considering weight loss history, changes in food

intake, gastrointestinal symptoms, functional capacity, metabolic stress and physical examination. The patients were classified as A (nourished); B (moderately or possibly malnourished); and C (severely malnourished). For the statistical analysis, the categories B and C were grouped.

Nutritional Risk Screening 2002

The Nutritional Risk Screening 2002 was performed as recommended by Kondrup *et al*.[8] Nutritional risk was determined by two components: impaired nutritional status (BMI, weight loss, food intake) and disease severity. The following scores were given for nutritional status and disease severity: 0 - absent; 1 - mild; 2 - moderate; and 3 - severe. Patients with a total score of 3 or more were considered at nutritional risk, and patients aged ≥70 years received an extra point in the total score[8].

Statistical analysis

The results were expressed as relative and absolute frequencies, mean and 95% confidence interval.

The Chi-square or Fisher's exact test was used for analyzing the association between the categorical variables and the Student's *t*-test or Mann-Whitney test for verifying the differences between the means of the groups, depending on the homogeneity of the variances, since the outcome variable was symmetrical. Multiple linear regression adjusted for age and gender was used for verifying the association between HGS and the other nutritional indicators. *P*-values <0.05 were considered statistically significant. All analyses were done by the software Stata, version 11.0 for Windows (Stata Corporation, College Station, TX, USA).

RESULTS

The sample consisted of 118 patients with a mean age of 50.4±15.0 years (19 to 85 years). Most were females (72.0%) aged <60 years (71.7%). The most common diagnoses were cancer (11.9%), pulmonary diseases (11.6%), heart disease (10.2%) and liver disease (7.6%). Two-thirds (66.1%) of the sample had some comorbidity (men=34.4% and women=76.6%;

Table 1. Prevalence of malnutrition according to Hand Grip Strength (HGS), Body Mass Index (BMI), Subjective Global Assessment (SGA) and Nutritional Risk Screening 2002 (NRS 2002) by gender. *Florianópolis* (SC), Brazil, 2011.

Method	Total		Men		Women		*p*-value*
	n	%	n	%	n	%	
HGS							0.242
≤*p*10	42	(35.6)	9	(27.3)	33	(38.8)	
>*p*10	76	(64.4)	24	(72.7)	52	(61.2)	
BMI							0.571
<18.5kg/m²	4	(3.5)	0	(0.0)	4	(4.8)	
≥18.5kg/m²	112	(96.5)	32	(100.0)	80	(95.2)	
SGA							0.084
B+C	60	(50.9)	21	(63.6)	39	(45.9)	
A	58	(49.1)	12	(36.4)	46	(54.1)	
NRS 2002							0.612
≥3	40	(33.9)	10	(30.3)	30	(35.3)	
<3	78	(66.1)	23	(69.7)	55	(64.7)	

*Chi-square or Fisher's exact test for the association between genders.

BMI <18.5: malnourished; BMI ≥18.5: nourished/overweight/obese; SGA B+C: malnourished; ASG A: well nourished; NRS 2002 ≥3: at nutritional risk; NRS 2002 <3: not at nutritional risk; HGS ≤*p*10: malnourished; HGS >*p*10: nourished.

p<0.001), and of these, 20.3% had Diabetes *Mellitus* (DM) and 39.8% had High Blood Pressure (HBP). HBP was significantly more common in women.

Table 1 shows the classification of the nutritional status of the patients according to gender. According to HGS, BMI, SGA and NRS 2002, 35.6%, 3.5%, 50.9% and 33.9%, respectively were at nutritional risk or malnourished. The prevalences of malnutrition of men and women did not differ.

The mean HGS of the sample was 25.0±11.6kg, and that of the women (20.2±6.6 kg) was significantly lower than that of the men (37.3±12.6kg; p<0.001). HGS was significantly lower in patients aged ≥60 years, in those with some comorbidity (Table 2) and in malnourished patients according to BMI (Table 3).

After adjusting for age and gender, the mean HGS of malnourished patients according to BMI was 11kg lower than that of nourished patients. Among those malnourished according to the SGA, the mean HGS was 2.8kg lower than that of the nourished. Among those at nutritional risk according to the NRS 2002, the mean HGS was 1.5kg lower than that of the nourished.

Table 2. Relationship between Hand Grip Strength (HGS) and age, presence of comorbidities, diabetes *mellitus* and High Blood Pressure (HBP) by gender. *Florianópolis* (SC), Brazil, 2011.

Methods	HGS[a] Total	p^*	HGS[a] Men	p^*	HGS[a] Women	$p^\dagger$
Age (years)		0.004		0.004		0.012
<60	26.8 (24.2; 29.5)		41.1 (36.2; 45.9)		21.3 (19.6; 23.1)	
≥60	20.1 (17.3; 22.9)		27.4 (19.9; 34.9)		17.3 (15.3;19.3)	
Presence of comorbidity		0.001		0.729		0.258
No	29.8 (25.5; 34.2)		36.4 (29.9; 42.8)		21.7 (18.4; 24.9)	
Yes	22.5 (20.4; 24.7)		37.9 (31.5; 44.5)		19.8 (18.2; 21.4)	
Diabetes *Mellitus*		0.799		0.698		0.682
No	25.2 (22.7; 27.6)		37.8 (32.6; 42.9)		20.1 (18.4; 21.8)	
Yes	24.5 (20.4; 28.5)		35.5 (23.2; 47.8)		20.1 (18.2; 23.5)	
HBP		0.348		0.932		0.849
No	26.1 (23.1; 29.2)		37.7 (31.7; 43.7)		20.1 (17.9; 22.2)	
Yes	23.3 (20.7; 25.9)		37.2 (31.5; 43.0)		20.4 (18.5; 22.3)	

[a]Mean and 95% confidence interval. *Student's t-test or Mann-Whitney test.

Table 3. Mean Hand Grip Strength (HGS) according to Body Mass Index (BMI), Subjective Global Assessment (SGA) and Nutritional Risk Screening 2002 (NRS 2002) by gender. *Florianópolis* (SC), Brazil, 2011.

Methods	HGS[a] Total	p^*	HGS[a] Men	p^*	HGS[a] Women	p^*
BMI		0,003		-		0.004
<18.5 kg/m²	11.3 (7.7; 14.8)		-		11.3 (7.7; 14.8)	
≥18.5 kg/m²	25.4 (23.3; 27.5)		-		20.8 (19.3;22.2)	
SGA		0.440		0.070		0.054
B+C	24.2 (21.3; 27.1)		34.4 (29.6; 39.1)		18.7 (16.5; 20.9)	
A	25.9 (22.7; 29.0)		42.6 (33.2; 51.9)		21.5 (19.7; 23.3)	
NRS 2002		0.095		0.322		0.117
≥3	22.5 (19.2; 25.7)		34.0 (26.3; 41.7)		18.7 (16.1; 21.4)	
<3	26.3 (23.6; 29.0)		38.8 (33.1; 44.6)		21.1 (19.4; 22.7)	

[a]Mean and 95% confidence interval. *Student's *t*-test or Mann-Whitney test.

Table 4. Multiple linear regression of hand grip strength and nutritional indicators. *Florianópolis* (SC), Brazil, 2011.

	Crude			Adjusted*		
	Beta	95%CI	*p*-value	Beta	95%CI	*p*-value
BMI			0.014			0.008
≥18.5 kg/m²	0.0	-		0.0	-	
<18.5 kg/m²	-14.2	(-25.5;-2.9)		-11.0	(-19.1;-2.9)	
SGA			0.440			0.078
A	0.0	-		0.0	-	
B+C	-1.7	(-5.9;2.6)		-2.8	(-5.9;0.3)	
NRS 2002			0.095			0.352
<3	0.0	-		0.0	-	
≥3	-3.8	(-8.2;0.7)		-1.5	(-4.8;1.7)	

*Adjusted for age and gender.

BMI: Body Mass Index; SGA: Subjective Global Assessment; NRS 2002: Nutritional Risk Screening 2002.

However, the difference between the mean HGS of nourished and malnourished patients according to the SGA and NRS 2002 was not significant, even after adjustment (Table 4).

DISCUSSION

The relationship between HGS and BMI, SGA and NRS 2002 was investigated to verify its use for the diagnosis of malnutrition. Malnourished patients or those at risk of malnutrition should be identified at hospital admission to receive nutritional support, reduce their nutritional deficiencies and contribute to the improvement of their clinical prognosis[3,15,16].

Body cell mass may decrease in malnourished patients, leading to functional loss. Therefore, it is important to use a technique capable of assessing functional capacity[17] and detecting malnutrition early[18].

Hand grip strength is a method that assesses muscle strength and functional capacity[11,19]. It has been described as an appropriate tool for the nutritional screening and diagnosis of healthy populations[11,12] and hospitalized individuals[17].

The prevalence of malnutrition in the present study varied from 3.5% to 50.9%, confirming that the assessment method may affect nutritional diagnosis[20]. The low prevalence of malnutrition according to BMI corroborated other studies[21,22]. On the other hand, the prevalence of malnutrition according to the SGA (50.9%) was higher than that reported by other studies (22.0%, 28.0%, 18.7% and 29.6%)[21,23-25]. Likewise, the classification of nutritional risk according to the NRS 2002 (33.9%) was also higher than that reported by other studies (20.0% and 27.5%)[21,25].

The different prevalences of malnutrition in the present study may be attributed to the specificities of each method, which can assess distinct characteristics. BMI considers only the relationship between weight and height[6]. Meanwhile, the SGA and NRS 2002 investigate aspects associated with weight loss, food intake and disease-related stress. Furthermore, the SGA also takes into account gastrointestinal symptoms, functional capacity and physical examination, and the NRS 2002 considers BMI[7,8]. Finally, HGS estimates muscle strength by determining the prehension force that an individual exerts on the dynamometer[11].

The higher prevalence of malnutrition according to the SGA compared with other studies of patients with similar ages may stem from the smaller impact of the latter's diagnoses on nutritional status.

Cut-off points for the determination of malnutrition according to HGS are scarce. The present study used the reference values for the Brazilian population proposed by Schlüssel *et al*.[11]. The prevalence of malnutrition according to HGS was low (38.1%) when compared with other studies that found a prevalence of 73.3% in patients with Crohn's disease[24] and 63% in patients with cyrrhosis[23]. One of the justifications is the different cut-off points used and, possibly, disease severity.

The presence of malnutrition did not differ between the genders. However, in other studies, men were more often malnourished according to HGS[24] and SGA[17,26]. In the present study, none of the men was malnourished according to BMI.

The prevalence of malnutrition according to HGS was greater than that according to BMI. A similar result was obtained by Gottschall *et al*.[10] for patients with cirrhosis; they found that HGS was more sensitive for the detection of malnutrition than BMI. This probably occurred because BMI does not distinguish between lean and fat mass[6]. Hence, an individual may often seem to have an appropriate nutritional status (BMI>18.5kg/m^2) but have low lean body mass[27], which can be directly verified by HGS[11]. Moreover, some diseases, such as liver cirrhosis and pulmonary diseases, may cause hydration changes, and consequently affect BMI[10,14,22].

The hand grip strength of men was significantly higher than that of women, as was those of patients aged <60 years compared with older patients, which is in agreement with Brazilian studies of healthy[11] and hospitalized individuals[28,29].

Álvares-da-Silva & Silveira[23] showed that HGS was capable of predicting clinical complications, which may explain the lower HGS of individuals with comorbidities in the present study. In the malnourished and nourished patients according to BMI, SGA and NRS 2002, regardless of confounding factors (age and gender), only BMI was associated with HGS, that is, the mean HGS of the malnourished individuals according to BMI were significantly lower than those of the nourished individuals, which is in agreement with Norman *et al*.[9] and Schlüssel *et al*.[11]. Meanwhile, a study done with hemodialysis patients found that the mean BMI of patients above and within the tenth percentile for HGS did not differ[4].

On the other hand, many patients with BMI ≥18.5kg/m² had low HGS, indicating that normal BMI values do not reflect adequate muscle mass[27]. There were only four malnourished women according to BMI.

The absence of an association between HGS and SGA is not confirmed by other studies[9,17,23] which showed that malnourished patients according to the SGA had lower HGS. Regarding the NRS 2002, Matos *et al*.[30] found that malnourished patients also presented lower HGS.

Hence, this study contradicts those that showed that HGS was capable of diagnosing nutritional risk or malnutrition[17,23,24,28]. A probable explanation is that HGS values were appropriate for most patients, contrary to the findings of other studies[23,24].

The limitation of the present study may have been the variety of diseases of the study sample. Additional studies are needed to identify the efficiency of the method as a nutritional parameter, comparing HGS with other nutritional assessment methods in hospitalized patients.

CONCLUSION

Hand grip strength was associated with BMI but not with the SGA or NRS 2002. Hence, the present results suggest that HGS is not a good indicator of nutritional risk and malnutrition in hospitalized patients.

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C O N T R I B U T O R S

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