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### LETTER TO THE EDITOR

## Calf Circumference Adjusted According to Body Mass Index in Nutritional Assessment of Cardiac Patients Admitted in Intensive Care Unit

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Dear Editor,

The cardiovascular disease as well as admission to the Intensive Care Unit (ICU) are risk factors for muscle loss<sup>1-2</sup>. The prevalence of muscle loss had been reported to be 19-52% and defined as an independent predictor of death among cardiac patients<sup>3</sup>. Several measurements are used for determining the body composition, and calf circumference (CC) should be considered in the identification and follow-up of muscle mass decline in these patients<sup>4,5</sup>. Previously, to the CC evaluation between elderly subjects, the World Health Organization (WHO) recommended a cut-off value of 31 cm for sexes<sup>5</sup>. And in a survey conducted, by Barbosa-Silva *et al.*<sup>6</sup>, in southern Brazil, the cut-off value of 34 cm for men and 33 cm for women was adopted to identify the muscle loss.

Based on the National Health and Nutrition Examination Survey (NHANES 1999-2006), calf circumference can be used clinical

populations with probable weight or muscle loss by applying an adjustment for body mass index (BMI), before comparing to cut-off value (34 cm for men and 33 cm for women)<sup>7,8</sup>. And so, in the context of the ICU, calf circumference becomes a potential indicator for the identification of muscle loss and to guide nutritional therapy, among adults and the elderly<sup>9,10</sup>.

In this context of clinical population, the aim of this study was to evaluate the calf circumference, adjusted according to body mass index, in nutritional assessment of cardiac patients admitted to an intensive care unit.

For that reason, we present a cross-sectional, descriptive study with an approach to cardiac patients admitted to an intensive care unit (ICU) located in the Recôncavo da Bahia region, in the period from August 2019 to December 2019. The study was



approved by the Ethics Committee of the Federal University (CAAE: 7118618.2.0000.0056).

All participants signed an informed consent. In the first 72 hours of ICU admission, the following data were collected: age; with the estimated height and body mass, the body mass index (BMI, kg/m<sup>2</sup>) was calculated; and calf circumference (CC, cm) was measured. Two cut-offs were used to consider the appropriate CC: 1) Above or equal to 31 cm for both sexes<sup>5</sup>; 2) Above or equal to 34 cm for males and 33 cm for females<sup>6</sup>. Subsequently, before comparing CC to suggested sex-specific cut-off<sup>2</sup> (34 cm for males and 33 cm for females), the CC was adjusted according to BMI categories: <18.5 kg/m<sup>2</sup> (use original CC value); 18.5-24.9 kg/m<sup>2</sup> (use original CC value); 25-29.9 kg/m<sup>2</sup> (-3 cm); 30-39.9 kg/m<sup>2</sup> (-7 cm) and ≥40 kg/m<sup>2</sup> (-12 cm)<sup>7,8</sup>.

Data were analyzed using the software Graph Pad Prism (Version 5.0, 2007, San Diego, CA, USA) and Microsoft Excel. Data were

analyzed by column statistics and expressed as means ± standard deviation. To evaluate the difference between the diagnostic methods (cut-off 1 vs. cut-off 2, with CC adjusted according to BMI categories), the Chi-square test was used, with statistical significance set at 5% (p<0.05).

In the study, fifty-four (n=54) cardiac patients admitted to the ICU were evaluated, thirty-six (n=36) males and eighteen (n=18) females. The CC, regarding cut-off 1 (31cm): 30.55% of males and 27.77% was below the recommended. To cut-off point 2 (34cm and 33cm): 50% of males and females was below the recommended. However, after adjusting to BMI, all the patients (100%) showed CC below the cut-off 2. In addition, it was observed that there is a significant difference between the methods, in which the CC adjusted to BMI categories, before comparing to cut-off 2 (vs. cut-off 1) interfered with the assessment of nutritional status in both sexes (Table 1)

**Table 1.** Anthropometric data of the patients admitted to an intensive care unit.

Parameters	Male (n=36)	Female (n=18)
Age (years)	61.92 ± 12.87	64.56 ± 12.10
BMI (kg/m <sup>2</sup> )	23.61 ± 5.59	23.44 ± 5.52
CC (cm)	34.85 ± 5.62	32.97 ± 3.91
<b>Cut-off 1 to CC:</b>		
CC above 31 cm (M=25 and F=13)	37.25 ± 5.09 (69.44%)	34.82 ± 2.83 (72.22%)
CC below 31 cm (M=11 and F=5)	29.41 ± 1.15 (30.55%)	28.17 ± 1.12 (27.77%)
<b>Cut-off 2 to CC:</b>		
CC above 34 cm (M=18) and 33 cm (F=9)	39.15 ± 4.77 (50%)	36.09 ± 2.38 (50%)
CC below 34 cm (M=18) and 33 cm (F=9)	30.56 ± 1.77 (50%)	29.85 ± 2.23 (50%)
<b>CC adjusted to BMI categories, before comparing to Cut-off 2:</b>		
CC (<18.5 kg/m <sup>2</sup> , M, n=5 and F, n=2)	30.12 ± 3.34 (13.88%)	27.97 ± 0.04 (11.11%)
CC (18.5-24.9 kg/m <sup>2</sup> , M, n=18 and F, n=11)	33.02 ± 6.33 (50%)	31.95 ± 4.39 (61.11%)
CC (25-29.9 kg/m <sup>2</sup> , M, n=7 and F, n=2)	32.40 ± 2.84 (19.44%)	30.88 ± 3.42 (11.11%)
CC (30-39.9 kg/m <sup>2</sup> , M, n=6 and F, n=3)	33.64 ± 4.40 (16.66%)	30.39 ± 4.10 (16.66%)
CC (≥40 kg/m <sup>2</sup> )	-	-
<b>Cut-off 1 vs. Cut-off 2 (with CC adjusted according to BMI categories) by the chi-square test</b>		
Male (n=36)	CC above 31 cm	CC below 31 cm
CC above 34 cm	11 (37.9%)	0 (0.0%)
CC below 34 cm	18 (62.1%)	7 (100.0%)
<b>p-value***</b>	<b>&lt;0.0001</b>	
Female (n=18)	CC above 31 cm	CC below 31 cm
CC above 33 cm	6 (46.2%)	0 (0.0%)
CC below 33 cm	7 (53.8%)	5 (100.0%)
<b>p-value*</b>	<b>0.016</b>	

**BMI:** Body mass index; **CC:** Calf circumference; **M:** Male; **F:** Female. Mean ± Standard Deviation (Column statistics). **Cut-off 1** proposed by WHO<sup>5</sup>. **Cut-off 2** proposed by Barbosa-Silva et al.<sup>6</sup>. CC adjusted according to BMI categories, before comparing to Cut-off 2, as proposed by Gonzalez et al.<sup>7</sup> and Prado et al.<sup>8</sup>. \*Represent significant difference (\*p<0.05; \*\*\*p<0.0001; Chi-square test).

Cardiac patients admitted to the intensive care unit had a mean age above 60 years. In fact, the number of older people (>60 years) in intensive care unit is increasing substantially, as population ages<sup>9</sup>. And ageing is associated with increased fat mass and decreased muscle mass<sup>10</sup>. In present study no patient had a BMI over 40 kg/m<sup>2</sup>. However, the calf circumference adjusted according to BMI categories, before comparing CC to cut-off 27,<sup>8</sup> was a more sensitive method for diagnostic (as observed in the Chi-square test, regarding cut-off 1<sup>5</sup>). And in fact, all cardiac patients (including those with overweight and obesity) evaluated in the ICU showed probable weight or muscle loss.

The calf circumference, adjusted according to body mass index categories, was relevant for the diagnostic/classification of nutritional risk of cardiac patients admitted to the intensive care unit.

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## AUTHORS' CONTRIBUTIONS

D.B-A, P.C-R, J.S-B, A.J-S, V.G-S, T.B-S, B.S-B and A.D-P were responsible for extracting and interpreting results. C.A-C was responsible for designing the protocol and wrote the final versión of manuscript.

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## COMPETING INTERESTS

The authors state that there are no conflicts of interest when writing the manuscript.

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