



## Original article

# Translation and cross-cultural adaptation of 14-item Mediterranean Diet Adherence Screener and low-fat diet adherence questionnaire



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## SUMMARY

**Background and aims:** The Mediterranean diet and the low-fat diet are recognized as cardioprotective dietary patterns, and the use of validated instruments that quickly identify adherence to these diets is very useful in the daily practice of the nutritionist. Our aim was to translate and cross-culturally adapt the 14-point Mediterranean Diet Adherence Screener (MEDAS) and a 9-item quantitative score of compliance with the low-fat diet (low-fat diet questionnaire) to the Brazilian Portuguese language.

**Methods:** The process of translation and cultural adaptation was conducted in six stages: initial translation, synthesis of translations, back-translation, proof of cross-cultural equivalence, pre-final version testing, and final evaluation of the cultural adaptation process. Interviews and assessments were administered to 30 nutritionists, and to 51 healthy participants and 50 individuals at cardiovascular risk. MEDAS ranges from 0 (minimum) to 14 (maximum) points and a total score  $\geq 10$  points was considered for high adherence to MedDiet. Low-fat diet questionnaire ranges from 0 (minimum) to 9 (maximum) points and a total score  $\geq 6$  points was considered for high adherence to a diet restricted in fat.

**Results:** MEDAS and low-fat diet questionnaire were translated, synthesized and then back-translated, and few grammatical and/or semantic changes were required. About 24 participants suggested at least one modification in low-fat diet questionnaire's questions/terms, and 28 participants suggested at least one change in MEDAS items. The process produced a valid version of both the MEDAS and low-fat diet questionnaire in the Brazilian Portuguese language. Participants showed an average MEDAS questionnaire of  $5.3 \pm 2.5$  points, and an average low-fat diet questionnaire of  $5.9 \pm 1.9$  points. Nutritionists showed higher means of low-fat diet scores when compared to healthy and at high cardiovascular risk individuals ( $7.1 \pm 1.3$ ,  $5.6 \pm 2$  and  $5.4 \pm 1.9$ , respectively [ $P < 0.0001$ ]) but not for MEDAS questionnaire. With a cutoff of  $\geq 10$  points, 2.3% (95% CI 0.78–6.52) of the participants showed high adherence to MedDiet based on MEDAS score, and with a cutoff of  $\geq 6$  points, 58% (95% CI 49.5–66.1) of the participants showed high adherence to a diet restricted in fat based on the low-fat diet questionnaire.

**Conclusions:** MEDAS and low-fat diet questionnaire were successfully translated to the Portuguese language. Regarding the results from questionnaires applied to our sample, in general, poor adherence was found for both Mediterranean and low-fat diet.

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## 1. Introduction

An unhealthy dietary pattern is an important risk factor for cardiovascular disease (CVD), disability-adjusted lost years of life, and mortality [1,2]. High intake of sodium, processed meats, and sugar-sweetened beverages, and low intake of nuts and seeds, fish,

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vegetables, and fruits appear to be the major dietary factors related to cardiometabolic outcomes [2,3]. Thus, screening tools that quickly identify diet quality and inadequate dietary components associated with risk factors for CVD are highly useful.

Dietary patterns associated with reduced CVD risk and mortality from cardiometabolic causes include the Mediterranean diet (MedDiet) [4,5] and, with less available evidence, low-fat diets [6,7]. Both MedDiet and low-fat diets are widely recommended in primary and secondary prevention guidelines for cardiovascular disease [8–10]. The PREDIMED (*PRE*venición con *DI*eta *MEDI*terránea) randomized trial ([www.predimed.es](http://www.predimed.es)), however, showed that the incidence of major cardiovascular events was lower among individuals at high cardiovascular risk assigned to the MedDiet compared to those assigned to a low-fat diet [5].

Two instruments were used in the PREDIMED trial for screening and assessing the adherence to prescribed diets: the 14-point Mediterranean Diet Adherence Screener (MEDAS) and the 9-item quantitative score of compliance with the low-fat diet (low-fat diet questionnaire) [11–13]. Higher adherence score on the MEDAS (suggesting higher diet quality and nutrient adequacy) [14] has been associated with lower obesity indexes [15], better lipid and glycemic profiles [12] and decreased incidence of diabetes mellitus, CVD, and mortality [16]. Originally developed and validated in a Spanish population, the MEDAS has already been adapted and validated for the Israeli [17], Greek [18] and British [19] populations, and its feasibility has also been assessed among populations whose eating patterns are not originally the MedDiet [19–23].

Cross-cultural adaptation of a questionnaire for use in a new country, culture, or language is a fundamental step in achieving equivalence between the original instrument and the target version and should be preceded by all stages of the validation process, along with a translation if necessary [24]. Considering that few instruments are available for the specific assessment of diet quality adherence in the Brazilian population, the available instruments are complex, require time and/or the additional use of other dietary surveys [25–27], and considering also the importance of both MedDiet and low-fat dietary patterns for health promotion and cardiovascular prevention, the aim of this study was to perform the translation and cross-cultural adaptation of the MEDAS and low-fat diet questionnaire to Brazilian Portuguese.

## 2. Materials and methods

In this study, we performed the translation and cross-cultural adaptation to Brazilian Portuguese of two instruments used in the PREDIMED study [5,11–13] for evaluation of adherence to a Mediterranean dietary pattern or to a low-fat dietary pattern. The protocol was approved by the Research Ethics Committee of the Federal University of Health Sciences of Porto Alegre (UFCSA) under CAAE No. 88207718.6.0000.5345.

The MEDAS consists of 14 questions, 12 of which are related to the frequency of consumption or quantity of the main MedDiet components and 2 of which are related to the eating habits of the Spanish Mediterranean region. Each question is scored as a 0 or 1, and a higher score (maximum of 14 points) indicates a greater adherence to the Mediterranean eating pattern [11,12]. The low-fat diet questionnaire consists of 9 questions regarding the consumption of low-fat foods or the habit of removing fat from foods in food preparation. A higher score (maximum of 9 points) indicates greater adherence to a low-fat dietary pattern [11,13].

The translation and cultural adaptation of both instruments were performed with authorizations granted by e-mail by the author (M.A.M.-G.), which maintains the copyright of the questionnaires and the web page where they are available ([www.predimed.es](http://www.predimed.es)). This study followed the stages proposed by Beaton

et al. [24] for translation and cultural adaptation, which are as follows: initial translation, synthesis of translations, back-translation, proof of cross-cultural equivalence (committee of judges), pre-final test (pre-test), and final evaluation of the cultural adaptation process (submission of the questionnaires for evaluation by the author of the original instrument).

The first stage involved the direct translation of the instruments from English [11,12] to Brazilian Portuguese. Two direct translations were performed for each questionnaire. Two bilingual independent translators, whose native language was Portuguese, but who were fluent in English, were contacted to produce the independent versions. One of the translators had prior knowledge of the subject (nutrition) (T1), and the other professional had no prior knowledge about nutrition (T2). Thus, it was possible to compare the two translations of each instrument and to detect possible discrepancies between them.

In the second stage, a synthesis/fusion of the translations was performed by two researchers of the study and the translators in order to produce one unique translation (T12) for each instrument. Next, in the third stage, to assess the reliability of the Portuguese (T12) translations, another two translators—who were unaware of the aims of the study and not experts in the health area—translated the T12 version of both instruments to the English language independently, in order to verify the validity of the translations and whether they reflected the original content. English was these translators' native language; however, they were fluent in the Portuguese language. In addition, both were advised not to consult the original questionnaires.

In the fourth stage, proof of cross-cultural equivalence was obtained. A committee of judges, including two researchers of the study who had not been involved in the previous stages, was formed to consolidate the translations obtained for both instruments. These pre-final versions were sent to the author of the original instruments for evaluation and approval.

The fifth stage (pre-test) consisted of applying the preliminary versions of the MEDAS and low-fat diet questionnaire translated to Portuguese to a sample representing the intended target population: 50 individuals with some cardiovascular risk factor (i.e., smoking, type 2 diabetes mellitus, hypertension, dyslipidemia, or obesity) or with CVD (e.g., previous myocardial infarction, angina, or heart failure), and 50 healthy individuals (with no known diagnosis of chronic diseases). In order to broaden the scope of possible suggestions for the instruments, a group of 30 nutritionists was also selected.

In total, 101 men and women aged 18–80 years were recruited by convenience from the community and primary care outpatient clinics in Porto Alegre (Rio Grande do Sul/Brazil) for the pilot study, and 30 additional nutritionists (volunteers selected from hospitals, universities, and primary care setting) were invited in person or by telephone. In addition to answering the questions included in both translated instruments, participants were administered a questionnaire with items on sociodemographic, clinical, and lifestyle characteristics (smoking and alcohol abuse episodes in the past month [defined by drinking 5 or more doses of alcoholic beverages in a single day]).

Anthropometric measurements were performed, along with systolic and diastolic blood pressure measurements. Waist circumference (WC, in cm) was measured midway between the iliac crest and the lower costal margin of the participant, with an inelastic tape measure from 0 to 150 cm, accurate to 1 mm. Abdominal obesity was defined in the presence of WC > 94 cm in men and WC > 80 cm in women. Body weight (in kg) was measured using a Filizola digital scale (São Paulo, Brazil) with a capacity of up to 150 kg and a precision of 0.01 kg. Height (in cm) was measured using a Tonelli professional stadiometer (Santa Catarina, Brazil)

with a capacity of up to 220 cm, and accuracy of 1 mm. Body mass index (in kg/m<sup>2</sup>) was calculated, and values  $\geq 30$  kg/m<sup>2</sup> were defined for the diagnosis of general obesity. Systolic and diastolic blood pressure, in mmHg, were measured according to guidelines [28] with an automatic Omron HEM-7200 blood pressure monitor (Omron Healthcare, Inc., Kyoto, Japan) and cuff suitable for arm circumference.

Hypertension [28], type 2 diabetes mellitus [29], dyslipidemia [30], and previous CVD [31] were identified by previous self-reported medical diagnosis or use of drugs for treatment of such conditions.

Participants also answered questions about the level of difficulty of the items of the questionnaires and the representativeness of the items in relation to their usual eating pattern. They were able to give their opinions and to suggest modifications to the instruments. Thus, it was possible to check participants' understanding of the content of each question. Illiterate individuals or those without anthropometric assessment conditions were excluded from the study. Data were collected after signing the consent form at a private location at UFCSPA from November 2018 to April 2019.

The sixth stage of the cultural adaptation process was the evaluation stage. The final versions of the instruments were consolidated, based on the evaluation and comments of the nutritionists and other participants, together with the study researchers. These final versions of the MEDAS and low-fat diet questionnaires were sent to the Spanish coauthor (M.A.M.-G.) for final approval.

### 2.1. Statistical analysis

Analyses were performed using SPSS version 17 for Windows (Chicago, IL, USA). Continuous variables were described by means and standard deviation or medians and interquartile range, and categorical variables were described by absolute numbers and frequency. Comparisons between means were performed by analysis of variance (ANOVA) followed by Bonferroni post hoc test, and between medians by Kruskal–Wallis test. Pearson's chi-square test was used for comparison of proportions. Adherence to diet was categorized for both instruments as high (MEDAS  $\geq 10$  points; low-fat diet questionnaire  $\geq 6$  points) and low (MEDAS  $< 10$  points; low-fat diet questionnaire  $< 6$  points) [5]. The internal consistency of the scales was assessed using Cronbach's alpha. *P* values  $< 0.05$  were considered significant, and the respective 95% confidence intervals (CI) were reported for the prevalence of dietary compliance identified by the instruments.

## 3. Results

In the first stage, the Portuguese versions of the MEDAS and the low-fat diet questionnaire were produced by independent translators. There were differences in the translations for all questions of both questionnaires and in the titles of the instruments. In the second stage, a researcher of the study (L.M.V.) made the first versions of the syntheses of the translations. Subsequently, other study researcher expert in the field (A.M.) reviewed all questionnaire items and made suggestions for the synthesized versions. These versions were sent to the translators, who, for semantic reasons, disagreed with some of the suggestions proposed by the researchers. In a meeting between the two researchers and the translators, it was decided to keep the terms that corresponded to the practical use of the tool and that was more familiar to the professionals who specialized in the area of nutrition, in order to improve the understanding of the questions and their level of clarity. Discrepancies between T1 and T2 were then resolved, and the final synthesis of translations (T12) was

defined for each of the questionnaires. Tables 1 and 2 show in detail the discrepancies between the two independent translations (T1 and T2) and also the final version discussed and approved by the researchers and translators (T12), summarizing all modifications made during the translation and synthesis of both questionnaires.

The T12 versions of the MEDAS and low-fat diet questionnaire were then back-translated (third stage). These versions were very similar to the original versions, and few grammatical and/or semantic changes were required. A panel of judges formed by the translators/language professionals and two other study research experts (C.B.A.G. [clinical nutritionist - health professional] and D.B.V. [epidemiologist and methodologist]), participated in the fourth stage, and the pre-final version of both questionnaires was then consolidated. All reports and forms concerning translation, adaptation, and back-translation processes were submitted and analyzed by the Spanish coauthor (M.A.M.-G.), who approved the translated versions into Portuguese, the synthesized versions (T12 pre-final version of each one), and the back-translated versions.

In the fifth stage (pre-test), data collection was performed with the nutritionists as well as among the participants of the pilot study, using the pre-final T12 version of each questionnaire for evaluations. The mean age of the participants was  $32.3 \pm 15.2$  years. They had an average of  $15.8 \pm 4.7$  years of schooling. The majority were women (69.4%) and white (90%).

Regarding cardiovascular risk factors, 11.5% were smokers, 61% had at least one episode of alcohol abuse in the past month, 5.3% had type 2 diabetes mellitus, 13% had hypertension, 24.4% had dyslipidemia, 16.8% were obese, 39.7% had high WC, and 5 participants had previous CVD (2 previously had arrhythmia, 1 acute myocardial infarction, 1 congenital heart disease, and 1 hypertrophic cardiomyopathy). Table 3 presents the sociodemographic and clinical characteristics of the participants by group, and also scores for the MEDAS and low-fat diet questionnaire.

Overall, participants showed an average MEDAS questionnaire of  $5.3 \pm 2.5$  points, and an average low-fat diet questionnaire of  $5.9 \pm 1.9$  points. Nutritionists showed higher means of low-fat diet scores when compared to healthy and at high cardiovascular risk individuals ( $7.1 \pm 1.3$ ,  $5.6 \pm 2$  and  $5.4 \pm 1.9$ , respectively [ $P < 0.0001$ ]) but not for MEDAS questionnaire (Table 3). With a cutoff of  $\geq 10$  points, 2.3% (95% CI 0.78–6.52) of the participants had high adherence to MedDiet based on MEDAS score, and with a cutoff of  $\geq 6$  points, 58% (95% CI 49.5–66.1) of the participants had high adherence to a diet restricted in fat based on the low-fat diet questionnaire.

Table 4 shows dietary scores of both questionnaires according to sociodemographic and clinical characteristics of the participants. Men and individuals with lower scholaryty had poorer adherence to both MEDAS and low-fat diet questionnaire, and those with obesity showed lower adherence to the low-fat diet.

Table S1 (Supplementary material) presents the proportion of the participants who obtained maximum score at the items of each questionnaire according to study groups. The nutritionists had higher prevalence of low consumption of sugar-sweetened beverages ( $P = 0.005$ ), and individuals at higher cardiovascular risk were less likely to score positively in the item of low consumption of non-homemade baked goods ( $P = 0.045$ ) according to the MEDAS score. For the low-fat diet questionnaire, nutritionists had higher proportions of positive responses about removing apparent fat from the preparations ( $P = 0.03$ ), lower weekly intake of fatty meat and sausages ( $P = 0.04$ ), higher consumption of low-fat dairy products ( $P = 0.006$ ), and lower weekly intake of foods prepared with olive oil ( $P = 0.009$ ).

Regarding the clarity of the MEDAS, 81.7% of participants reported that the questionnaire was "understandable" or "fully

**Table 1**  
Modifications made during the process of translation from English to Brazilian Portuguese of the instrument 14-point Mediterranean Diet Adherence Screener (MEDAS).

Tool Items	T1 e T2	T12
14-point Mediterranean Diet Adherence Screener (MEDAS)	T1: Rastreador de adesão à Dieta Mediterrânea – 14 pontos (MEDAS) T2: Triagem de 14 pontos para Adesão à Dieta Mediterrânea (MEDAS)	Triagem de 14 pontos para Adesão à Dieta Mediterrânea (MEDAS)
1. Do you use olive oil as the principal source of fat for cooking?	T1: Você utiliza azeite como a principal fonte de gordura para cozinhar? T2: Você usa azeite de oliva como fonte principal de gordura para cozinhar?	<i>Você usa azeite de oliva como a principal fonte de gordura para cozinhar?</i>
2. How much olive oil do you consume per day (including that used in frying, salads, meals eaten away from home, etc.)?	T1: Que quantidade de azeite você consome por dia (incluindo o uso em frituras, saladas, refeições feitas fora de casa, etc.)? T2: Quanto azeite de oliva você consome por dia (incluindo o usado em frituras, saladas, refeições fora de casa, etc.)?	<i>Que quantidade de azeite de oliva você consome por dia (incluindo o usado em frituras, saladas, refeições feitas fora de casa, etc.)?</i>
3. How many servings of vegetables do you consume per day? Count garnish and side servings as 1/2 point; a full serving is 200 g.	T1: Quantas porções de verduras e/ou legumes você consome por dia? Decorações de pratos e acompanhamentos contam 1/2 ponto; uma porção inteira é 200g. T2: Quantas porções de verduras você consome por dia? Conte guarnições e acompanhamentos como 1/2 ponto; uma porção completa contém 200g.	<i>Quantas porções de verduras você consome por dia? Conte guarnições como 1/2 ponto; uma porção completa é 200g.</i>
4. How many pieces of fruit (including fresh-squeezed juice) do you consume per day?	T1: Quantas frutas (incluindo em sucos naturais) você consome por dia? T2: Quantos pedaços de frutas (incluindo suco natural feito na hora) você consome por dia?	<i>Quantas frutas (incluindo suco natural feito na hora) você consome por dia?</i>
5. How many servings of red meat, hamburger, or sausages do you consume per day? A full serving is 100–150 g	T1: Quantas porções de carne vermelha, hambúrguer, ou salsichas você consome por dia? Uma porção inteira é 100–150g. T2: Quantas porções de carne vermelha, hambúrguer ou salsichas você consome por dia? Uma porção completa contém de 100g a 150g.	<i>Quantas porções de carne vermelha, hambúrguer, ou salsichas você consome por dia? Uma porção inteira é 100-150g.</i>
6. How many servings (12 g) of butter, margarine, or cream do you consume per day?	T1: Quantas porções (12g) de manteiga, margarina ou creme de leite você consome por dia? T2: Quantas porções (12g) de manteiga, margarina ou creme de leite você consome por dia?	<i>Quantas porções (12g) de manteiga, margarina ou creme de leite você consome por dia?</i>
7. How many carbonated and/or sugar-sweetened beverages do you consume per day?	T1: Quantas bebidas gaseificadas e/ou bebidas com adição de açúcar você consome por dia? T2: Quantas bebidas gaseificadas e/ou adoçadas com açúcar você consome por dia?	<i>Quantas bebidas gaseificadas e/ou adoçadas com açúcar você consome por dia?</i>
8. Do you drink wine? How much do you consume per week?	T1: Você toma vinho? Que quantidade você consome por semana? T2: Você bebe vinho? Quanto você consome por semana?	<i>Você bebe vinho? Quanto você consome por semana?</i>
9. How many servings (150 g) of pulses do you consume per week?	T1: Quantas porções (150g) de leguminosas você consome por semana? T2: Quantas porções (150g) de leguminosas você consome por semana?	<i>Quantas porções (150g) de leguminosas você consome por semana?</i>
10. How many servings of fish/seafood do you consume per week? (100–150g of fish, 4–5 pieces or 200g of seafood)	T1: Quantas porções de peixe/frutos do mar você consome por semana? (100–150g de peixe, 4–5 unidades ou 200 g de frutos do mar). T2: Quantas porções de peixe/frutos do mar você consome por semana? (de 100g a 150g de peixe, de 4 a 5 pedaços ou 200g de frutos do mar).	<i>Quantas porções de peixe/frutos do mar você consome por semana? (100-150g de peixe, 4-5 pedaços ou 200g de frutos do mar).</i>
11. How many times do you consume commercial (not homemade) pastry such as cookies or cake per week?	T1: Quantas vezes por semana você consome produtos de confeitaria tipo biscoitos e bolos feitos fora de casa? T2: Quantas vezes por semana você consome produtos industrializados (que não são caseiros) como confeitos, biscoitos ou bolos?	<i>Quantas vezes por semana você consome produtos de confeitaria/padaria (não caseira) como biscoitos ou bolos?</i>
12. How many times do you consume nuts per week? (1 serving = 30 g)	T1: Quantas vezes por semana você consome oleaginosas? (1 porção = 30 g) T2: Quantas vezes você consome nozes por semana? (1 porção = 30g).	<i>Quantas vezes você consome nozes por semana? (1 porção = 30g)</i>
13. Do you prefer to eat chicken, turkey or rabbit instead of beef, pork, hamburgers, or sausages?	T1: Você prefere comer frango, peru ou coelho em vez de carne de vaca, carne de porco, hambúrgueres ou salsichas? T2: Você prefere comer frango, peru ou coelho em vez de carne vermelha, carne de porco, hambúrgueres ou salsichas?	<i>Você prefere comer frango, peru ou coelho em vez de carne vermelha, carne de porco, hambúrgueres ou salsichas?</i>
14. How many times per week do you consume boiled vegetables, pasta, rice, or other dishes with a sauce of tomato, garlic, onion or leeks sautéed in olive oil?	T1: Quantas vezes por semana você consome vegetais cozidos, massas, arroz ou outros pratos com molhos de tomate, alho, cebola ou alho-poró refogados em azeite? T2: Quantas vezes por semana você consome verduras cozidas, massas, arroz ou outros pratos com molho de tomate, alho, cebola ou alho-poró refogados no azeite?	<i>Quantas vezes por semana você consome vegetais cozidos, massas, arroz ou outros pratos com molho de tomate, alho, cebola ou alho-poró refogados em azeite de oliva?</i>

(continued on next page)

Table 1 (continued)

Tool Items	T1 e T2	T12
<sup>1</sup> Criterion to score 1 point. Otherwise, 0 recorded.	T1: <sup>1</sup> Critério para marcar 1 ponto. Caso contrário, marque 0.	<sup>1</sup> Critério para pontuar 1 ponto. Caso contrário, marque 0.
<sup>2</sup> 1 tablespoon = 13.5 g.	<sup>2</sup> 1 colher de sopa = 13,5g.	<sup>2</sup> 1 colher de sopa = 13,5g
<sup>3</sup> 1 cup = 100 mL.	<sup>3</sup> 1 taça = 100 mL.	<sup>3</sup> 1 copo = 100 mL.
	T2: <sup>1</sup> Critério para pontuar 1 ponto. Outros, marque 0.	
	<sup>2</sup> 1 colher de sopa = 13,5g	
	<sup>3</sup> 1 xícara = 100 mL.	

understandable,” and 71% reported that the questions were “easy” or “very easy” to answer. With regard to the clarity of the low-fat diet questionnaire, 80.9% of participants reported that the questionnaire was “understandable” or “fully understandable,” and 77.1% reported that the instrument’s questions were “easy” or “very easy” to answer. When asked about a specific question from the MEDAS that proved too difficult to answer, 16 participants reported that question 3 (How many servings of vegetables do you consume per day? Count garnish and side servings as 1/2 point; a full serving is 200 g./*Quantas porções de verduras você consome por dia? Conte guarnições como ½ ponto; uma porção completa é 200 g*) and 9 reported that question 14 (How many times per week do you consume boiled vegetables, pasta, rice, or other dishes with a sauce of tomato, garlic, onion or leeks sautéed in olive oil?/*Quantas vezes por semana você consome vegetais cozidos, massas, arroz ou outros pratos com molho de tomate, alho, cebola ou alho-poró refogados em azeite de oliva?*) was too difficult to answer. For the low-fat diet questionnaire, 11 participants reported that question 6 (How many times per week do you prepare rice, pasta, potato, or legume dishes by using “sofrito” sauce (based on olive oil), bacon, salami or fatty meats such as pork or lamb ribs?/*Quantas vezes por semana você prepara arroz, massas, batatas ou leguminosas usando molho “sofrito” [à base de azeite de oliva], bacon, salame ou carnes gordurosas como costelas de porco ou cordeiro?*) was very difficult to answer. Seven participants reported that questions 1, 2, and 14 of the MEDAS seemed repetitive, and 4 participants reported that questions 3 and 6 seemed repetitive on the low-fat diet questionnaire.

Twenty-four participants suggested replacing the word *sofrito* on the low-fat diet questionnaire, because it is not an eating habit of the Brazilian population; 20 participants suggested replacing the word *guarnição* (garnish) and 8 suggested substituting the word *leguminosas* (pulses) on the MEDAS. Other suggestions made by the participants were the substitution of terms such as *peru* (turkey), *coelho* (rabbit), *pato* (duck), and *vitela* (veal) as these foods are meats rarely eaten in Brazil and the modification of portion identification (replacing grams with homemade measures). Table S2 (supplementary material) shows other proposals and more specific suggestions regarding the instruments made by the participants. Overall, 65.7% of subjects reported that the MEDAS was “effective or very effective” for assessing their usual diet, and 60.3% stated that the low-fat diet questionnaire was “effective or very effective” for assessing their usual dietary pattern.

The researchers gathered to evaluate all the placements and suggestions. In the end, it was decided to replace the word *guarnição* (garnish) with *acompanhamento* in question 3 of the MEDAS and the word *leguminosas* (pulses) in question 9 of the same instrument with examples of *leguminosas* (*feijão, ou lentilha, ou grão-de-bico* [beans, or lentils, or chickpeas]). The words *frango* (chicken), *peru* (turkey) or *coelho* (rabbit) in question 13 of the MEDAS were replaced with the term *carnes brancas* (white meat). For the low-fat diet questionnaire, the word *pato* (duck) was removed, and the word *vitela* (veal) was replaced with *carne bovina* (beef) in question 2, and the word *sofrito* was removed from question 6. Regarding the other suggestions, the researchers chose

to maintain the structure of the original version of the instruments, as these suggestions either would not significantly alter the original meaning and intelligibility of the questions (thus not being applied to the process of cultural adaptation) or would be appropriate in a validation process of both questionnaires. For the low-fat diet questionnaire, the authors chose to replace the expression “or less” with the symbol  $\leq$ .

Tables 5 and 6 show the final versions of the Portuguese translated and adapted versions of the MEDAS and low-fat diet questionnaire. Cronbach’s alpha calculated for internal consistency assessment of the MEDAS and low-fat diet questionnaire were 0.61 and 0.59, respectively. The final and culturally adapted versions of the questionnaires were submitted to the Spanish coauthor, who suggested little modifications (to include the expression *frutos secos* [dry fruits] in both questionnaires [MEDAS: question 12; low-fat diet: question 9]; to include the words *cordeiro* [lamb] and *vitela* [veal] in low-fat diet questionnaire [question 13]) and approved the instruments.

#### 4. Discussion

In this study, the MEDAS and low-fat diet questionnaire were translated and culturally adapted to the Portuguese language, and easily understandable tools similar to the original versions were produced, with minor modifications that would allow a wide application. Despite the availability of a range of questionnaires and indexes for assessing adherence and diet quality, many are not available in countries other than those in which they were originally developed or have not been culturally adapted. Choosing the right questionnaire for a specific purpose can become a difficult and time-consuming task. Thus, in order to have a wider range of instruments (especially those that are easy to apply) the process of translation and cross-cultural adaptation is necessary as a step prior to validation [32].

Cross-cultural adaptation of questionnaires facilitates the collection and standardization of information and the conduction of multicenter epidemiological studies considering cultural differences between cities, states, and countries. Therefore, the adaptation of instruments to different contexts, including language adaptations based on the specific characteristics of the culture, facilitates the comparison and exchange of knowledge in the international scientific setting [24]. Despite MedDiet is not characteristic of the Brazilian territory, and, for this population, adhering to this dietary pattern can be expensive and difficult [33], many of its main components and culinary ingredients are available for general population. Besides, the adaptation of a standardized instrument that represents the peculiarities of the dietary pattern from the Mediterranean region, including elements of the culture of the Brazilian population, can facilitate the comparison with other populations, the evaluation of the adherence to a similar MedDiet dietary model in other continents, and the standardization of the data obtained in different places.

In addition to the fact that the MedDiet is not characteristic of the Brazilian territory, dietary patterns with reduced or very-low-

**Table 2**

Modifications made during the process of translation from English to Brazilian Portuguese of the instrument 9-item quantitative score of compliance with the low-fat diet (low-fat diet questionnaire).

Tool Items	T1 e T2	T12
Quantitative 9-item Score of Compliance with the Low-Fat Diet	T1: Escore quantitativo de 9 itens de adesão à dieta controle (pobre em gordura) T2: Pontuação Quantitativa de 9 itens de Concordância com a Dieta de Baixa Gordura	<i>Escore quantitativo de 9 itens de adesão à dieta pobre em gordura</i>
How much olive oil do you consume in a given day (including oil using for frying, salads, out of house meals, etc.?)	T1: Que quantidade de azeite de oliva você consome por dia (incluindo o uso em frituras, saladas, refeições feitas fora de casa, etc.?) T2: Quanto azeite de oliva você consome por dia (incluindo o usado em frituras, saladas, refeições fora de casa, etc.?)	<i>Que quantidade de azeite de oliva você consome por dia (incluindo o azeite usado para fritar, saladas, refeições feitas fora de casa, etc.?)</i>
Do you remove visible fat (or the skin) of chicken, duck pork, lamb or veal meats before cooking and the fat of soups, broths, and cooked meat dishes before consumption?	T1: Você retira a gordura (ou pele) visível de frango, pato, porco, cordeiro ou vitela antes de cozinhá-las, bem como a gordura de sopas, caldos e carnes cozidas antes de consumi-los? T2: Você remove gorduras visíveis (ou a pele) de frango, pato, carne de porco, cordeiro ou vitela antes de cozinhar; e também remove a gordura de sopas, caldos e carne cozida antes de consumir?	<i>Você retira a gordura (ou pele) visível de frango, pato, porco, cordeiro ou vitela antes de cozinhá-las, bem como a gordura de sopas, caldos e carnes cozidas antes de consumi-los?</i>
How many servings of fat-rich meats, hamburger, commercial ground meat, sausage, cold meat, cured ham, bacon, salami, or offal do you consume per week? (meat serving: 100 g; salami or bacon: 30 g).	T1: Quantas porções de carnes gordurosas, hambúrgueres, carne moída, salsicha, embutidos, presunto, bacon, salame, ou vísceras você consome por semana? (porção de carne: 100g; salame ou bacon: 30 g) T2: Quantas porções de carnes ricas em gordura, hambúrguer, carne moída, salsicha, frios, presunto, bacon, salame ou miúdos você consome <u>por semana?</u> (porção de carne: 100g; salame ou bacon: 30g)	<i>Quantas porções de carnes gordurosas, hambúrguer, carne moída industrializada, salsicha, embutidos, presunto, bacon, salame ou miúdos você consome por semana? (porção de carne: 100g; salame ou bacon: 30g)</i>
How many servings of butter, margarine, lard, mayonnaise, milk cream, or milk-based ice cream do you consume per week? (spread fat: serving: 12 g; ice cream: 100 g).	T1: Quantas porções de manteiga, margarina, banha, maionese, creme de leite, ou sorvete à base de leite você consome por semana? (porção manteiga/margarina: 12g; sorvete: 100g) T2: Quantas porções de manteiga, margarina, banha, maionese, creme de leite ou sorvete feito com leite você consome <u>por semana?</u> (porção: 12g; sorvete: 100g)	<i>Quantas porções de manteiga, margarina, banha, maionese, creme de leite ou sorvete à base de leite você consome por semana? (porção de manteiga/margarina: 12g; porção de sorvete: 100g).</i>
Do you exclusively consume low-fat dairy products?	T1: Você consome somente produtos lácteos com baixo teor de gordura? T2: Você usa apenas laticínios com baixo teor de gordura?	<i>Você consome somente produtos lácteos com baixo teor de gordura?</i>
How many times per week do you prepare rice, pasta, potato, or legume dishes by using “sofrito” sauce (based on olive oil), bacon, salami or fatty meats such as pork or lamb ribs?	T1: Quantas vezes por semana você prepara arroz, massas, batata ou leguminosas usando “sofrito” (molho à base de azeite), bacon, salame ou carnes gordurosas como costelas de porco ou cordeiro? T2: Quantas vezes por semana você prepara arroz, massas, batatas ou legumes usando alho e cebola refogados no azeite, bacon, salame ou carnes gordurosas como porco ou costelas de cordeiro?	<i>Quantas vezes por semana você prepara arroz, massas, batatas ou leguminosas usando molho “sofrito” (à base de azeite de oliva), bacon, salame ou carnes gordurosas como costelas de porco ou cordeiro?</i>
How many times per week do you consume fatty fish or fish or seafood canned in oil?	T1: Quantas vezes por semana você consome peixes gordurosos ou peixes ou mariscos enlatados em óleo? T2: Quantas vezes por semana você consome peixes gordurosos ou peixes ou frutos do mar enlatados em óleo?	<i>Quantas vezes por semana você consome peixes gordurosos ou peixes e frutos do mar enlatados em óleo?</i>
How many servings of commercial sweets or industrial bakery products (not homemade), such as cakes, cookies, biscuits, or custard do you consume per week? (cake serving: 80 g; 6 biscuits: 40 g)	T1: Quantas porções de doces ou pães industrializados (não caseiros), tais como bolos, biscoitos, bolachas, ou pudins você consome por semana? (1 porção de bolo: 80 g ou 6 biscoitos: 40g) T2: Quantas porções de doces ou confeitados industrializados (que não foram feitos em casa), tais como bolos, biscoitos ou sobremesas você consome <u>por semana?</u> (porção de bolo: 80g; 6 biscoitos: 40g)	<i>Quantas porções de doces comerciais ou produtos de panificação industrial (não caseiros), tais como bolos, cookies, biscoitos, ou sobremesas você consome por semana? (porção de bolo: 80g; 6 biscoitos: 40g)</i>
How many times per week do you consume nuts (including peanuts), potato chips, French fries, or commercial snacks?	T1: Quantas vezes por semana você consome castanhas (incluindo amendoins), batata frita ou salgadinhos industrializados? T2: Quantas vezes por semana você consome castanhas (incluindo amendoim), batatas industrializadas, batatas fritas ou salgadinhos industrializados?	<i>Quantas vezes por semana você consome nozes (incluindo amendoins), batatas chips, batatas fritas, ou salgadinhos industrializados?</i>
*0 points if these criteria are not met	T1: *0 ponto se esses critérios não forem preenchidos. T2: -	<i>Pontuar 0 se estes critérios não forem atendidos.</i>

fat content (especially saturated fatty acids) are incorporated in most of the Brazilian clinical guidelines for the prevention and treatment of cardiovascular risk factors and established CVD [10,28–30]. This would justify the higher proportion of adherence to a low-fat diet compared with adherence to the MedDiet observed among participants. Although current guidelines for the general population in Brazil focus mainly on the consumption of

ultra-processed foods [34], the culture of dietary fat being a “bad nutrient” unfortunately still prevails. Another possible explanation could also be because the low-fat questionnaire does not focus foods that contribute to the fat intake of Brazilian population.

As expected, nutritionists showed higher average scores compared with the other groups, especially for the low-fat diet questionnaire (as has been shown in other populations with prior

**Table 3**  
Sociodemographic and clinical characteristics and dietary scores of the sample according to study groups (mean  $\pm$  standard deviation, median [interquartile range] or n [%]).

	G1 (n = 51)	G2 (n = 50)	G3 (n = 30)	P-value
Age, in years	24.9 $\pm$ 9.4 <sup>b</sup>	38 $\pm$ 18.2 <sup>a</sup>	35.4 $\pm$ 12.5 <sup>a</sup>	<0.001*
Sex				<0.001**
Men	21 (41,2)	25 (50)	0 (0)	
Women	30 (58,8)	25 (50,0)	30 (100)	
White ethnicity	46 (90,2)	43 (86)	29 (96,7)	0.30**
Education, in years	15.5 $\pm$ 3.3 <sup>a</sup>	14.9 $\pm$ 4.4 <sup>a</sup>	18.3 $\pm$ 1.9 <sup>b</sup>	0.002*
Current smoking	0 (0)	14 (28)	1 (3,3)	<0.001**
Abusive alcohol consumption	32 (62,7)	34 (68)	14 (46,7)	0.16**
Type-2 diabetes mellitus	0 (0)	7 (14)	0 (0)	0.003**
Dyslipidemia	0 (0)	27 (54)	9 (16,7)	<0.001**
Obesity	0 (0)	20 (40)	2 (6,7)	<0.001**
Body mass index, in kg/m <sup>2</sup>	23.2 $\pm$ 3.3 <sup>a</sup>	28.5 $\pm$ 5.1 <sup>b</sup>	24.2 $\pm$ 3.4 <sup>a</sup>	<0.001*
Higher waist circumference	10 (19,6)	30 (60)	12 (40)	<0.001**
Waist circumference in men, in cm	83.1 $\pm$ 10.7	99.5 $\pm$ 16.2	–	<0.001*
Waist circumference in women, in cm	73 $\pm$ 6.9 <sup>a</sup>	84.9 $\pm$ 13.7 <sup>b</sup>	79 $\pm$ 9.2 <sup>a</sup>	<0.001*
Hypertension	0	16 (32)	1 (3,3)	<0.001**
Systolic blood pressure, in mmHg	116 $\pm$ 17.9 <sup>a</sup>	126.2 $\pm$ 14.3 <sup>b</sup>	110.9 $\pm$ 8.9 <sup>a</sup>	<0.001*
Diastolic blood pressure, in mmHg	69.8 $\pm$ 9.3	72.3 $\pm$ 10.5	68.9 $\pm$ 7.7	0.23*
MEDAS Score, in points	5 (3–7)	4.5 (3–8)	6 (4–8)	0.06***
MEDAS Score $\geq$ 10 points	2 (3,9)	0 (0)	1 (3,3)	0.38**
Low-fat diet Score, in points	5.6 $\pm$ 2 <sup>a</sup>	5.4 $\pm$ 1.9 <sup>a</sup>	7.1 $\pm$ 1.3 <sup>b</sup>	<0.001*
Low-fat diet Score $\geq$ 6 points	26 (51)	25 (50)	25 (83,3)	0.006**

MEDAS: 14-point Mediterranean Diet Adherence Screener. G1: healthy individuals' group; G2: high cardiovascular risk group; G3: nutritionists' group. \* Analyses of Variance (ANOVA) test; \*\* Pearson's Chi-squared test; \*\*\* Kruskal-Wallis test.

a, b: different letters indicate a difference between groups.

**Table 4**  
Dietary scores according to sociodemographic and clinical characteristics of the participants (mean  $\pm$  standard deviation or median [interquartile range]).

	MEDAS (n = 131)	P-value	Low-fat diet (n = 131)	P-value
Sex		0.01**		<0.0001*
Men (n = 46)	4 (3–6.25)		5 $\pm$ 2.1	
Women (n = 85)	6 (4–8)		6.4 $\pm$ 1.6	
Ethnicity		0.71**		0.06**
White (n = 118)	5 (4–7)		6 $\pm$ 1.9	
Non-white (n = 13)	5 (1.5–8)		4.9 $\pm$ 2	
Scholarship <sup>a</sup>		0.043**		0.015*
< 16 years at school (n = 60)	4.5 (3–6.75)		5.4 $\pm$ 2	
$\geq$ 16 years at school (n = 71)	6 (4–8)		6.2 $\pm$ 1.7	
Smoking		0.69**		0.14*
Current/former (n = 54)	5 (3–8)		5.6 $\pm$ 2	
Never smoked (n = 77)	5 (4–7)		6.1 $\pm$ 1.8	
Abusive alcohol consumption		0.52*		0.47*
Yes (n = 80)	5.2 $\pm$ 2.4		5.8 $\pm$ 2	
No (n = 51)	5.5 $\pm$ 2.6		6 $\pm$ 1.8	
Type-2 diabetes mellitus		0.20*		0.21*
Yes (n = 7)	4.1 $\pm$ 1.5		5 $\pm$ 1.2	
No (n = 124)	5.4 $\pm$ 2.5		5.9 $\pm$ 2	
Hypertension		0.06**		0.05**
Yes (n = 17)	4 (2.5–6)		4 (4–7)	
No (n = 114)	5.5 (4–8)		6 (5–8)	
Dyslipidemias		0.86**		0.90*
Yes (n = 32)	5 (3–8)		5.9 $\pm$ 1.8	
No (n = 99)	5 (4–7)		5.9 $\pm$ 2	
Obesity		0.18**		0.046*
Yes (n = 22)	5 (2–7.25)		5.1 $\pm$ 1.6	
No (n = 109)	5 (4–7.5)		6 $\pm$ 2	
Higher waist circumference		0.37*		0.10*
Yes (n = 52)	5.1 $\pm$ 2.5		6.1 $\pm$ 2	
No (n = 79)	5.5 $\pm$ 2.4		5.5 $\pm$ 1.7	
Previous cardiovascular disease		0.17*		0.88*
Yes (n = 5)	3.8 $\pm$ 1.3		6 $\pm$ 1.6	
No (n = 126)	5.4 $\pm$ 2.5		5.9 $\pm$ 2	

\*Analyses of Variance (ANOVA) test; \*\*Kruskal-Wallis test.

<sup>a</sup> Defined according to the median of the sample; MEDAS: 14-point Mediterranean Diet Adherence Screener.

**Table 5**

Translated into Brazilian Portuguese and culturally adapted version and of the questionnaire 14-point Mediterranean Diet Adherence Screener (MEDAS).

Triagem de 14 pontos para Adesão à Dieta Mediterrânea (MEDAS)	Frequência <sup>a</sup>
1. Você usa azeite de oliva como a principal fonte de gordura para cozinhar?	Sim
2. Que quantidade de azeite de oliva você consome por dia (incluindo o usado em frituras, saladas, refeições feitas fora de casa, etc.)?	≥4 col. sopa <sup>b</sup>
3. Quantas porções de verduras você consome por dia? Conte acompanhamentos como ½ ponto; uma porção completa é 200g.	≥2
4. Quantas frutas (incluindo suco natural feito na hora) você consome por dia?	≥3
5. Quantas porções de carne vermelha, hambúrguer, ou salsichas você consome por dia? Uma porção inteira é 100–150g.	<1
6. Quantas porções (12g) de manteiga, margarina ou creme de leite você consome por dia?	<1
7. Quantas bebidas gaseificadas e/ou adoçadas com açúcar você consome por dia?	<1
8. Você bebe vinho? Quanto você consome por semana?	≥7 copos <sup>c</sup>
9. Quantas porções (150g) de feijão, ou lentilha, ou grão-de-bico você consome por semana?	≥3
10. Quantas porções de peixe/frutos do mar você consome por semana? (100–150g de peixe, 4–5 pedaços ou 200g de frutos do mar).	≥3
11. Quantas vezes por semana você consome produtos de confeitaria/padaria (não caseira) como biscoitos ou bolos?	<2
12. Quantas vezes você consome nozes ou frutos secos por semana? (1 porção = 30g)	≥3
13. Você prefere comer carnes brancas em vez de carne vermelha (carne de porco, cordeiro ou vitela ou hambúrgueres ou salsichas)?	Sim
14. Quantas vezes por semana você consome vegetais cozidos, massas, arroz ou outros pratos com molho de tomate, alho, cebola ou alho-poró refogados em azeite de oliva?	≥2

<sup>a</sup> Critério para pontuar 1 ponto. Caso contrário, marque 0.<sup>b</sup> 1 colher de sopa = 13,5g.<sup>c</sup> 1 copo = 100 mL.**Table 6**

Translated into Brazilian Portuguese and culturally adapted version and of the questionnaire 9-item quantitative score of compliance with the low-fat diet (low-fat diet questionnaire).

Escore quantitativo de 9 itens de adesão à dieta pobre em gordura	
Alimentos e frequência de consumo	Critério para 1 ponto <sup>a</sup>
1. Que quantidade de azeite de oliva você consome por dia (incluindo o azeite usado para fritar, saladas, refeições feitas fora de casa, etc.)?	≤2 colheres de sopa (1 colher de sopa = 10 mL)
2. Você retira a gordura (ou pele) visível de frango, porco, cordeiro ou carne bovina antes de cozinhá-las, bem como a gordura de sopas, caldos e carnes cozidas antes de consumi-los?	Sim
3. Quantas porções de carnes gordurosas, hambúrguer, carne moída industrializada, salsicha, embutidos, presunto, bacon, salame ou miúdos você consome por semana? (porção de carne: 100g; salame ou bacon: 30g)	≤1
4. Quantas porções de manteiga, margarina, banha, maionese, creme de leite ou sorvete à base de leite você consome por semana? (porção de manteiga/margarina: 12g; porção de sorvete: 100g).	≤1
5. Você consome somente produtos lácteos com baixo teor de gordura?	Sim (ignorar se não consome produtos lácteos)
6. Quantas vezes por semana você prepara arroz, massas, batatas ou leguminosas usando molho à base de azeite de oliva, bacon, salame ou carnes gordurosas como costelas de porco ou cordeiro?	≤2
7. Quantas vezes por semana você consome peixes gordurosos ou peixes e frutos do mar enlatados em óleo?	≤1
8. Quantas porções de doces comerciais ou produtos de panificação industrial (não caseiros), tais como bolos, cookies, biscoitos, ou sobremesas você consome por semana? (porção de bolo: 80g; 6 biscoitos: 40g)	≤1
9. Quantas vezes por semana você consome nozes ou frutos secos (incluindo amendoins), batatas chips, batatas fritas, ou salgadinhos industrializados?	≤1

<sup>a</sup> Pontuar 0 se estes critérios não forem atendidos.

knowledge of nutrition [22]). Lower adherence to both dietary patterns have already been observed among individuals with overweight [15,35,36] and with lower scholary [35], in accordance to our results. Despite the small sample size, the instruments translated by our protocol seem to have reflected some findings from other studies conducted in diverse populations, especially regarding the use of the MEDAS. We are not aware of other studies that have translated and culturally adapted the low-fat diet questionnaire. In addition, both instruments seem to reflect the Brazilian dietary pattern, which is characterized by low intake of vegetables, fruits, nuts and fish, and high intake of saturated fats, sugar-sweetened beverages, trans unsaturated fats and dietary cholesterol [37,38].

Many scores and questionnaires have been proposed for the assessment of diet quality and adherence to healthy eating patterns in various scenarios. However, many of them are dependent on other dietary surveys, require considerable time to complete and evaluate, were constructed based on specific foods/nutrients, or

may have methodological failures when adapted from other instruments [39]. Thus, the construction and validation of questionnaires/scales that are easy to understand, that quickly identify already known cardioprotective dietary patterns, and can be widely used in clinical practice providing rapid feedback to the individual are desirable. The MEDAS [12] and the low-fat diet [13] questionnaires were constructed and validated among the Spanish population with the objective of quickly assisting in the identification of dietary inadequacies and adherence to the MedDiet, and a dietary pattern restricted in fats. The MEDAS has already been validated for the British [19] and German [21] populations; however, the process of translation and especially of cultural adaptation is an important prior step to be undertaken.

Our study had some limitations. We did not evaluate the levels of physical activity of participants. It is known that higher MEDAS score values, for example, may reflect a healthier lifestyle, including higher levels of physical activity [35]. The individuals evaluated, selected by convenience, were predominantly young and had a

high level of education by Brazilian standards - which may have overestimated the understanding of the instruments; in addition, this convenience sample do not represent our target-population in terms of age, ethnicity and education level. We did not apply other indexes or other dietary surveys to evaluate adherence to the diet, and we did not obtain laboratory test values associated with cardiometabolic control for potential concurrent and predictive validity analyses. However, our objective was primarily to conduct a translation and cultural adaptation study, to further evaluate reliability and validity of MEDAS and low-fat diet questionnaires among individuals at cardiovascular risk and in the general population. And finally, Cronbach's alpha detected for internal consistency in both questionnaires was considered low; however, it is known that the number of questions which composes an instrument affects Cronbach's alpha values (very long questionnaires increase them), an lower values may represent just a small number of questions [40].

In conclusion, the translation of the MEDAS and low-fat diet questionnaire from English to Brazilian Portuguese following an internationally accepted methodology was obtained, along with their cultural adaptation. The produced versions presented idiomatic, semantic, and conceptual equivalence with the original sources. In addition, the viability of the instrument was demonstrated in order to identify the prevalence of adherence to both dietary patterns in the population evaluated. The MEDAS and the low-fat diet questionnaire may be useful in daily clinical practice. However, it is necessary to conduct large-scale validation studies, given that: 1) several proposed modifications of the items of both instruments have been suggested; 2) Brazil is a continental country with a diversity of different eating habits; and 3) the two instruments have been previously validated in a population at high cardiovascular risk, and not in the general population.

#### Statement of authorship

A.M. designed the study; L.M.V. was responsible for the data collection; A.M. analyzed the data; L.M.V. and A.M. wrote the draft of the manuscript; C.B.A.G., D.B.V., and M.A.M.-G. revised the manuscript. All authors read and approved the final version of this article.

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#### Data availability statement

The data used to support the findings of this study are available from the corresponding author upon request.

#### Declaration of Competing Interest

The authors declare that they have no competing interests.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clnesp.2020.06.018>.

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