

Cross-cultural adaptation and assessment of reproducibility of the Duke Activity Status Index for COPD patients in Brazil*

Adaptação cultural e avaliação da reprodutibilidade do *Duke Activity Status Index* para pacientes com DPOC no Brasil

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Abstract

Objective: To cross-culturally adapt the Duke Activity Status Index (DASI) for use in Brazil and evaluate the reproducibility of the new (Brazilian Portuguese-language) version. **Methods:** We selected stable patients with clinical and spirometric diagnosis of COPD. Initially, the DASI was translated into Brazilian Portuguese, and the cross-cultural adaptation was performed by an expert committee. Subsequently, 12 patients completed the questionnaire, so that their questions and difficulties could be identified and adjustments could be made. An independent translator back-translated the final version into English, which was then submitted to and approved by the original author. The final Brazilian Portuguese-language version of the DASI was applied to 50 patients at three distinct times. For the assessment of interobserver reproducibility, it was applied twice within a 30-min interval by two different interviewers. For the assessment of intraobserver reproducibility, it was applied again 15 days later by one of the interviewers. **Results:** The mean age of the patients was 62.3 ± 10.0 years, the mean FEV₁ was $45.2 \pm 14.7\%$ of the predicted value, and the mean body mass index was 26.8 ± 5.8 kg/m². The intraclass correlation coefficients for intraobserver and interobserver reproducibility were 0.95 and 0.90, respectively. The correlations between the DASI and the Saint George's Respiratory Questionnaire (SGRQ) domains were all negative and statistically significant. The DASI correlated best with the SGRQ activity domain ($r = -0.70$), the total SGRQ score ($r = -0.66$), and the six-minute walk distance ($r = 0.55$). **Conclusions:** The Brazilian Portuguese-language version of the DASI is reproducible, fast, and simple, correlating well with the SGRQ.

Keywords: Activities of daily living; Pulmonary disease, chronic obstructive; Reproducibility of results.

Resumo

Objetivo: Adaptar culturalmente e avaliar a reprodutibilidade do *Duke Activity Status Index* (DASI) para o português do Brasil. **Métodos:** Foram selecionados pacientes estáveis com diagnóstico clínico e espirométrico de DPOC. Inicialmente, o DASI foi traduzido para o português, e a adaptação cultural foi realizada por uma comissão de especialistas. Em seguida, o questionário foi aplicado em 12 pacientes para saber suas dúvidas e dificuldades, sendo realizadas as devidas adaptações. Um tradutor independente fez a tradução retrógrada, que foi submetida e aprovada pelo autor original. A versão final do DASI foi aplicada em 50 pacientes em dois momentos, com intervalo de 30 minutos (reprodutibilidade interobservador) e, num terceiro momento, após 15 dias (reprodutibilidade intraobservador). **Resultados:** A média de idade dos pacientes foi de $62,3 \pm 10,0$ anos, a média do VEF₁ foi de $45,2 \pm 14,7\%$ do valor previsto, e a do índice de massa corpórea foi de $26,8 \pm 5,8$ kg/m². Os coeficientes de correlação intraclass intraobservador e interobservador foram de 0,95 e 0,90, respectivamente. As correlações do DASI com todos os domínios do *Saint George's Respiratory Questionnaire* (SGRQ) foram negativas e estatisticamente significantes. As melhores correlações ocorreram com o domínio atividade ($r = -0,70$) e a pontuação total do SGRQ ($r = -0,66$), assim como com a distância percorrida no teste de caminhada de seis minutos ($r = 0,55$). **Conclusões:** A versão em língua portuguesa do Brasil do DASI é reprodutível, de rápida e fácil aplicação e apresentou uma boa correlação com o SGRQ.

Descritores: Atividades cotidianas; Doença pulmonar obstrutiva crônica; Reprodutibilidade dos testes.

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Introduction

A preventable and treatable respiratory disease, COPD is characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and is associated with a chronic inflammatory response of the airways and lungs to the inhalation of noxious particles or gases. Exacerbations and comorbidities individually contribute to the severity of COPD.⁽¹⁾ Patients with COPD present with significantly impaired functional capacity, which is usually due to airflow limitation, static and dynamic hyperinflation, peripheral muscle dysfunction, oxidative stress, poor peripheral perfusion, and physical deconditioning.⁽²⁾ This leads to limitations in activities of daily living (ADL)⁽³⁾ and impairs quality of life.⁽⁴⁾

In addition to being a rapid and practical way of measuring the extent to which functional capacity is impaired, the use of a specific questionnaire to evaluate functional changes in ADL can show how patients view their ability to perform ADL, their level of independence, and their functional status.⁽⁵⁾ The Saint George's Respiratory Questionnaire (SGRQ) is a comprehensive, disease-specific questionnaire consisting of 76 items assessing the following domains: symptoms; activity; and impact.⁽⁶⁾ However, the time required to complete the SGRQ is long, and the SGRQ does not show which activities patients can perform. The Portuguese-language version of the SGRQ was validated for use in Brazil in 2000.⁽⁷⁾ All of the abovementioned factors have motivated the development of instruments to predict cardiorespiratory fitness on the basis of the physical characteristics and lifestyle habits of individuals.⁽⁸⁾

The Duke Activity Status Index (DASI) was developed and validated at Duke University, in Durham, NC, USA, in 1989.⁽⁹⁾ The DASI is an easy-to-administer questionnaire aimed at predicting oxygen consumption (VO_2) without the need for maximal cardiopulmonary exercise testing. The DASI is a fast and simple questionnaire that can be administered to patients with physical limitation, having previously been validated with physiological measurements, such as VO_2 .⁽⁹⁾ Although it was originally designed to evaluate patients with cardiovascular disease, the DASI also proved to be valid and appropriate for assessing functional capacity in patients with moderate to severe COPD.⁽¹⁰⁾ None of the instruments

currently available for use in Brazil can assess exercise capacity in patients with COPD. However, for a given questionnaire to be administered to patients whose native language and culture are different from those of those for whom it was originally developed and validated, it needs to undergo cross-cultural adaptation, and the reproducibility of the new version needs to be evaluated. The objective of the present study was to cross-culturally adapt the DASI for use in Brazil and evaluate the reproducibility of the new (Brazilian Portuguese-language) version.

Methods

The present study was approved by the Research Ethics Committee of the Federal University of Sergipe, located in the city of Aracaju, Brazil, and was conducted at the Pulmonology Outpatient Clinic of the Federal University of Sergipe University Hospital. The inclusion criteria were as follows: having been clinically and functionally diagnosed with COPD in accordance with the Brazilian Thoracic Association/Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria⁽¹¹⁾; being clinically stable (i.e., having had no episodes of exacerbation, no changes in medication, no increased cough, and no increased dyspnea in the last four weeks); being over 40 years of age; and having given written informed consent. The exclusion criteria were as follows: having been unable to answer the questionnaires; having failed to return to the outpatient clinic for the second study visit; having had exacerbations between the two stages of the study; having other lung diseases; and having severe or uncontrolled comorbidities.

The DASI is a 12-item questionnaire covering self-care, ambulation, household chores, sexual activity, and recreational activities.⁽⁹⁾ Each item is scored proportionally to the metabolic cost of each activity (in metabolic equivalents). For each affirmative answer, points are added. The sum of the points for all affirmative answers results in a total score ranging from zero (worst result) to 58.2 (best result). In order to estimate VO_2 ($mL \cdot kg^{-1} \cdot min^{-1}$), the following multiple linear regression equation is used⁽⁹⁾:

$$VO_2 = 0.43 \times DASI + 9.6$$

The estimation of VO_2 is based on self-reported levels of physical activity. Lower VO_2 values indicate greater limitations in ADL.

Initially, the original (English-language) version of the DAS1 was translated to Brazilian Portuguese by a physiotherapist who was a native speaker of English and who was fluent in Portuguese. Subsequently, the cross-cultural adaptation was performed by an expert committee. This initial version of the DAS1 was administered to and discussed with 12 COPD patients in order to analyze their questions and difficulties. The difficulties encountered by those 12 patients were discussed between the principal investigator and three experts, and a new Brazilian Portuguese-language version of the DAS1 was developed. This new version was then back-translated to English by a second independent translator, who had never had any contact with the questionnaire. The author of the original DAS1 analyzed the new Brazilian Portuguese-language version of the questionnaire and found that it maintained the essence of the original DAS1. The final Brazilian Portuguese-language version of the DAS1 was thus arrived at (Appendix 1, available online at www.jornaldepneumologia/link). The final Brazilian Portuguese-language version of the DAS1 was administered to 50 COPD patients three times, in two visits. In the first visit (V1), the questionnaire was administered twice within a 30-min interval by two different interviewers in order to assess interobserver reproducibility. In the second visit (V2), 15 days after the first, the questionnaire was administered for the third time, by the same interviewer who had administered it the first time, in order to assess intraobserver reproducibility. We recorded the time required to complete the questionnaire each time it was administered. The questionnaire was administered in a standardized manner, the questions having been read to all patients because of the large proportion of illiterate individuals in the study population. The interviewers read the questions in an unbiased manner and wrote down the answers given by the patients.

In the first visit, we assessed patient weight, height, and level of education. In addition, the patients underwent spirometry (before and after bronchodilator use) and the six-minute walk test (6MWT). The body mass index (BMI) was calculated as follows: $BMI = \text{weight}/\text{height}^2$ (in kg/m^2). The Brazilian Portuguese-language version of the SGRQ, adapted and validated for use in Brazil in 2000,⁽⁷⁾ was also administered

to the patients. The SGRQ was also read to the patients by the investigators.

Spirometry (before and after bronchodilator use) was performed with a Koko spirometer (PDS Instrumentation Inc., Louisville, CO, USA) in accordance with the acceptability and reproducibility criteria recommended by the American Thoracic Society⁽¹¹⁾ and the Brazilian Thoracic Association Guidelines for Pulmonary Function Tests.⁽¹²⁾ The variables analyzed were FEV₁, FVC, and post-bronchodilator FEV₁/FVC. The predicted values were based on the equation developed by Pereira.⁽¹³⁾ The severity of COPD was determined in accordance with the criteria established by the GOLD⁽¹⁾ and the Second Brazilian Consensus on COPD.⁽¹⁴⁾

The 6MWT was performed in a 30-m corridor that was straight and level, in accordance with the American Thoracic Society guidelines.⁽¹⁵⁾ Two tests were performed (at least 30 min apart), the greater six-minute walk distance (6MWD) being chosen for analysis.

For the cross-cultural adaptation of the DAS1, we selected 12 patients who were considered to have an appropriate cognitive level to suggest the necessary adjustments. For the assessment of reproducibility, we selected a sample of 50 patients, none of whom had participated in the cross-cultural adaptation of the DAS1. Our sample size was based on the sample size in the study validating the original DAS1 and on that in studies cross-culturally adapting and evaluating the reproducibility of quality of life questionnaires for use in Brazil, as well as on that in the studies validating the SGRQ⁽⁷⁾ and airways questionnaire 20⁽¹⁶⁾ for use in Brazil. In addition, we followed recommendations for achieving a smaller margin of error.⁽¹⁷⁾ Those 50 patients were chosen consecutively.

Continuous variables were expressed as mean and standard deviation. Categorical variables were expressed as absolute numbers and proportions. We used the paired t-test in order to compare the mean scores for the DAS1 domains and subscales between the two visits. In order to assess interobserver and intraobserver reproducibility, we used the intraclass correlation coefficient (ICC), values greater than 0.75 being considered excellent. In order to determine the correlations between the DAS1 and the remaining tests, we used Pearson's correlation coefficient. We used Bland & Altman plots in order to assess the

variability in the estimated VO_2 between the two visits.⁽¹⁸⁾ We used one-way ANOVA followed by the Bonferroni test in order to compare the mean DASI scores among the stages of COPD severity. The level of significance was set at 5%.

Results

The original (English-language) version of the DASI was translated to Brazilian Portuguese and initially administered to 12 patients (6 males and 6 females). The mean age of the patients was 63.6 years.

Some patients reported having difficulty understanding the questions beginning with “*Você consegue*”, having misinterpreted them as “*Você faz*”. For instance, in response to question 6 (“*Você consegue realizar tarefas domésticas, como tirar pó ou lavar pratos?*”), some of the males stated that those activities were the responsibility of females. Therefore, we had to make clear that the objective of that question was to determine whether they were physically able to perform such activities.

Only two questions in the original DASI required cross-cultural adaptation for use in Brazil. Question 11 mentioned recreational activities such as golf, bowling, and baseball, which are not widely disseminated in Brazil. Those activities were therefore replaced by jogging and volleyball. In question 12, skiing was replaced by cycling. Those changes were suggested by the author of the original questionnaire because the energy expenditure in individuals performing the selected activities is similar to that in those performing the activities mentioned in the original DASI.

For the assessment of reproducibility, we selected 50 patients, whose mean age was 62.3 years. Of those 50 patients, 56% were female. Most had moderate obstructive lung disease, were normal weight, and were illiterate (Table 1).

The mean time to complete the DASI was 2 min and 19 s at V1 and 1 min and 38 s at V2. There were no statistically significant differences between illiterate and literate individuals in terms of the time required to complete the questionnaire.

Table 2 shows the mean DASI scores and the estimated VO_2 as assessed by the same investigator at V1 and V2. There were no statistically significant differences between the values. The mean DASI scores and the mean estimated VO_2 were, respectively, $23.9 \pm 14.9 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ and $19.9 \pm 6.4 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, as assessed

Table 1 – Demographic data of the study participants.^a

Variable	Result
Gender	
Male	22 (44)
Female	28 (56)
BMI, kg/m ²	26.8 ± 5.8
Smoking history, pack-years	47.4 ± 45.2
Level of education	
Illiterate	29 (58)
9 years of schooling	12 (24)
High school	8 (16)
College	1 (2)
FEV ₁ , % of predicted	45.2 ± 14.7
FVC, % of predicted	72.34 ± 17.30
FEV ₁ /FVC	0.62 ± 0.13
6MWD, m	489.8 ± 105.5
GOLD stage	
II	19 (38)
III	24 (48)
IV	7 (14)

BMI: body mass index; 6MWD: six-minute walk distance; and GOLD: Global Initiative for Chronic Obstructive Lung Disease. ^aValues expressed as n (%) or mean ± SD.

by the second investigator at V1, and were not significantly different from the values obtained by the first investigator. Table 2 shows the ICCs for intraobserver reproducibility of the DASI score and the estimated VO_2 , the ICCs for both variables being 0.95 ($p < 0.001$) and therefore indicating excellent reproducibility. The ICC for interobserver reproducibility was 0.90 (95% CI: 0.81–0.95; $p < 0.001$).

Figure 1 shows the Bland & Altman plots of the individual variability in DASI scores between V1 and V2.

Although VO_2 (as estimated by the DASI) did not correlate significantly with age or BMI, it correlated positively with FVC ($r = 0.37$; $p < 0.05$), FEV₁ ($r = 0.37$; $p < 0.05$), and the 6MWD ($r = 0.55$; $p < 0.01$).

As can be seen in Table 3, the correlations between VO_2 (as estimated by the DASI) and the SGRQ domains were all negative and statistically significant. The DASI correlated best with the SGRQ activity domain and the total SGRQ score.

Table 4 shows a comparison of the GOLD stages of COPD severity with the DASI scores and the estimated VO_2 . Greater disease severity translated to lower DASI scores.

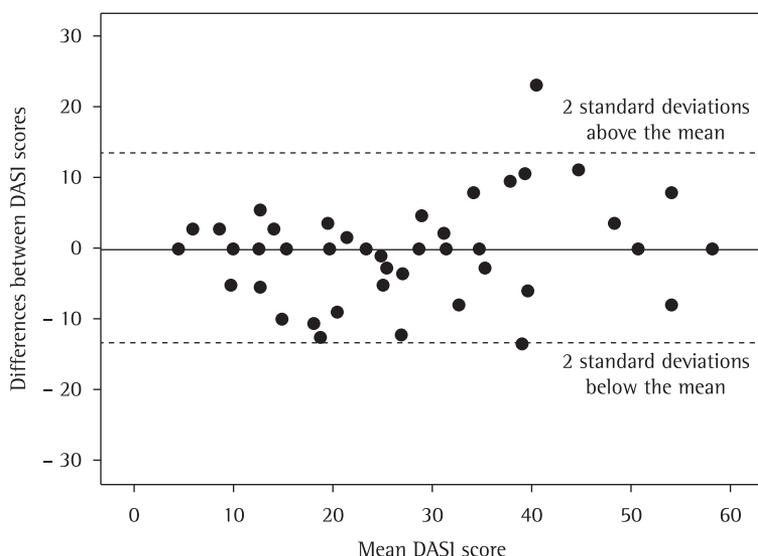


Figure 1 – Bland & Altman plots. Differences between Duke Activity Status Index (DASI) scores in the first and second visits, plotted against the mean DASI score.

Table 2 – Duke Activity Status Index scores, oxygen consumption as estimated by the Duke Activity Status Index, and intraclass correlation coefficients in the two visits in which the questionnaire was administered by the same observer.

Variable	V1 ^a	V2 ^a	ICC	95% CI
DASI score	27.4 ± 15.8	27.7 ± 14.7	0.95	0.91-0.97
Estimated VO ₂ , mL · kg ⁻¹ · min ⁻¹	21.4 ± 6.8	21.5 ± 6.3	0.95	0.91-0.97

V1: first visit; V2: second visit; ICC: intraclass correlation coefficient; DASI: Duke Activity Status Index; and VO₂: oxygen consumption. ^aValues expressed as mean ± SD.

Table 3 – Correlations between oxygen consumption as estimated by the Duke Activity Status Index and the Saint George's Respiratory Questionnaire domains.

SGRQ domains	Correlation	p
Symptoms	-0.44	0.004
Activity	-0.70	< 0.001
Impact	-0.54	< 0.001
Total	-0.66	< 0.001

SGRQ: Saint George's Respiratory Questionnaire.

Discussion

The objectives of the present study were to translate the DASI to Brazilian Portuguese and cross-culturally adapt it for use in Brazil, as well as to assess the reproducibility of the new (Brazilian Portuguese-language) version and determine its correlations with other physiological variables in patients with COPD. The DASI proved to be an adaptable instrument, and the Brazilian Portuguese-language version of the questionnaire was found to be reproducible, fast, and simple.

During the cross-cultural adaptation of the DASI, two physical activities mentioned in the original questionnaire needed to be changed in order to achieve cross-cultural equivalence. We selected 12 patients with appropriate cognitive levels, significant life experience, and a proper understanding of COPD-related limitations. Question 11 in the original DASI mentioned activities such as golf, bowling, and baseball, and question 12 mentioned skiing. Those are not traditional Brazilian sports, being practiced by few Brazilians. For cross-cultural adaptation, the author of the original questionnaire suggested that those sports be replaced by sports that are more commonly practiced in Brazil, provided that the recreational nature and metabolic cost of such sports were similar to those of those mentioned in the original DASI. Therefore, golf and bowling (mentioned in question 11 in the original DASI) were replaced by jogging and volleyball in the Brazilian Portuguese-language version of the DASI, whereas skiing (mentioned in question 12 in the original DASI) was replaced by cycling.

Table 4 – Duke Activity Status Index score and oxygen consumption as estimated by the Duke Activity Status Index, by Global Initiative for Chronic Obstructive Lung Disease stage of COPD severity (as determined by spirometry).

Variable	GOLD stage			p
	II	III	IV*	
	(n = 19)	(n = 24)	(n = 7)	
DASI score	34.3 ± 18.4	23.4 ± 11.4	16.8 ± 7.7	0.014
Estimated VO ₂ , mL · kg ⁻¹ · min ⁻¹	24.3 ± 7.9	19.7 ± 4.9	16.8 ± 3.3	0.014

GOLD: Global Initiative for Chronic Obstructive Lung Disease; DASI: Duke Activity Status Index; and VO₂: oxygen consumption. *Patients with stage II COPD were significantly different from those with stage IV COPD.

This demonstrates that questionnaires originally developed in a given country should be cross-culturally adapted for use in other countries, and that it is imperative that the author of the original questionnaire be involved in the process of cross-cultural adaptation. The DASI has been adapted for use in various countries in which English is not the official language, including China,^(19,20) Greece,⁽²¹⁾ and Turkey.⁽²²⁾

The reproducibility of the DASI was demonstrated by the absence of significant differences between the evaluations at V1 and V2 and by the high ICC values, all of which were above 0.75, a value that has been defined as being indicative of reproducibility.⁽²³⁾ The ICCs for interobserver and intraobserver reproducibility were 0.90 and 0.95, respectively, both of which were considered excellent. Therefore, we can state that the Brazilian Portuguese-language version of the DASI is reproducible when administered to stable patients by the same interviewer or by different interviewers. Other studies^(20,21) have found ICCs of 0.78 and 0.90. These values show that cross-cultural adaptation of the DASI is easy, the questionnaire having been used in other countries with a reproducibility that is similar to or even lower than that found in our study but with values above the levels of reproducibility. As can be seen in Figure 1, regardless of whether the DASI score was high or low, the variability in the score between the two visits was the same, meaning that the reproducibility of the DASI is good regardless of the score.

The SGRQ is a widely used quality of life questionnaire specifically developed for patients with COPD, having been cross-culturally adapted for use in Brazil in 2000.⁽⁷⁾ We found that the DASI scores correlated significantly with all SGRQ domains. The DASI correlated best with the SGRQ activity domain (r = -0.70). This finding was not unexpected, given that the DASI estimates

VO₂ on the basis of ADL, similar to the SGRQ activity domain. The total DASI score correlated well with the total SGRQ score (r = -0.66). All correlations between the DASI and the SGRQ were negative, i.e., higher VO₂ values (as estimated by the DASI) translated to lower SGRQ scores, therefore indicating better quality of life. To our knowledge, this is the first study to evaluate the correlations between the DASI and the SGRQ in patients with COPD. The DASI is an instrument that assesses physical limitation and complements the assessment by the SGRQ.

The DASI correlated significantly but moderately with the 6MWD (r = 0.53; p < 0.001), a finding that is consistent with those of a study validating the use of the DASI to assess functional capacity in patients with COPD.⁽¹⁰⁾ The DASI was expected to correlate with the 6MWD, given that the DASI assesses the ability to perform ADL and the 6MWT assesses the ability to perform physical activities. In our study, the DASI score did not correlate significantly with age or BMI. Long-term follow-up studies of patients with cardiovascular disease have shown that age, BMI, female gender, and comorbidities (e.g., between COPD and diabetes) negatively affect the DASI score.⁽²⁴⁻²⁶⁾

The DASI can be used in order to estimate VO₂. In the study validating the original DASI, the DASI score was found to correlate well and significantly with objectively assessed VO₂ in healthy individuals (r = 0.58)⁽⁹⁾ but less so in COPD patients (r = 0.39).⁽¹⁰⁾ Because the VO₂ as predicted by the DASI correlates moderately with the actual VO₂, the former should be used as an estimate and should not replace the combination of maximal exercise testing and exhaled gas measurements. However, the present study provides health professionals in Brazil with a useful and easy-to-administer instrument for the functional assessment of patients with

chronic diseases. By estimating VO_2 , we can determine whether patients can perform ADL, engage in physical activity, and even undergo surgery. According to the American College of Cardiology and the American Heart Association, patients with exercise tolerance > 4 metabolic equivalents, $VO_2 \geq 14 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, or a DASI score > 11.6 can undergo cardiac surgery without the need for further investigation or changes in perioperative management.⁽²⁷⁾

A comparison between VO_2 as predicted by the DASI and the stages of COPD severity showed that greater severity translated to lower functional capacity, with statistically significant differences between stages II and IV. Had the number of patients with stage II, stage III, and stage IV COPD been higher, there might have been statistically significant differences among all stages. However, the investigation of this hypothesis was outside the scope of the present study, further studies being therefore required.

Although we obtained excellent results, our study has some limitations. First, many of the individuals in our sample were illiterate. However, the DASI can be used in various ways without losing its sensitivity^(24,25,28,29):

- It can be self-administered at the site where the study is conducted.
- It can be mailed to respondents.
- It can be read to respondents.

Because most of the patients in our sample had a low level of education, we chose to read the questionnaire to all (regardless of their level of education), knowing that that would not affect the results obtained. Another limitation is the fact that most of the patients were female. However, the original version of the DASI was administered to males and females, with no differences in reproducibility. In addition, our objective was to cross-culturally adapt the DASI for use in Brazil and assess the reproducibility of the new (Brazilian Portuguese-language) version rather than to investigate possible differences between the genders.

In conclusion, the Brazilian Portuguese-language version of the DASI is easy to understand, which demonstrates that the process of cross-cultural adaptation for use in Brazil was appropriate. In addition, the Brazilian Portuguese-language version of the DASI is reproducible, fast, and simple, correlating well with the SGRQ and the 6MWD. We therefore believe that this new

instrument will be very useful in assessing the functional capacity of COPD patients in Brazil.

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