Duke Activity Status Index for Cardiovascular Diseases: Validation of the Portuguese Translation

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Abstract

Background: The Duke Activity Status Index (DASI) assesses the functional capacity of patients with cardiovascular disease (CVD), but there is no Portuguese version validated for CVD.

Objectives: To translate and adapt cross-culturally the DASI for the Portuguese-Brazil language, and to verify its psychometric properties in the assessment of functional capacity of patients with CVD.

Methods: The DASI was translated into Portuguese, then checked by back-translation into English and evaluated by an expert committee. The pre-test version was first evaluated in 30 subjects. The psychometric properties and correlation with exercise testing was performed in a second group of 67 subjects. An exploratory factor analyses was performed in all 97 subjects to verify the construct validity of the DASI.

Results: The intraclass correlation coefficient for test-retest reliability was 0.87 and for the inter-rater reliability was 0.84. Cronbach's α for internal consistency was 0.93. The concurrent validity was verified by significant positive correlations of DASI scores with the VO_2max ($r = 0.51$, $p < 0.001$). The factor analysis yielded two factors, which explained 54% of the total variance, with factor 1 accounting for 40% of the variance. Application of the DASI required between one and three and a half minutes per patient.

Conclusions: The Brazilian version of the DASI appears to be a valid, reliable, fast and easy to administer tool to assess functional capacity among patients with CVD. (Arq Bras Cardiol. 2014; 102(4):383-390)

Keywords: Cardiovascular diseases; Work capacity evaluation; Practice guidelines; Exercise test; Questionnaires; Validation studies.

Introduction

Cardiovascular diseases (CVD) lead to physical disabilities and reduce patients' quality of life by their direct impact on functional capacity and performance. Assessment of functional capacity is important to investigate the impact of the disease on a patient's life, to determine the degree of constraint imposed by CVD, as well as by being a factor in diagnosis, prognosis and a strong predictor of mortality[1].

The maximal exercise testing is the only accurate method to determine the aerobic capacity[1]. However, it is not always usable either due to patient physical condition or when it may expose a given patient to higher-than-normal risk. Questionnaires are an inexpensive, simple and safe tool to assess the functional or clinical status[1,2] that might be used before the exercise test to determine a patient's ability to perform appropriate effort[3].

The Duke Activity Status Index (DASI) is a questionnaire, originally developed in English[4], to assess the functional capacity. DASI has been used mainly to evaluate patients with cardiovascular diseases, such as coronary artery disease, heart failure, myocardial ischemia and infarction[5,6]. In clinical practice, DASI can be used to assess the effects of medical treatments and cardiac rehabilitation[7] and to assist clinical decisions[3,8]. In controlled clinical trials, DASI can serve to evaluate interventions and as a component of the assessment of the treatment cost/benefit[8].

Considering that DASI is characterized as a good functional capacity questionnaire, the evidence of validity, the usefulness and large clinical and scientific applicability, it appears to be a useful tool to evaluate cardiac patients[1-3]. So, to be used with Brazilian CVD patients it is necessary to validate DASI and verify its psychometric properties in this population[9,10].

The aim of this study was to translate, culturally adapt and validate the DASI to Brazilian Portuguese and verify its psychometric properties in the assessment of functional capacity of individuals with CVD.

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Methods

Participants

The participants were of both sexes, diagnosed with CVD, older than 22 years old, with body mass index between 18.6 and 39.9 kg/m^2, from Brazilian nationality and who had lived most of their life in Brazil. The inclusion criteria were: diagnosis of cardiovascular disease such as coronary artery disease, valvular heart disease, arrhythmia with at least one symptom[11] such as chest pain, palpitations, fatigue, or dyspnea and physician referral to exercise testing. The excluded criteria were: cognitive deficit screened by Mini Mental State Examination according to the cutoff points recommended by Bertolucci et al[12], emergency care or hospitalization two months before as well as acute illness, fever or severe physical limitation that would prevent from doing the exercise test[13].

Data was collected between February and August 2012 and patients were recruited at Stress Testing Laboratory of the University Hospital's Cardiology Service. The research was carried out according to the Declaration of Helsinki and was approved by the Ethics Committee of the institution. All subjects were informed about the research objectives and signed a consent form.

Duke Activity Status Index (DASI)

The DASI was developed aiming at correcting failures presented by other instruments such as the New York Heart Association Scale (NYHA) and the Canadian Cardiovascular Society (SCCS). It is a 12-item questionnaire that assesses daily activities such as personal care, ambulation, household tasks, sexual function and recreation with respective metabolic costs. Each item has a specific weight based on the metabolic cost (MET). The participants were asked to identify each activity they are able to do. The final score ranges between zero and 58.2 points. The higher the score, the better the functional capacity[4].

Translation and Cultural Adaptation

The process of translation and cultural adaptation followed the steps proposed by Beaton et al[9]. The original version (Table 1) was independently translated into Brazilian Portuguese by two bilingual translators, qualified, whose mother tongue was Portuguese, generating versions T1 and T2. The first translator had no knowledge about medical area and was not informed about the goals and concepts studied. The second translator was a physiotherapist, PhD in Rehabilitation Sciences, with knowledge about the concepts assessed. The translators were instructed to make a report about doubts and difficulties.

A third bilingual translator, whose mother tongue is Portuguese, synthesized the translations T1 and T2, comparing them with the original version. Thus, it was generated the consensus version (T-1.2). From this version, the back translation was done into English by two other independent translators with no knowledge about the original version. These translators were English native speakers, lived in Brazil, did not belong to the medical area and were not informed about the concepts assessed in the questionnaire.

The translations were reviewed by an expert committee formed by a multidisciplinary team including the researchers, the translators, the five translators and an healthcare professional an expert in research methodology and who understands the concepts and goals of DASI.

Table 1 - Original version of Duke Activity Status Index[5]

Duke Activity Status Index *Mark A. Hlatky et al*[5]	
Can you	Weight
1. Take care of yourself, that is, eating, dressing, bathing or using the toilet?	2.75
2. Walk indoors, such as around your house?	1.75
3. Walk a block or two on level ground?	2.75
4. Climb a flight of stairs or walk up a hill?	5.50
5. Run a short distance?	8.00
6. Do light work around the house like dusting or washing dishes?	2.70
7. Do moderate work around the house like vacuuming, sweeping floors, or carrying in groceries?	3.50
8. Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?	8.00
9. Do yardwork like raking leaves, weeding, or pushing a power mower?	4.50
10. Have sexual relations?	5.25
11. Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?	6.00
12. Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?	7.50
Total Score: _____	

DASI scoring: *Positive responses are summed to get a total score, which ranges from 0 to 58.2. Higher scores indicate higher functional capacity.*

From all versions, based on the sociocultural context of Brazil, the committee assessed the clarity, relevance, coherence and significance of the items. All items of the consensus version were evaluated and compared to the original version in order to achieve the semantic, idiomatic, conceptual and content equivalence.

The pre-test version was approved by all committee members, with items considered clear and easy to understand even to a 12- year old person[9]. This version was submitted to subjects with CVD to evaluate possible deviations and errors committed during translation checking whether all items were clearly and unequivocally understood. Participants were questioned about the clarity of the items and if they knew all the activities contained in the questionnaire.

Psychometric Validation

The DASI was submited as an interview considering the lower education level of the population. However, the researchers maintained a neutral stance during the submission. Two trained raters, blinded as to the application of another evaluator, were given the questionnaire with an interval of one hour to assess interrater reliability. The same examiner reapplied the questionnaire personally or by phone with an interval between seven to ten days to assess the test-retest reliability. The time required for the questionnaire application was recorded.

Exercise Test Protocol

The exercise test protocol was the routinely used in the laboratory where patients were recruited. A cardiologist performed the tests and all equipments required to life support were available. The subjects were instructed to maintain their usual medication, resting two hours before the test and avoid caffeine, smoking and exercise on the test day. The exercise testing was performed according to the Bruce protocol[13], using a treadmill (*Micromed®, Brazil*) following the recommendations of the Brazilian Cardiac Society[14]. A minimal handrail support was allowed. During the test, including rest and recovery periods, heart rate (HR) and 12-lead electrocardiographic were continuously monitored by electrocardiograph (*Micromed®, Brazil*) in connection with the software (*PC Ergo Elite 13*) as well as blood pressure every three minutes. The test was finished upon subject request, on report of symptoms such as leg pain, tachycardia, angina or any other discomfort and according to the absolute criteria for interruption[14].

Unfortunately we did not have an oxygen consumption analyzer available, the oxygen uptake (VO_2) was estimated using a software according to the following formulas[15]:

VO_2 (ml/kg.min)=(time-minutes from exercise test x 2.33)+9.48 for men

VO_2 (ml/kg.min)=(time-minutes from exercise test x 3.36)+1.06 for women

In order to avoid confounding factors, the physician conducting the exercise test was blinded regarding the outcome of the DASI questionnaire.

Statistical Analysis

The SPSS version 15.0 was used to store and analyse data. The normal distribution of data was verified using the Kolmogorov-Smirnov test. Variables with normal distribution were expressed as mean, standard deviation and confidence interval of 95%. Variables with non-normal distribution were expressed as median and interquartile range of 25-75%. A significance level of 5% was adopted for all statistical tests.

The group that submitted the pre-test was compared with the group that performed the exercise test by independent t-test. To assess the test-retest and interrater reliabilities it was used the intraclass correlation coefficient (ICC) calculated for the total score of the questionnaire. Internal consistency was assessed using α-Cronbach's coefficient. The assessment of concurrent criterion validity was performed using the Spearman correlation between the final score of the DASI and maximal VO_2 achieved in exercise test.

Factor analysis was used to assess the construct validity[16]. We performed principal components analysis with varimax rotation with Kaiser normalization. The adequacy of the correlation matrix was verified by the Kaiser-Meyer-Olkin (KMO) criteria, which should be greater than 0.60 and Bartlett's test considering a significance level of 0.05. As a criterion for extracting the number of factors, eigenvalues greater than or equal to one were considered relevant factors. Following rotation matrix, items with a factor loading greater than or equal to 0.4 were added to the factor. The time required for the application of DASI was expressed as median, in minutes.

Results

Participants

Following Beaton et al[9] recommendations, 30 individuals participated in the pre-test. The test-retest and interrater reliabilities and internal consistency were observed in other 67 subjects. The characteristics of these participants are presented in Table 2. The concurrent criterion validity was performed in 62 subjects, since five were excluded due to non completion of exercise test. The verification of construct validity was conducted with the total sample of 97 individuals. There was no statistically difference between individuals who participated in the pre-test and those who participated in the evaluation of psychometric properties ($p > 0.05$). The sample consisted predominantly of males and coronary artery disease patients. The majority of the subjects had cardiovascular risk factors such as hypertension, hypercholesterolemia and smoking addiction.

Translation and Cultural Adaptation

From the analysis and suggestions of the expert committee, aiming at getting greater equivalence of the translated version with the original, a better adaptation of the questionnaire to Brazilian culture and a greater understanding of the items, changes were made in version T-1.2. In the item 7, the term

Table 2 – Demographic, clinical and functional capacity

Variable	n = 67
Male/Female	41/26 (61.2% / 38.8%)
Age (years)	56.88 ± 11.93 (53.97-59.79)
Weight (Kg)	72.63 ± 15.61 (68.37-75.84)
Height (m)	1.63 ± 0.09 (1.60-1.65)
Body Mass Index (Kg/m^2)	27.28 ± 4.76 (26.12-28.44)
Type of Cardiovascular Disease	
Coronary arterial disease	27 (40.31%)
Acute myocardial infarction	21 (31.34%)
Ischemic Cardiomiopathy	8 (11.94%)
Valvulopathy	9 (13.43%)
Arrhythmia	2 (2.98%)
Risk Factors	
Hypertension	53 (79.1%)
Diabetes	11 (16.4%)
Hypercholesterolemia	42 (62.7%)
Obesity	17 (25.4%)
Smoker	14 (20.9%)
Ex-smoker	23 (34.3%)
Schooling	
Illiterate	9 (13.4%)
1 to 7 years	34 (50.7%)
8 years or more	19 (28.4%)
College	5 (7.5%)
Functional Capacity	
DASI[a]	42.7 ± 1.95 (28.45-52.95)
VO_2max (ml.kg^{-1}.min^{-1})[b]	26.17 ± 9.07 (23.85-28.46)
METmax[b]	7.47 ± 2.60 (6.81-8.13)

Data expressed as frequency (%), mean ± standard deviation (confidence interval 95%) or median ± standard error (interquartile range of 25-75%); [a]data expressed as median; [b] n = 62; MET: maximal metabolic equivalent at exercise test; VO_2max: maximal oxygen uptake at exercise test.

"use vacuum cleaner" (usar o aspirador de pó) was replaced by *"vacuuming"* (passar o aspirador de pó), considered more appropriate and used by the Brazilian population. In item 8, the term *"scrubbing floor"* (esfregar o chão) could be understood to mop the floor using a broom or other object in a standing position. To clarify this activity, which should be held in the kneel down position to match the desired metabolic expenditure (8 METS), was chosen the term *"scrubbing the floor with your hands using a brush"* (esfregar o chão com as mãos usando uma escova). The term *"moving heavy furniture"* (deslocar móveis pesados) was also considered not clear. Thus, it was added *"move heavy furniture of the place"* (deslocar móveis pesados do lugar). It was included the term *"electric"* to item 9 to specify the equipment correctly and match the metabolic expenditure (4.5 METS). Items 11 and 12 referred activities that are not usual in Brazil. These activities have been replaced by volleyball, riding a bicycle, doing water aerobics, soccer and running, which have equivalent metabolic expenditure[17].

All participants of the pre-test said that the questionnaire was easy to answer; the items were clear, they had no doubts during application and knew all the activities listed. However, from that application, it was found that the term "walk" (caminhar) in items 2 and 3 was confused with habitual physical activity known as "walk" (caminhada) to Brazilians. So, we decided to replace the word "walk" by "walking" (andar). This version was considered culturally adapted to Brazil, showing equivalence with the original version and was used for testing the psychometric properties (Table 3).

Psychometric Validation

The ICC found for the test-retest reliability was 0.87 and 0.84 for interrater. We found a Cronbach's α of 0.93 for internal consistency. In the analysis of concurrent criterion validity, there were significant and positive correlation between VO_{2max} and DASI score ($r = 0.51$, $p < 0.001$) as shown in Figure 1.

The exploratory factor analysis to assess construct validity was conducted excluding items 1 and 2 of the questionnaire, since all subjects in the sample responded that they were able to carry out the proposed activities. Therefore, there was no variance of these items. The significance value obtained by KMO (0.85) and Bartlett's test ($p < 0.0001$) were adequate to the use of factor analysis for the data treatment. We extracted two factors. These factors accounted for 53.81% of total variance, with factor 1 accounting for 39.99% of the variance. The first factor was composed of items 5,8,9,11,12 and reflects activities with higher metabolic demand. The second factor was composed of items 3,4,6,7,10 and reflects activities with a lower metabolic cost.

The questionnaire application varied between one and three and a half minutes, with a median of 1.57 ± 0.56 (1.37 to 2.05) minutes.

Discussion

This study translated the DASI questionnaire, adapted it culturally, and verified its psychometric properties. The questionnaire had high internal consistency, good test-retest and interrater reliabilities, excellent concurrent criterion validity and it also was quick and easy to use in the target population.

It is important to emphasize the importance of multidisciplinary experts committee in the process of translation and cultural adaptation. After evaluation of people from different areas, it was possible to make items clearer and more equivalent to the original version. Moreover, the pre-test indicated a possible misinterpretation of items 2 and 3 that were corrected in the final version. The methodology provided the translation quality and safety. So, following the steps proposed for the translation and cultural adaptation studies it is essential for the final

Table 3 - Final Version Duke Activity Status Index Brazilian version

Duke Activity Status Index Versão Brasileira Coutinho-Myrrha MA et al			
Você consegue	**Peso (MET)**	**Sim**	**Não**
1. Cuidar de si mesmo, isto é, comer, vestir-se, tomar banho ou ir ao banheiro?	2,75		
2. Andar em ambientes fechados, como em sua casa?	1,75		
3. Andar um quarteirão ou dois em terreno plano?	2,75		
4. Subir um lance de escadas ou subir um morro?	5,50		
5. Correr uma distância curta?	8,00		
6. Fazer tarefas domésticas leves como tirar pó ou lavar a louça?	2,70		
7. Fazer tarefas domésticas moderadas como passar o aspirador de pó, varrer o chão ou carregar as compras de supermercado?	3,50		
8. Fazer tarefas domésticas pesadas como esfregar o chão com as mãos usando uma escova ou deslocar móveis pesados do lugar?	8,00		
9. Fazer trabalhos de jardinagem como recolher folhas, capinar ou usar um cortador elétrico de grama?	4,50		
10. Ter relações sexuais?	5,25		
11. Participar de atividades recreativas moderadas como vôlei, boliche, dança, tênis em dupla, andar de bicicleta ou fazer hidroginástica?	6,00		
12. Participar de esportes extenuantes como natação, tênis individual, futebol, basquetebol ou corrida?	7,50		
Pontuação total: _____			

Pontuação DASI: *o peso das respostas positivas são somados para se obter uma pontuação total que varia de 0 a 58.2. Quanto maior a pontuação, maior a capacidade funcional.*

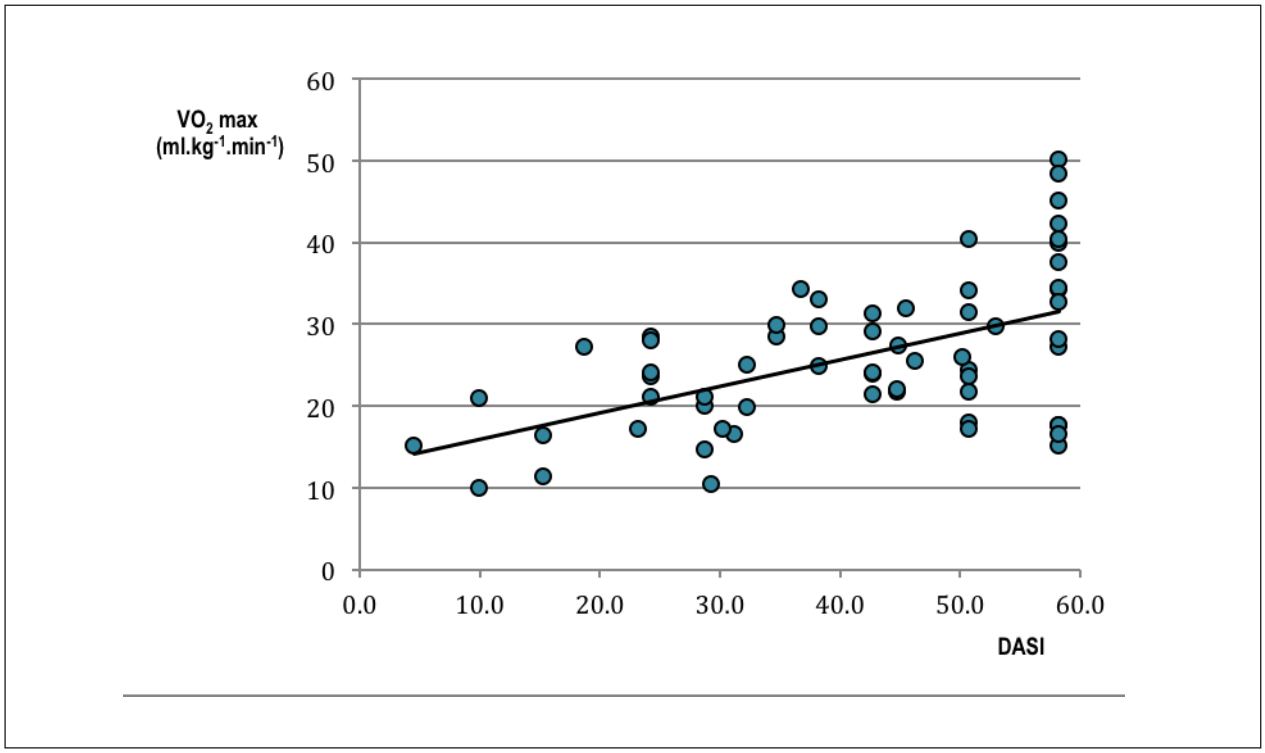

Figure 1 - *Correlation between DASI score and maximal functional capacity. DASI: Duke Activity Status Index; METmax: Maximal metabolic equivalent; VO_2max: Maximal oxygen uptake.*

version to be equivalent to the original. The results of this study showed that the DASI, adapted to Brazil, showed semantic, idiomatic and conceptual equivalence with the original version.

There were no statistically significant differences between the pre-test sample and the sample in which the psychometric properties were verified. These samples should be similar and composed by the target population, thus, ensuring that the translated version is suitable for this population.

It is important to verify the psychometric properties because the simple translation does not ensure the maintenance of such proprieties[9]. This evaluation demonstrated that DASI presents an adequate reliability and validity for assessing the functional capacity of individuals with CVD. The high value of CCI found for the test-retest reliabilities and interrater demonstrates the consistency of the measure. The questionnaire proved to be homogeneous, measuring the same construct, with adequate internal consistency (α-Cronbach's values > 0.90). Moderate correlations were found between the questionnaire score and variables obtained at maximal exercise test. This is a favorable outcome and expected because the DASI assesses the functional capacity perceived by the individual, being a subjective measure, while exercise test evaluates objectively the maximum capacity. So the concurrent criterion validity was suitable. Moreover, other authors found a similar correlation between scores on the DASI and VO_2peak in cardiac subjects ($r = 0.62$[18] and $r = 0.64$[19], $p < 0.001$).

Among other questionnaires that also evaluate functional capacity, such as the Veterans Specific Activity Questionnaire (VSAQ)[20], the Specific Activity Questionnaire (SAQ)[18] and the Specific Activity Scale of Goldman (SAS)[21], the DASI showed better correlation with VO_2 obtained by using the exercise test[18]. The correlation between DASI and VO_2peak showed good to excellent correlation when applied as an interview ($r = 0.81$, $p < 0.001$) and moderate when self-administered ($r = 0.58$, $p < 0.001$), being better than the correlation between peak VO_2 and SCCS ($r = 0.49$, $p < 0.01$) and SAS ($r = 0.30$, $p < 0.01$) in subjects with DCV[4]. The MET assessed by DASI before the exercise test, showed direct correlation with functional capacity assessed by Bruce protocol[3,5]. These studies emphasize the usefulness to choose the best exercise protocol[3]. The lower the DASI score before performing the exercise test, the greater the possibility of being unable to perform some test protocol.

The exploratory factor analysis results indicated the presence of two factors and the items were separated according to the metabolic cost (MET). Item 9 regarding gardening works, despite the correspondence to a low metabolic cost (4 METS), was related to items corresponding to high MET (Factor 1). Gardening activities are not very usual among Brazilians residing in an urban environment. So it may have been an overestimation by the participants on the level of difficulty of this activity. During the evaluation of the expert committee it was discussed the possibility of replacing this item by another activity. However, we opted to maintain this item due to the population residing in rural areas in Brazil (15.64%)[22] and the assumption that those residing in urban areas have access to such activities.

In previous studies, the DASI demonstrated to be a useful tool in clinical practice and in research, being possible to discern different disease severity, assess effects of medical treatment[23], cardiac rehabilitation and provide relevant information to clinical decisions[7,8]. Despite the great clinical and scientific utility, the DASI may not be suitable to differentiate individuals with high functional capacity, due to a ceiling effect found in this and other studies[24]. This effect exists when more than 15% of the sample reaches the total score[10]. In this study, 17.52% of the total sample (n = 97) obtained the total score. It was also observed, as the original study, that patients with low capacity reported the maximal DASI score (see Figure 1, less than 20 $ml.kg^{-1}.min^{-1}$). So, future studies have to be done to investigate the relationship between reduced physical capacity and patient perception.

Recent studies have applied this questionnaire in other populations, such as those with chronic obstructive pulmonary disease (COPD)[25] and kidney disease[26]. Tavares et al[27], in a parallel conducted study performed the cultural adaptation and evaluation of the reproducibility of the DASI to Brazil in a sample of individuals with COPD. The authors found an ICC of 0.95 intraobserver and interobserver agreement of 0.90 and a better correlation with the activity domain of the Saint George's Respiratory Questionnaire (SGRQ) ($p < 0.001$, $r = -0.70$).

It is recommended that health professionals assess and develop treatment plans according to the model proposed by the International Classification of Functioning, Disability and Health (ICF). It is important to focus on the implications of a health condition on an individual's life, adopting instruments based on a model that not only informs about conditions, but also on its impact on the peoples' lives[28]. The DASI provides this information, specifying which activities are limited by disease and the impact on patient's life. In this study DASI presented appropriated characteristics to be considered a good tool in rehabilitation area[29].

This study has several limitations. First, we did not use an individualized ramp treadmill protocol or directly measured the oxygen uptake. Second, although the questionnaire was applied as an interview, the lower educational level of the subjects could have increased the interpretation difficulties inherent to this kind of tool. Probably these limitations might have contributed to the smaller correlation (0.51) with maximal capacity compared to the original study[4] (0.81). Finally, we have to consider that some questions are related to unspecific activities that could have variations in terms of MET (for example the item 10 - "have sexual relations?"). Future studies are necessary to clarify these points.

Conclusions

The present Portuguese version of DASI is adapted for Brazilian culture and appears to be a valid, reliable, quick and easy instrument to assess the functional ability of individuals with CVD.

This DASI Brazilian version can be used in clinical practice and also in research area to compare Brazilian studies with those from other countries using the same tool.

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Author contributions

Conception and design of the research: Coutinho-Myrrha MA, Dias RC, Britto RR; Acquisition of data: Coutinho-Myrrha MA, Fernandes AA, Araújo CG; Analysis and interpretation of the data and Writing of the manuscript: Coutinho-Myrrha MA, Dias RC, Fernandes AA, Pereira DG, Britto RR; Statistical analysis: Coutinho-Myrrha MA, Pereira DG, Britto RR; Obtaining funding: Britto RR; Critical revision of the manuscript for intellectual content: Dias RC, Araújo CG, Hlatky MA, Pereira DG.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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References

1. Arena R, Myers J, Williams MA, Gulati M, Kligfield P, Balady GJ, et al. Assessment of functional capacity in clinical and research settings: a scientific statement from the American Heart Association Committee on Exercise, Rehabilitation, and Prevention of the Council on Clinical Cardiology and the Council on Cardiovascular Nursing. Circulation. 2007;116(3):329-43.
2. George MJ, Kasbekar SA, Bhagawati D, Hall M, Buscombe JR. The value of Duke Activity Status Index (DASI) in predicting ischaemia in myocardial perfusion scintigraphy - a prospective study. Nucl Med Rev Cent East Eur. 2010;13(2):59-63.
3. Phillips L, Wang JW, Pfeffer B, Gianos E, Fisher D, Shaw LJ, et al. Clinical role of the Duke Activity Status Index in the selection of the optimal type of stress myocardial perfusion imaging study in patients with known or suspected ischemic heart disease. J Nucl Cardiol. 2011;18(6):1015-20.
4. Hlatky MA, Boineau RE, Higginbotham MB, Lee KL, Mark DB, Califf RM, et al. A brief self-administered questionnaire to determine functional capacity (the Duke Activity Status Index). Am J Cardiol. 1989;64(10):651-4.
5. Shaw LJ, Olson MB, Kip K, Kelsey SF, Johnson BD, Mark DB, et al. The value of estimated functional capacity in estimating outcome: results from the NHBLI-Sponsored Women's Ischemia Syndrome Evaluation (WISE) Study. J Am Coll Cardiol. 2006;47(3 Suppl):S36-43.
6. Chung SC, Hlatky MA, Stone RA, Rana JS, Escobedo J, Rogers WJ, et al. Body mass index and health status in the Bypass Angioplasty Revascularization Investigation 2 Diabetes Trial (BARI 2D). Am Heart J. 2011;162(1):184-92.
7. Scotto CJ, Waechter DJ, Rosneck J. Adherence to prescribed exercise and diet regimens two months post-cardiac rehabilitation. Can J Cardiovasc Nurs. 2011;21(4):11-7.
8. Hlatky MA, Rogers WJ, Johnstone I, Boothroy D, Brooks MM, Pitt B et al. Medical care costs and quality of life after randomization to coronary angioplasty or coronary bypass surgery. Bypass Angioplasty Revascularization Investigation (BARI) Investigators. N Engl J Med. 1997;336(2):92-9.
9. Beaton DE, Bombardier C, Guillemin F, Ferraz MB, et al. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976). 2000;25(24):3186-91.
10. Mather CG, LatimerJ, Costa LO. The relevance of cross-cultural adaptation and clinimetric for physical therapy instruments. Rev bras fisioter. 2007;11(4):245-52.
11. Domingues GB, Gallani MC, Gobatto CA, Miura CT, Rodrigues RC, Myers J. et al. Cultural adaptation of an instrument to assess physical fitness in cardiac patients. Rev Saude Publica. 2011;45(2):276-85.
12. Bertolucci PH, Brucki SM, Campacci SR, Juliano Y. [The Mini-Mental State Examination in a general population: impact of educational status]. Arq Neuropsiquiatr. 1994;52(1):1-7.
13. Bruce RA. Exercise testing of patients with coronary heart disease. Principles and normal standards for evaluation. Ann Clin Res. 1971;3(6):323-32.
14. Meneghelo RS, Araújo CG, Stein R, Mastrocolla LE, Albuquerque PF, Serra SM, et al; Sociedade Brasileira de Cardiologia. III Diretrizes da Sociedade Brasileira de Cardiologia sobre teste ergométrico. Arq Bras Cardiol. 2010;95(5 supl.1):1-26.
15. Marins JC, Giannichi RS. Avaliação da componente cardiorrespiratória. In: Marins JC, Giannichi RS. (editores). Avaliação e prescrição de atividade física: guia prático. Rio de Janeiro: Shape; 2003. p. 143-203.
16. Hair JF(editor). Análise fatorial. Análise multifatorial de dados. Porto Alegre: Bookman; 2005. p. 89-127.
17. Ainsworth BE, Haskell WL, Herrmann SD, Mecker N, Bassett DR Jr, Tudor-Locke C, et al. 2011 Compendium of Physical Activities: a second update of codes and MET values. Med Sci Sports Exerc. 2011;43(8):1575-81.
18. Rankin SL, Briffa TG, Morton AR, Huna J. A specific activity questionnaire to measure the functional capacity of cardiac patients. Am J Cardiol. 1996;77(14):1220-3.
19. Arena R, Humphrey R, Peberdy MA. Using the Duke Activity Status Index in heart failure. J Cardiopulm Rehabil. 2002;22(2):93-5.
20. Maranhao-Neto GD, Leon AC, Farinatti PD. Validity and equivalence of the Portuguese version of the Veterans Specific Activity Questionnaire. Arq Bras Cardiol. 2011;97(2):130-5.
21. Goldman L, Hashimoto B, Cook EF, Loscalzo A. Comparative reproducibility and validity of systems for assessing cardiovascular functional class: advantages of a new specific activity scale. Circulation. 1981;64(6):1227-34.
22. Instituto Brasileiro de Geografia e Estatística. (IBGE). Censo 2010. [Acesso em 2012 nov 11]. Disponível em: http://www.ibge.gov.br/home/estatistica/ populacao/censo2010/

23. Shaw LJ, Mieres JH, Hendel RH, Boden WE, Gulati M, Veledar E, et al. Comparative effectiveness of exercise electrocardiography with or without myocardial perfusion single photon emission computed tomography in women with suspected coronary artery disease: results from the What Is the Optimal Method for Ischemia Evaluation in Women (WOMEN) trial. Circulation. 2011;124(11):1239-49.

24. Alonso J, Permanyer-Miralda G, Cascant P, Brotons C, Prieto L, Soler-Soler J, et al. Measuring functional status of chronic coronary patients: reliability, validity and responsiveness to clinical change of the reduced version of the Duke Activity Status Index (DASI). Eur Heart J. 1997;18(3):414-9.

25. Carter R, Holiday DB, Grothues C, Nwasuruba C, Stocks J, Tiep B. Criterion validity of the Duke Activity Status Index for assessing functional capacity in patients with chronic obstructive pulmonary disease. J Cardiopulm Rehabil. 2002;22(4):298-308.

26. Ravani P, Kilb B, Bedi H, Groeneveld S, Yilmaz S, Mustata S, et al. The Duke Activity Status Index in patients with chronic kidney disease: a reliability study. Clin J Am Soc Nephrol. 2012;7(4):573-80.

27. Tavares LA, Barreto Neto J, Jardim JR, Souza GM, Hlatky MA, Nascimento AO. Cross-cultural adaptation and assessment of reproducibility of the Duke Activity Status Index for COPD patients in Brazil. J Bras Pneumol. 2012;38(6):684-91.

28. Sampaio RF, Mancini MC, Fonseca ST. Produção científica e atuação profissional: aspectos que limitam essa integração na fisioterapia e na terapia ocupacional. Rev Bras Fisioter. 2002;6(3):113-8.

29. Gadotti IC, Vieira ER, Magee DJ. Importance and clarification of measurement properties in rehabilitation. Rev Bras Fisioter. 2006;10(2):137-46.