Translation, Cultural Adaptation, and Validation of the Duke Activity Status Index in the Hindi Language

Abstract

Background: The Duke Activity Status Index (DASI) is a validated questionnaire in English to assess the functional capacity (FC) of patients with cardiovascular disease (CVD). **Aim:** The aim of the study is to translate, cross-culturally adapt, and validate the DASI in Hindi. **Settings and Study Design:** Observational validation study. **Methodology:** Different translators translated the DASI into Hindi and then back-translated it into English. Validation for feasibility and psychometric properties of translated questionnaire was done on 200 adults, Hindi-speaking patients with CVD, who were advised exercise testing by a cardiologist. **Statistical Analysis:** Internal consistency (Cronbach's α) and test–retest reliability (Pearson's correlation coefficient) were calculated. Construct (correlation with the Canadian Cardiovascular Society Classification [CCSC] for angina and exercise capacity with treadmill testing [TMT]) and content validity (time taken to fill the questionnaire, ease of understanding the questionnaire items, and comprehensibility) were calculated. $P < 0.05$ was considered significant. **Results:** The Cronbach's α for internal consistency was 0.78, which indicates adequate relatedness among the items of questionnaire, and the test–retest reliability was 0.65 ($P < 0.05$). A significant correlation between CCSC ($r = -0.60$) and TMT ($r = 0.56$) was found. The median time taken by the respondents to fill the questionnaire was 4 min. Of all the respondents, 95.74% of the respondents agreed that the Hindi questionnaire was easy to comprehend and 97.87% patients correlated the translated items to their daily physical activity. **Conclusions:** The Hindi translated and culturally adapted version of the DASI is reliable, valid, and feasible to assess the FC in the Hindi-speaking CVD patients.

Keywords: *Duke Activity Status Index, Hindi, translation, validation*

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Introduction

The Duke Activity Status Index (DASI) questionnaire was developed in 1989 by MA Hlatky to predict the functional capacity (FC) in patients with cardiovascular disease (CVD).[1] It has also been validated to quantify the FC in patients with chronic obstructive pulmonary disease (COPD), heart failure, chronic kidney disease (CKD), and cancer patients.[2-5] The peak oxygen consumption (VO_2) calculated by the DASI has also been tested for its criterion validity in predicting prognosis in stable peripheral artery disease, major noncardiac surgery, and disability-free survival after surgery with varying results.[6–8]

Quantifying the FC by calculating the VO_2 is done to prognosticate and look for treatment response.[9] VO_2 is calculated accurately with the help of cardiopulmonary exercise testing (CPET) using a cycle ergometer or a treadmill.[10] The DASI and a 6-min walking test are other simple and effective tools to calculate VO_2, and they are cheap and easy to perform in a resource-limited environment.[11,12]

Self-assessed FC by a patient shows different results from clinician assessment of FC.[13] When a clinician administered the DASI questionnaire, it had a better correlation with VO_2 as differences exist between clinician assessment and patient self-assessment of FC. The DASI is used more frequently as a self-administered questionnaire by the patients based on their daily activity. For self-administration by the patient, DASI has to be in the native language of the patients for easy understanding and application. No translation of DASI exists in Hindi though it has been translated into Portuguese, Brazilian, and Thai language.[14–16]

We decided to translate the DASI into Hindi, as well as made cultural adaptations

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and checked the reliability and validity of the translated questionnaire.

Methodology

The study was conducted in All India Institute of Medical Sciences (AIIMS), Rishikesh from May 2018 to December 2018. Permission was taken from the institutional ethical committee and Elsevier Rightlink to translate and cross-culturally adapt English version of the DASI into Hindi and later publish the Hindi version in a medical journal.

After explaining the purpose of the study, methodology, content of the questionnaire, and respondent's rights, written consent were taken from the patients. Patients between 18 and 60 years of age with CVD (coronary artery disease [CAD], heart failure, valvular heart disease, and symptomatic arrhythmia), who were able to read, speak, understand, and write Hindi and had studied at least up to grade six, were included in the study. Patients who had not given consent to be part of the study had physical disability, and vulnerable patient groups were excluded from the study. Methods to translate and validate DASI questionnaire were based on the methods given by Beaton *et al*.[17] Activities, which were not routinely performed in the studied population, were replaced with culturally adapted activities of equal metabolic equivalents according to the Compendium of Physical Activity.[18]

Forward Translation of questionnaire was done by two native Hindi-speaking translator. One of the translator was uninformed to the objective of the questionnaire while another translator, doing course in cardiac nursing, understands the objective of questionnaire. They made independent forward translations into Hindi and made report of the problems they faced during the translation. An expert committee was formed, which included one cardiologist, one epidemiologist, one professor in nursing, one senior Hindi translator, and two anesthesiologists. The committee synthesized a final version by combining the two forward translations, removing the challenging phrases, and resolving the discrepancies noticed between the two translators. They also made reports about the different nuances and rationale in making the synthesized version. Two experienced English teachers, naive to the objectives of the original questionnaire, back-translated this synthesized version into English. The committee observed any difference in the back translation from the original questionnaire. They also looked into the idiomatic (expression native to a language), semantic (connecting with the meaning of words or expression), conceptual (having same meaning across the culture), and experiential equivalence (cultural adaptation) of the prefinal translated questionnaire. This prefinal questionnaire was consolidated and finalized by the expert committee along with the four translators for clarity and relevance to the Hindi-speaking population. This prefinal version was
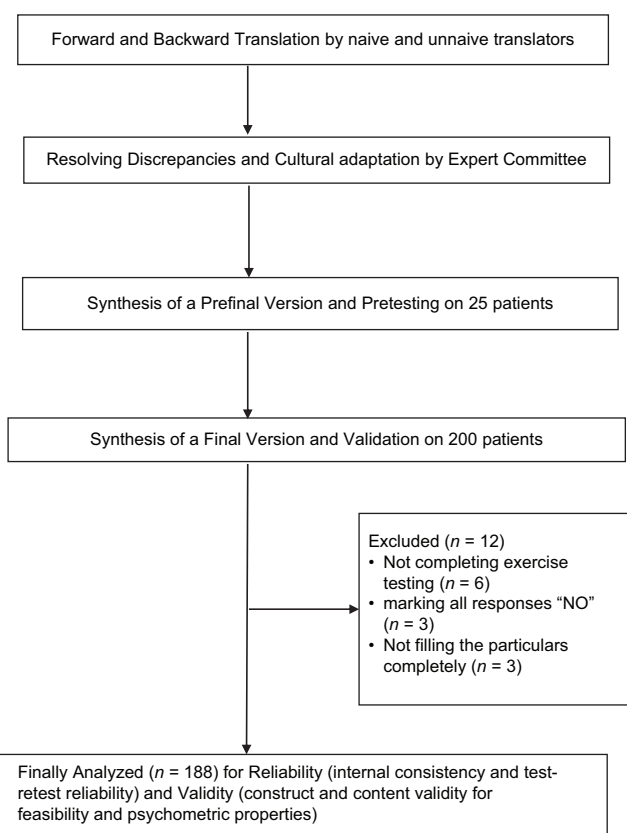

Figure 1: Process of translation and cross cultural adaptation

applied to a small population of 25 patients as an interview. Based on feedback (with open ended questions) about their understanding of the questionnaire, small changes were made in the prefinal version to create the final version. This final version was checked for its reliability and validity by testing on a population of patients with CVD who had been advised treadmill testing (TMT) by the cardiologist [Figure 1].

Similar to the original study for DASI development by MA Hlatky, the translated version of the DASI was validated using the exercise testing on a treadmill and Canadian Cardiovascular Society Classification (CCSC).

The CCSC is used for grading symptoms of angina based on limitation of patient's physical activity. Patients are grouped in four classes based on chest pain and level of activities performed, from unable to do any physical activity (Class IV) to no limitation of physical activity (Class I). The CCSA class and DASI scores were negatively correlated as performing activities of daily living become increasingly difficult with increasing CCSA class.[19] TMT was based on Bruce protocol using a treadmill (Mortara XScribe Milwaukee, WI USA). VO_2 was calculated from the following linear equations:

- Men- VO_2 (ml/kg.min) = (time-minutes from exercise test X 2.33) + 9.48
- Women- VO_2 (ml/kg.min) = (time-minutes from exercise test X 3.36) + 1.06[20]

ड्यूक गतिविधि स्थिति सूचकांक
Duke Activity Status Index
एक आत्म–प्रशासित प्रश्नावली है जो एक रोगी के कार्यात्मक क्षमता का अनुमान करता हैं।
इसका इस्तेमाल रोगी के चरम ऑक्सीजन के उपभोग के अनुमान को प्राप्त करने के लिये किया जा सकता हैं।

क्रम सं0	प्रश्नावली बिंदु	हाँ	नहीं
1	Take care of yourself, i.e., eating, dressing, bathing, or using the toilet?	2-75	0
	क्या आप खुद का ख्याल रख सकते हैं (खाने, कपडे बदलना, स्नान या शौचालय का उपयोग)?		
2	Walk indoors, such as around your house?	1-75	0
	क्या आप घर के अंदर या अपने घर के आसपास चल सकते है। ?		
3	Walk a block or two on level ground?	2-75	0
	क्या आप समतल जमीन पर 100–200 मीटर या थोडी दूर तक चल सकते हैं ?		
4	Climb a flight of stairs or walk up a hill?	5-50	0
	क्या आप सीढियों द्वारा दो मंजिल तक या एक पहाडी पर चढ सकते हैं ?		
5	Run a short distance?	8-00	0
	क्या आप थोडी दूर तक भाग सकते हैं ?		
6	Do light work around the house like dusting or washing dishes?	2-70	0
	क्या आप घर का हल्का काम कर सकते है जैसे बर्तन धोना या झाड पोछ करना ।		
7	Do moderate work around the house like vacuuming, sweeping floors, or carrying in groceries?	3-50	0
	क्या आप घर के सामान्य काम कर सकते है जैसे झाड़ू मारना या किराने का सामान घर लाना ।		
8	Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?	8-00	0
	क्या आप घर के भारी काम कर सकते है जैसे फर्श पर पौछा मारना या भारी फर्नीचर उठाना / खिसकाना ।		
9	Do yard work like raking leaves, weeding, or pushing a power mower?	4-50	0
	क्या आप बगीचे के काम कर सकते है जैसे पत्ते, खरपतवार हटाना या घास काटने वाली मशीन को धकेलना ।		
10	Have sexual relations?	5-25	0
	क्या आप यौन सम्बन्ध रख सकते ह		
11	Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?	6-00	0
	क्या आप मध्यम मनोरजंक गतिविधियों मे भाग ले सकते हैं जैसे नाचना, बैडमिंटन, क्रिकेट खेलना, धीरे – धीरे रस्सी कूदना या मध्यम गति से साइकिल चलाना।		
12	Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?	7-50	0
	क्या आप जोरदार खेल गतिविधियों मे भाग ले सकते हैं जैसे तैराकी, फुटबाल खेलना या तेज दौडना / जॉगिंग करना, पहाडी पर साइकिल चलाना ।		

ड्यूक गतिविधि स्थिति सूचकांक (DASI) = "हां" का योग _____
VO2peak = (0.43 x DASI) + 9.6
VO2peak = _____ ml/kg/min ÷ 3.5 ml/kg/min = _____ METS

Figure 2: Hindi-translated version of the Duke Activity Status Index questionnaire

Statistical methods

Statistics and results analysis were done using IBM Statistical Package for the Social Sciences (SPSS) software version 23. The sample size was taken as 200 patients, based on patient to number of questionnaire items ratio as 15:1 and assuming loss of 10% of the patients.[21] Systematic sampling was conducted on patients who were advised TMT in the outpatient department (OPD) of cardiology at AIIMS, Rishikesh.

Reliability was checked for internal consistency (Cronbach's α) and stability coefficient of the test–retest reliability was done after a period of 4 to 6 days in the same patients (Pearson's correlation coefficient *r*).

The translated version was checked for construct and content validity. Spearman's rank correlation coefficient value was calculated by correlation matrices to check the construct validity. Content validity was checked with patient's feedback about ease of understanding and answering the questions on a 3-point Likert scale (very easy, moderately easy, and easy). The time taken to fill the questionnaire and number of patients, who were able to complete the questionnaire on their own, were recorded. Any part of the question, which may be objectionable, was culturally unacceptable, intruded into their privacy, or hurt their sentiments, was also recorded.[22]

The normality of the data was tested with the Kolmogorov–Smirnov test (K–S test), normally distributed data were expressed as mean ± standard deviation (SD) and confidence interval (CI) of 95%, non-normally distributed data were expressed as median (interquartile range [IQR]), and numbers were expressed as proportions. $P < 0.05$ was taken as a significant difference.

Results

The results shown here are based on the analysis done on 188 patients (94% of the initially assessed patients), as 12 patients were excluded from the analysis because of the noncompletion of the exercise test, marking all the answers "No," and not completely filling their particulars. The results are shown in Table 1 and translated final version in the Hindi language is shown in Figure 2.

Discussion

The process of translating a questionnaire into a different language is a challenging task. After translating and culturally adapting the original questionnaire, the next step is to check for its psychometric properties in the target population and validated for its reliability and validity in an adequate sample.[23]

The original DASI questionnaire is a continuous quantified measure of FC. There are four activity domains in the original questionnaire, including personal care and ambulation, daily household chores, sexual activity, and recreational activities. This is a close-ended, self-administered questionnaire with response to the question as "Yes" or "No". Weighted scores were given to each questionnaire items answered "Yes" and zero score for items answered "No." The total score was calculated, and then, VO_2 was calculated from a linear regression equation.

A cross-cultural adaptation is a process that requires change in language or making cultural changes so that the adapted questionnaire works in a similar manner across different cultures. Although the questionnaire is translated into Hindi, it is difficult to apply the Hindi-translated version in a vast country like India where language, culture, and socioeconomic status changes from state to state.

Questionnaire items 1, 2, 4, 5, and 6, related to personal care and ambulation, were easy to translate without any cultural adaptation. In item 3, "walk a block or two" was replaced with walking 100–200 m, as blocks are not planned for distance in India. Questionnaire items 7, 8, and 9 had words like "vacuuming," "raking leaves," and "pushing a power mower" for which we could not find any suitable alternative as these are not the routine activities done in our target population. Majority of patients from hilly regions and rural areas were able to comprehend and answer the question related to gardening based on their farming practices.

We thought questionnaire item 10 to be culturally sensitive and difficult to answer, especially by females, although almost all of the respondents communicate no difficulty in answering. Many respondents said they are not able to work in the garden though they can have sexual relations. One of the reason this paradox may be that the metabolic equivalents spent for working in garden and having sexual relations are almost equal as per Compendium of Physical Activities.

Recreational activities in questionnaire items 11 and 12 were difficult to translate as almost none of the games mentioned like golf, bowling, double or single tennis, baseball, basketball, and skiing are popular in rural, hilly, or urban regions. Additionally, although cricket and football are popular in the Hindi-speaking population, they are considered as games of youth. The mid-elderly population correlates dancing as a recreational activity and cycling as a part of daily activity. Sporting activities that have been replaced with equivalent activities were selected from the Compendium of Physical Activity.

As we did not have two natives of English origin (who understand Hindi) for backward translation, we asked we asked two senior English teachers of Indian origin to do

Table 1: Results expressed as mean±SD, median (IQR), and proportion. *P*<0.05 is considered significant	
Statistical Tests	**Values**
Male: Female (Numbers) (Percentage)	126 (67%) : 62 (33%)
Age (Year Completed) (Mean±SD)	54.40±10.20
Cronbach's α for internal consistency	0.78 (adequate relatedness)
Pearson's correlation coefficient for test-retest reliability	$r = 0.65$ (*P*<0.05)
Construct validity	
CCSC functional status	$r = -0.60$ (*P*<0.05)
TMT (peak VO_2 consumption)	$r = 0.56$ (*P*<0.05)
Content validity: Feasibility	
Independent completion of the questionnaire; numbers (%)	172 (91.49%)
Median time (min) taken to complete the questionnaire	4 (3-5)
Content validity: Psychometric properties numbers (%)	
Easy to understand	180 (95.74%)
Easy to complete	175 (93.09%)
Relate to their daily activity	184 (97.87%)

SD=Standard deviation, CCSC=Canadian Cardiovascular Society Classification, VO_2=Peak oxygen consumption

the back translation of the DASI questionnaire from Hindi to English language.

After translation and pilot testing, tests of reliability and validity were done to check whether the translated questionnaire was assessing the equivalent construct in a different setting. Reliability means an agreement to the measured value at different points of time by same or very similar methods. Internal consistency reflects the relatedness between the items in measuring the construct of interest. It is estimated using Cronbach's α, which depends on the number of items in the questionnaire and the variance of the items.

Cronbach's α value 0 means no relatedness and value 1 indicates perfect internal consistency. A value of more than 0.7 is considered good or an adequate internal consistency while a value above 0.9 means that the items are asking the same thing in different ways. Our value of α comes out to be 0.78, which looks good in our target population and shows adequate variance among the items.

The test–retest reliability was checked for the consistency of answers of respondents by administering the same questionnaire twice to the same population. The test–retest reliability is applicable to those questionnaires, which measures stable attributes and is measured by coefficient of stability (Pearson's r). Test–retest should be done after an adequate gap of time (4 to 6 days) to let the memory fade in recalling the last answer but the gap should not be long enough to prevent other factors from changing the last response.

Validity or accuracy means an agreement to the measured value when measured by two maximally different methods. For our newly developed and translated questionnaire, we assessed construct validity and content validity. Construct validity is an important concept to understand a questionnaire's performance in the behavioral domain. It is measured by looking for association with a similar construct measured by a different pre-existing instrument. Correlation matrices are then used to look for association whether negative, positive, or none at all and also to find out whether the correlation coefficient is small (0.1), moderate (0.3), or large (0.5).[24]

Exercise testing on a treadmill was used to calculate VO2 though directly measuring the oxygen consumption with gas analyzer is more accurate. A correlation value of 0.56 with TMT and −0.6 with CCSC was close to the value attained in the original DASI and the Portuguese version of DASI translation, which is expected in a self-administered questionnaire.

Content validity assumes more importance than construct validity when a new questionnaire is developed in checking the feasibility of the translated construct. The expert committee assessed the content validity on the following parameters:

- Feasibility of the questionnaire in the Hindi-speaking population
- Time taken for answering the questionnaire
- The ability to understand and complete the questionnaire by themselves.

Another important part of content validity is face validity, which refers to the suitability of the questionnaire to the layperson. In the content validation form, respondents feels that the questionnaire items were definitely related to their activity of daily living and recreation.

Limitations in translated DASI

The "known group validity" and "inter-rater variability" were not checked for populations living in urban areas or metro cities with the same questionnaire. Similarly, the translated questionnaire needs to be applied in different cohorts of patients (like patients with pulmonary disease, preoperative patients) to detects its discriminating abilities across various cohorts in predicting FC or prognosis.

In our study we should have included an equivalent number of patients in each CCSC class to increase the variability of the estimates. Only four patients (3.33%) were of the CCSC class IV while class II and III combine have 80 patients (66.67%). As class IV patients were not advised TMT, their representation is very low in our study.

To examine the high ceiling effect (14.16%) found in our study, the translated version of DASI should be repeated after completion of the treatment (as the patient's functional status improves). A high ceiling effect (>15%) means that more patients are scoring higher in the construct, which may raise a question about the validity of the construct.

Another limitation was that construct validity was not checked with CPET (the gold standard for calculating VO2; exercise testing with gas analyzer), which would have been a better validation tool than TMT. But, it is preferred to make comparisons with the similar tests (if feasible) used in the original version to see that the translated version performs in the same manner.[17]

Future direction calls for developing a new scale that can replace TMT or CPET by calculating VO_2 without the use of costly and arduous equipment in a resource-limited environment. Some questions in the DASI have variations in terms of outcome or level of performance (playing sports or having sexual activity). A questionnaire that will be more pragmatic, patient-centered, and acceptable to people across cultures and economic statuses will be the need for our next research.

Conclusion

Results of our study show that the translated questionnaire in Hindi language is reliable, valid and show psychometric as well as conceptual equivalence in the Hindi-speaking patients with CVD to assess their FC. The Hindi

version of the DASI questionnaire is more feasible and better correlated to patient's daily physical activity in Hindi-speaking patients.

Acknowledgements

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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