

Agreement between Duke Activity Status Index and Modified Veterans Specific Activity Questionnaire in Healthy Individuals: A Cross-sectional Study

Poonam R Navbade¹, Raziya M Nagarwala², Rachana P Dabadghav³, Ashok K Shyam⁴, Parag K Sancheti⁵

ABSTRACT

Background: Metabolic equivalents (METs) are used during exercise testing as an estimate of functional capacity. There are specifically designed questionnaires to find out MET and exercise capacity. The Duke Activity Status Index (DASI) is a self-administered questionnaire designed to assess physical function and predict exercise capacity. The Modified Chinese version Veterans Specific Activity Questionnaire (VSAQ) is a 13-item self-administered questionnaire that estimates functional capacity expressed in METs.

Materials and methods: Two hundred and thirty participants were included in the study according to inclusion criteria and were made to answer DASI and Modified Chinese version VSAQ, and METs were calculated. Participants performed treadmill test, i.e., Bruce Protocol. All the vital parameters were assessed before and after the completion of the treadmill test and METs achieved at that stage were noted.

Results: The limits of agreement between DASI, VSAQ, and Bruce Protocol were assessed using Bland–Altman method. Duke Activity Status Index and Bruce Protocol showed $p = 0.001$, CI – 95%, and Modified Chinese version of VSAQ and Bruce Protocol showed $p = 0.001$, CI – 95%. The mean of MET calculated by the Modified Chinese version of VSAQ was statistically close to the mean of MET calculated by Bruce Protocol MET.

Conclusion: There is no agreement between DASI and the Modified Chinese version of VSAQ with Bruce Protocol in healthy individuals. The Modified Chinese version of VSAQ has closer MET values to Bruce Protocol. Hence, the Modified Chinese version of VSAQ may be considered for the assessment of functional capacity in the Indian population.

Keywords: Bruce Protocol, Duke activity status index, Functional capacity, Metabolic equivalent, Modified Chinese version of veterans specific activity questionnaire.

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INTRODUCTION

To know the physical activity level of an individual, metabolic equivalent (MET) is useful. Metabolic equivalents are a simple, practical, and easily understood procedure to quantify the energy cost of activities.¹

Metabolic equivalents are described as the caloric consumption of an individual compared with the resting basal metabolic rate at rest. They are used during exercise testing (ET) as an estimate of functional capacity, or aerobic power, as well as it provides a list of activities that the subject can safely engage in.¹

The functional capacity reflects the ability of an individual to perform the activities of daily living that require corresponding aerobic metabolism. The combined efforts and health of the pulmonary, cardiovascular, and skeletal muscle systems dictate an individual's functional capacity.²

Metabolic equivalents are a practical, standardized, and convenient way to express the absolute intensity of physical activities. 1 MET is equivalent to an oxygen uptake of 3.5 [mL/kg/min].²

Exercise testing provides information on exercise capacity and helps in the planning of treatment Protocol. It also facilitates the assessment of potential risk for an individual. Various treadmill or cycle ergometer tests are used for ET.

In this study, we have used Bruce Protocol to calculate MET.³ At each stage, the individual's vital parameters (heart rate, oxygen saturation, blood pressure, respiratory rate) were checked. There is also an increase in MET value at each stage normally about 2–3 METs or more in healthy populations.⁴

¹Sancheti College of Physiotherapy, Pune, Maharashtra, India

²Cardiovascular-respiratory Physiotherapy Department, Sancheti Institute College of Physiotherapy, Pune, Maharashtra, India

³Physiotherapy Department, Sancheti Institute College of Physiotherapy, Pune, Maharashtra, India

⁴Department of Orthopaedics, Sancheti Institute of Orthopaedics and Rehabilitation, Pune, Maharashtra, India

⁵Physiotherapy Department, Sancheti Institute of Orthopaedics and Rehabilitation, Pune, Maharashtra, India

Corresponding Author: Raziya M Nagarwala, Cardiovascular-respiratory Physiotherapy Department, Sancheti Institute College of Physiotherapy, Pune, Maharashtra, India, Phone: +91 9850816350, e-mail: rnagarwala@yahoo.com

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There are specifically designed questionnaires to find out MET and exercise capacity.

The Duke Activity Status Index (DASI) is a self-administered questionnaire. It is a 12-item questionnaire that measures overall metabolic expenses of daily activities like personal care, ambulation,

household tasks, sexual function, and recreation. Based on the metabolic expense, each item has a specified weight (MET). The ultimate score could range from 0 to 58.2 points. The higher the score, the better is the functional capacity.⁵

Veterans Specific Activity Questionnaire (VSAQ) is another questionnaire-based scoring for MET value. It was developed for the individualization of ET. In this, 13 items are enumerated for corresponding MET.⁶

Wang et al. validated the Modified Chinese version of VSAQ. The Modified Chinese version of VSAQ is a 13-item self-administered questionnaire that estimates aerobic fitness expressed in METs. It is designed to measure the maximal level of physical activity that an individual can achieve.⁷

The Modified Chinese VSAQ includes activities that are more appropriate for the Indian population than the original VSAQ. There are limited studies done to check the Modified Chinese VSAQ.

Khan et al. validated DASI as a predictable measure for the assessment of functional capacity in healthy individuals. They correlated maximum oxygen uptake (VO₂ max) obtained from a subjective measure using the DASI scale with an objective assessment of aerobic capacity measured by VO₂ max (using predicted VO₂ equation) during submaximal ET in young healthy individuals. They concluded that the subjective functional scales (DASI) used to assess basic physical capacity have moderate ability to predict actual functional capacity as measured by VO₂ max achieved by an objective assessment of aerobic capacity by ET in young healthy individuals.⁸

In situations where the ET cannot be performed, the DASI and Modified Chinese VSAQ can be replaced with the ET for the exercise capacity assessment, to follow-up the physical fitness evolution as well as to detect the mortality risk, especially in individuals with cardiopulmonary disease.

The purpose of the study was to check whether DASI and Modified Chinese version of VSAQ is appropriate to measure MET level in the Indian population, and hence the aim was to check whether there is an agreement between DASI and Modified Chinese VSAQ with Bruce Protocol for Functional Capacity in healthy individuals.

MATERIALS AND METHODS

After the approval from the ethical committee (ref. IEC-SIOR/Agenda 059), 230 subjects both male and female were recruited in the study. The inclusion criteria were participants in the age-group of 18–28 years who were healthy adults without any comorbid illness those who answered No for all questions on PAR-Q and You were included. Participants with any neuromusculoskeletal problems, cardiovascular and respiratory problems, and any other systemic illness were excluded from the study. All the participants were asked to sign an informed consent.

Participants were made to answer DASI and Modified Chinese version of VSAQ, and MET was calculated. The modified Chinese version of VSAQ represents the MET values for each activity.

For calculation of MET by DASI, the formula used is:

$$VO_2 \text{ peak (mL / kg)} = 0.43 \times \text{DASI score} + 9.6$$

$$\text{MET} = VO_2 \text{ peak} / 3.5 \text{ mL / kg / min}$$

where VO₂ peak is maximal oxygen consumption.

All subjects underwent a treadmill test with Bruce Protocol. Instructions for the treadmill test were given to the subjects before

the testing. The vital parameters heart rate (HR), respiratory rate (RR), blood pressure (BP), and oxygen saturation (SpO₂) were assessed before and after the completion of the treadmill test. Metabolic equivalents were achieved at that stage and the reason for stopping the test was noted.

Statistical Analysis

Statistical analysis was done by using the SPSS version 26. Descriptive statistics (mean and SD) were done for all the data. Bland–Altman method was used to check the limits of agreement between METs assessed by DASI, VSAQ, and Bruce Protocol. The level of significance for the statistical test was set at $p \leq 0.05$.

RESULTS

Two hundred and thirty participants were assessed using DASI, Modified Chinese versions of VSAQ, and Bruce Protocol, and METs were analyzed. The p value of the DASI and Bruce Protocol was found to be, $p = 0.001$, which was < 0.05 , and the Modified Chinese version of the VSAQ and Bruce Protocol was $p = 0.001$, which was < 0.05 . Metabolic equivalents calculated by Bruce Protocol compared with MET calculated by DASI and Modified Chinese version of VSAQ by Bland–Altman method were statistically significant. The mean of MET calculated by the Modified Chinese version of VSAQ was statistically close to the mean of MET calculated by Bruce Protocol METs. The mean of MET calculated by the Modified Chinese version of VSAQ was 12.26 and the mean of MET calculated by Bruce Protocol was 13.25.

p value – DASI and Bruce Protocol: CI – 95%, $p = 0.001$, which is < 0.05 suggesting there is a significant difference in their MET values (Table 1).

Modified Chinese version of VSAQ and Bruce Protocol: CI – 95%, $p = 0.001$, which is < 0.05 suggesting there is a significant difference in their MET values (Table 1).

This result suggests that the magnitude of METs between the DASI and Bruce Protocol and the Modified Chinese version of the VSAQ and Bruce Protocol are not in agreement. But the mean of MET calculated by the Modified Chinese version of VSAQ was statistically close to the mean of MET calculated by Bruce Protocol METs (Table 2).

Table 1: p value of DASI, modified Chinese version of VSAQ, and BRUCE protocol

METs assessed using	N	p value	
DASI	230	< 0.001	95% confidence interval
Modified Chinese version VSAQ	230	< 0.001	
Bruce Protocol	230	< 0.001	

Table 2: Mean and standard deviation between DASI, modified Chinese version of VSAQ, and BRUCE protocol

METs assessed using	N	Mean	Std. deviation
DASI	230	9.77	0.308
Modified Chinese version VSAQ	230	12.26	0.966
Bruce Protocol	230	13.25	2.023

DISCUSSION

One of the components for the assessment of the functional capacity is to calculate the METs level.

Duke Activity Status Index and Modified Chinese version of VSAQ scales assess the individual's activities of daily living which calculate functional capacity in terms of METs. The activities in the scales represent major aspects of physical function.^{5,7}

In this study, METs calculated by DASI and the Modified Chinese version of VSAQ have a statistically significant p value ($p < 0.01$) with METs calculated by Bruce Protocol analyzed by using Bland–Altman method (Table 1). The mean of MET calculated by the Modified Chinese version of VSAQ was statistically close to the mean of MET calculated by Bruce Protocol METs (Fig. 1).

We found that both DASI and the modified Chinese version of VSAQ are not in agreement with Bruce Protocol because the maximum values of MET calculated by these three scales are different. Subjects achieved higher MET values with Bruce Protocol.

The maximum value of MET in DASI, Modified Chinese version of VSAQ, and Bruce Protocol are different. Duke Activity Status Index has a maximum MET value of about 9.89. The Modified Chinese version of VSAQ has a maximum MET value of 13. Bruce Protocol has the highest met value about 22.7. In our study, participants achieved MET up to 16.3 with Bruce Protocol.

Kojima et al. assessed the relationship between age and exercise capacity predicted by modified VSAQ and 6 minutes walk test and correlated the MET values. They found a moderate correlation between METs calculated by modified VSAQ and 6 minutes walk test.⁹

A study conducted by Bastone et al. where they compared the aerobic capacity of older adults in terms of METs measured by the VSAQ with the METs found in an incremental shuttle walk test. They found moderate agreement with the METs measured by VSAQ and Incremental Shuttle Walk Test.¹⁰

Rankin et al. measured the functional capacity in cardiac patients using Specific Activity Questionnaires (SAQ) such as DASI, VSAQ, and Specific Activity Scale (SAS). They found that DASI and VSAQ had a much better correlation with the treadmill Protocol. They concluded that the SAQ should be a useful tool in

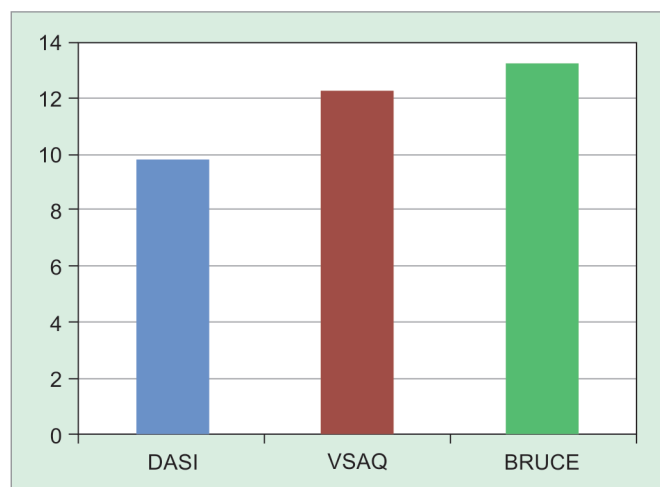


Fig. 1: Mean value of DASI, modified Chinese VSAQ, and Bruce Protocol

cardiac population studies when individual ET is impractical or uneconomical.¹¹

Most of the studies are done in the elderly population or patients with cardiac diseases. In our study, the participants were healthy, exercising, and without any comorbid illness. So they achieved MET higher with Bruce Protocol on the treadmill than DASI and Modified Chinese version of VSAQ. Hence, we found no agreement between DASI and the modified Chinese version of VSAQ with Bruce Protocol in healthy individuals.

Duke Activity Status Index and Modified Chinese version of VSAQ both the scales provide information about activities limited by the disease and its impact on patient's life as well as in healthy individuals. These scales measure functional capacity in the elderly, people with cardiovascular disorders more appropriately than healthy individuals.

One of the limitations of the study was that most of the population included in the study were exercising and achieved a higher MET level with Bruce Protocol. Future studies are required to analyze the agreement between the DASI and Modified Chinese version of VSAQ with Bruce Protocol non-exercising subjects.

CONCLUSION

In this study, we found that there is no agreement between DASI and the Modified Chinese version of VSAQ with Bruce Protocol in healthy individuals. The Modified Chinese version of VSAQ has closer MET values (MET-12.26) to Bruce Protocol (MET-13.25). Hence, a Modified Chinese version of VSAQ may be considered for the assessment of functional capacity where treadmill Protocol is impractical.

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