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Translation and validation of Marathi version of Borg CR10 scale

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Abstract
The present study was conducted to translate the original English version of the Borg CR10 scale into Marathi language. The purpose of this study is to evaluate validity of the Marathi translated version of the scale. An observational study was conducted on 50 healthy individuals. The study was conducted in two parts, first including the translation of the English version of the modified Borg CR10 scale into Marathi language. Second is validation of the Marathi version of Borg CR10 scale was carried out. Then Pearson's correlation coefficient was calculated between subjective and objective measures. The result of the study showed that there was linear correlation between rate of perceived exertion and heart rate (r = 0.37). A two-tailed p-value is 0.0068 which is considered very significant. This study concluded that the Marathi version of Borg CR10 scale a valid tool to measure perceived exertion during 6MWT in a healthy population.

Keywords: Marathi, Borg CR10 scale, validity

Introduction
Physical activity continues to take on an increasingly important role in the prevention and treatment of multiple chronic diseases, health conditions, and their risk factors [1]. Physical activity is an important component of many rehabilitation programs [2]. Exercise intensity is probably the most important component of the exercise prescription in terms of safety and efficacy [2].

Physiological work or exercise intensity is typically assessed using objective and subjective methods. [3] Maximal oxygen consumption (VO2max) by definition is the ability to consume, transport, and utilize oxygen during exhausted work and is considered Gold standard for objectifying exercise intensity [3]. Heart rate (HR) because of its linear relationship with % $VO2_{max}$ is in turn considered as a silver standard to measure exercise intensity [3].

A sufficient level of intensity is needed to induce a training effect without initiating abnormal clinical sign and symptoms [2].

Typically, heart rate is used to monitor exercise intensity. however, some medication, autonomic dysfunction, mode of exercise, environmental condition, and psychological influences may affect heart rate and heart rate response to exercise [2].

Distinct from these objective methods, the rating of perceived exertion (RPE) scale integrate signals from various sources such as peripheral working muscles and joints, cardiovascular, respiratory, and central nervous system giving a subjective perception to quantify exercise intensity [3].

RPE is one of the methods that may help client or patients to monitor exercise intensity without the need to palpate pulse [2].

Rating of Perceived Exertion (RPE) is used to subjectively quantify an individual's perception of the physical demands of an activity [2].

American College of Sports Medicine (ACSM) has recommended RPE since 1986 for both fitness and cardiac rehabilitation purpose [4].

'Borg Scale' is the most widely used RPE tool.

Borg's Rating of Perceived Exertion (RPE) is based on subjective feeling of exertion and fatigue during exercise, and it is used to asses and regulate exercise intensity [4].

Borg developed ratings of perceived exertion (RPE) scales in the 1960s and 1970s [5].

The assessment of perceived exertion scales has become a ubiquitous practice in fitness and clinical settings to quantify subjective feelings of fatigue and exercise tolerance when prescribing safe amounts of exercise [5].

The most common applications of Borg Scale are found in exercise test on healthy people or patient and rehabilitation of cardiac patients [6]. The scale is also useful to athletes for determining and monitoring the appropriate intensity level for their training [6]. In many daily activities the scale offers an important way to compare the exertion and difficulty when using different tools [6].

The 2 most widely used scales of perceived exertion in Exercise were developed by Borg; they are Borg's 6–20 RPE and category ratio scale (CR-10) [7].

The original Borg 6 to 20 was designed to match the heart rate response i.e.,9 was correlated with very light effort and a heart rate of 90 beats/minute [8].

Rating of Perceived Exertion (The Borg CR10 scale) has been correlated with VO2, making it is a useful mean of prescribing and monitoring exercise intensity [9]. Perceived exertion rating of 3, 4 and 5 were correlated with 60%, 72%, and 78% of VO2max, respectively [9].

A variation of the RPE scale uses rating of perceived dyspnoea (RPD) as a gauge for exercise intensity. Perceived dyspnoea rating between 3 (moderate shortness of breath) and 6 (between severe and very severe shortness of breath) define the range within which patient with pulmonary dysfunction generally exercise [9].

During performance testing, perceived level of fatigue can be documented using the Borg Scale for Rating of Perceived Exertion.[9] In order to better determine the level of muscle fatigue, the therapist should ask the patient to identify two separate scores, one for the level of muscular fatigue and one for the level of central fatigue(breathlessness) [9]. The therapist is then able to differentiate between peripheral factors and central factors contributing to fatigue [9].

The 6 to 20 scale was considered difficult to understand, so the revised 0 to 10 scale was developed [8]. Although subjective measure of exercise intensity, both Borg scale provide valuable insight into the intensity of exercise [8].

As the RPE scale denotes the subjective perception of physical effort, it should be in a language easily understood by its user [3]. For this reason, efforts to translate the scale into different languages have been made recently [3]. Researchers mainly reported a strong positive linear relation between subjective (RPE) and objective (HR, VO2max, and power output) measures of exercise intensity with moderate to high correlations when the English RPE scale was translated into Japanese, Cantonese and Chinese [3].

There is a wide increase in a number of multicultural research projects with the need for translation, validation and generalization of health care instruments for its use in other than the source language [3]. Cross-cultural adaptation is a process aiming in translation of an instrument and its adaptation for a sample of population different from the original population where it is applied [3]. This process is faster, economical, and reliable in comparison with the processes involved in creating a new instrument hence, it is frequently been used [3].

Besides the original English version, the Borg RPE scale users in several countries have translated the scale into their own respective languages without relying upon an empirically supported cross-cultural adaption process, including, for example Brazilian Portuguese, Cantone, Japanese, French, Yoruba, Persian.

India is a country in south Asia, according to population census 2011 the population of India was 1210.2 million. [10] India is home to several hundred languages.

According to census 2011, Marathi speakers in India are 8,30,26,680 of the total population [11].

Maharashtra is one of the major states of north India. Maharashtra is the second populous state in India according to population census, the population of the state was 11,23,74,333, The literacy rate of the state was 82.91% [12].

Marathi is the most widely spoken and also the official language of the Maharashtra. According to census 2011, scheduled languages in Maharashtra out of 10,000 Marathi speakers are 6893 [11].

It is therefore very difficult for patient whose English is not his or her first language to fully understand and interpret Borg RPE Scale, since it is designed in English language and in a different population setting. It may however difficult to use in an environment like this where Marathi is a major language.

Since the people who didn't understand English for those people it will be barrier to interpret their exertional level. This shows how much the translation of Borg RPE scale into Marathi language is important to determine the level of muscle fatigue and central fatigue without the barrier of language.

Till now no version of Borg RPE into Marathi language is available.

Subjects and Method

After getting approval from the Institutional Ethical Committee an observational analytical study was conducted on 50 healthy individuals. Subjects were selected according to inclusion criteria i.e. between 20 and 70 years of age without any existing cardiopulmonary conditions and all of them were able to read and understand Marathi Language properly.

Subjects were having any gait abnormality due to any Musculoskeletal, Neurological, and Cardiovascular, Pulmonary and/or Visual impairments were excluded from the study.

The study was conducted in two parts

1st part included translation of English version of Modified Borg CR10 Scale in Marathi language. 2nd part included validation of Marathi translated version of Borg CR-10 scale by comparing the subjective value of RPE with the objective parameter of heart rate during 6 MWT.

Phase 1: consisted of translation of Marathi version of Borg CR10 scale.

Step 1: Forward translation: Two translators were asked to independently translate the English version of Borg CR10 scale into Marathi language.

Step 2: Synthesis of the translation: These two translated versions were reviewed by a three-member panel of health professional's expert in the field of cardiovascular and respiratory physiotherapy and fluent in both languages [13]. Any questionable issues or language related problems were solved by this panel [13]. Finally, a single version was accepted after combining the items and coming to a consensus on each item in the Marathi scale [13].

Step 3: Back translation: final version then retranslated by two health professionals who were fluent in English. [13] These two translators were unaware of the previous translation. [13]

Step 4: Both translated versions were again reviewed by the panel, and it was then compared with the original questionnaire [13]. Any specific words which did not match in two versions were discussed by the committee and the appropriate word was used in the scale. The expert committee amalgamated both the versions of the scale, resolved discrepancies, and developed a pre-final version of the scale for pilot testing.

Step 5: Pilot testing: To use the pre-final version of the Marathi translated version of the Borg CR10 scale, pilot testing was done on the 10 healthy individuals who gave consent to participate in the study. Each of them was given the Marathi translated version of Borg CR-10 scale and asked them to rate their perceived level of exertion. They showed some difficulty in understanding the newly developed Marathi translated version of the Borg CR10 scale, that were discussed with the panel and the pre-validated version of the scale was finalised.

Phase 2: Validation of the Marathi translated version of Borg CR-10 Scale.

The finalised Marathi translated version of the Borg CR10 scale was then given to the individuals carefully selected according to the inclusion and exclusion criteria. Informed consent was obtained from them. Demographic data of the participants including age, gender, height, weight was noted. Procedure was explained to the participants in brief. Introduced the Marathi translated version of the Borg CR10 scale, standard instructions for the use of the scale and verbal explanation about the scale should be interpreted in numerical form was given. Pre-exercise resting Heart rate, blood pressure, respiratory rate, SPO_2 and rate of perceived exertion of each participant were recorded. Then 6-minute walk test were performed on the participants and vitals were recorded immediately, 1 minute, 3 minute and 9 minutes after the test. accordingly, participants were instructed to rate their perceived exertional level in terms of numerical value on Marathi version of Borg CR10 scale. Each participant was monitored until their vital parameters, i.e., heart rate, blood pressure, respiratory rate and RPE returned to baseline. All data were recorded on 6-minute walk test report sheet.

Results

- Total number of 50 healthy individuals were participated in study between the age of 20-70 year out of which 32 were females and 18 were male.
- 6 Minute Walk Test were performed on them and pre and post vitals were recorded. Individuals have been asked to rate their perceived exertional level on the Marathi translated version of Borg CR10 Scale.
- Table 1: shows the numbers of individuals who participated in study. 18 male participants and 32 female participants. Hence, 64% are female and 36% are male participants.
- Table 2: shows that number of individuals who participated in study according to distribution of age group. Hence, out of 50 participants 31% individuals are between the age of 20-29 year, 12% between the age of 30-39 year, 19% between the age of 40-49 year, 23% between the age of 50-59 year, and 15% individuals between the age of 60-69 year were participated.
- Figure 3 shows there is a linear correlation between RPE and Heart rate in overall population, total number of participants were 50, Correlation coefficient (r) found to be 0.3782 and the two-tailed P value is 0.0068, considered very significant.
- Figure 4 shows linear correlation between RPE and Heart rate in female individuals Correlation coefficient (r) found to be 0.4625 and the two-tailed P value is 0.0077, considered very significant.
- Figure 5 shows linear correlation between RPE and heart rate in male individuals, Correlation coefficient (r) value is 0.1247 and the two-tailed P value is 0.6221, considered not significant.

Discussion

Borg scale is an outcome measure scale used in knowing exercise intensity prescription. For the Marathi speaking people to interpret their level of exertion without barrier of language, original English version of modified Borg CR10 scale was translated into Marathi version. The back translation of the Marathi version of Borg CR10 scale was accomplished successfully, an integrated version was created from all the translated versions while maintaining the meaning of each item in the back translation. Some individuals who took part in the pilot study claimed that it was difficult to understand the wording used in a few of the scale's elements. Those items were discussed with the panel of people who are experts in cardio-vascular-respiratory field, according to the panel there was no requirement for any changes in the items of scale but it was advised that the scale should be explained to the people in detail. It is vital to confirm the scale's validity for use in subsequent study after it has been translated into the source language. To finalize the Marathi version of the scale, expert opinion was sought following the validation of the Borg rate of perceived exertional scale utilized content validity.

A systematic review of cross-cultural adaptation and validation of Borg RPE scale utilized Concurrent validity as the only method of validation for Borg's scale (6-20).[3] This type of validity is most frequently found in correlations related with ratings of perceived exertion, probably due to the ease of relating the scale with physiological measures of HR, oxygen consumption, rate of ventilation, etc., that have already been validated for evaluating the intensity of exercise.[3] Borg 6-20 RPE Scale was originally validated against HR between 60 and 200 beats/min (r = 0.80-0.90), and since then it has been researched extensively.[3]

In the study done by Riddhi R Shah, Razia Agarwal, Seema Rethread, Rachana Dabanga, Ashok Sham, Parag Sachet, Translation and Validation of the Modified Borg Scale (CR-10) in Hindi Language in Healthy Indian Adults in 2022, showed that there was a high positive correlation between RPE and HR with r = 0.822, $p<0.01$ and r = 0.97, $p<0.05$ by using two different methods of statistical analysis, There was a moderate correlation between RPE and VO2 max with r = 0.587, $p<0.01$ and a high correlation with r = 0.98, $p< 0.05$ [3].

Thus, in the present study, using standard measure i.e., heart rate, the concurrent validation of Marathi translated version of modified Borg CR10 scale was constituted. This study found a linear correlation between rate of perceived exertion

and heart rate during a 6-minute walk test in healthy individuals using a Marathi translated version of the modified Borg CR10 Scale.

Table 1: Shows that number of healthy individuals who participated in study.

Gender	No of Participants
Overall	50
Male	18
Female	32

Table 2: No of individuals participated in study according to distribution of age criteria.

Age Group	No of participants
20-70 years	50
20-29 years	15
30-39 years	6
40-49 years	9
50-59 years	11
60-69 years	7

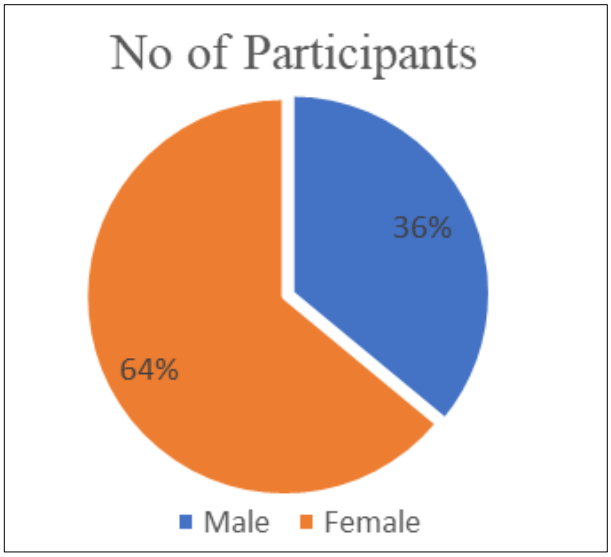


Fig 1: Shows that number of healthy individuals who participated in study.

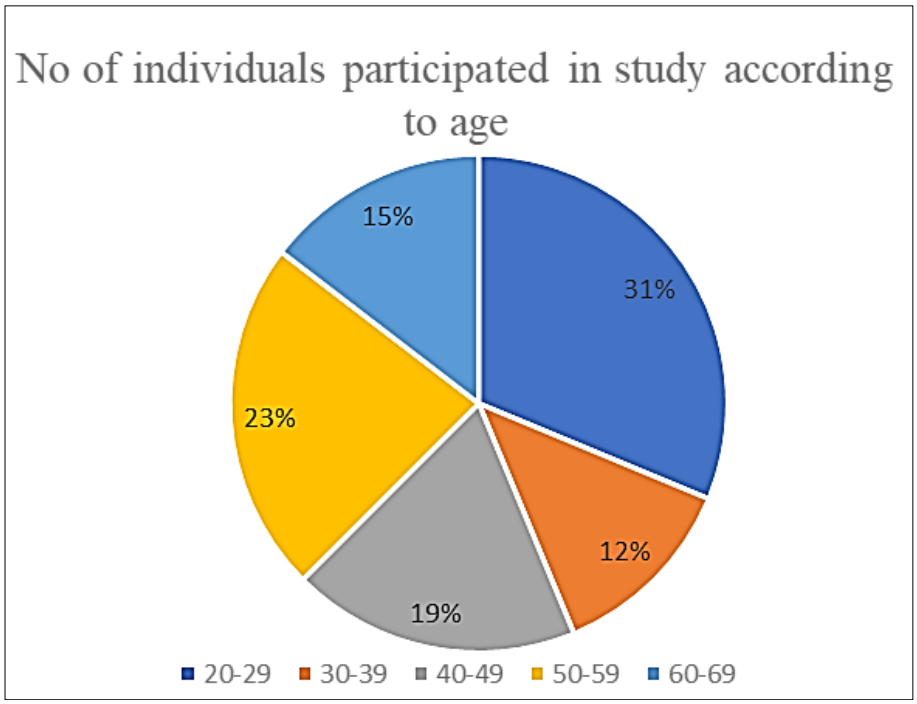


Fig 2: Shows that number of individuals participated in study according to age criteria.

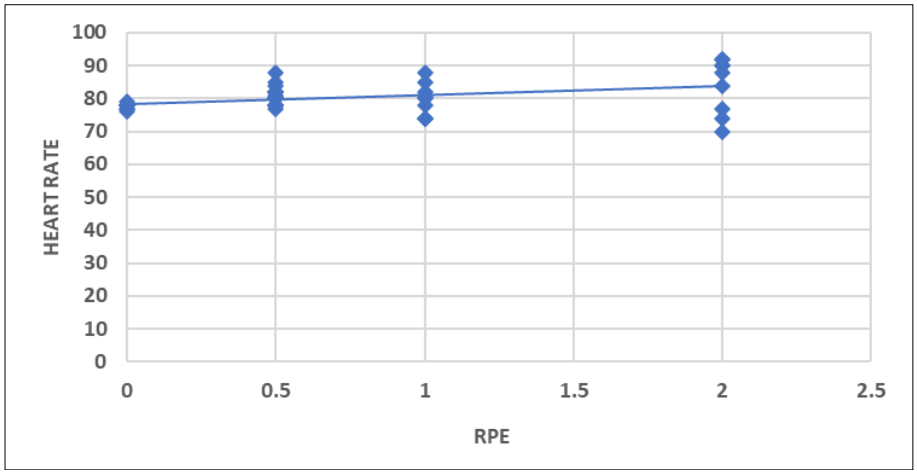


Fig 3: Linear correlation between RPE and heart rate in overall population

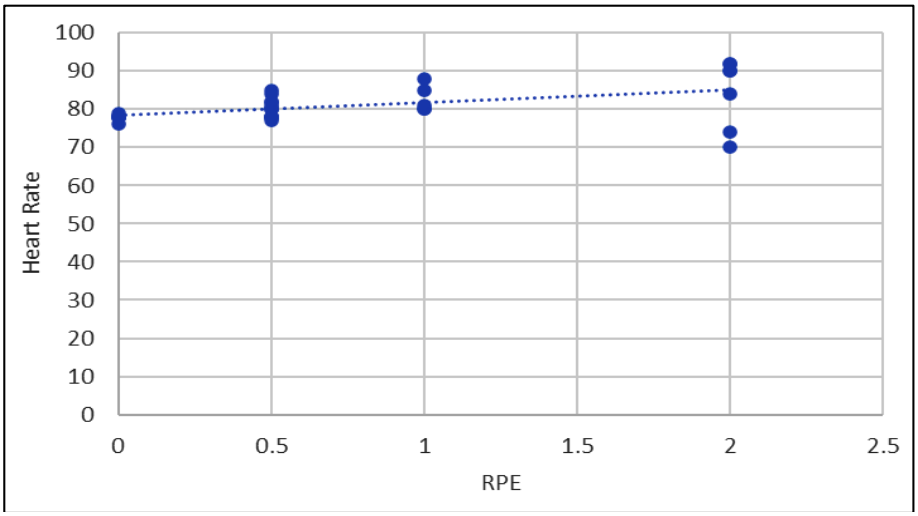


Fig 4: Linear correlation between rpe and heart rate in female individuals

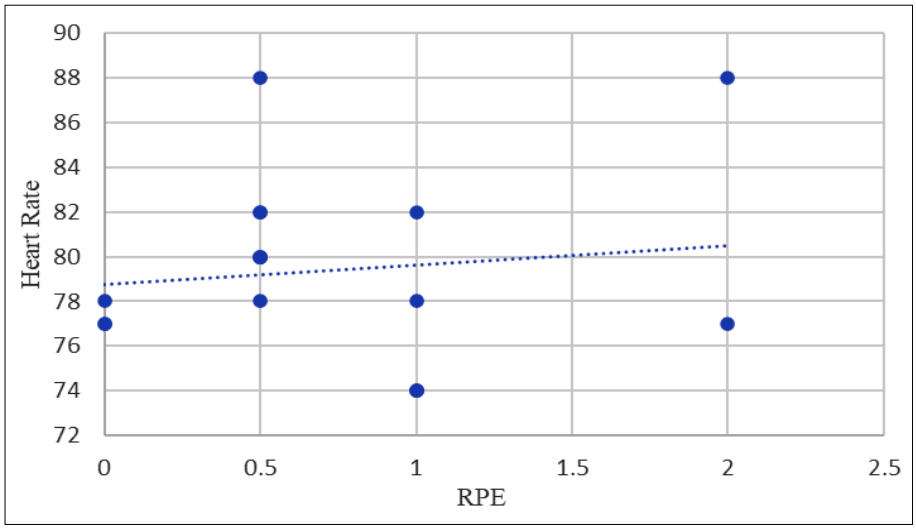


Fig 5: Linear correlation between rpe and heart rate in male individuals

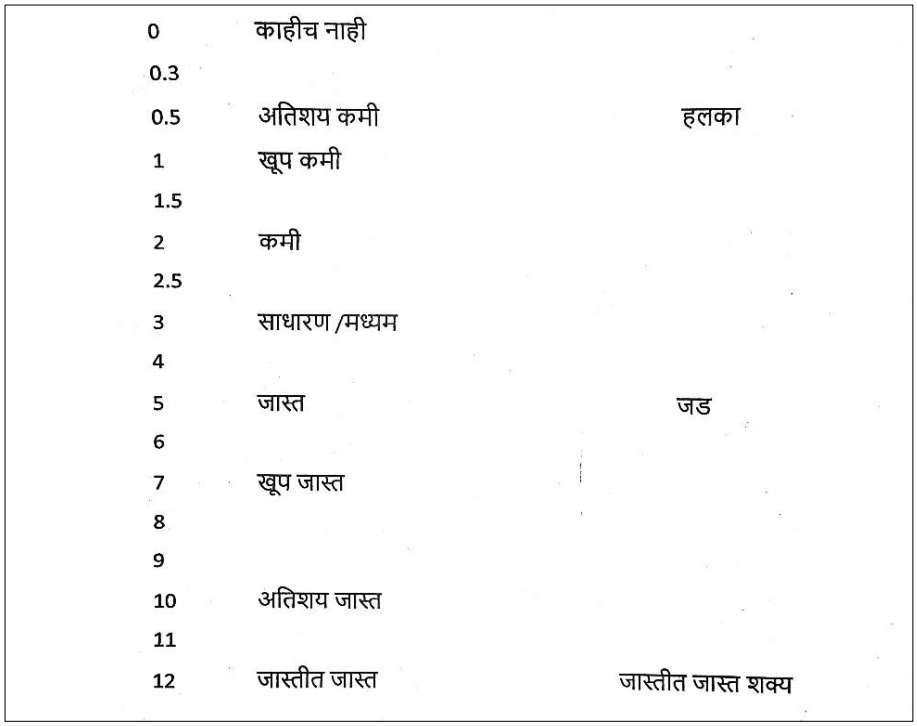
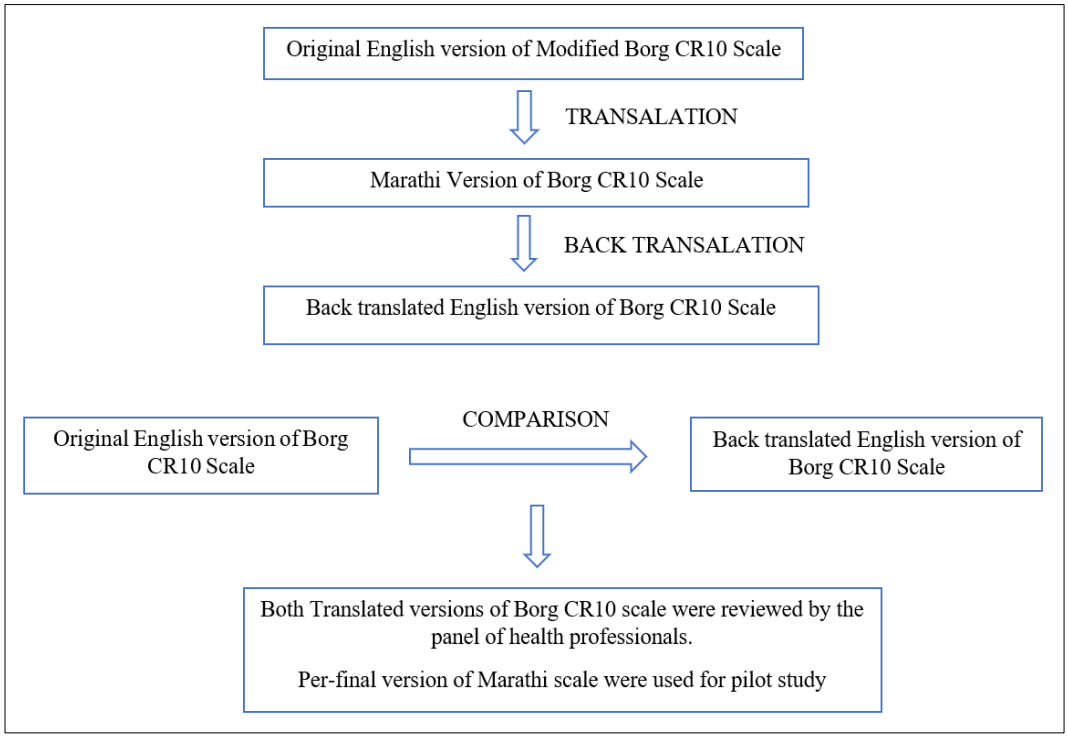
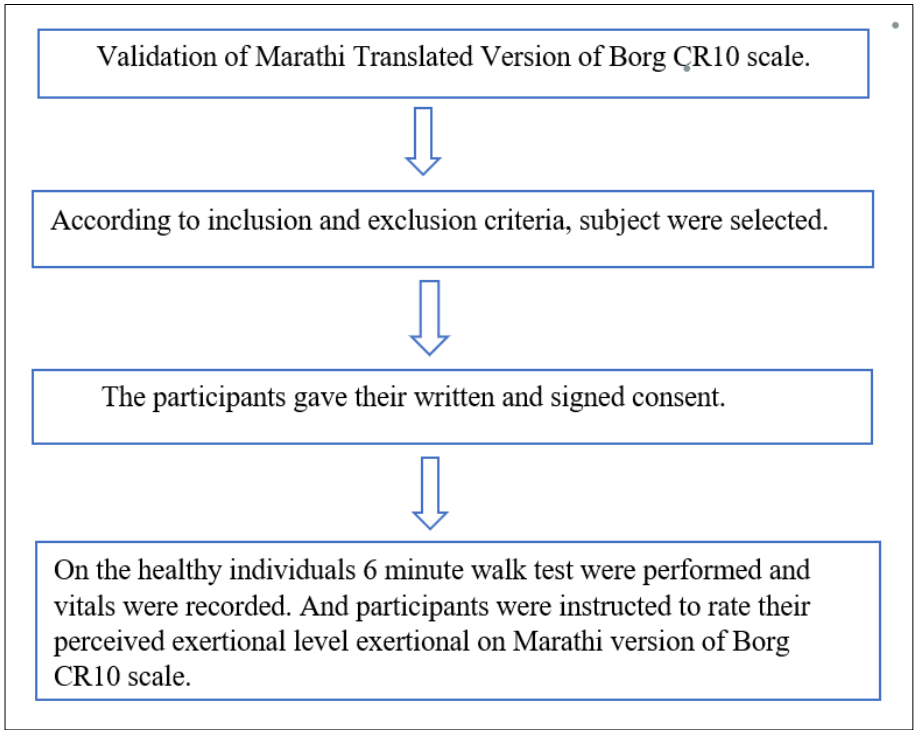


Fig 6: Marathi Version of Borg CR10 scale

Phase 1



Phase 2



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