Cross-Cultural Adaptation and Validation of the Exercise Adherence Rating Scale to Nepali language: A Methodological Study

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Research

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Abstract

Background The Exercise Adherence Rating Scale (EARS) is a commonly used outcome tool, which helps to identify the adherence rate of exercises and reasons for adherence and non-adherence. There is no evidence of availability of any measurement tools to assess exercise adherence in Nepalese context and cultural background. Therefore, we conducted a cross-cultural adaptation of the EARS in to Nepali language and investigated its reliability and validity.

Methods Cross-cultural adaptation of the EARS was done based on Beaton guidelines. Psychometric properties were evaluated among 18 participants aged 18 years or older with pre-diabetes or confirmed diagnosis of any disease who were prescribed with home exercises by physiotherapists. Any disease that limited participants from doing exercise and individuals unwilling to participate were excluded. Reliability was evaluated through internal consistency, using the Cronbach's alpha. Exploratory Factor Analysis (EFA) was performed to explore construct validity and confirm its unidimensionality. Receiver Operating Characteristic (ROC) curve was analyzed to identify cut-off score, sensitivity and specificity of the tool.

Results The Cronbach's alpha was 0.94 for EARS-adherence behavior. The EFA of 6-items adherence behavior revealed the presence of one factor with an eigenvalue exceeding one. The scree-plot suggested for extraction of only one factor with strong loading (75.84%). The Area Under the Curve was 0.91 with 95% confidence interval 0.77 to 1.00 at p = 0.004. The cutoff score was found 17.5 with 89% sensitivity and 78% specificity.

Conclusions The EARS was cross-culturally adapted to Nepali language. The reliability and construct validity of the Nepali version of the EARS were acceptable to assess exercise adherence in Nepali-speaking individuals. This validated tool might facilitate the evaluation of exercise related interventions. Future studies could investigate other psychometric properties of the Nepali EARS.

Background Exercise adherence is the extent to which person's behavior corresponds with agreed recommendations from health care providers [1]. The benefits of exercise can only be obtained when a person is adhering to the prescribed exercises. Multiple factors are associated with exercise adherence such as sociocultural factors, knowledge towards exercise, self-efficacy, ethnicity, and economic status of an individual [2]. Within physiotherapy services, the concept of exercise adherence is associated with the performance of the prescribed exercise appropriately following the advice given by the physiotherapists [3]. There is no any gold standard outcome tool to measure exercise adherence rate in Nepalese cultural context and background. People commonly use self-reported diaries to reflect exercise adherence; however, they lack standardization, accuracy and possess self-presentation bias that limit their validity [4]. The Exercise Adherence Rating Scale (EARS) is one of the commonly used outcome tools, which helps to identify the adherence rate of exercises and reasons for adherence and non-adherence [5].
The original English version of the EARS is a 16-item, self-reported questionnaire, which assess adherence of prescribed exercises [6]. The EARS consist of 3 sections. Section ‘A’ is about prescribed exercise questionnaire. This section consists of 5 questions, which are related to way of doing activities and exercise that people often do to improve their physical quality of life. Section ‘B’ is about exercise adherence behavior, so called exercise adherence rating scale. This section consists of 6 items, which is an actual measure to identify exercise adherence. This evaluates whether individuals do their exercise as per recommendation or not. Section ‘C’ is about reasons for adherence/non-adherence of exercises. This section consists of 10 items, which assesses factors that hinders and facilitates the exercises [5]. The internal consistency (0.81), test-retest reliability (0.94), construct validity (70%) and face validity of the original version have been established [5, 6]. Acknowledged with good validity and reliability, the EARS scale has been established as an appropriate and feasible tool to assess exercise adherence.

The “cross-cultural adaptation” is a process that looks at both language (translation) and cultural adaptation issues for a questionnaire to use in another setting [7]. The cross-cultural adaptation is important when an instrument has to be used in a different language, setting and time because of diversified context of geography, ethnicity, economic status, culture and diseases [2, 8]. When there is no any tool available to assess exercise adherence in Nepal, a tool that is valid and reliable in measuring exercise adherence of Nepali-speaking individuals was required. Therefore, the aim of this study was to conduct the cross-cultural adaptation of the EARS to Nepali language and investigate its reliability and validity.

**Methods And Materials**

**Cross-cultural adaptation**

Beaton Guidelines is one of the commonly used guidelines for the translation and cross-cultural adaptation of measurement tools [7]. As per the suggestion from the developer of the tool, Dr. Emma L Godfrey, we considered Beaton guidelines and an evidence of cross-cultural adaptation process followed in a study by Takasaki et al., in 2017 [7, 9] to cross-culturally adapt the EARS into Nepali language. The five steps of cross-cultural adaptation were; forward translation, synthesis, back translation, expert committee review and pre-testing, which are described in Fig. 1.

Two independent non-medical translators, who were bilingual in English and Nepali, translated the original English EARS into Nepali language and developed two forward translated versions (FT1 and FT2). Reconciliation meeting was held among two translators and investigators of present study to reach to a consensus without compromising one’s feeling and opinion. All minor issues encountered were addressed and resolved, as there were no any major issues. Through reconciliation, a common forward translation (FT12) was synthesized. Two Physiotherapists who were bilingual in English and Nepali then back translated the FT12 version into English. The purpose of the back translation was for validity checking to make sure that the adapted version was reflecting the same item content as the original version [10]. The back-translated versions were reviewed and a consensus version was developed [7, 9].
Pretesting was done on 10 individuals with pre-diabetic conditions to explore clarity, understandability, comprehensibility and feasibility of the adapted version of the EARS using a visual analogue scale; ranging from 0 (not clear at all and difficult to understand) to 10 (clear and easy to understand). The average score of 8.10 indicated that the adapted version was clear, comprehensible and understandable. No ambiguity of meaning on any item was reported. Thus, the pre-testing version was considered as a final version without any modification in the original English version. This was similar with the findings from De Lara et al., in which no difficulty was faced, or no any suggestions were given during cross-cultural adaptation of the EARS into Brazilian version [11]. Thus, a Nepali version of EARS (N-EARS) was cross-culturally adapted (see Additional file 1).

Validation of N-EARS: Individuals at pre-diabetic stage as well as patients with various conditions were screened. Patients were eligible if they satisfied the following inclusion criteria: (i) individuals with pre-diabetes (HbA1c level between 5.7–6.4%) [12] or any patients with confirmed diagnosis of any disease who were prescribed with home exercises by physiotherapists, (ii) aged 18 years or older, and (iii) those who gave informed consent. Any disease that limited participants from doing exercise like recent surgery and individuals unwilling to participate were excluded from the study.

Statistical analysis

The descriptive statistics were used to analyze demographic and clinical data. The Cronbach's alpha (α) was calculated to determine internal consistency. Exploratory Factor Analysis (EFA) was performed in the study by Newman-Beinart et al., to determine factors in the original English tool [5]. With an aim to compare findings with the study, we performed EFA to explore construct validity. Kaiser-Meyer-Olkin (KMO) test and Bartlett's test were used to check for sampling adequacy and sphericity, respectively. The minimum recommended value of 0.60 was considered for sampling adequacy [13]. The Varimax rotation was used during analysis. Eigenvalues were calculated to select number of components in EFA [5]. Receiver Operating Characteristic (ROC) curve was analyzed to identify cutoff score, sensitivity and specificity of N-EARS. Data were analyzed using SPSS (version 21.00). The significant level was considered at p < 0.05.

Results

Total of 18 individuals participated in the study. The mean age of the participants was 38 years with standard deviation (SD) of 11.88). Two-third of the participants (n = 12, 66.6%) were females. Similarly, 12 (66.6%) participants were pre-diabetic. Out of remaining 6 (33.3%) participants, one was with anterior cruciate ligament injury of knee (at 3 months of surgical repair), two were with low back ache (one at 18 days and another at 1.5 months), one was with stroke (at 1.5 months who was able to do activities independently), one was with Bell's palsy (at 15 days of disease onset) and one was with cardiac disease (at 3 months after open heart surgery). As shown in Table 1, the mean score for 6-item adherence behavior and 10-item reasons for adherence/non-adherence ranged from 2.17 to 2.83 and 0.83 to 3.39
respectively. The score of item 9 of 10-item reasons for adherence/non-adherence was minimum (mean: 0.83, SD: 1.38).
Table 1
Demographic and clinical characteristic of the participants (N = 18)

| Variables                                | Mean (SD) | N (%) |
|------------------------------------------|-----------|-------|
| **Age (year)**                           | 38 (11.88)|       |
| **Gender**                               |           |       |
| Male                                     |           | 6 (33.3) |
| Female                                   |           | 12 (66.6) |
| **Participants’ conditions**             |           |       |
| Pre-diabetic                             |           | 12 (66.6) |
| Others (ligament injury, low backache, stroke, Bell’s palsy and cardiac disease) | | 6 (33.3) |
| **Exercise Adherence Rating Scale**      |           |       |
| 1. I do my exercises as often as recommended | 2.83 (1.30) | -     |
| 2. I forget to do my exercises           | 2.50 (1.58) | -     |
| 3. I do less exercise than recommended by my health care professional | 2.17 (1.38) | -     |
| 4. I fit my exercises into my regular routine | 2.61 (1.38) | -     |
| 5. I don't get around to doing my exercises | 2.78 (1.59) | -     |
| 6. I do most, or all, of my exercises    | 2.56 (1.29) | -     |
| **Reasons for adherence/ non-adherence** |           |       |
| 1. I don't have time to do my exercises  | 3.00 (1.28) | -     |
| 2. Other commitments prevent me from doing my exercises | 2.83 (1.43) | -     |
| 3. I don't do my exercises when I am tired | 1.56 (1.20) | -     |
| 4. I feel confident about doing my exercises | 2.72 (1.23) | -     |

Note: SD: Standard Deviation, N: Number
| Variables                                                                 | Mean (SD)  | N (%) |
|--------------------------------------------------------------------------|------------|-------|
| 5. My family and friends encourage me to do my exercises                | 2.39 (1.29)| -     |
| 6. I do my exercises to improve my health                               | 2.61 (1.38)| -     |
| 7. I do my exercises because I enjoy them                                | 2.39 (1.50)| -     |
| 8. I adjust the way I do my exercises to suit myself                     | 1.67 (1.57)| -     |
| 9. I stop exercising when my pain is worse                               | 0.83 (1.38)| -     |
| 10. I'm not sure how to do my exercises                                  | 3.39 (1.29)| -     |

Note: SD: Standard Deviation, N: Number

**Test of reliability**

As shown in Table 2, the Cronbach's alpha was 0.94 and 0.74 for adherence behavior and reasons for adherence/non-adherence scale respectively. The Cronbach's alpha if item deleted ranged from 0.91 to 0.93 for 6-item adherence behavior. Removal of any item would result lower Cronbach's alpha, and therefore each item has to be retained.
### Table 2
Internal consistency of N-EARS (N = 18)

| Scale (Adherence behavior) | Items                                                                 | Cronbach's Alpha | Corrected item-total correlation | Cronbach's Alpha if item deleted |
|----------------------------|----------------------------------------------------------------------|------------------|----------------------------------|----------------------------------|
| Exercise Adherence Rating Scale | 1. I do my exercises as often as recommended                             | 0.94             | 0.79                             | 0.92                             |
|                            | 2. I forget to do my exercises                                           |                  |                                  |                                  |
|                            | 3. I do less exercise than recommended by my health care professional     | 0.71             |                                  | 0.93                             |
|                            | 4. I fit my exercises in to my regular routine                           |                  |                                  |                                  |
|                            | 5. I don't get around to doing my exercises                               |                  |                                  |                                  |
|                            | 6. I do most, or all, of my exercises                                    | 0.88             |                                  | 0.91                             |

**Note:** N-EARS: Nepali-Exercise Adherence Rating Scale, N: Number

**Test of validity:** Construct validity was explored using an EFA. The KMO value for 6-items adherence behavior was 0.73, exceeding the recommended minimum value of 0.60 which verified sampling adequacy for the analysis. Bartlett’s test for sphericity indicated that correlations between items were sufficiently large (Chi square: 110.19, p < 0.001) for factor analysis. Thus, the criteria for sampling adequacy and sphericity for 6-items adherence behavior scale was achieved. As depicted in Table 3, the EFA of 6-items adherence behavior revealed the presence of one factor with an Eigen value exceeding one. The scree-plot suggested for extraction of only one factor with strong loading (75.84%). Since KMO value of 10-items of reasons for adherence/non-adherence was < 0.60, it was not suitable for EFA.
Table 3  
Outcome of exploratory factor analysis of 6-items of N-EARS (N = 18)

| Items                                              | Component 1 | Total loading |
|----------------------------------------------------|-------------|---------------|
| 1. I do my exercises as often as recommended       | 0.86        | 75.84%        |
| 2. I forget to do my exercises                     | 0.78        |               |
| 3. I do less exercise than recommended by my health care professional | 0.79        |               |
| 4. I fit my exercises in to my regular routine     | 0.93        |               |
| 5. I don't get around to doing my exercises        | 0.92        |               |
| 6. I do most, or all, of my exercises              | 0.93        |               |

Note: N-EARS: Nepali-Exercise Adherence Rating Scale, N: Number

The ROC curve, as shown in Fig. 2, demonstrated that Area Under the Curve (AUC) was 0.91 with 95% confidence interval 0.77 to 1.00 at p = 0.004. The cutoff score was found 17.5 with 89% sensitivity and 78% specificity.

**Correlation**: As a means of validating 6-item adherence behavior, the correlation analysis was done between 6-item adherence behavior with 10-item reasons for adherence/non-adherence scale, which demonstrated significant correlation (Pearson's Coefficient, PC: 0.83, p < 0.001). The 6-items adherence scale demonstrated significant correlation with item 1 (PC = 0.69, p = 0.002), item 2 (PC = 0.55, p = 0.02), item 4 (PC = 0.76, p < 0.001), item 6 (PC = 0.84, p < 0.001), item 7 (PC = 0.70, p = 0.001) and with item 10 (PC = 0.75, p < 0.001). There was no significant correlation with items 3, 5, 8 and 9 (p > 0.05).

**Discussion**

The highlights of the study are as follows: the EARS has been cross-culturally adapted to Nepali language. The adapted N-EARS has been validated. The N-EARS showed excellent internal consistency. The EFA indicated good construct validity. The 6-items adherence behavior scale revealed presence of only one factor with strong loading. The cutoff score was 17.5 with sensitivity of 89% and specificity of 78%. The 6-item adherence behavior and 10-item reasons for adherence/non-adherence scale were highly correlated.

Heterogeneous participants with respect to age, gender and diagnosis, were involved in the study. The study site had an easy access to the participants from urban, sub-urban as well as rural areas of Nepal. So, the participants comprised of diverse ethnicity, geographical regions and education level.
Cross-cultural adaptation

The EARS has been cross-culturally adapted to Nepali language based on Beaton guidelines [7]. The forward and back translation as well as adaptation procedure revealed no content or language related issues. Through pre-testing, good clarity and understandability of the N-EARS were demonstrated. In contrast to the findings of a study by Meade et al., where re-framing for some items was required [6], there was no need of refining or redefining any item or words while adapting to Nepali language. The N-EARS has been formatted in such a way so that it is concise, short, easy to administer and looks attractive. In section ‘A’ of the tool, participants did not have any issues in understanding the questions. However, in agreement with the findings from the study by Meade et al., they had difficulties to complete the answers of the questions when exercises were not prescribed in appropriate dosage or prescribed dosage was not understood properly by the participants [6].

Reliability of N-EARS

The internal consistency was assessed to evaluate the degree of the interrelatedness among the items [14]. The internal consistency of N-EARS was excellent ($\alpha = 0.94$) for 6-item adherence behavior [14, 15]. The internal consistency of the original English versions was 0.8 and that of Brazilian version was 0.88 [5, 11]. Present study demonstrated higher internal consistency ($\alpha = 0.94$) of N-EARS than both English and Brazilian versions. An $\alpha$ value of 0.70 to 0.95 were considered acceptable values [16]. Therefore, the internal consistency of N-EARS was comparable with the values of English as well as Brazilian versions and it was in acceptable range.

Since the recommendation was against adding up of items to calculate a final score in 10-items for reasons of adherence/non-adherence, we did not determine internal consistence of the 10-items [5]. This was not established even in Brazilian version by De Lira et al., in their study [11].

Validity of N-EARS

The EFA demonstrated adequate construct validity of 6-item adherence behavior scale of N-EARS. The 6-item adherence scale revealed one factor solution with a strong loading (75.84%) to exercise adherence. The factor loading was higher than that of the original version which demonstrated 71% factor loading [5] and other self-reported outcome measures [17]. We could not perform EFA on 10-item reasons for adherence/non-adherence as it could not fulfill the criteria of sampling adequacy (KMO < 0.60) [13] which was in contrast with the Brazilian versions (KMO = 0.64) (11). the 10-item would be useful in exploring reasons why participants adhere or do not adhere to prescribed exercises via. single-item question as described by Newman-Beinart et al., in their study [5].

The ROC curve was used to analyze the predictive effect of the 6-item adherence scale [18]. The AUC of the total score of 6-item adherence behavior scale was 0.91 which was statistically significant and suggested a predictive validity which is in line with literature evidence [18, 19]. The cutoff score of the tool was 17.5 with a sensitivity of 89% and specificity of 78% that discriminates adherent and non-adherent participants with respect to exercises. De Lira et al., in Brazilian version, demonstrated a cutoff score of
17 with sensitivity and specificity higher than 80% [11]. The findings of present study was comparable with the findings from the Brazilian study. We compared the findings with the study of Wang et al., in which similar scale for exercise adherence was used and sensitivity (87.20%) as well as specificity (76.34%) they found were in line with the findings of present study [18]. The cutoff score of 17.5 indicated that any individual obtaining score > 17.5 out of 24 on 6-item adherence scale is said to be adherent to the prescribed exercises. However, the cutoff score has to be cautiously used during interpretation because without knowing the level of exercise that is necessary for treatment to be effective, a cutoff score in assessing exercise adherence may not be useful [5, 19]. The cutoff score, sensitivity and specificity reflected a preliminary predictive validity, which was not established even in the original version of the EARS and was a limitation [5]. On the other hand, fully relying on the established guidelines with the back translation reflecting the same item content as the original version supported good face validity of the N-EARS [7, 10, 20].

The correlation between total score of 6-item adherence behavior and 10-item reasons for adherence/non-adherence demonstrated a validity of the N-EARS. The strength of correlation has been used in describing validity in patient-reported outcome measures [6, 21]. The 6-item adherence scale demonstrated strong correlation (0.55 to 0.84) with items 1, 2, 4, 6, 7, and 10 in present study. Therefore, these 6 items are important to consider while finding non-adherence to exercises. The reasons for non-adherence in the participants of a study by Newan-Beinart et al., were item numbers 1, 2, 3, 4, 7, and 9 [5]. Thus, the 10-items adherence/non-adherence gives clear information on reasons for non-adherence to exercise on one-to-one analysis, which may vary from one participant to another.

**Strengths and Limitations**

The strengths of this study include: (i) The method of cross-cultural adaptation by fully relying on the established guidelines giving a methodological strength; (ii) The reliability and validity were established on pre-diabetic who were healthy during recruitment and on patients with various other health conditions as well. We could evaluate the feasibility of the N-EARS on healthy individuals who were recommended for exercises to prevent disease or remain fit and on patients who were prescribed exercises to treat their impairments or activity limitations. Therefore, the reliability and validity were demonstrated in heterogeneous group of participants; and (iii) The N-EARS yielded identical psychometric properties as original EARS. On the other hand, convenient sampling, small sample size and possibility of recall bias were main limitations of this study.

**Conclusions**

The EARS has been cross-culturally adapted to Nepali language. This study provided excellent internal consistency and adequate face, construct as well as predictive validity of the N-EARS. The N-EARS yielded identical psychometric properties as the original EARS. A cutoff score of 17.5 was found with good sensitivity and specificity. The findings of present study provided evidence to use N-EARS in research and clinical practice that might facilitate the evaluation of exercise related interventions. Further studies are recommended to investigate other psychometric properties of the N-EARS.
**Abbreviations**

EARS  
The Exercise Adherence Rating Scale  
N-EARS  
Nepali version of the Exercise Adherence Rating Scale  
EFA  
Exploratory Factor Analysis  
ROC  
Receiver Operating Characteristic  
FT  
Forward Translation  
KMO  
Kaiser-Meyer-Olkin test  
SD  
Standard Deviation  
N  
Number

**Declarations**

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**Statement of Ethics**

A written permission was received from the developer of the original scale to cross-culturally adapt the scale into Nepali. An ethical approval was taken from Kathmandu University School of Medical Sciences – Institutional Review Committee (approval number: 118/19) to conduct the study. A written informed consent was obtained from all the participants prior to data collection.

**Conflict of interest**

The authors declare no conflict of interest.

**Availability of data and materials**
The dataset supporting the conclusion of this article is available in additional files (see additional file 2).

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**Authors’ contributions**

SPA was responsible for literature reviews, formulating research questions and objectives, designing the study, extracting and analyzing data, interpreting results, creating tables, figures and writing the manuscript.

RD was responsible for helping to analyze data and interpret results, reviewing manuscripts and providing critical comments

JNS was responsible for literature reviews, screening and recruiting eligible participants, and providing comments in the manuscript

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Figures
Figure 1

Receiver Operating Characteristic (ROC) curve of 6-items of adherence behavior scale
Figure 2

Steps of cross-cultural adaptation based on Beaton guidelines (7)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile2Dataset.xlsx
- Additionalfile1NepaliversionofEARS.pdf