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General

Psychometric testing of the Maltese versions of the Exercise Benefits/Barriers Scale and Exercise Motivation Inventory – 2

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Background

Consideration of psychological factors towards exercise participation is important, especially when placed within a cultural context.

Objective

The aim of this study was to translate the Exercise Benefits/Barriers Scale and Exercise Motivation Inventory-2 to Maltese and undertake psychometric testing.

Methods

Maltese-speaking participants (n = 170) aged 18 to 69 years were recruited. 72% completed both questionnaires twice within an 8-to 48-hour period. Reliability was calculated using the Spearman correlation, intraclass correlation coefficient, and Bland–Altman plots. Convergent construct validity was tested using Spearman correlation between theoretical variables.

Results

In total 155 participants completed the questionnaires at both time points. The test/re-test reliability of the two questionnaires was >0.7 for all analyses. Correlations for validity were statistically significant ($p < 0.05$).

Conclusion

The translated tools have similar psychometric properties to the original version; the authors recommend that health care professionals and physical activity practitioners use these tools when examining population-level physical activity behaviour among Maltese-speaking individuals.

INTRODUCTION

Psychological factors are understood to be critical in the understanding of physical activity (PA) behaviours with as many as 84 different psychological determinants identified.[1] Two factors, motivation, and perceived barriers were found to be strongly correlated with PA behaviour. Whilst autonomous motivation and intrinsic motivation has been found to positively predict PA behaviour, this influence varies.[1] According to the self-determination theory this could be due to different types of external motivations, some of which are internalised within the persons value system.[2] Other types of external motivations are outwardly conditioned and not in line with the value system and may have a negative effect on PA behaviour.[3] Perceived barriers were found to negatively influence PA behaviour.[1]

The measurement of barriers and motivators for PA varies across multiple tests being used. There is no gold standard described within the literature. Such tools vary according to the theoretical framework and type of PA behaviour being measured, for overall PA or exercise. Nonetheless using a tool that has been validated allows for the comparison between different cultures, and studies. Perceived barriers refer to "an individual's evaluation of the

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potential obstacles that curtail him from engaging" in PA[4] (pg. 107). Motivation is described across a spectrum ranging from amotivation, which is a state in which the person has no intention to act to external regulation, introjected regulation, identified regulation, and intrinsic regulation.[2] The latter is when an individual engages in an activity which is congruent with his/her values.[2,3] Two established tools that have been validated to assess motivation and perceived barriers towards exercise are the Exercise Benefits/Barriers Scale (EBBS)[5] and the Exercise Motivation Inventory – 2 (EMI-2).[6]

The EBBS was developed based on the Pender health promotion model.[5] Two of the concepts within the model are perceived benefits of exercise behaviour and perceived barriers. The first version of the EBBS was written in English and was tested on adults aged 18 to 88 years. The tool comprises 43 questions, 14 items that assess perceived barriers and 29 that assess perceived benefits. This tool has demonstrated good reliability with a test re-test reliability correlation score across the whole questionnaire of 0.889 and an internal consistency of 0.952.[5] The content validity of the tool was based on literature and participants' interviews. Structural validity was based on factorial analysis which identified a 10-factor solution, 6 perceived benefits and 4 perceived barriers.[5] Similar reliability scores were obtained for different populations.[4] The EBBS has been translated into different languages including Iranian,[7] Turkish,[8] Mexican,[9] Spanish (Brazil)[10] and Korean.[11] These translations were found to have test re-test reliability between 0.6 and 0.87.[7,8,10,11]

The EMI-2 tool was based on the self-determination theory. It measures 14 factors, with higher order motives that vary between intrinsic and extrinsic types of motivation. Through these factors the tool measures a wide range of the possible reasons as to why a person exercises.[12] The tool was developed to be used by non-exercisers as well as exercisers.[6] In the initial development of the tool, construct validity was demonstrated by being able to distinguish between different gender motivations, that correlated with other tools which measured social desirability and intrinsic motivation.[12] On further testing of the tool, factorial validity was carried out using sequential model testing. The results had shown that the model was valid to be used across genders. The internal reliability of the different factors was good, and with the exception of health pressure (0.686) the remaining factors were reported with a reliability of 0.832.[6] The EMI-2 has been translated into different languages including Arabic, Dutch, Italian and Spanish.[13] The disadvantage of the EMI-2 is due to the tool being developed towards the measurement of goal seeking behaviour, rather than true motivation.[14]

The aim of this current study was to a) translate the EBBS and EMI-2 into the Maltese language and b) check the test re-test reliability, internal consistency, and concurrent validity of the translated versions. To the authors knowledge this is the first study to have translated these tools into the Maltese language. The translation will allow use of reliable and validated tools within Maltese speaking populations and allow for comparison with other studies on a global scale

MATERIALS AND METHODS

The translation of the EBBS and EMI-2 was carried out following the World Health Organisation cultural adaptation guidelines. The English version was translated into Maltese by two paid professional translators. The translations were compared by authors KS and JXDC and merged into one. This Maltese version was then cross checked by three experts: 1) a public health specialist, 2) a physiotherapist, and 3) a Maltese linguist all of whom were bilingual. This ensured that semantic equivalence was maintained in the Maltese language. Minor suggestions were proposed, which were reviewed by the same two authors. The final Maltese version was then translated back into English by two different paid translators. The resulting version was compared to the original English version, whereby only minor discrepancies were identified. As the Maltese language did not allow for certain words, these differences were discussed with one of the translators and re-wording was completed.[15]

Cognitive interviews were undertaken with people from different educational backgrounds, to ensure semantic equivalence and eliciting the appropriate cognitive response.[16] Participants were recruited using convenience sampling with over sampling in those with low educational attainment. Informed consent was obtained from the participants and interviews were held at a place convenient for them. Sample size was not decided a prior but based on saturation. A total of ten interviews were held until the questionnaires were eliciting the appropriate response. The participants' ages ranged from 25 to 67 years with an average age of 45 years (SD ±17.4). Interviews lasted an average of 45 minutes in duration. They were conducted using open-ended questions, and the participants were asked to read the questions and verbalize their thought process to ensure that the translated version elicited similar understanding.[17] These participants were not included in the psychometric testing stage.

Psychometric testing was then carried out on a broad population age group, between 18 and 69 years. Previous literature found that the EBBS has an intraclass correlation coefficient (ICC) of 0.85 for benefits and 0.79 for barrier related questions.[4] Using a formula based on the expected ICC values,[18] the minimal expected ICC value and the number of observations as recommended by Streiner et al.,[19] a sample size of 116 was recommended. Considering the likelihood of non-completion which was predicted to be 15%, the quota set was 134 participants.

ETHICAL CONSIDERATIONS

Ethical approval was obtained from the Sheffield Hallam University Research Ethic committee reference number: ER9249191. Written consent was obtained from participants prior to participating in the study. Recruitment was voluntary and participants could withdraw at any time.

Data was analysed in an anonymised format to maintain confidentiality of participants.

RECRUITMENT FOR PSYCHOMETRIC TESTING

Participants had to be able to read, write and be comfortable replying to the questionnaire in the Maltese language. Non-random convenience sampling was used to recruit participants. Initial contacts were from personal contacts after which snowball sampling was used to reach the required quota. Participants were given the option to complete either online or paper copies of the questionnaires depending on their preference.

The time period between the test and re-test had to be long enough to reduce recall bias but not too long that responses may change.[20] The questionnaire was eight pages long and included 128 questions. It took between 20 to 40 minutes to complete. Considering the length of the questionnaire, between 8 to 48 hours was deemed acceptable as a test and re-test period, and all cases were reviewed within a 48hour timeframe. In case of online submission, the re-test was sent via email to the participant the day after their first submission, and the request was made to complete within two days. In case of paper-based submission, KS met the following day with the participants to fill in the second questionnaire, which was collected once ready. In addition to the questionnaires, demographic data on age, gender, education and self-reported height and weight were collected.

DATA ANALYSIS

EBBS SCORING AND EMI-2 SCORES

The tools published scoring sheets were used to calculate the results from the questionnaires. For the EBBS each item score ranges from 4 (strongly agree) to 1 (strongly disagree) with the barriers' score being reversed score. Scoring the EBBS culminates with a barriers and benefits score. The EMI-2 score is made up of 14 different sub scores for each motive. The mean score for each motive was calculated for each participant. The Guidelines for Reporting Reliability and Agreement Studies (GRRAS) were used[21] to determine analysis for reliability and validity.

RELIABILITY

The reliability of the tools was calculated using Inter class correlation co-efficient (ICC), standard error of measurement (SEM) and Bland and Altman's plots. Prior to checking level of agreement, the correlation between the variables was checked. After checking for normality, Spearman correlation was used to check the correlation between test and re-test results, which if this was not significant further testing was not performed. Bland and Altman's plots were used to check for repeatability of measures by plotting the mean differences between the two measures. 95% of the difference should be within one standard deviation of the mean difference for the tool to have good repeatability.[22] The SEM is the standard deviation of the measurement error.[23] SEM measures the difference in measurement between test and re-test and is a measure of reliability. Cronbach alpha was used to measure the internal consistency of the questionnaires and its subscales. As the subscale within the questionnaires were supposed to measure the same construct the internal consistency within the subscale was expected.[24]

VALIDITY

Convergent construct validity for the EBBS was assessed by correlation with leisure time PA, total PA and sitting time. PA was measured using the International Physical Activity Questionnaire in Maltese (IPAQ-MT).[25] To check the convergent construct validity of the translated EMI-2 intrinsic motivation (enjoyment, revitalisation, and nimbleness)[3] were correlated with leisure time PA and Social Recognition, Competition, Health pressures, Ill-health avoidance with age.[14]

Data analysis was carried out in accordance with the EMI-2[13] and EBBS guidelines.[26] A Microsoft Excel © spreadsheet was developed to store and analyse the data. IBM SPSS © version 26 was used for inferential statistical analysis with $p < 0.05$ deemed to be statistically significant.

RESULTS

RESPONSE RATE AND DEMOGRAPHICS

The total number of questionnaires distributed was 160 with a response rate of 85% (n = 136 participants) for first questionnaire. A total of 115 (72%) completed the test-retest of the questionnaires with all questions answered.

Respondents were aged between 18 and 69 years with a mean age of 39 years (SD ±14. 43). The proportion of male participants was 39%, and females at 61%. The education level for 32% of the participants was secondary education or less, the remaining 68% had a tertiary level of education.

EXERCISE BENEFITS/BARRIERS SCALE

The EBBS had a total mean score of 120.5 ±28.1, the mean barriers score was 38.1 ± 10 and benefits score 82.4 ± 20.3. Age was not correlated with either the barriers score ($p = 0.792$) or benefits score ($p = 0.754$). Total leisure time in MET minutes per week was positively correlated with barriers 0.184 ($p = 0.032$) and benefits 0.190 ($p = 0.027$) scores. Total PA in MET minutes per week was not significantly correlated with barriers ($p = 0.955$) or benefits ($p = 0.053$) scores. Total sitting time in minutes per week was significantly correlated with barriers score 0.204 ($p = 0.017$) but not with the benefits score ($p = 0.097$).

The ICC for the EBBS barriers score was 0.709 (CI 0.604 – 0.7900) and 0.811 (CI 0.737-0.865) for the benefit score. The Cronbach alpha of the benefits score was 0.963 and barriers score 0.899. The SEM for the barriers score was 3.60 and benefits score was 4.66. Bland-Altman plots for both barriers and benefits had 95% of the mean difference between test and re-test within 2 SD (supplementary file 1). Spear-

Table 1. Descriptive statistics for EMI-2 subscale

Subscale	Mean	±SD
Stress management	3.2	1.5
Revitalisation	3.8	1.1
Enjoyment	3.2	1.4
Challenge	2.2	1.4
Social Recognition	0.86	1.2
Affiliation	1.6	1.5
Competition	1.1	1.4
Health pressures	1.6	1.5
Ill-health avoidance	3.5	1.4
Positive health	4.0	1.1
Weight management	3.5	1.4
Appearance	2.7	1.5
Strength and Endurance	3.4	1.3
Nimbleness	2.9	1.4

Table 2. EMI-2 subscales correlation with age, total PA, leisure time PA and total sitting time

Subscale	Age	Leisure time PA	Total PA	Total PA adjusted to Leisure time	Total sitting time
Enjoyment	NA	0.399**	0.314**	0.134	-0.240
Revitalisation	NA	0.187*	0.188*	0.056	-0.151
Nimbleness	NA	0.166	0.166	0.023	-0.059
Social Recognition	-0.241**	NA	NA	NA	NA
Competition	-0.425**	NA	NA	NA	NA
Health pressures	0.338**	NA	NA	NA	NA
Ill-health avoidance	0.423**	NA	NA	NA	NA

* Significant at 0.05 level; ** significant at 0.01 level; NA – not assessed

man correlation for barriers was 0.708 ($p < 0.001$) and for benefits score 0.821 ($p < 0.001$).

EXERCISE MOTIVATION INVENTORY -2

The EMI-2 has 14 subscales for which the mean and SD for each are presented in table 1. The EMI-2 subscales were significantly correlated with age, total PA in MET minutes per week, leisure time PA in MET minutes per week and sitting time.

Enjoyment and nimbleness subscale were not significantly correlated with sitting time. Leisure time PA and total PA was positively correlated with enjoyment but not nimbleness. The correlation between total PA, enjoyment and revitalisation was not significant when adjusted for leisure time PA (table 2). Age was significantly negatively correlated with social recognition, and competition and positively correlated with health pressures and ill-health avoidance.

The ICC for the EMI-2 subscales ranged between 0.783 to 0.916 (Table 3). The spearman correlation co-efficient ranged from 0.919 to 0.789 (Table 3). The SEM ranged between 0.19 to 0.44 (Table 3). All Bland-Altman plot had 95% of the values within 2 standard deviation (supplementary file 1).

DISCUSSION

The aim of this study was to assess the reliability and convergent construct validity of the translated versions of the EBBS and EMI-2. The study found the reliability of both questionnaires to be acceptable for use in the Maltese language. Both questionnaires had a test re-test reliability ICC, correlation, and internal consistency higher than 0.7. The test re-test reliability correlation of the original EMI questionnaire subscales varied between 0.58 to 0.88,[12] in this study the correlation was higher. The better reliability than that presented in the originally developed tool is likely because the test re-test period was 4 to 5 weeks while in this study the period was limited to 8 to 48 hours. The potential for recall bias is a limitation of the current study, but the questionnaire was tested with additional questionnaires with a total of 145 questions. This number of questions would reduce recall bias. The short retest period also reassures that the constructs being measured would not

Table 3. Reliability testing for EMI-2 subscales

Subscale	Spearman correlation	ICC	Cronbach Alpha	SEM
Stress management	0.919*	0.916 (0.88-0.941) *	0.899*	0.190
Revitalisation	0.781*	0.816 (0.742–0.870) *	0.864*	0.301
Enjoyment	0.870*	0.882 (0.832-0.918) *	0.892*	0.248
Challenge	0.787*	0.783 (0.697-0.847) *	0.832*	0.442
Social Recognition	0.754*	0.820 (0.747-0.873) *	0.845*	0.346
Affiliation	0.840*	0.890 (0.843-0.923) *	0.877*	0.279
Competition	0.789*	0.838 (0.773-0.886) *	0.922*	0.305
Health pressures	0.825*	0.852 (0.792-0.896) *	0.773*	0.302
Ill-health avoidance	0.867*	0.871 (0.819-0.909) *	0.892*	0.243
Positive health	0.810*	0.823 (0.753-0.875) *	0.899*	0.219
Weight management	0.848*	0.889 (0.843-0.923) *	0.833*	0.283
Appearance	0.878*	0.884 (0.834-0.919) *	0.887*	0.236
Strength and Endurance	0.843*	0.848 (0.784-0.894) *	0.773*	0.298
Nimbleness	0.823*	0.828 (0.760-0.879) *	0.850*	0.356

*significant at 0.05 level

have changed due to time. A future study could assess the Maltese versions of the tools using a test-retest period of 4-5 weeks.

Due to the limited sample size used in the study, construct validity could not be assessed using factorial analysis.[27,28] Based on the latent analysis in initial construct validity of the tool,[6] the study assumed that factors within the EMI-2 which are of intrinsic nature would be correlated with leisure time PA, but not with total PA or sitting behaviour. Out of the two intrinsic factors identified only enjoyment was significantly positively correlated with leisure time PA unlike nimbleness. One possible reason for the lack of correlation is the translation of questions around nimbleness into the Maltese language (questions 27 and 41) being difficult to differentiate between the two. Another measure of the convergent construct validity of the translated tool was to assess the correlation between competition, social recognition, health pressure and ill-health with age,[12] due to the changes in motivation associated with aging. It is expected that competition and social recognition act less of motivators in older age, whilst health pressure and ill-health become more of a motivator.[14,29] A negative correlation was found with competition, social recognition and a positive one with the latter two factors. This confirms that the Maltese translated version has similar concurrent validity to the original published tool.

The EBBS has already been translated into different languages, Turkish,[8] Iranian,[7,30] and Mexican[31] and assessed on different age groups.[10] The reliability obtained from this study is similar to the English version and the aforementioned translated versions. The reliability of the EBBS for barriers score was less than the benefit score, which was also found in the other studies. The validity of the questionnaires was confirmed through the correlation with related PA measures. As the EBBS measures perceived barriers and benefits towards exercise it was expected that scores would be correlated with leisure time PA but not total PA and sitting time. Leisure time PA is a structured form of PA which can include planned exercise, whereas other forms of PA such as domestic and transport are not. It is therefore anticipated that those with lower barriers would have higher leisure time PA.

To check the concurrent validity of the translated EMI-2 intrinsic motivation (enjoyment, revitalisation, and nimbleness)[3] are expected to correlate with leisure time PA. Motivation changes are expected with increasing age[14,29]: competition and social recognition are less important whilst health and fitness reasons are more important.[12] A correlation between leisure time PA and intrinsic factors would give an indication of the convergent construct validity of the translated tool. Extrinsic motivation factors prediction of long term PA was found to be negatively correlated with long term commitment towards PA behaviour.[32,33] However, data on length of exercise engagement was not collected within the study.

The EBBS was developed to assess barriers specific to exercise and not to the broader term of PA.[4] The current study assessed PA behaviour using IPAQ-long which measures total PA, and leisure time PA which is related to exercise. A positive correlation with benefits and barriers scores was found with leisure time PA but not total PA. The correlation was weak but statistically significant. The weak correlation could be attributed to the possible limitations in PA measurement and the study not being able to distinguish between length of exercise engagement. The PA measurement was based on the recall of the past week, which might not be a typical week. Using self-reported measures for PA can have a social bias towards over estimation of PA behaviour engagement.[34] These factors might have influenced the strength of the correlation between EBBS score and leisure time PA. Another possible explanation is the nonconclusive evidence about the influence of perceived barriers on exercise participation.[1] Leisure time PA engagement is not limited to perceived benefits and barriers other

factors such a motivation and socio-economic factors influence PA behaviour, the lack of adjustment for these factors could have led to the weak positive association between perceived barriers and leisure time PA.

A high barriers score was correlated with prolonged sitting time but not benefits score. Sedentary time is reported as a measure of sitting time during a normal working day and weekends. A higher number of perceived barriers was identified to correlated with lower engagement with exercise in different population groups.[35,36] If people are engaged in less leisure time PA a high rate of sedentary activity was expected. The internal consistency of the EBBS obtained in this study was similar to other translated languages.[7,8,10]

Compared to other studies which have assessed the reliability of these two questionnaires, this study used Bland-Altman plots (supplementary file 1) and SEM to evaluate their reliability. When using Bland-Altman plots 95% of the difference between test and re-test fit within 1 standard deviation which shows that the tools have good reliability. The maximum SEM for the EMI-2 was 0.44 which shows the test to re-test error is minimal. The SEM showed the good reliability of the EBBS. The SEM was higher for the benefits score as expected given the higher possible score.

LIMITATIONS

The main limitation of this study is the short recall period which was used for the test re-test period. However, this was mitigated with a long questionnaire to limit recollection. The small sample size was appropriate to assess for the reliability of the questionnaire as this was based on pre-established sample size calculation formula. However, a larger sample size would give more confidence in the interpretation of the validity testing of the tools given that a heterogenous group was used and psychological determinants vary with age. Finally this study was unable to distinguish between participant's amount of time exercising based on stage of change as this influences motivation[33] this would have allowed for better validity testing.

This study is the first to have translated the tools into Maltese as well as test the psychometric properties. For future research it is now possible to compare different Maltese speaking populations and to conduct studies using a validated tool. Psychological determinants are important when establishing PA and exercise patterns in different populations.[1] Being able to use standardized tools which are based on theoretical knowledge allows for cross country comparison. Having translated tools which are based on theoretical knowledge can allow for the development and implementation of appropriate PA interventions. We therefore encourage practitioners and health professionals to use these tools in Maltese speaking populations when examining motivators and barriers to physical activity and exercise.

CONCLUSIONS

This study found that the Maltese versions of the EBBS and EMI-2 have an acceptable test re-test reliability and internal consistency all of which were similar to the originally developed tools. The concurrent validity of the EBBS and EMI-2 was also confirmed within the study. These findings add to the body of knowledge of translated tools which assesses psychological determinants of exercises in a different language. Based on the study results, we recommended that the translated tools can be used in populations which are Maltese speaking in order to optimise the selection and effectiveness of PA and exercise interventions.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

AUTHOR'S CONTRIBUTIONS

Karl Spiteri: Drafting of manuscript, Analysis, Interpretation of data, acquisition.

John Xerri de Caro: Revising manuscript, Analysis, Interpretation of data.

Kate Grafton: Revising manuscript, Analysis.

David Broom: Drafting of manuscript, Analysis, Interpretation of data.

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SUPPLEMENTARY MATERIALS

Supplementary file 1

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