Validity and reliability of the Finnish Motivation for Physical Activity (RM4-FM) questionnaire

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Mikko Uimonen
Central Finland Centrl Hospital

Jussi P. Repo
Keski-Suomen keskussairaala

Kiira Grönroos
Jyvaskylan yliopisto Liikuntatieteellinen tiedekunta

Arja Häkkinen
Jyvaskylan yliopisto Liikuntatieteellinen tiedekunta

Simon Walker
University of Jyväskylä

✉ simon.walker@jyu.fi Corresponding Author
ORCiD: https://orcid.org/0000-0002-6804-0741

Abstract

Background There is a lack of properly validated instruments measuring motivation for physical activity in the Finnish language. The study aimed to translate the Motivation for Physical Activity (RM4-FM) instrument into Finnish and examine its psychometric properties in a sample of healthy, older Finnish adults.

Methods The RM4-FM was translated and linguistically validated adhering to published guidelines. The sample consisted of 102 65–75-year old participants, who completed the RM4-FM, the Physical Activity Acceptance Questionnaire (PAAQ) and sociodemographic characteristics questionnaires electronically. The RM4-FM was re-administered one month after the initial assessment.

Results RM4-FM translated well into Finnish. The motivation dimension scores were skewed towards high internal and low external motivation. A floor effect was confirmed in the External regulation dimension and a ceiling effect was confirmed in the Identified regulation dimension. Confirmatory factor analysis indicated inadequacy of the four-dimension model. Separate assessment of each of the four motivation dimensions with Exploratory factor analysis showed unidimensionality for all dimensions. Exploratory factor analysis provided a best-fit model of three factors (influence of other people, intention of well-being and emotional aspect of motivation). Re-administration of the instruments showed good test-retest reliability in all motivation dimensions. Female gender, higher education and higher PAAQ score were associated to higher internal motivation and lower external motivation scores.

Conclusions The Finnish version of the RM4-FM instrument provides valid and reliable scores in assessing motivation for physical activity in a sample of healthy, older Finnish adults. The score distributions suggested shortages in the scale when evaluating internally motivated subjects. The three-factor model of the RM4-FM provided more favorable structural validity compared to the original version. This work may aid in future translations into other languages and uses of the questionnaire.

Background

Physical activity has a key role promoting well-being and quality of life [1]. Inactivity has been shown to be a major risk factor for several chronic diseases, such as cardiovascular diseases, diabetes mellitus

type 2, osteoporosis and colon cancer as well as psychological disorders [25]. The prevalence of such diseases in western countries is high [5,11,12,15,30,34]. In addition, cardiovascular diseases are a major cause of death [30,34]. Overall, the burden of such diseases for society are substantial measured in costs and healthy years lived [3,38]. The evidence of the positive effects of physical activity on the risk and, on the other hand, the prognosis of the chronic diseases is indisputable [26]. Despite these positive effects on health, inactivity is still a major issue in public health [2,16].

On an individual level, a key point of the decision of whether to be physically active is motivation. The Self-determination theory by Deci and Ryan [9] divides motivation into controlled and autonomous aspects. In the field of physical activity, the autonomous aspect of motivation refers to the intention of joy, well-being and achievement of personal goals derived from physical activity, while the controlled aspect refers to the influence and the pressure of others, as well as the guilt of not exercising [9]. Self-determination theory proposes the importance of the motivational factors originating from oneself, rather than external factors, on the determination between physically active or physically inactive lifestyles. Strong intrinsic motivation has been shown to be associated with positive long-term effects of physical activity, as intrinsically motivated individuals continue being active even when the influence of external pressure has stopped [9] [32]. Thus, to achieve permanent positive change in one's physical activity habits, it is crucial to enhance the intrinsic motivation aspect.

Lately, the development of interventions on strengthening the motivation for physical activity has been a subject of interest in the field of sport science and medicine [10,29,31,36]. Such interventions have been effective in enhancing internal motivation for physical activity [10,31]. However, it is important to identify the individuals who are at risk for physical inactivity-related diseases and have issues with their motivation to provide targeted interventions to those who benefit most. For this purpose, several questionnaires have been developed [7,21,23].

The Motivation for Physical Activity (RM4-FM) questionnaire is a self-administered instrument

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developed to assess the internal and external aspects of physical activity motivation [7]. RM4-FM was developed based on Self-determination theory. RM4-FM has been utilized to examine motivation for physical activity [24], yet it has not been properly validated for this purpose. In addition, modified versions of RM4-FM have been used in assessing motivation for dieting and quitting smoking [17]. Validation and understanding of psychometric properties of measurement instruments is indispensable for correct use of these questionnaires [19,20]. Proper validation processes enable researchers to evaluate the usability of the instrument when assessing whether to choose the instrument when initiating a new study. Additionally, proper validation creates the frames for interpreting and assessing the meaning of the results obtained from these instruments.

Hitherto, the psychometric properties of the RM4-FM questionnaire have not been examined properly. In addition, the instrument has not been translated or validated for the Finnish population. The aim of the present study was to translate the RM4-FM instrument into Finnish and examine the psychometric properties of the translated version in a sample of healthy, older adults.

Methods

The study was conducted as part of an exercise intervention study examining the effect of resistance training frequency on strength, functional capacity and health outcomes (NCT02413112). The study contacted two-thousand 65–75-year old people living in the Jyväskylä city region by recruitment mail, who were identified based on age and selected randomly from the Population Register. Those who were willing to participate to the study (n = 454) completed an electronic preliminary registration questionnaire that was used to select individuals to an information meeting (n = 148). The individuals with health issues that may hamper involvement to physical activity (notable overweight with BMI 37 or above, poorly controlled cardiovascular disease or lower extremity injury that may complicate physical training and testing, a need of assistive device, use of medication that influences the neurological or endocrinal functions) or who already involved regularly in physical exercise or sport (over 180 minutes per week) or had other factors which may affect the physical performance and exercise (previous experience of strength training, previous testosterone treatment, smoking) were

excluded. After all, 102 suitable individuals signed informed consent to participate and were included

to the study. The baseline characteristics of the participants are shown in Table 1. The participants

completed the RM4-FM and the Physical Activity Acceptance Questionnaire (PAAQ) questionnaires

electronically, as well as a questionnaire on sociodemographic characteristics. The participants were

asked to re-complete the RM4-FM questionnaire one month after the initial assessment.

Table 1

Sociodemographic and clinical characteristics of the participants.

	N = 102
Women, n (%)	57 (56)
Age, mean (SD) years	69 (3)
BMI, mean (SD) kg/m^2	28 (4)
Physical activity, mean (SD) minutes per week	104 (61)
Education, n (%)	
Basic education or general upper secondary	65 (64)
University or college	37 (36)
Marital status, n (%)	
Married or living with the spouse	79 (77)
Divorced, widow or unmarried	23 (23)
Chronic diseases, n (%)	
Cardiovascular	32 (31)
Respiratory	10 (10)
Musculoskeletal	11 (11)
Diabetes	7 (7)
Gastrointestinal	3 (3)
Neurological	3 (3)
Other	17 (17)
Using medication, n (%)	52 (51)
Physical Activity Acceptance Questionnaire (PAAQ) score, mean (SD)	50 (8)

Instruments

RM4-FM: Motivation for Physical Activity

RM4-FM is a 16-item questionnaire measuring the four dimensions of motivation for physical activity

[7]. All items use a seven-point Likert-scale. The RM4-FM is divided in four dimensions of four items:

External regulation, Introjected regulation, Identified regulation, and Intrinsic motivation. The score of

each dimension is calculated as a mean of the scores of that dimension's items. Higher scores

indicate stronger influence of motivation within the specific dimension. In addition, the Relative

Autonomy Index (RAI) is calculated by using a formula including all four motivation dimension scores

(RAI = 2 × Intrinsic motivation + Identified regulation – Introjected regulation – 2 × External

regulation). RAI indicates the relative impact of intrinsic and extrinsic factors in motivation for

physical activity. A negative RAI value indicates that extrinsic factors have stronger influence on

motivation while a positive RAI value indicates stronger influence of intrinsic factors on motivation,

and thus autonomy.

Physical Activity Acceptance Questionnaire (PAAQ)

The PAAQ is a 10-item questionnaire measuring the subjective psychological and physical discomfort caused by physical activity [4]. All items use a seven-point Likert-scale and the maximum score is 70. Lower scores indicate higher amount of discomfort caused by physical activity and problems with motivation to continue such activity. The PAAQ has been shown to be valid and reliable in measuring psychological factors behind motivation for physical activity [4].

Translation and cultural adaptation process

The translation process and linguistic validation of the RM4-FM questionnaire adhered to the guidelines of Wild et al. (2005) [37]. Two native Finnish academic researchers of sport science independently forward-translated the RM4-FM into Finnish language. These two translated versions were then compared and reconciliated. The reconciliated version was then back-translated to English by a native English-speaking researcher that is also fluent in Finnish. After back-translation, discrepancies between forward- and back-translated versions of RM4-FM were corrected and accordance between the original and translated versions was verified. Finally, all researchers that participated in the translation process proofread and approved the final version.

Statistical analysis

The sociodemographic and clinical data are presented as means, standard deviations (SD) and 95% confidence intervals (CI) or as counts with percentages. Normality of the RM4-FM and its dimensions score distributions were assessed. Floor and ceiling effects were examined from baseline measurement to assess the scale targeting. If 15% of patients scored minimum or maximum points, the floor or ceiling effect was considered confirmed [18].

To test cross-cultural validity, the differences in the motivation dimension scores between gender, educational and relationship status subgroups were assessed using independent samples t-test. Pearson correlation coefficients were calculated to assess the association between RM4-FM and sociodemographic characteristics of the participants. Furthermore, convergence with the PAAQ score was examined by calculating Pearson correlation coefficients for each dimension as well as for RAI

against the PAAQ score. The coefficient values of 0.3, 0.5, 0.7 and 0.9 were interpreted as low, moderate, strong and very strong correlation, respectively [22].

To assess the structural validity of RM4-FM, confirmatory factor analysis was conducted. The presumed factor structure consisting of four motivation dimensions was tested. The Chi-square test of model fit, the root mean square error of approximation (RMSEA), the comparative fit index (CFI) and the standardized root mean square residual (SRMR) were calculated. A non-significant chi-square test value, RMSEA less than 0.05, CFI over 0.95 and SRMR less than 0.80 were interpreted as good fit of the tested model [28]. The unidimensionality of the RM4-FM dimensions were examined with exploratory factor analysis (EFA). In addition, a best-fit factor model was explored with EFA. Varimax rotation with the Kaiser normalization method was used to obtain the most distinguishable factor structure. A factor loading of 0.4 was used as a cutoff value representing that the item typifies the factor sufficiently [27].

Internal consistency of RM4-FM and its dimensions were assessed using Cronbach's alpha with bootstrapping method of 1000 repetitions to obtain the 95% CIs [6]. Alpha values over 0.7 were considered as acceptable [28].

Intraclass Correlation Coefficients (ICC) and 95% confidence intervals were calculated to assess test-retest-reliability. ICC over 0.7 was interpreted as sufficient stability, while ICC values under 0.7 represent unacceptable stability [28,33].

The statistical analyses were conducted with R and SPSS 25.0 statistical software. Interpretation and reporting of the results of this study adhere to the COnsensus-based Standards for the selection of health status Measurement INstruments (COSMIN) guidelines [28]. The present study was conducted as part of a larger study investigating the effects of resistance training on functional capacity [35], health [13] and psychological well-being [14]. The study protocol was approved by The Ethical Committee of The University of Jyväskylä.

Results
Translation

RM4-FM translated well in to Finnish. The comparison of the two forward-translated versions of RM4-FM revealed minor linguistic differences that did not change the content of the questionnaire. In addition, the cross-checking of back-translated and the original version of the RM4-FM showed no substantial discrepancies. After minor adjustments, the translated version of RM4-FM was approved by the researchers (Appendix 1).

Sample characteristics

A total of 102 eligible participants completed the questionnaires in their entirety. Table 1 presents the sociodemographic and clinical characteristics of the participants. The mean body mass index (BMI) of the participants was 28 indicating mild overweight. While a proportion of participants undertook medication for blood pressure, cholesterol and/or blood glucose, none had serious injury or illness and could be considered healthy and cognitively proficient for this age group. Variation in the average duration of physical activity per week was high ranging from 0 to 200 minutes.

Distribution of the RM4-FM

Figure 1 presents the distributions of each RM4-FM dimensions. Distribution of External regulation score was skewed towards low scores while distributions of Identified regulation and Intrinsic motivation scores were skewed towards high scores. Introjected regulation score and RAI were normally distributed. The coverage of the distribution was good in Introjected regulation dimension while in other dimensions the skewness of the distribution impaired the coverage. A floor effect was confirmed in the External regulation dimension and a ceiling effect was confirmed in the Identified regulation dimension (Table 2). No other floor or ceiling effects were observed.

Table 2

Mean scores, Cronbach's alphas, and percentage of maximum and minimum points of RM4-FM dimensions.

Dimension	Mean (SD)	Alpha (95% CI)	Minimum (%)	Maximum (%)
External regulation	2.3 (1.3)	0.82 (0.72 to 0.89)	21.6	2.0
Introjected regulation	4.1 (1.3)	0.75 (0.63 to 0.83)	0	2.9
Identified regulation	6.2 (0.9)	0.72 (0.60 to 0.80)	0	21.6
Intrinsic motivation	5.7 (1.1)	0.84 (0.76 to 0.90)	0	11.8

Cross-cultural validity

The examination of differences in motivation dimension scores and RAI between subgroups by gender revealed, that External regulation score was higher among male (2.6 vs. 2.1, p = 0.030) and mean RAI of female participants was higher than in males (9.8 vs. 7.8, p = 0.009). No other significant

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differences were observed between genders. The External regulation (1.9 vs. 2.6, p = 0.003) and

Introjected regulation (3.7 vs. 4.3, p = 0.027) scores of participants with higher education were lower

compared to basic educated participants. Other dimension scores or RAI did not differ between

educational subgroups. In addition, marital status was not associated to dimension scores or RAI.

The Pearson correlation coefficients of age, BMI and physical activity time with RM4-FM dimensions

and RAI showed no notable correlations. Yet, the correlations of BMI with Introjected regulation score

(r = -0.273, p = 0.006) and Intrinsic motivation score (r = -0.20, p = 0.045), and of physical activity

time with Intrinsic motivation score (r = 0.276, p = 0.006), Identified regulation score (r = 0.21, p =

0.034) and Introjected regulation score (r = 0.20, p = 0.048) were statistically significant but still of

negligible strength. PAAQ scores correlated positively to RAI (r = 0.422, p < 0.001), Intrinsic

motivation (r = 0.394, p < 0.001) and Identified regulation (r = 0.341, p < 0.001) scores.

Nevertheless, the strength of the correlations was low.

Structural validity

The results of confirmatory factor analysis indicated poor fit of the tested four-dimension factor model

of RM4-FM, as the Chi-square test of model fit (X^2 = 256, df = 98, p < 0.001), the RMSEA value 0.126

(90% CI = 0.107 to 0.145, p < 0.001), the CFI value 0.811 and the SRMR 0.103 demonstrated

inadequacy of the model. On the other hand, when unidimensionality of each RM4-FM dimension was

tested separately with exploratory factor analysis (EFA), all motivation dimensions showed

unidimensionality as only one factor with Eigenvalue over 1 was found for each dimension.

Furthermore, all items in each dimension loaded strongly (loading value over 0.4) on these identified

factors. Internal consistency of the RM4-FM was good as the Cronbach's alpha was 0.88 (95% CI 0.83

to 0.91). In addition, the alphas of the RM4-FM dimensions showed acceptable internal consistency

with values over 0.7 (range 0.72 to 0.84) (Table 2).

Examination of the best-fit factor model of RM4-FM with EFA revealed three factors with eigenvalues

over 1 (Table 3). Factor 1 (Eigenvalue = 6.0) consisted of all items of External regulation and one item

of Introjected regulation dimensions, which all emphasize the influence of other people on motivation

(items 2, 6, 7, 11 and 14). Factor 2 (Eigenvalue = 3.1) consisted of two items of Intrinsic motivation

and three items of Identified regulation dimensions (items 8, 9, 12, 15 and 16). The items of factor 2

concentrate on intention of well-being. Three items of Introjected regulation, two items of Intrinsic

motivation and one item of Identified regulation dimensions formed factor 3 (Eigenvalue = 1.1, items

1, 3, 4, 5, 10 and 13). Factor 3 incorporates the items on emotional aspect of motivation comprising

the items on joy of physical activity and, on the other hand, guilt of inactivity. Cronbach's alphas of

these factors were 0.86, 0.85 and 0.81 for factors 1, 2 and 3, respectively.

Table 3

Factor loadings of RM4-FM items in the best-fit factor model.

Item number	Dimension	Factor 1	Factor 2	Factor 3
1	Introjected regulation	0.23	0.27	0.54
2	External regulation	0.80	-0.03	0.17
3	Intrinsic motivation	-0.02	0.31	0.79
4	Introjected regulation	0.50	0.16	0.60
5	Identified regulation	0.06	0.25	0.71
6	Introjected regulation	0.79	0.01	0.20
7	External regulation	0.83	0.02	0.05
8	Intrinsic motivation	0.23	0.61	0.47
9	Identified regulation	-0.10	0.67	0.40
10	Intrinsic motivation	-0.02	0.52	0.64
11	External regulation	0.82	-0.05	0.19
12	Identified regulation	0.21	0.79	0.18
13	Introjected regulation	0.36	0.17	0.52
14	External regulation	0.73	0.32	-0.18
15	Intrinsic motivation	0.06	0.81	0.25
16	Identified regulation	-0.06	0.76	0.24

Test-retest reliability

Eighty-one participants (79%) re-completed the RM4-FM. Figure 2 shows the baseline and repeated

measure scores of RM4-FM dimensions. The ICC values of RM4-FM dimensions of Intrinsic motivation

(ICC = 0.87, 95% CI = 0.79 to 0.92), External regulation (ICC = 0.85, 95% CI = 0.76 to 0.90) and

Identified regulation (ICC = 0.80, 95% CI = 0.68 to 0.87) indicated good stability while ICC value of

Introjected regulation (ICC = 0.78, 95% CI = 0.66 to 0.86) showed moderate stability. Mean RAI

remained stable in baseline and repeated measures (8.9 in baseline vs. 9.2 in repeated). The ICC of

RAI (ICC = 0.86, 95% CI = 0.78 to 0.91) indicated good stability.

Discussion

The main finding of this study was that the Finnish version of RM4-FM provides valid and reliable

scores in physical activity motivation assessment. Nevertheless, our findings showed limitations

regarding the targeting of the dimension scores and a need for consideration of factor structure of

RM4-FM (Table 4).

Table 4
Predefined hypotheses and conclusions for validation of the RM4-FM.

Feature	Hypothesis	Conclusion
Coverage and targeting		
Floor and ceiling effect	No floor effect (min score ≤ 15%)	
	Intrinsic motivation	Confirmed
	Identified regulation	Confirmed
	Introjected regulation	Confirmed
	External regulation	Rejected
	No ceiling effect (max score ≤ 15%)	
	Intrinsic motivation	Confirmed
	Identified regulation	Rejected
	Introjected regulation	Confirmed
	External regulation	Confirmed
Validity		
Cross-cultural validity	Non-significant associations between the RM4-FM score and sociodemographic characteristics	Confirmed /Rejected
Convergence with the PAAQ	Significant and at least low correlation between the PAAQ and the RM4-FM scores	Confirmed /Rejected
Structural validity		
CFA	Chi-square test non-significant	Rejected
	RMSEA < 0.05	Rejected
	CFI > 0.95	Rejected
	SRMR < 0.80	Rejected
EFA	Unidimensional structure of dimensions	
	Intrinsic motivation	Confirmed
	Identified regulation	Confirmed
	Introjected regulation	Confirmed
	External regulation	Confirmed
Internal consistency	Cronbach's alpha is ≥ 0.7	
	Intrinsic motivation	Confirmed
	Identified regulation	Confirmed
	Introjected regulation	Confirmed
	External regulation	Confirmed
Reliability		
Test-retest reliability	ICC ≥ 0.7	
	Intrinsic motivation	Confirmed
	Identified regulation	Confirmed
	Introjected regulation	Confirmed
	External regulation	Confirmed
CFA = Confirmatory Factor Analysis		
EFA = Exploratory Factor Analysis		
RMSEA = Root Mean Square Error of Approximation		
CFI = Comparative Fit Index		
SRMR = Standardized Root Mean Square Residual		
ICC = Intraclass Correlation Coefficient		

There is a lack of validated instruments concerned with motivation of physical activity for the Finnish population. In this study, the translation and cross-cultural validation of the RM4-FM was performed according to internationally submitted guidelines [37]. There were only minor discrepancies between two forward translated versions, as well as between the original and backward translated versions, and these discrepancies did not affect the content of the instrument. Furthermore, the examination of the association of sociodemographic factors and RM4-FM scores indicated good cross-cultural validity

of RM4-FM.

The scale targeting of RM4-FM dimensions was not optimal on the basis of the distributions and coverage of each dimension scores. The scores of the dimensions associated to internal motivation (Intrinsic motivation and Identified regulation) were skewed towards high scores and a ceiling effect was confirmed in Identified regulation dimension, whereas External regulation score was skewed towards low scores and was confirmed with a floor effect. The result suggests that applicability of RM4-FM is limited in a sample of highly internally motivated people. A study by Nurmi et al (2005) [24] investigated the mediator effect of self-regulation in the association between intrinsic motivation and participation in physical activity in adolescents using a broadly similar questionnaire with minor differences (SRQ-E). The scores of Intrinsic motivation and Identified regulation dimensions in that study were focused around high scores with mean scores 3.84 (SD 0.97) and 3.85 (SD 0.96), respectively. On the other hand, the mean scores of External regulation and Introjected regulation were 1.78 (SD 0.85) and 2.78 (SD 1.09). The distributions of the scores in the study by Nurmi et al. [24] and in the present study were very similar supporting the suggestion that scale targeting and ceiling effects might be a problem independent of age group.

The confirmatory factor analysis (CFA) showed that RM4-FM did not obey the presumed four-dimension structure. The results of CFA on the four-dimensional model indicated weak structural validity of RM4-FM. In addition, despite the sufficiency of Cronbach alphas of the RM4-FM and its dimensions, the values were relatively low, especially within the individual dimensions. Low Cronbach alphas of the dimensions may be due to a low number (4) of items in each dimension, but, on the other hand, it may reflect that items within the dimensions do not measure the same construct. The exploratory factor analysis (EFA) produced a best-fit model of three factors: influence of other people, intention of well-being and emotions of physical activity. The three-factor model showed at least comparable, if not better, performance in psychometric properties compared to the original model. However, despite the strengths of the three-factor model, it is limited due to losing the basis and division in motivation dimensions based on the Self-determination theory [8]. The three-factor model

would provide specific information on motivation from a different perspective than the original model. Nevertheless, the EFA of single RM4-FM dimensions showed unidimensionality of each dimension, which in turn support the sufficiency of structural validity and applicability of the four-dimensional model of RM4-FM.

High ICC values indicated high test-retest reliability with one-month re-completion interval. Motivation for physical activity is a dynamic phenomenon that may vary depending on changing situations and mood of one's life. High ICC suggests that RM4-FM is not strongly affected by these varying circumstances, but it rather reflects more permanent aspects of motivation.

There were some limitations in the present study. Firstly, criterion validity of RM4-FM was not measured, as there was not a sufficient instrument to compare the results. Secondly, the study sample was limited to older individuals (i.e. 65–75 years of age), which, in addition, may be influenced by a high rate of chronic diseases and medication use in the sample. The age and health status of the participants may have also affected habits and attitudes, as well as motivation for physical activity, particularly since the present sample were highly functionable for their age despite the fact that they were not physically activity. The advantages of this study were a large randomly selected sample from the Population Register, which represents well the average population as the regularly physically active individuals were excluded, as well as comprehensive translation and statistical methods, which adhere to the international guidelines on questionnaire validation studies. In addition, the questionnaires were completed electronically, and the questionnaire program required the participant to complete all the items, thus, preventing missing data.

In conclusion, the Finnish version of RM4-FM instrument provides valid and reliable scores in assessing motivation for physical activity in a sample of healthy, older Finnish adults. However, regarding the floor and ceiling effects of the dimensions, the scale seemed to be improperly targeted suggesting shortages in the scale when evaluating internally motivated subjects. A three-factor model of the RM4-FM provided more favorable psychometric properties than the original version though it loses the basis of Self-Determination Theory. The three-factor model is a noteworthy alternative when assessing motivation for physical activity using the RM4-FM. This work may aid in future translations

into other languages and uses of the questionnaire.

Declarations

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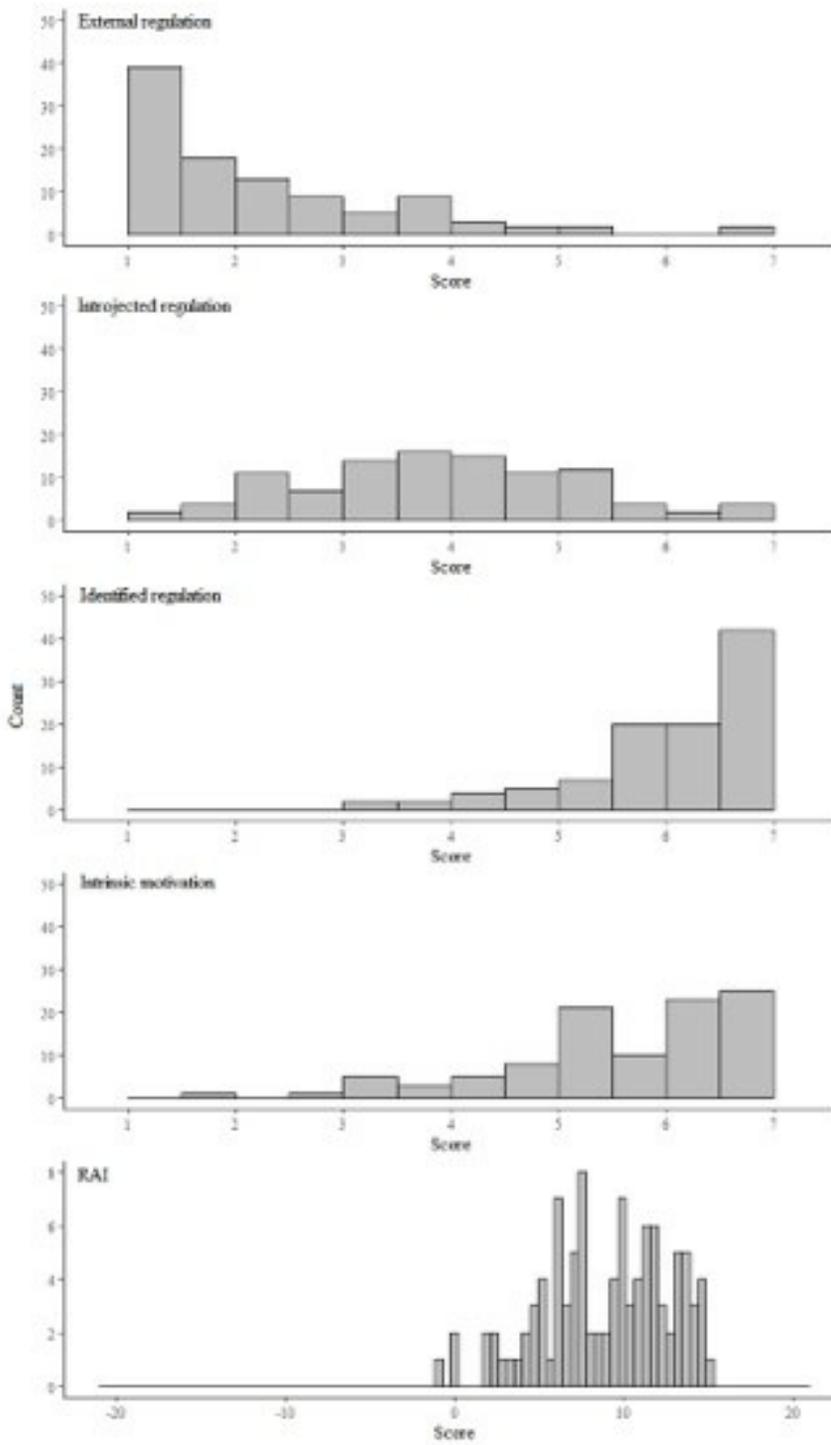
Figures

Figure 1

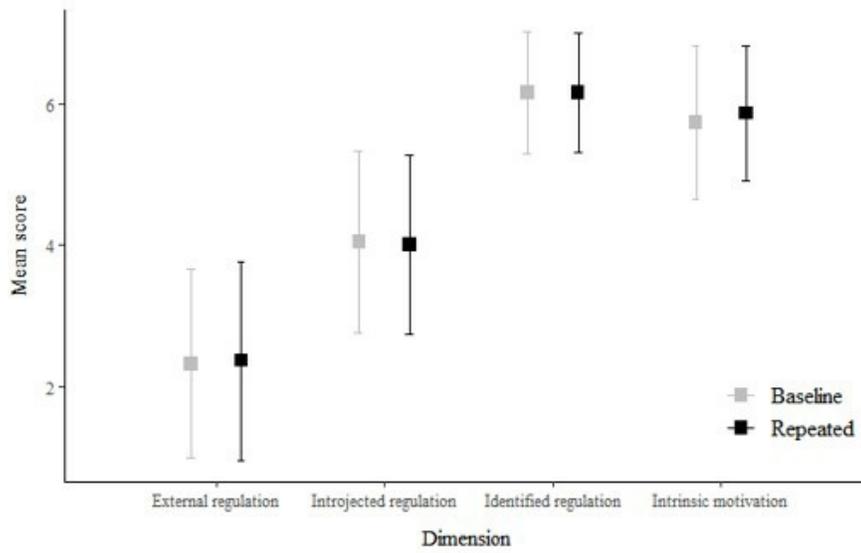Distributions of individual RM4-FM dimension scores and RAI.

Figure 2

Comparison of baseline and repeated RM4-FM dimension scores.

Supplementary Files

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Appendix 1.docx