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Validation of the Behavioural Regulation in Exercise Questionnaire-2 for adults with chronic musculoskeletal pain

Jessica M Brooks [Assistant Professor],

Department of Rehabilitation & Health Services, University of North Texas, Denton, Texas, USA

Cahit Kaya [Assistant Professor],

Department of Educational Sciences, Giresun University, Giresun, Turkey

Fong Chan [Professor],

Department of Rehabilitation Psychology and Special Education, University of Wisconsin-Madison, Madison, Wisconsin, USA

Kerry Thompson [Postdoctoral Fellow],

The Lorenz Clinic, Victoria, Minnesota, USA

Brandi Parker Cotton [Assistant Professor],

College of Nursing, The University of Rhode Island, Kingston, Rhode Island, USA

Jennifer Sánchez [Assistant Professor],

Rehabilitation and Counsellor Education, University of Iowa, Iowa City, Iowa, USA

Karen Fortuna [Postdoctoral Fellow]

Department of Psychiatry, Dartmouth College, Lebanon, New Hampshire, USA

Abstract

Background/Aims: The Behavioural Regulation in Exercise Questionnaire-2 (BREQ-2) has demonstrated reliability and validity in the general population; yet the psychometric properties have not been tested among rehabilitation populations, such as persons experiencing chronic musculoskeletal pain. The objective of the current study was to examine the factorial structure and psychometric properties of the BREQ-2 in a sample of adults with chronic musculoskeletal pain.

Methods: Adults with chronic musculoskeletal pain (n=211) were recruited from clinical and community networks in the United States. Data were collected using a cross-sectional online survey and analysed using confirmatory factor analysis, multiple indicators multiple causes analysis, and correlational techniques. Participants completed the BREQ-2 and other measures relevant to self-determination theory, including outcome expectancies, self-efficacy and family and friend support for physical activity and exercise.

Findings: Results indicated the intercorrelated model fit the data well. The five factors of amotivation, external regulation, introjected regulation, identified regulation and intrinsic

Correspondence to: Jessica Brooks, Jessica.Brooks@unt.edu.

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regulation toward physical activity and exercise demonstrated good reliability and construct validity.

Conclusions: This study provides evidence of factorial and construct validity for the BREQ-2 among people with chronic musculoskeletal pain. Implications for rehabilitation practitioners and researchers are discussed.

Keywords

Behavioural Regulation in Exercise Questionnaire-2; Chronic musculoskeletal pain; Exercise and physical activity; Motivation; Rehabilitation; Validity

Musculoskeletal pain conditions are caused by injury (e.g. back pain), aging (e.g. arthritis) or unknown reasons (e.g. fibromyalgia) (Goldberg and McGee, 2011). When musculoskeletal pain persists for more than 3 months or for longer than the expected healing time, it is diagnosed as chronic pain (International Association for the Study of Pain [IASP], 2009). Regular physical activity and exercise reduces pain and strengthens bones and muscles in people experiencing chronic musculoskeletal pain (IASP, 2009; Centers for Disease Control and Prevention, 2015). Graded activity, light-to-moderate intensity exercise and other structured exercise programmes, in particular, have proven effective for this group (IASP, 2009). Despite the positive outcomes associated with physical activity and exercise, rehabilitation practitioners frequently report that clients with chronic musculoskeletal pain have difficulties with self-determination and motivation to exercise (Searle et al, 2015; López-de-Uralde-Villanueva et al, 2016).

People with chronic musculoskeletal pain also have reduced physical capability for intense levels or greater amounts of exercise due to functional impairment (Washburn et al, 2002; Mannerkorpi and Hernelid, 2005). Therefore, people with chronic pain are required to pace their activities, take frequent breaks and reduce the total amount of physical activity they undertake. To monitor levels of motivation for physical activity and exercise in rehabilitation programmes, exercise motivation measurement instruments originally designed for the general population should be tested for usability and applicability among persons with chronic musculoskeletal pain.

Building upon early instrument development research (Ryan and Frederick, 1997), Mullan et al (1997) constructed the Behavioural Regulation in Exercise Questionnaire (BREQ) as a self-report measure to assess self-determined motivation for exercise. Self-determined motivation for exercise stems from self-determination theory, which explains the quality or nature of motivation directing physical activity and exercise behaviour (Deci and Ryan, 2002). Self-determination theory proposes that when basic needs are met, such as the needs for competence, relatedness and autonomy, human beings will shift toward self-determined motivation (Deci and Ryan, 1985). Self-determined motivation lies on a continuum regulating a person's behaviour, ranging from autonomous to controlled motivation (Ng et al, 2012). Autonomous forms of motivation – namely identified motivation – are defined as one's interest in activities or behaviours that are aligned with personal goals, interests and values or identity. Intrinsic regulation is considered the most self-determined form of autonomous motivation, as the person is fully engaged in an activity for its inherent

enjoyment and satisfaction. Controlled motivation, in contrast, consists of introjected regulation in which the regulation of action is internalised and energised through pressure of guilt or shame (Deci and Ryan, 2008). External regulation is when one's behaviour is contingent on rewards or punishment (Deci and Ryan, 2008). Finally, amotivation is defined as the absence of motivation for behavioural regulation (Ryan and Deci, 2000). People with amotivation are not self-determined and usually will not engage in the particular activity and, if they do, their behaviours are driven largely by external demands (Vansteenkiste et al, 2005).

The BREQ is comprised of items on external, introjected, identified and intrinsic regulation as it pertains to engagement in exercise. After the initial development of the BREQ, several researchers further examined its psychometric properties and confirmed its reliability and factorial, convergent, discriminant and predictive validity (Mullan et al, 1997; Wilson et al, 2002).

Markland and Tobin (2004) expanded the conceptual framework of the BREQ by adding the subscale of amotivation to a revised 19-item version of the scale known as the BREQ-2. Using confirmatory factory analysis, Markland and Tobin demonstrated that the model had a very good fit to the data. Other preliminary evidence provided additional support for the psychometric properties of the BREQ-2 (Mullan et al, 1997; Murcia et al, 2007). Follow-up studies further examined the psychometric properties and reconfirmed the five-factor structure (Farmanbar et al, 2011; Cr ciun and Rus, 2012; Vlachopoulos, 2012; Hassel et al, 2015). The BREQ-2 has also been translated and validated using Spanish (Murcia et al, 2007), Greek (Moustaka et al, 2010) and Persian (Farmanbar et al, 2011) samples. Although there is strong evidence to support the factorial validity and other psychometric properties of the BREQ-2 (Wilson et al, 2002), ongoing empirical evaluation of construct, content and criterion-related validity from multiple sources and diverse samples are necessary steps to determine the merit of the instrument in understanding motivation for exercise (Wilson et al, 2008). Thus far, several studies have been conducted among people with chronic illnesses and disabilities, including adults with schizophrenia (Vancampfort et al, 2013), cancer survivors (Milne et al, 2008) and post-cardiac rehabilitation clients (Sweet et al, 2014). To date, however, there has not been a study testing the applicability of the BREQ-2 among people with chronic musculoskeletal pain.

The objective of this study was to evaluate the factorial structure of the BREQ-2 in a sample of adults with chronic musculoskeletal pain to determine whether it would be a useful indicator for self-determination and motivation directed toward physical activity and exercise in this group, and to extend the evidence for construct validity by linking the BREQ-2 to other self-determination theory measures. Given that the BREQ-2 is a promising tool for investigating motivational determinants of exercise behaviour, this measurement instrument may have use in the routine assessment of physical activity and exercise goals and outcomes among people with chronic musculoskeletal pain.

METHODS

Participants

Participants included a convenience sample of 211 people with low back pain, arthritis, fibromyalgia and other types of chronic musculoskeletal pain from the following community or clinic networks: churches; pain clinics, physical therapy and primary care clinics; and national chronic pain and fibromyalgia support groups located in the mid-west of the United States. To be eligible, participants had to be 18 years or older and have had chronic pain for more than 3 months in accordance with the 2009 IASP guidelines. Prospective participants who were younger than 18 years old or had pain that was due to severe physical illnesses, such as cancer, were excluded from the study.

Following institutional review board approval, prospective participants from the above institutions were contacted and recruited by advertisements through newsletters, bulletins and recruitment flyers. They were invited to complete the BREQ-2 (Markland and Tobin, 2004) on SurveyMonkey. Clinical and demographic information was collected from participants regarding age, gender, relationship status, race/ethnicity, physical activity and exercise levels before chronic pain onset, time since chronic pain onset, pain intensity, and height, weight and waist measurements. The online survey also included validated instruments related to the key self-determination theory constructs of competency and relatedness through the Exercise Self-Efficacy Scale (Bandura, 1997), Outcome Expectations for Exercise Scale (Resnick et al, 2000), and the Friend/Family Support for Exercise Habits Scale (Sallis et al, 1987). According to the SurveyMonkey response summary, 253 participants started the survey and 211 (83%) completed it. It is possible that 17% of participants did not finish the survey due to its length.

Ethics and consent

Participants provided informed consent on SurveyMonkey before completing the questionnaire. They had the option to request a \$15 gift card on completion. Their contact information was automatically transmitted to a file independent from their survey data to ensure confidentiality.

Measures

The BREQ-2 is a 19-item scale developed by Markland and Tobin (2004) based on self-determination theory to assess behavioural regulation in exercise. This study modified the items to indicate the broader exercise term of 'physical activity and exercise' to accommodate for the needs for modified exercise and/or light-to-moderate intensity levels of physical activity among people with chronic musculoskeletal pain. Participants were asked questions relating to why they engage in physical activity and exercise and their responses were measured on a five-point Likert-type scale ranging from 1 (not true for me) to 5 (very true for me). The scale is comprised of five subscales measuring five types of exercise regulation (Table 1). For this study, internal consistency reliabilities (Cronbach's alphas) were reported to be 0.85 for amotivation, 0.76 for external regulation, 0.81 for introjected regulation, 0.84 for identified regulation and 0.94 for intrinsic regulation subscales (Markland and Tobin, 2004).

The Exercise Self-Efficacy Scale was developed by Bandura (1997) and has been psychometrically evaluated in a sample of Korean adults (Shin et al, 2001). The scale has a total of 18 items and participants rate how confident they are that they could perform physical activity and exercise routines regularly under various circumstances on a scale from 0% (cannot do) to 100% (certain can do).

Outcome expectancy was measured with the Outcome Expectations for Exercise Scale, which was developed and validated by Resnick et al (2000). This scale consists of nine items that focus on the positive expectations of physical activity and exercise, and it uses a five-point rating scale from 1 (strongly agree) to 5 (strongly disagree).

The Friend/Family Support for Exercise Habits Scale was developed and validated by Sallis et al (1987) and it measures perceived friend and family support specific to physical activity and exercise behaviours. The measure has a total of 20 items. For this study, only 10 of the most relevant items were used and endorsed on a five-point rating scale from 1 (never) to 5 (very often).

Data analysis

Means, standard deviations, skewness and kurtosis of the items were calculated for overall representation of the items. Given that the BREQ-2 was previously validated in other populations, the measurement structure of the BREQ-2 was confirmed using confirmatory factor analysis in people with chronic musculoskeletal pain. Confirmatory factor analysis is a statistical procedure that tests relationships between observed variables or indicators – e.g. test items or test scores – and latent variables or factors. A one-factor and a five-factor measurement structure of the BREQ-2 were tested using the AMOS statistical software programme. All items were freed and allowed to load on their respective factors; whereas cross-loadings were constrained to zero. To test model fit – i.e. to test whether the hypothesised underlying latent factors exist within the data – several fit indices were used. The chi-square goodness-of-fit test that measures discrepancy between data-implied and model-implied covariance matrices, the chi-square:degrees of freedom (χ^2/df) ratio that takes into account sample size and provides another estimation of chi-square, and the comparative fit index (CFI) that compares the hypothesised model with a null model that represents no relationship between variables. A non-significant chi-square, a relative chi-square (χ^2/df) in the range of three to one, and CFI values >0.95 indicate an acceptable model fit. In addition, we reported the root mean square error of approximation that tests the error approximation of a model with population data with a 90% confidence interval. A value of $P < 0.05$ was considered a close fit and values up to 0.08 considered reasonable errors of approximation in the population (Byrne, 2001). In addition, Bayesian Criterion Information (BIC) was used to compare the one-factor and five-factor models. BIC is used to detect improvements between competing models. Decreases in BIC represent a better model fit (Kaplan, 2000).

To assess the effects of covariates on the factorial structure of participants, we used a multiple indicators, multiple causes model (MIMIC) (Proitsi et al, 2011). In this study, the MIMIC model was used to test the effects of gender, time since onset of chronic pain, body

mass index, and previous engagement with exercise on the five motivation-to-exercise factors simultaneously.

The validity of the scale was analysed using discriminant validity and construct validity. Discriminant validity assesses whether there is divergence between related but conceptually distinct scales utilising previous research results and theoretical assumptions (Campbell and Fiske, 1959). To assess discriminant validity, the confirmatory factory analysis results of the five-factor model were compared with a series of four-factor models in which items from each possible pair of factors were restricted to load on the same factor. The construct validity of the scale was assessed by correlating the factor scores with several instruments related to key self-determination theory constructs. A conventional *P* level of 0.05 was used to determine significance for the analysis.

RESULTS

Clinical and demographic characteristics

The ages of study participants ranged from 18 to 82 years (mean age 43.37; standard deviation [SD]: 14.43). Mean age of onset for chronic pain was 30.30 (SD: 12.52). Thirteen per cent of participants (*n*=28) were male and 87% (*n*=183) were female. The majority of participants (89.1%; *n*=188) were white. About half of the participants were married or in a significant relationship (59.7%; *n*=126). When asked to report their pain using a 1 (i.e. no pain) to 10 (i.e. most imaginable pain) rating scale, participants on average reported moderate pain. A mean of 12.92 years (SD: 9.82) had passed since the onset of their chronic pain condition.

Participants' body mass index calculation indicated that 0.9% (*n*=2) participants were underweight, 30.3% (*n*=64) were in the normal range, 23.7% (*n*=50) were overweight and 45% (*n*=95) were obese. With respect to weekly amounts of physical activity and exercise (e.g. aerobics, bicycling, swimming, team sports) before chronic pain onset, 5.7% of participants (*n*=12) had no engagement, 19.0% (*n*=40) engaged one to two times per week, 38.4% (*n*=81) engaged three to four times a week and 37% (*n*=78) engaged more than five times a week.

Confirmatory factor analysis

Bartlett's test of sphericity was significant, χ^2 (142, *n*=211)=2488.02 (*P*<0.01), and the Kaiser–Meyer–Olkin measure was 0.87, indicating that the correlation matrix was not an identity matrix and the sampling was adequate for the factor analysis. The 19×19 correlation matrix of the BREQ-2 was subjected to a confirmatory factory analysis using the maximum likelihood estimation method. Two confirmatory factory analysis models were evaluated: the one-factor model (to confirm the BREQ-2 is not unidimensional) and the five-factor intercorrelated model (amotivation, external regulation, introjected regulation, identified regulation and intrinsic regulation). The goodness-of-fit indexes for the one-factor model were χ^2 (152, *n*=211)=1109.40 (*P*<0.001); χ^2 /df=7.29; BIC=11 472.869; CFI=0.60 and root mean square error approximation=0.17 (90% confidence interval [CI]: 0.16–0.18). The results indicated that the one-factor model did not fit the data.

The results for the five-factor model (χ^2 (142, $n=211$)=220.14 [$P<0.001$]; $\chi^2/\text{df}=1.55$; BIC=477.02; CFI=0.96 and root mean square error approximation=0.05 [90% CI: 0.03–0.06]) indicated that the model fit the data well, as presented in Figure 1. The χ^2/df showed a good fit, the five-factor model explained data well over a null model, and the error approximation of the model in the population represented a close fit.

The decreases in BIC also indicated that the five-factor model was a better fit than the one-factor model. The factor loadings ranged from 0.84 to 0.91 for intrinsic regulation, 0.59 to 0.86 for identified regulation, 0.72 to 0.86 for introjected regulation, 0.59 to 0.75 for external regulation and 0.72 to 0.86 for amotivation.

All of the correlations between factors were significant at $P<0.05$ level, except the correlations between introjected and intrinsic regulation and between introjected regulation and amotivation. Amotivation and external regulation were negatively correlated with identified and intrinsic regulation, reflecting a continuum of amotivation to intrinsic regulation. The correlations between factors are shown in Table 2.

Multiple indicators, multiple causes model

MIMIC analysis indicated the five-factor model also had a good fit (χ^2 (198, $n=211$)=301.49 [$P<0.001$]; $\chi^2/\text{df}=1.52$; BIC=14537.29; CFI=0.95; and root mean square error approximation=0.05 [90% CI: 0.03–0.06]). Overall, the inclusion of the covariates in the model did not change the loadings on their respective factors.

Table 3 shows the relationship between the covariates and five factors. The results indicate that both gender and body mass index had an effect on amotivation: male gender and higher body mass index scores were significantly related to amotivation ($P<0.05$). Only time since onset of chronic pain significantly predicted external regulation ($P<0.05$): participants' time since onset increased as their external regulation decreased. None of the covariates significantly predicted introjected regulation.

Time since onset of chronic pain and body mass index significantly predicted identified and intrinsic regulation ($P<0.05$). As time since onset of chronic pain increased, identified and intrinsic regulation increased; whereas as participants' body mass index increased, their identified and intrinsic regulation significantly decreased. body mass index was the strongest predictor of amotivation as well as identified and intrinsic regulation.

Overall, the results indicate that the four factors represented a continuum, as shown in the relationship between the covariates and first two factors (i.e. amotivation and external regulation), which were in the opposite direction to the relationship between the covariates and last two factors (i.e. identified and intrinsic regulation). Introjected regulation was in between these factors.

Validity tests

Discriminant validity—The results for the confirmatory factory analysis are shown in Table 4. The results indicate that the five-factor correlated model had a better fit than the rest of the models. All of the four-factor models had significantly higher chi-square values than

the five-factor model, indicating that the four-factor models were significantly different from the five-factor model. None of the four-factor models had indices in an acceptable range, suggesting that none of them had an acceptable fit. Overall, the five-factor model is shown to fit the data better in this population, and each factor in the model appears to construct a different latent meaning.

Construct validity—The correlations between factors and outcome expectancies, self-efficacy and family and friend support for exercise are shown in Table 5. The results indicate that outcome expectancies and self-efficacy had significant negative correlations with amotivation and significant positive correlations with identified and intrinsic regulation. Outcome expectancy had a significant, small correlation with introjected regulation. Family and friend support as well as self-efficacy had significant but small correlations with external regulation. Family and friend support was significantly correlated with identified and intrinsic regulation. The correlations between the external correlates and the factors were highest among the forms of autonomous motivation.

DISCUSSION

The findings provide further support that the BREQ-2 is a multidimensional scale and offers empirical evidence for a five-factor measurement structure in a community and clinical sample of people with chronic musculoskeletal pain. The five-factor model for the BREQ-2 was the best fit for the data when compared to other models, which is similar to previous findings (Mullan et al, 1997; Markland and Tobin, 2004). Elimination of any of the items would not significantly increase the alpha coefficients of the subscales, indicating that all of the items meaningfully contributed to the reliability of their respective factors. These results suggest that the BREQ-2 has applicability among people with chronic musculoskeletal pain. During initial evaluations and treatment planning in rehabilitation settings, the BREQ-2 can therefore be used to determine the type and level of self-determination and motivation held toward physical activity and exercise goals or interventions.

Examination of the external correlates provided evidence for construct validity. Identified and intrinsic regulation toward physical activity and exercise had strong associations with outcome expectancies, self-efficacy and family and friend support for physical activity and exercise. These findings are similar to research on the associations between self-determined motivation and other self-determination theory variables (Pelletier et al, 2001; Gagné, 2003; Farrell et al, 2004). In addition, external and introjected regulation had a small to non-significant relationship with the self-determination theory variables. These findings somewhat reflect those found in published research studies. One study, for example, used external cues for exercise and was deemed relatively ineffective (Lubans et al, 2009). Also, introjected regulation has been associated with rapid dropout (Pelletier et al, 2001).

However, other studies have found a positive relationship between external regulation and outcome expectancies (Farrell et al, 2004). Amotivation had a negative relationship with outcome expectancies and self-efficacy and no relationship with support from family and friends. These findings also align with previous research indicating that amotivation negatively impacts self-efficacy (Gagné, 2003) and outcome expectancies (Pelletier et al,

2001). Previous studies have also found no significant correlations between amotivation and support provided by family and friends (Gagné, 2003).

Although this is the first study to validate the BREQ-2 among people with chronic musculoskeletal pain, this study has limitations that should be considered when interpreting the results. First, the self-reported nature of an online questionnaire may lead to reporting bias. For example, participants may have misreported their motivation for physical activity and exercise or answered questions in a manner that aimed to seek a favourable response.

Second, the study design involved a convenience sample of participants with chronic musculoskeletal pain who were provided with a financial incentive, which means there could be unique motivational differences among those who chose to participate in this study and those who opted out. Third, this study was not completed as a part of an intervention study or within the limits of a clinic or hospital setting; therefore, our results may not be generalisable to persons actively engaged in treatment or other rehabilitation programmes.

Participants who had access to the online survey may be more financially stable and better educated than those who did not have access. Based on the availability of and apparent ease of use with Internet services, it may be that our participants are healthier and have higher mental health and cognitive functioning than other pain sub-populations, which further indicates that our results may not be applicable to all people with chronic musculoskeletal pain. Finally, the majority of participants in this study were female European Americans from overweight and obese weight groups. Men and people from normal weight groups and racial and ethnic minority backgrounds were notably underrepresented. The generalisability of the study may therefore be restricted to overweight and obese female European Americans. Future research should examine the applicability of the BREQ-2 with diverse groups, including other populations of females and males from various weight groups with chronic illness and disability.

CONCLUSIONS

This is the first study to provide evidence of the excellent psychometric properties for the BREQ-2 among people with chronic musculoskeletal pain. During initial evaluations in rehabilitation research and practice, the BREQ-2 and other self-determination theory measures may be used to determine the type of motivation held toward physical activity and exercise. It may also be helpful in treatment planning to determine whether physical activity and exercise is a viable rehabilitation option for clients based on their motivation level and adjust interventions accordingly. Finally, rehabilitation practitioners can assess whether motivational and/or health promotion interventions were effective in enhancing self-determined motivation and determine whether to modify the current strategies or implement new interventions.

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Figure 1.
Five-factor measurement structure of the BREQ-2

Table 1.

Items from the BREQ-2

Amotivation	5. I don't see why I should have to engage in physical activity and exercise
	9. I can't see why I should bother engaging in physical activity and exercise
	14. I don't see the point in engaging in physical activity and exercise
	18. I think physical activity and exercise is a waste of time
External regulation	1. Because other people say I should
	6. Because my friends/family/spouse say I should
	11. Because others will not be pleased with me if I don't
	16. I feel under pressure from friends/family to engage in physical activity and exercise
Introjected regulation	2. I feel guilty when I don't engage in physical activity and exercise
	7. I feel ashamed when I miss a physical activity and exercise session
	12. I feel a failure when I haven't engaged in physical activity and exercise in a while
Identified regulation	3. I value the benefits of physical activity and exercise
	8. It's important to me to engage in physical activity and exercise regularly
	13. It's important to make an effort to engage in physical activity and exercise regularly
	17. I get restless if I don't engage in physical activity and exercise regularly
Intrinsic motivation	4. I engage in physical activity and exercise because it's fun
	10. I enjoy my physical activity and exercise sessions
	15. I find physical activity and exercise a pleasurable activity
	19. I get pleasure and satisfaction from engaging in physical activity and exercise

Table 2. Correlations between amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation factors

	Amotivation	External	Introjected	Identified	Intrinsic
Amotivation	1.00				
External	0.43 ^{**}	1.00			
Introjected	0.03	0.32 ^{**}	1.00		
Identified	-0.59 ^{**}	-0.19 [*]	0.25 ^{**}	1.00	
Intrinsic	-0.46 ^{**}	-0.18 [*]	0.08	0.80 ^{**}	1.00

* P<0 .05,

** P<0 .01;

coefficients greater than or equal to 0.30 are shown in bold

Impact of age at onset of pain, gender, body mass index, and prior engagement in physical activity and exercise on the BREQ-2 Factors

Table 3.

Factor	Covariate and significant factor on each effect	Beta coefficient	Standard error	P
Amotivation				
	Time since onset of chronic pain	-0.044	0.072	0.543
	Gender	-0.160	0.073	0.028 *
	Body mass index	0.173	0.073	0.018 *
	Prior engagement in physical activity and exercise	-0.102	0.073	0.161
External				
	Time since onset of chronic pain	-0.199	0.078	0.010 *
	Gender	-0.010	0.077	0.900
	Body mass index	0.065	0.077	0.402
	Prior engagement in physical activity and exercise	-0.097	0.078	0.210
Introjected				
	Time since onset of chronic pain	-0.030	0.075	0.692
	Gender	0.013	0.075	0.863
	Body mass index	-0.048	0.076	0.523
	Prior engagement in physical activity and exercise	0.118	0.076	0.122
Identified				
	Time since onset of chronic pain	0.216	0.070	0.002 *
	Gender	0.059	0.068	0.385
	Body mass index	-0.266	0.072	0.000 *
	Prior engagement in physical activity and exercise	0.226	0.071	0.001 *
Intrinsic				
	Time since onset of chronic pain	0.194	0.067	0.004 *
	Gender	0.000	0.067	0.999
	Body mass index	-0.227	0.067	0.001 *
	Prior engagement in physical activity and exercise	0.176	0.067	0.009 *

* P<0.05

Table 4.

Factor separability results through confirmatory factor analysis

CFA models	χ^2	df	diff	χ^2 diff	χ^2/df	CFI	RMSEA (90%CI)	BIC
Model 1: Correlated 5-factor	220.14	-	-	-	1.55	0.96	0.05 (0.03–0.06)	477.02
Model 2: amotivation – external regulation	396.84	4		176.70*	2.71	0.89	0.09 (0.08–0.10)	10792.41
Model 3: amotivation – introjected regulation	477.76	4		257.62*	3.27	0.86	0.10 (0.09–0.11)	10873.33
Model 4: amotivation – identified regulation	476.13	4		255.99*	3.26	0.86	0.10 (0.09–0.11)	10871.71
Model 5: amotivation – intrinsic regulation	564.94	4		344.80*	3.86	0.82	0.11 (0.10–0.12)	10960.51
Model 6: external regulation – introjected regulation	431.66	4		211.52*	2.95	0.88	0.09 (0.08–0.010)	10827.23
Model 7: external regulation – identified regulation	463.97	4		243.83*	3.17	0.86	0.10 (0.09–0.11)	10859.55
Model 8: external regulation – intrinsic regulation	466.62	4		246.48*	3.19	0.86	0.10 (0.09–0.11)	10862.20
Model 9: introjected regulation – identified regulation	456.16	4		236.02*	3.12	0.87	0.10 (0.09–0.11)	10851.73
Model 10: introjected regulation – intrinsic regulation	473.40	4		253.26*	3.24	0.86	0.10 (0.09–0.11)	10868.98
Model 11: identified regulation – intrinsic regulation	358.20	4		138.06*	2.45	0.91	0.08 (0.07–0.09)	10753.82

df:degrees of freedom; diff: difference; CFI: confirmatory factor analysis; CFI: Comparative fit index; RMSEA: Root mean square error approximation; BIC: Bayesian information criteria; CI: confidence interval;

* significant at P<0.001 level

Table 5.
Correlations between amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation factors

	Amotivation	External	Introjected	Identified	Intrinsic
Outcome expectancies	-0.42^{**}	-0.11	0.16 [*]	0.66^{**}	0.68^{**}
Self-efficacy	-0.34^{**}	-0.14 [*]	-0.06	0.65^{**}	0.60^{**}
Family and friend support	-0.04	0.18 [*]	0.01	0.32^{**}	0.37^{**}

* P<0.05;

** P<0.01;

coefficients greater than or equal to 0.30 are shown in bold