

VALIDATION OF BEHAVIORAL REGULATION IN EXERCISE QUESTIONNAIRE-2 (BREQ-2) AND DIETARY SELF-REGULATION (DSR) IN OVERWEIGHT HIGH SCHOOL STUDENTS IN THAILAND

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ABSTRACT:

Background: This study aimed to validate the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2) and Dietary Self-Regulation (DSR) in overweight high school students in Thailand.

Methods: The original (English) versions of the BREQ-2 and DSR scale were translated into Thai using a forward- and back-translation method. Four hundred twenty-nine overweight high school students in four public secondary schools in Nan Province, Thailand, completed the Thai version of the questionnaires (97.5% of participants returned questionnaires). Their mean age was 15.7±1.7 years old. Data analyses were performed using Cronbach's alpha coefficients, intra-class Correlation Coefficients (ICC), and a confirmatory factor analysis via structural equation modeling.

Results: The confirmatory factor analysis revealed that the factor structures of 5 subscales for the Thai-translated BREQ-2 and 3 subscales for the Thai-translated DSR replicated the original version. The Cronbach's alpha reliability coefficients of the BREQ-2 subscales ranged between .35 and .83 while those of the DSR subscales ranged between .63 and .81. Test-retest reliabilities for the two scales demonstrated a moderate extent (ICC = .04 to .50 for the BREQ-2; ICC = .15 to .45 for the DSR).

Conclusions: Although the original versions of the BREQ-2 and DSR scale were developed for use with the adult population, the Thai versions of these instruments are also generally appropriate for use with obese Thai high school students.

Keywords: Scale validation, Dietary self-regulation, Behavioral regulation in exercise questionnaire, Overweight, High school students, Thailand

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INTRODUCTION

Thailand reported prevalence rates in 1995, 2001, and 2008–2009 to be 5.8%, 6.7%, and 9.7%, respectively [1]. Obese children and adolescents are likely to become obese adults [2], resulting in an increase of diseases related to obesity-mortality rates in adulthood [3]. Previous research studies have developed behavioral assessment tools, including those grounded in self-determination theory (SDT), to evaluate intervention efforts

centered on controlling and reducing the weight of those who are overweight and obese in different contexts and different populations [4].

As traditional weight control programs have had limited success, particularly in the long-term, motivation-focused interventions based on SDT have recently been proposed as a potentially more promising alternative. According to SDT, motivation is a multidimensional and continuous range of self-determination that includes intrinsic motivation or autonomous motivation [5] as well as controlled motivation [6, 7]. It also proposes that self-determined motivation leads to behavioral

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changes in exercise levels and health concerns for overweight or obese children and adolescents [8]. However, evidence supporting the effectiveness and mechanisms of the action of SDT-based interventions is currently limited. Valid assessment tools that emphasize the qualitative aspect of motivation are essential in examining these issues.

A number of motivation assessment tools grounded in SDT have been developed and utilized in the field of weight control, including the Behavioral Regulation in Exercise Questionnaire (BREQ) [9] and the Dietary Self-Regulation (DSR) [10]. The BREQ was initially developed by Mullan, Markland and Ingledew [11] for use with adults in order to measure 4 types of motivation of physical activity, including external regulation, introjected regulation, identified regulation, and intrinsic regulation. Markland and Tobin [9] subsequently developed a new BREQ, called BREQ-2, in which they added a fifth type of motivation: amotivation. Thereafter, Verloigne et al. [12] demonstrated that the BREQ-2 can also identify exercise behavior motivation regulation in adolescents with obesity. Similarly, Craciun et al. [13] found that BREQ-2, which they translated into Romanian, was able to classify exercise motivation in young Romanians with a high degree of reliability (a correlation coefficient or r of .70–.87). The tool was further demonstrated to be reliable in many languages, such as in the Greek BREQ-2 ($r = .77$ –.88 in 5 structure factors) [14], Spanish BREQ-2 ($r = .81$ –.89), [15] Iranian BREQ-2 ($r \geq .70$) [16], and Malaysian BREQ-2 ($r = .60$ –.78) [17]. However, other than with Malaysian people, the reliability of the BREQ-2 has not been examined among other Southeast Asian populations, including Thais.

The DSR is the first of four questionnaire sets of the Treatment Self-Regulation Questionnaire (TSRQ) based on SDT. It was developed by Williams et al. [10] to assess the degree to which an individual's motivation for consuming a healthy diet is autonomous or self-determined. The three subscales of the tool consist of autonomous motivation, externally controlled motivation, and a motivation (i.e., lack of motivation). Its internal consistency was good (Coefficient alpha for subscales ranging between .70 and .98) [10]. DSR validity and reliability have been tested in various settings and languages; Levesque et al. [18] used DSR across three different health behaviors (tobacco, diet, and exercise) and across different research sites to distinguish different forms of motivation with a high degree of reliability for each motivation type ($r > .73$). Życińska et al. [19] also used DSR with participants diagnosed to have

chronic diseases. The DSR translated into Polish had a high level of reliability ($r = .78$ –.89) [19]. However, no such questionnaire was available in a Thai version.

Although both the BREQ-2 and DSR questionnaires have been widely used and shown to have adequate psychometric properties in different cultural contexts, previous studies indicated that some items of the subscales are unstable. For example, the Greek-translated BREQ-2 had a very weak item loading of .28 on identified regulation subscales of item 17 (*I get restless if I don't exercise regularly*), resulting in the item being removed and the model being re-estimated [14]. In addition, existing literature suggests a high correlation between the adjacent structure factors of BREQ-2, compared to more distant structural factors. Because items of adjacent structural factors were harmonized, it was difficult to separate more than one distant structure factor.

Both the hierarchical 5-factor structure and the single-factor structures of the Romanian-translated BREQ-2 demonstrated that the proposed model validation using confirmatory factor analysis (CFA) did not fit the data well ($p < .001$) [13] for adolescents, younger adults, and older adults [13, 14]. Similarly, the DSR was shown to have overlapping structural factors, such as Item 12 (Because I want others to approve of me) and Item 14 (*Because I want others to see I can do it*), which belong to two factors (2 and 3) from the external regulation subscale and showed relatively acceptable loadings ($> .3$) [19]. Although both BREQ-2 and DSR demonstrated acceptable reliability and appropriate cross-national measurement equivalence in healthy and ill populations [19], their validity for use in Thailand needs to be addressed by further study. Thus, the present study aims to examine the psychometric properties of the Thai-translated BREQ-2 and DSR among obese high school students in Thailand.

MATERIALS AND METHODS

Subjects

Totally of 440 overweight Thai high school students from four public schools in Nan Province, Thailand were invited into this study. A total of 429 participants returned the questionnaires (97.5% response rate) (male = 194; female = 234; no gender identification for 1 case). They were students in the 7th to 12th grades. Their mean age was 15.7+1.7 years old. The condition of being overweight was classified as having a BMI more than or equal to the 85th percentile for their specific age and sex when using the WHO growth standard reference in 2007 [20].

Table 1 Thai-translated BREQ-2 and DSR Scale Model Fit Statistics

Scale	N	χ^2	df	p value	RMSEA	NNFI	CFI
The Thai-translated BREQ-2 (19 items and 5 factors)	429	126.86	103	0.05537	0.023	0.99	0.99
The Thai-translated DSR (15 items and 3 factors)	429	94.62	53	0.00057	0.042	0.98	0.99

Note χ^2 = Chi-Square, RMSEA = Root Mean Square Error of Approximation; NNFI = Non-Normed Fit Index; CFI = Comparative Fit Index.

They were recruited upon individual and parental consent. This study was approved by the Institutional Review Board of the Faculty of Medicine at Chulalongkorn University (IRB No. 253/56).

Instruments

The Thai version of BREQ-2 was developed from the original BREQ-2 [9], which was permitted from main author. The 19-item BREQ-2 uses a rating scale (from 0 = not true for me to 4 = very true for me) with 5 factors of motivation. The tool includes 4 items of amotivation (e.g., *I don't see why I should have to exercise*), 4 items of external regulation (e.g., *I exercise because other people say I should*), 3 items of introjected regulation (e.g., *I feel guilty when I don't exercise*), 4 items of identified regulation (e.g., *I value the benefits of exercise*), and 4 items intrinsic motivation (e.g., *I exercise because it's fun*). The Thai version of the BREQ-2 was used for classifying 5 different types of motivation of physical activity in overweight Thai high school students.

The Thai version of the DSR questionnaire was also developed from the original DSR [10], which was also permitted from main author, using a similar standard procedure as previously described for the Thai version of the BREQ-2. The 15-item DSR uses a rating scale (from 1 = not true at all to 7 = very true) with 3 factors of motivation. The tool includes 6 items of autonomous motivation (e.g., *Because I feel that I want to take responsibility for my own health*), 6 items of externally controlled motivation (e.g., *Because I would feel guilty or ashamed of myself if I did not eat a healthy diet*), and 3 items of a motivation (e.g., *I really don't think about it*). The Thai version of the DSR was developed to measure 3 different forms of motivation for consuming a healthy diet in overweight and obese Thai adolescents.

Procedure

Following the translation procedure recommended by the WHO guidelines [21], forward and backward translations of the original BREQ-2 and DSR items were conducted by separate sets of two expert bilingual translators; any

discrepancies were resolved through consensus among the authors and translators. The Thai-translated version was then examined for their cognitive equivalence by the two experts in health promotion and an expert in psychology. After minor revisions, the draft questionnaire was pre-tested among the overweight and obese high school students in the study province. This step aimed to ensure that the original instructions, items, and scoring materials are clearly expressed. Additional later modifications were made to the scale format (from visual to numeric scales). For instance, original BREQ-2 items (6, 8, 9, 11, 12, 14 and 17) and the DSR items (4, 7, 8, 9, 10, and 15) were revised in order to make their meaning more suitable for Thai adolescents and the Thai cultural context. The Thai-translated BREQ-2 and DSR were then self-administered, requiring 10 minutes to complete by students in classrooms. Only completed questionnaires were used for further data analysis.

Statistical analyses

CFA via structural equation modeling was used to determine the structural factors of the two instruments using LISREL version 8.72. The models fitted were assessed using the goodness of fit χ^2 , RMSEA, NNFI, and CFI indices. A p value of < .05 was used as the cut-off point for statistical significance. To determine the internal consistency of the Thai-translated BREQ-2 and DSR, they were examined using the Cronbach's alpha coefficient, while their reliability (5-week test-retest reliability) was examined using ICC.

RESULTS

Psychometric properties of the questionnaires

CFA was conducted to define a one-directional construct of the Thai-translated BREQ-2 and DSR questionnaires for overweight Thai high school students as presented in the original version of the questionnaires. The goodness-of-fit indices obtained for the 19-item and 5-factor Thai-translated BREQ-2 and the 15-item and 3-factor Thai-translated DSR models indicated an acceptable overall model fit, as shown in Table 1.

Table 2 Descriptive statistics and factor loading results from the Thai-translated BREQ-2 (n=429)

Item No	\bar{X}	(SD)	CV (%)	Min-Max	SK	KU	Factor loading				
							1	2	3	4	5
Factor 1: Amotivation											
5.	I don't see why I should have to exercise	1.5	(1.28)	85.33	0-4	.38	-.96	.57			
9.	I can't see why I should bother exercising	1.7	(1.12)	65.88	0-4	.08	-.77	.51			
12.	I don't see the point in exercising	1.4	(1.31)	93.57	0-4	.46	-.94	.61			
19.	I think exercising is a waste of time	1.2	(1.23)	102.5	0-4	.66	-.71	.67			
Factor 2: External regulation											
1.	I exercise because other people say I should	2.1	(1.15)	54.76	0-4	-.12	-.46		.36		
6.	I take part in exercise because my friends/family say I should	2.0	(1.19)	59.50	0-4	-.10	-.73		.39		
11.	I exercise because others will not be pleased with me if I don't	1.4	(1.18)	84.29	0-4	.33	-.86		.75		
16.	I feel under pressure from my friends/family to exercise	1.6	(1.28)	80.00	0-4	.28	-.97		.61		
Factor 3: Introjected regulation											
2.	I feel guilty when I don't exercise	1.8	(1.09)	60.56	0-4	-.08	-.45			.61	
7.	I feel ashamed when I miss an exercise session	1.7	(1.14)	67.06	0-4	.03	-.69			.69	
13.	I feel like a failure when I haven't exercised in a while	1.9	(1.13)	59.47	0-4	-.06	-.53			.54	
Factor 4: Identified regulation											
3.	I value the benefits of exercise	3.0	(1.01)	33.67	0-4	-.65	-.60			.63	
8.	It's important to me to exercise regularly	2.6	(1.08)	41.54	0-4	-.35	-.38			.69	
14.	I think it is important to make the effort to exercise regularly	2.6	(1.11)	42.69	0-4	-.50	-.44			.58	
17.	I get restless if I don't exercise regularly	1.8	(1.15)	63.89	0-4	.03	-.74			.29	
Factor 5: Intrinsic motivation											
4.	I exercise because it's fun	2.7	(1.06)	39.26	0-4	-.47	-.38			.61	
10.	I enjoy my exercise sessions	2.6	(1.11)	42.69	0-4	-.36	-.64			.71	
15.	I find exercise a pleasurable activity	2.6	(1.12)	43.08	0-4	-.52	-.37			.74	
18.	I get pleasure and satisfaction from participating in exercise	2.5	(1.13)	45.20	0-4	-.34	-.59			.63	

Note SK = skewness, KU = kurtosis

Regarding the Thai-translated BREQ-2 questionnaire, the standardized factor loadings for 19 items of the 5 subscales ranged from .29 to .74, all of which were significant at $p < .05$. For the Thai-translated DSR, the standardized factor loadings for the 15 items of the 3 subscales ranged from .28 to .77, all of which were significant at $p < .05$. Descriptive statistics, factor loadings for individual items, and reliability for subscales of the measures are summarized in Tables 2 and 3.

Internal consistency and reliability

The test-retest reliability of the Thai-translated

BREQ-2 and DSR questionnaires were examined among 50 Thai high school students, using ICC, over a 5-week period. The ICC were calculated between time 1 and time 2 for 5-factor of the Thai-translated BREQ-2 and 4-factor of the DSR. Cronbach's alpha coefficients indicated that the subscales of the Thai-translated BREQ-2 and DSR questionnaires identified by the factor analyses were internally consistent. Regarding the Thai-translated BREQ-2, Cronbach's alpha coefficients of the subscales varied from .35 to .83. Cronbach's alpha coefficients of the subscales for the Thai-translated

Table 3 Descriptive statistics and factor loading results from the Thai-translated DSR (n=429)

Item No	\bar{X}	(SD)	CV (%)	Min-Max	SK	KU	Factor loading		
							1	2	3
Factor 1: Autonomous motivation									
1. Because I feel that I want to take responsibility for my own health	4.7	(1.57)	33.40	1-7	-.05	-.73	.64		
3. Because I personally believe it is the best thing for my health	4.7	(1.66)	35.32	1-7	-.23	-0.68	.68		
6. Because I have carefully thought about it and believe it is very important for many aspects of my life	4.4	(1.66)	37.73	1-7	.08	-.81	.72		
8. Because it is an important choice I really want to make	4.6	(1.58)	34.35	1-7	-.03	-.77	.72		
11. Because it is consistent with my life goals	4.4	(1.63)	37.05	1-7	-.06	-.72	.78		
13. Because it is very important for being as healthy as possible.	4.7	(1.67)	35.53	1-7	-.10	-.94	.71		
Factor 2: Externally controlled motivation									
2. Because I would feel guilty or ashamed of myself if I did not eat a healthy diet.	3.7	(1.54)	41.62	1-7	.08	-.25	.48		
4. Because others would be upset with me if I did not.	3.1	(1.71)	55.16	1-7	.27	-.85	.50		
7. Because I would feel bad about myself if I did not eat a healthy diet.	3.7	(1.56)	42.16	1-7	.11	-.45	.56		
9. Because I feel pressure from others to do so.	3.7	(1.83)	49.46	1-7	.007	-.98	.56		
12. Because I want others to approve of me.	3.8	(1.83)	48.16	1-7	.10	-.82	.60		
14. Because I want others to see I can do it.	4.2	(1.77)	42.14	1-7	-.07	-.82	.54		
Factor 3: Amotivation									
5. I really don't think about it.	3.3	(1.62)	49.09	1-7	.26	-.53	.50		
10. Because it is easier to do what I am told than think about it.	3.9	(1.68)	43.08	1-7	.17	-.57	.47		
15. I don't really know why.	3.2	(1.92)	60.00	1-7	.47	-.86	.58		

Note SK = skewness, KU = kurtosis

Table 4 Cronbach's alpha and ICC (5 weeks) of the Thai-translated BREQ -2 and DSR scores

Scale	Cronbach's alpha (n=429)		ICC (n=50)
	α		
The Thai- translated of BREQ-2			
Amotivation	.57		.20
External Regulation	.35		.23
Introjected Regulation	.70		.04
Identified Regulation	.55		.50
Intrinsic Motivation	.83		.40
Overall	.77		.27
The Thai- translated of DSR			
Amotivation	.67		.22
Externally Controlled Motivation	.83		.15
Autonomous Motivation	.81		.45
Overall	.82		.24

* p < .05; ** p < .01

DSR varied from .67 to .83. The Thai-translated BREQ-2 and DSR were shown to have adequate 5-week test-retest reliability of .27 and .24, respectively. Data are presented in Table 4.

Correlations among subscales

The Thai-translated BREQ-2 questionnaire

classified the following subscales: A motivation was found to have a significant positive relationship with external regulation and introjected regulation ($p < .001$) and a significant negative relationship with intrinsic regulation ($p < .01$). External regulation was found to have a significant positive relationship with

Table 5 Correlation coefficients of BREQ-2 motivation types (n=429)

Subscales	Amotivation	External regulation	Introjected regulation	Identified regulation
Amotivation	-			
External regulation	.52 **	-		
Introjected regulation	.45 **	.44 **	-	
Identified regulation	.04	.29 **	.42 **	-
Intrinsic regulation	-.13 *	.09	.22 **	.64 **

* p < .01; ** p < .001

Table 6 Correlation coefficient of DSR motivation types (n=429)

Subscales	Autonomous motivation	Externally controlled motivation
Autonomous motivation	-	
Externally controlled motivation	.43**	-
Amotivation	.18**	.59**

** p < .001

introjected regulation and identified regulation ($p < .001$). Introjected regulation was found to have a significant positive relationship with identified regulation and intrinsic regulation ($p < .001$). Finally, identified regulation was found to have a significant positive relationship with intrinsic regulation ($p < .001$). Data are presented in Table 5.

The Thai-translated DSR questionnaire classified the following subscales: Autonomous motivation was found to have a significant positive relationship with externally controlled motivation and amotivation ($p < .001$). Externally controlled motivation was found to have a significant positive relationship with amotivation ($p < .001$). Data are presented in Table 6.

DISCUSSION

The theoretical framework for SDT states that self-determined motivation leads to behavioral changes in exercise levels and health concerns for overweight or obese children and adolescents. The proposed motivation in SDT is a multidimensional and continuous range of self-determination that includes intrinsic motivation or autonomous motivation and controlled motivation [6, 7]. The results of this study show that the total scale and subscales of the Thai-translated BREQ-2 and DSR questionnaires demonstrated an acceptable fit to theoretical constructs for SDT. Confirmatory factor analyses revealed that the factor structures of the Thai-translated BREQ-2 and DSR questionnaires were consistent with the theoretical framework for SDT and the original version and previous studies [9, 13-16]. The Thai-translated BREQ-2 was classified into 5 factors: amotivation, external regulation, introjected regulation, identified regulation, and intrinsic regulation. The Thai-

translated DSR was classified into 3 factors: autonomous motivation, externally controlled motivation, and amotivation.

The inter-correlations of 5-factor of the Thai-translated BREQ-2 ($r = -0.13$ to 0.64 , $p < .01$ to $<.001$, as in Table 5) and 4-factor of the DSR questionnaires ($r = 0.18$ to 0.59 , $p <.001$, as in Table 6) were significantly minimal to moderate. The inter-correlation results indicated that the types of regulations that are close along the motivational continuum have higher correlations compared to those that are opposite, which is similar to results in previous studies [7].

Regarding its reliability, the Thai-translated BREQ-2 questionnaire demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of .77. In addition, the BREQ-2 revealed a 5-week test-retest reliability to a moderate extent ($ICC = .04$ to $.50$). The age of the population surveyed using the Thai-translated BREQ-2 questionnaire was lower than the Greek BREQ-2 (which was applied to participants aged 18 to 64 years) [14], the Spanish BREQ-2 (applied to participants with a mean age of 30.36 ± 10.98 years) [15], the Romanian BREQ-2 (applied to adolescents with a mean age 17.84 ± 0.63 years) [13], and the Iranian BREQ-2 (applied to participants aged 18 to 30 years) [14]. However, the subscale reliability of the Thai-translated BREQ-2 was similar to the Malaysian BREQ-2, which was applied to adolescents with a mean age of 13.40 ± 0.49 years [17]. The BREQ-2 is traditionally used across an entire population. However, the Thai-translated BREQ-2 was tested on adolescents with a mean age of 15.7 ± 1.7 years, meaning the participants were younger than all participants tested by BREQ-2 in Greek, Spanish, Romanian, and Iranian. It is

possible that the younger age of Thai high school students affects their prudence when taking the tests.

The reliability of the Thai-translated DSR questionnaire was shown to have acceptable reliability, with a Cronbach's alpha coefficient of .82. In addition, the DSR revealed a 5-week test-retest reliability, albeit to a minimal extent (ICC = .15 to .45). This finding indicates that the internal consistency of the Thai-translated DSR questionnaire was higher than the original DSR, which was combined into a set of TSRQ and applied to measure motivation to change health behaviors in healthy participants with a mean age of 40 to 60.6 years [22]. The externally controlled motivation subscale's reliability in the Thai-translated DSR questionnaire was found to be lower than the Polish DSR version, which was applied to measure motivation to change patients' health behavior after receiving treatments in a hospital and combined into a set of TSRQ [19]. This lower reliability might stem from the Polish DSR's use across a diverse population whereas the Thai-translated DSR questionnaire was used only among overweight adolescents.

Although results of this study indicated that the subscales of the Thai-translated BREQ-2 and DSR questionnaires show a good fit to proposed motivation in SDT, there is room for improvement in adapting the Thai-translated questionnaires for the Thai adolescent population. For example, the Thai-translated BREQ-2 revealed a weak item loading on the external regulation (item 17: *I get restless if I don't exercise regularly* = .29) and on the identified regulation subscale (item 1: *I exercise because other people say I should* = .36; item 6: *I take part in exercise because my friends/family/partner say I should* = .39). This result is consistent with the previous report on the Greek-translated BREQ-2 [14]. This might be due to the cultural attributes of the response items. The Thai-translated BREQ-2 and DSR questionnaires in this study exactly replicated the original version, which aimed to measure the motivation of adult populations in a Western and international context. In general, both young individuals and adults in Western cultures tend to be individualist (i.e., more self-confident and courageous in expressing their ideas and actions). However, unlike people from Western cultures, Thai children and adolescents are likely to be collectivist (i.e., having a sense of taking part in the feelings of surrounding people, seeking others' advice). This indicates the possibility that culturally unbiased items need to be revised. In addition, in order to deepen our understanding of the differences in responses to scale items due to individualism and collectivism among respondents,

qualitative data (such as individual or focus group interview data) concerning the interpretation of items should be further examined. Comparisons between the BREQ-2 and DSR questionnaires and scenarios might provide some evidence of the importance of context when discussing cultural differences. Therefore, the next step in adapting the BREQ-2 and DSR questionnaires to obese Thai adolescents is to conduct individual or focus group interviews among obese Thai adolescents and explore culturally specific items and constructs of the range of self-determination, including intrinsic motivation or autonomous motivation and controlled motivation.

In conclusion, the Thai-translated BREQ-2 and DSR questionnaires are composed of subscales assessing different forms of motivation grounded in SDT among Thai adolescents. Both questionnaires demonstrated adequate psychometric properties among the Thai adolescent population, suggesting that the questionnaires offer promising evidence for use in Thai contexts with overweight high school students. Consistent with previous studies, low item loadings on the external regulation and identified regulation subscales of the Thai-translated BREQ-2 questionnaire were observed in this study. Thus, further study on the psychometric properties of the BREQ-2 and DSR questionnaires for use with Thai adolescents in a national sample is highly recommended.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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REFERENCES

1. Mo-suwan L. Lesson 8: Nutrition on children. In: Aeplakorn W, editor. The 4th National Health Examination Survey Report, year 2008-2009: Children Health. Nonthaburi: NHES; 2009.
2. Singh AS, Mulder C, Twisk JW, van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev.* 2008; 9(5): 474-88.
3. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. *Int J Obes (Lond).* 2011; 35(7): 891-8.
4. Deci EL, Ryan RM. *Intrinsic motivation and self-determination in human behavior.* New York: Plenum; 1985.

5. Stone DN, Deci EL, Ryan RM. Beyond talk: creating autonomous motivation through Self-Determination Theory. [Online]. 2008 [cited 2013 January 1]; Available from: http://selfdeterminationtheory.org/SDT/documents/2009_StoneDeciRyan_JGM.pdf
6. Deci EL, Ryan RM. Self-determination theory: a macrotheory of human motivation, development, and health. *Canadian Psychology*. 2008; 49(3): 182-5.
7. Deci EL, Ryan RM. The 'what' and 'why' of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry*. 2000; 11(4): 227-68.
8. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol*. 2000; 55(1): 68-78.
9. Markland D, Tobin V. A modification to the behavioural regulation in exercise questionnaire to include assessment of amotivation. *J Sport Exerc Psychol*. 2004; 26: 191-6.
10. Williams GC, Grow VM, Freedman ZR, Ryan RM, Deci EL. Treatment self-regulation questionnaire (TSRQ) based on self-determination theory (SDT): a user guide. [Online]. Department of Psychology, University of Rochester; 1996 [cited 2013 May 5]; Available from: <http://www.psych.rochester.edu/SDT/index.php>
11. Mullan E, Markland D, Ingledew DK. A graded conceptualisation of self determination in the regulation of exercise behaviour: development of a measure using confirmatory factor analytic procedures. *Personality and Individual Differences*. 1997; 23: 745-52.
12. Verloigne M, De Bourdeaudhuij I, Tanghe A, D'Hondt E, Theuwis L, Vansteenkiste M, et al. Self-determined motivation towards physical activity in adolescents treated for obesity: an observational study. *Int J Behav Nutr Phys Act*. 2011; 8: 97. doi: 10.1186/1479-5868-8-97.
13. Craciun MT, Rus CL. Factorial validity and reliability evidence for the modified behavioral regulation in exercise questionnaire-2 among Romanian adolescents. *Procedia Soc Behav Sci*. 2012; 33(2012): 528-32.
14. Moustaka FC, Vlachopoulos SP, Vazou S, Kaperoni M, Markland DA. Initial validity evidence for the behavioral regulation in exercise questionnaire-2 among Greek exercise participants. *European Journal of Psychological Assessment*. 2010; 26(4): 269-76.
15. Murcia JA, Gimeno EC, Camacho AM. Measuring self-determination motivation in a physical fitness setting: validation of the behavioral regulation in exercise questionnaire-2 (BREQ-2) in a Spanish sample. *J Sports Med Phys Fitness*. 2007; 47(3): 366-74.
16. Farmanbar R, Niknami S, Hidarnia A, Lubans DV. Psychometric Properties of the Iranian version of the behavioral regulation in exercise questionnaire-2 (BREQ-2). *Health Promotion Perspectives*. 2011; 1(2): 95-104.
17. Hashim HA, Golok F, Ali R. Profiles of exercise motivation, physical activity, exercise habit, and academic performance in Malaysian adolescents: a cluster analysis. *International Journal of Collaborative Research on Internal Medicine & Public Health*. 2011; 3(6): 416-28.
18. Levesque CS, Williams GC, Elliot D, Pickering MA, Bodenhamer B, Finley PJ. Validating the theoretical structure of the treatment self-regulation questionnaire (TSRQ) across three different health behaviors. *Health Educ Res*. 2007; 22(5): 691-702.
19. Życińska J, Januszek M, Jurczyk M, Syska-Sumińska J. How to measure motivation to change risk behaviours in the self-determination perspective? The Polish adaptation of the treatment self-regulation questionnaire (TSRQ) among patients with chronic diseases. *Polish Psychological Bulletin*. 2012; 43(4): 261-71.
20. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ*. 2007; 85(9): 660-7.
21. World Health Organization [WHO]. Process of translation and adaptation of instruments. [Online]. 2013 [cited 2013 April 12]; Available from: http://www.who.int/substance_abuse/research_tools/translation/en/
22. Ryan RM, Connell JP. Perceived locus of causality and internalization: examining reasons for acting in two domains. *J Pers Soc Psychol*. 1989; 57(5): 749-61.