Validation of a social-cognitive theory-based tool for measuring factors influencing obesity prevention behaviors in 4-6 years old children using confirmatory factor analysis (CFA)

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Abstract

Background: Child obesity is one of the main health problems all across the world, which leads to mental and physical health problems. There is no specific tool based on the constructs of social-cognitive theory (SCT) to assess the factors associated with child obesity. The aim of this study was to investigate the validity and confirmatory factor analysis of a SCT-based questionnaire for assessing obesity preventing behaviors among 4-6-year-old children.

Method: This cross-sectional study was conducted to validate a SCT-based instrument for measuring factors affecting obesity prevention behaviors among children aged 4-6 years. 240 preschool children aged 4 to 6 years in Behbahan city, southwest Iran participated in the study. After performing the forward-backward translation method, the face, content, and construct validity of the SCT-based questionnaire were confirmed. The content validity index (CVI) and the content validity ratio (CVR) were used to assess the difficulty, relevancy, and ambiguity of the items, and Confirmatory factor analysis (CFA) was performed to measure the construct validity. Structural Equation Modeling (SEM) was also performed to evaluate the fitness of the model. Reliability of the questionnaire was also measured through Cronbach's alpha coefficient and Intraclass Correlation Coefficient (ICC). The obesity prevention behaviors used in the model included physical activity, consumption of fruit and vegetable, consumption of sugar-free drinks, and screen.

Results: Results of this study confirmed the acceptable content and face validity of the SCT-based questionnaire. The results of confirmatory factor analysis also confirmed the factor loading of more than 0.3 for all variables; therefore the SCT-based questionnaire had an acceptable validity and reliability.

Conclusions: Since the SCT-based questionnaire had an acceptable validity and reliability, it can be used to assess the obesity prevention behaviors in 4-6-year-old children, and also to design relevant educational interventions.

Key Words: Childhood obesity, Confirmatory factor analysis, Social Cognitive Theory, Validation.

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1- INTRODUCTION

Childhood obesity is one of the main health problems in todays' world, and its provenance is on the rise, especially in developing countries, so that an estimation in 2013 suggested the prevalence of child obesity to be more than 42 million worldwide (1). Evidence indicate that obese children are more likely to become obese adults in the future (2). This is while obesity may lead to many health problems in children, including atherosclerosis, type II diabetes, and musculoskeletal disorders (3). Childhood obesity also decreases the children's self-confidence and quality of life (4); and obese children have higher levels of morbidity and mortality during adulthood (5). Several models have been suggested to prevent childhood-obesity, including those that focus on nutrition, physical activity (PA), and behavior change within a family-based approach (6)

Social-cognitive theory (SCT) is one of the most commonly used models for the design of obesity prevention interventions, (7) that mainly focus on behavior change (8). However, our literature view showed that there is no valid and reliable tool for measuring the effects of SCT-based intervention on the obesity prevention behaviors of 4-6-year-old children. To fill the gap in this area, we conducted a study on 240 preschool children aged 4-6-years in Behbahan city to assess the factors affecting obesity prevention behaviors in them, using a SCT-based questionnaire. This manuscript is a part of that study, related to the validation of the SCT-based questionnaire using the confirmatory factor analysis.
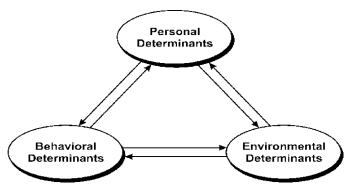

Fig. 1: Schematic model of Social Cognitive Theory

2- METHODS

This cross-sectional study was conducted to validate a SCT-based instrument for measuring factors affecting obesity prevention behaviors among children aged 4-6 years. 240 preschool children aged 4 to 6 years in Behbahan city, southwest Iran participated in the study. The samples were selected by a multi-stage random method. The study environment consisted of preschool centers for children aged 4-6 years in Behbahan city, from which 4 centers were selected randomly. Then, a total of 60 children aged 4 to 6 years were selected from each center. The inclusion criteria for children entering the study were; having no physical or mental disability or congenital disorder according to preschool health records. The mothers of the participating children gave informed consent for their children to take part in the study. They were also responsible for completing the questionnaires.

2-1. Instrument

To find the previously developed relevant instruments containing items related to

factors influencing obesity prevention behaviors in 4-6 year-old children, a literature review was conducted using different keywords or combinations of keywords such as obesity, childhood, social-cognitive theory, prevention, and behavior. The search was carried out in PubMed, Science Direct, ProQuest and Google Scholar databases. Eventually, the childhood health program measurement instrument (9) was found, which was later used as a basis for development of the Persian SCT-based questionnaire. The designed questionnaire, which is based on the constructs of social-cognitive theory, measures factors that affect four obesity-preventing behaviors including physical activity, consumption of fruit and vegetable, consumption of sugar-free drinks, and screen. Changing the physical activity behavior refers to performing 60 minutes of physical activity each day. The fruit and vegetable consumption refers to consuming at least 5 units of fruit and vegetables per day. The consumption of sugar-free drinks refers to the replacement of sugar-rich drinks by sugar-free ones, and finally, changing the screen behaviors indicates restricting the time spent in front of TV or computer/mobile phone screen for two hours per day (10)

The constructs of social-cognitive theory include environment, emotional coping, outcome expectations, goal setting and self-efficacy (**Table 1**).

Table-1: Characteristics of the study instrument

Construct	Definition	Item	Rresponse range	Scoring
Environment	Physical circumstances or conditions that surround a child(Physical surroundings)(11)	3	From never to always	0-4
Emotional coping	Techniques employed by the mother to control the emotional and physiological states associated with the acquisition of a new behavior (Managing emotions) (11)	3	From Not at all sure to Completely sure	0-4
Outcome expectations	Anticipation of the probable outcomes that would ensue as a result of engaging in the behavior under discussion (Expected resulted) (11)	4	From Not at all likely to Extremely likely	0-4
Self-efficacy	Confidence in one's ability to pursue a behavior (Behavioral confidence) (11)	3	From Not at all confident to extremely confident	0-4
Goal setting Or self- control	Setting goals and developing plans to accomplish the chosen behaviors (Establishing goal) (11)	3	From Not at all sure to Completely sure	0-4

2-2. Translation

Forward-backward method was used to translate the questionnaire from English into Persian. For this purpose, at first, two English-speaking experts of health sciences translated the questionnaire into Persian, and then, two other experts with the same English proficiency skills

translated the Persian version of the questionnaire to English. It should be noted that the two experts had no access to the original questionnaire. Then, a team composed of the researchers, translators, and an expert in tool psychometrics compared the two translations with the original version, and confirmed the Persian version of the questionnaire.

2-3. Face and content validity

To assess the face validity, the questionnaire was given to 15 mothers of preschool children aged 4 to 6 years, and they were asked to read and evaluate the questionnaire in terms of difficulty, relevancy, and ambiguity. These mothers were excluded from participating in the subsequent stages.

To assess the content validity, an expert panel of 10 health education specialists quantitatively evaluated the grammar, wording, item allocation and scaling of the SCT-based questionnaire. In addition, the content validity index (CVI) and the content validity ratio (CVR) were used to assess the difficulty, relevancy, and ambiguity of the items in a 4-point Likert scale ranging from not relevant, not simple and not clear (score 1) to very relevant, very simple and very clear (score 4). The CVI was estimated as the proportion of items that received the score of 3 or 4 by the experts (12).

Polite and Beck recommend minimum CVI of 0.8 to be acceptable (13). CVR is used to determine whether an item needs to be in the questionnaire (14). To calculate CVR, the experts rated each item as essential, useful but not essential, or not essential (15).

For reliability, 30 mothers of the preschool children, similar to our participants, completed the questionnaires twice, in a 2-week interval, and later they were omitted from participating in later stages of the study.

2-4. Statistical analysis

2-4-1. Construct validity

To evaluate construct validity of the questionnaire, the confirmatory factor analysis was used. To comply with the requirement of confirmatory factor analysis of a sample size with more than 200 individuals, a total of 240 participants were selected to take part in the study.

2-4-2. Reliability

The internal consistency of the SCT-based questionnaire was assessed through Cronbach's alpha coefficient with the value of 0.70, which was considered acceptable (16). The stability (test–retest reliability) of the questionnaire was also assessed through intra-class correlation coefficient (ICC). In regard to ICC, the value of < 0.40 is considered poor to fair ICC, the value of 0.41–0.60 indicates moderate ICC, the value of 0.61–0.80 indicates high ICC, and the value of > 0.80 indicates very high ICC (17).

2-4-3. Statistical analysis

The statistical software's of SPSS-23 and Amos were used to analyze the data. Confirmatory factor analysis was used to determine the relationship between the data and the structures. Structural Equation Modeling (SEM) was also performed to evaluate the fitness of the model by multiple fit indices, including chi-square ($\chi2/df$), comparative fit index (CFI), goodness-of-fit index (GFI), and root mean square error of approximation (RMSEA). The ratio of chi-Square to the degree of freedom ($\chi2/df$) is used as an indicator to measure the appropriateness of the model fit. The GFI index answers the question, "How much does the resulting model perform better than the worst model?" The RMSEA criterion measures the appropriateness of the statistical population. Appropriate fitness of the model is 0.90 or higher for the CFI and

GFI and less than 0.08 for the RMSEA (17).

3- RESULTS

From among the 240 participating children, 133 (55.4%) were males and 107 (44.6%) were females, and their mean age (±SD) was 5.13 ± 0.68 years (**Table 2**).

3-1. Content validity

The CVR and CVI of the questionnaire were 0.81 and 0.94, respectively.

3-2. Confirmatory factor analysis

Confirmatory factor analysis was used to evaluate the construct validity of each behavior based on the social-cognitive theory.

3-1-1. Physical activity

Factor loadings on all questions related to physical activity were more than 0.3,

which is desirable and significant, and no question was deleted (**Fig. 2**). The maternal-mediated protective child physical activity behavior (MM PC PAB) measurement model indicated that the data has an acceptable fitness (χ^2/df =2.23, P<0.0001, CFI=0.98, GFI=0.98, and RMSEA=0.05).

3-1-2. Fruit and vegetable consumption

Factor loadings on all questions related to the consumption of fruit and vegetables were more than 0.3, which is desirable and significant, and no questions were then removed (**Fig. 3**). The maternal-mediated protective child fruit and vegetable consumption behavior (MM PC FVCB) measurement model indicated reasonable fitness for the data (χ^2/df =2.65, P<0.0001, CFI=0.96, GFI=0.95, and RMSEA=0.06).
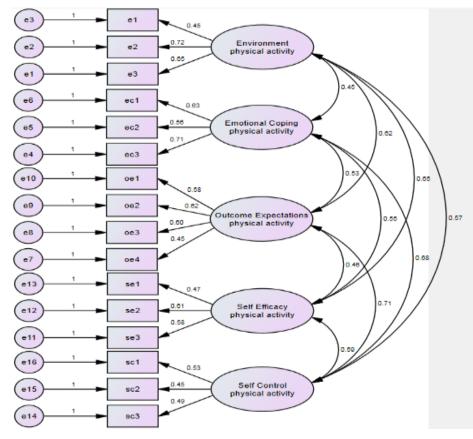

Fig. 2: Factor loadings of the Physical activity

Table-2: Demographic characteristics of the study population

Demographic Factors		N	%
Child's gender	male	133	55.4
	female	107	44.6
child's age (year)	4-5	165	68.7
	5-6	75	31.3
Mother's age (year)	<30	85	35.4
	30≤x≤40	137	57.1
	>40	18	7.5
Mother's educational level	≤Diploma	118	49.1
	Associate & Bachelor	112	46.7
	≥ Master	10	4.2
Mother's occupation status	Housewife	180	75.0
	Employed part-time	29	12.1
	Employed full-time	31	12.9

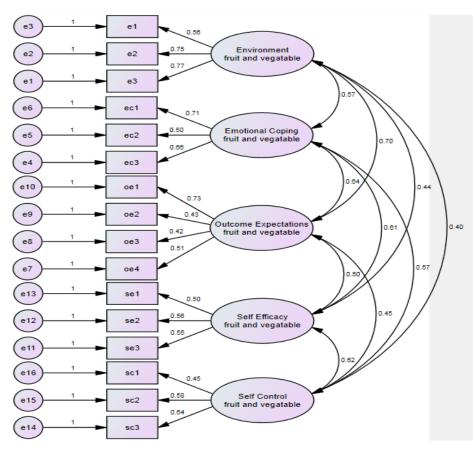**Fig. 3**: Factor loadings of the Fruit and vegetable consumption

3-1-3. Consumption of sugar-free drinks

Factor loadings on all questions related to this activity/ behavior were more than 0.3, which is desirable and significant, and thus no question was removed in this section

(**Fig. 4**). The maternal-mediated protective child sugar-free drink consumption behavior (MM PC SFDCB) measurement model indicated a reasonable fitness for the data ($\chi2/df=2.87$, $P<0.0001$, CFI=0.95, GFI=0.94, and RMSEA=0.07).
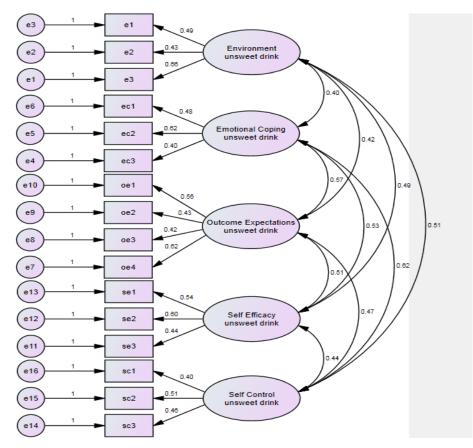
Fig. 4: Factor loadings of the Sugar-free beverage intake

3-1-4. Screen time

Factor loading of all questions related to screen behavior was more than 0.3, which is desirable and significant, and no questions in this section were removed (**Fig. 5**). The maternal-mediated protective child screen time behavior (MM PC STB) measurement model indicated reasonable fitness for the data ($\chi 2$/df =2.21, P<0.0001, CFI=0.94, GFI=0.98, and RMSEA=0.06).

3-2. Reliability of the tool

Internal consistency of the tool was measured by Cronbach's alpha. To evaluate the tool's stability, test-retest analysis was used.

3-2-1. Physical activity behavior

Cronbach's alpha coefficient of the questionnaire was between 0.76 and 0.85, which indicates the acceptable internal consistency of the questionnaire. Intra-class correlation coefficients (ICC) of the questionnaire were also between 0.71 and 0.77, which indicated a desirable ICC (**Table 3**).

3-2-2. Fruit and vegetable consumption behavior

Cronbach's alpha coefficient of the questions related to fruit and vegetable consumption behavior was between 0.80 and 0.88, indicating the acceptable internal consistency of the questions. Intra-class correlation coefficients (ICC) of the questions were between 0.71 and 0.88, indicating a desirable ICC for the questions (**Table 4**).

3-2-3. Sugar-free drinks consumption behavior

Cronbach's alpha coefficient of the questions related to the subscale of sugar-free drinks consumption behavior was between 0.86 and 0.92, indicating the

acceptable internal consistency of the questions. Intra-class correlation coefficients (ICC) of the questions were between 0.71 and 0.75, which indicated a desirable ICC of the questions (**Table 5**).
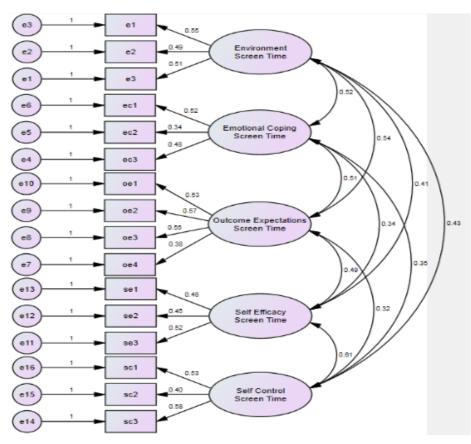

Fig. 5: Factor loading for the Screen time

Table-3: Internal consistency and stability of screen behavior

Variable	Number of items	Cronbach's alpha	ICC
Environment	3	0.76	0.77
Emotional coping	3	0.78	0.71
Outcome Expectations	4	0.85	0.72
Self-efficacy	3	0.84	0.73
Self-control	3	0.82	0.74

Table-4: Internal consistency and stability of screen behavior

Variable	Number of items	Cronbach's alpha	ICC
Environment	3	0.80	0.73
Emotional coping	3	0.85	0.71
Outcome Expectations	4	0.87	0.88
Self-efficacy	3	0.88	0.75
Self-control	3	0.84	0.72

Table-5: Internal consistency and stability of screen behavior

Variable	Number of items	Cronbach's alpha	ICC
Environment	3	0.86	0.75
Emotional coping	3	0.92	0.71
Outcome Expectations	4	0.89	0.71
Self-efficacy	3	0.87	0.74
Self-control	3	0.88	0.72

3-2-4. Screen behavior

Cronbach's alpha coefficient of the questions related to screen behavior was between 0.77 and 0.91, indicating the acceptable internal consistency of the questions. Intra-class correlation coefficients (ICC) of the questions were between 0.71 and 0.74, which indicates a desirable ICC for the questions (**Table 6**).

Table-6: Internal consistency and stability of screen behavior

Variable	Number of items	Cronbach's alpha	ICC
Environment	3	0.86	0.75
Emotional coping	3	0.92	0.71
Outcome Expectations	4	0.89	0.71
Self-efficacy	3	0.87	0.74
Self-control	3	0.88	0.72

4- DISCUSSION

Appropriate tools are needed to assess and evaluate behaviors that are associated with health (18-20). Moreover, questionnaires are among the most common tools that are used in scientific studies to evaluate health-related behaviors (21).

Any designed tool that intends to assess health-related behaviors should be evaluated by psychometric tests in order to be standard and produce correct information and data (22). However, no tool has been so far developed in Iran to evaluate and measure young children's obesity prevention behaviors based on the construct of social-cognitive theory.

The aim of the present study was to assess the validity of a SCT-based tool in determining and predicting the obesity prevention behaviors among 4-6-year-old children in Iran. Five constructs of social-cognitive theory, including environment, emotional coping, outcome expectation, goal setting, and self-efficacy are used in the design of this questionnaire.

In this study, various aspects of scale development such as translation and cultural adaptability of the questionnaire, which are often ignored in other studies (23), were assessed by a panel of experts. To determine CVI and CVR of the questionnaire, the views of 10 experts of health education were used to increase its scientific validity. In addition, the social-cognitive theory was implemented referred to by Adam Nolden as an appropriate model to determine obesity prevention behaviors (24). Furthermore, this questionnaire had a high Cronbach's alpha reliability, while the reliability of the scale of Childhood Health Program Measurement, from which the present questionnaire was translated, enjoyed an appropriate level of reliability (25).

The results of this study, in line with the findings of other studies, consider

Cronbach's alpha of 0.7 or higher as an indicator of scientific reliability of the questionnaire (26). Other studies, conducted on similar topics, also produce the same findings, which confirm the reliability of the questionnaire developed in this study (27).

Confirmatory factor analysis was used in this study to evaluate the four obesity prevention behaviors in 4-6-year-old children based on the constructs of social-cognitive theory derived from the childhood health program measurement instrument. The results of confirmatory factor analysis showed that the measurement model had acceptable goodness of fit in the model. The results of this study along with similar studies also show that the questionnaire that evaluates the effects of four obesity prevention behaviors in 4-6 years old children has acceptable validity and reliability.

The childhood health program measurement questionnaire is a valid and reliable tool evaluating the effects of obesity prevention behaviors among 4-6-year-old children, along with measuring the influence of the child's mother and the mother-child interaction on changing the child's behaviors in order to prevent and reduce obesity in 4-6year-old children.

So, we recommend this questionnaire to be used by researchers in conducting research on samples of mothers to measure their influence on the promotion of obesity prevention behaviors among their children. This tool also helps researchers to better understand the interaction between mothers and children and how mothers affect the behaviors of their children to change their unhealthy behavior to healthier ones. Moreover, this tool can be used by clinicians who intend to promote obesity preventing behaviors in children.

4-1. Study limitations

Like any other study, this study had some limitations. Firstly, in this study the effects of children's fathers on promoting obesity prevention behavior in their children were not considered; so, we recommend that future studies take this variable into account to provide a better picture of the factors affecting obesity prevention behaviors in 4-6-year-old children. Secondly, the data in this study were collected through self-reporting that might have negatively affected the accuracy of data, so we recommend direct observation methods to be added to the data collection tools in future studies.

5- CONCLUSION

The content, face and construct validity and reliability of a SCT-based questionnaire were evaluated and confirmed in this study. The results indicated that this scale, developed based on a translation of the childhood health program measurement instrument, is a reliable and valid instrument for measuring factors influencing obesity prevention behaviors in 4-6-year-old children. The developed tool can be used by clinicians to evaluate and identify factors that affect obesity prevention behaviors in children in order to design appropriate interventions to prevent child obesity.

6- CONFLICT OF INTEREST

None.

7- ETHICAL CONSIDERATIONS

The Research and Ethics Committee of Tehran University of Medical Sciences approved the study protocol (Code: IR.TUMS.REC.1394.1557). All participants completed the informed consent forms and entered the study with personal consent.

8- FUNDING

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10- AUTHORSHIP

Authors have read and approved the manuscript. MS and EN contributed equally to the study design and all matters related to the preparation of the manuscript.

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