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Development and Psychometric Properties of the Physical Activity Scale for Pregnant Women

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ABSTRACT

Aims Although physical activity has many health benefits during pregnancy, few women engage in regular physical activity. The purpose of this study was to test the validity and reliability of a physical activity scale in pregnant women based on social cognitive theory.

Instrument & Methods A multi-phase scale development method was used to build the scale. To generate a pre-final version of the instrument, face and content validity were measured at the following step. The validation of the instrument was evaluated through a sample of 240 pregnant women. Then, the construct validity, internal consistency, test-retest reliability, and Cronbach's alpha of the scale were calculated.

Findings In the beginning, a 36-item scale was created by undertaking a qualitative phase. This number was lowered to 24 items after content validity. Seven factors emerged from the exploratory factor analysis (outcome expectations, outcome value, self-efficacy, social support, self-regulation, mutual determinant, and behavior) which accounted for 52% of the observed variance. The confirmatory factor analysis revealed a model with a suitable fitness for the data. For the subscales, Cronbach's alpha coefficients ranged from 0.83 to 0.94, and the Intraclass correlation coefficient ranged from 0.80 to 0.88, which is within acceptable limits.

Conclusion The findings showed that the psychometric properties of the physical activity scale is valid and reliable scale that can help us better understand aspects associated to physical activity in pregnant women. As a result, it has the potential to be employed in the future research.

Keywords Physical Activity; Scale Development; Psychometrics; Pregnant Women

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Introduction

Physical activity (PA), as defined by the World Health Organization, is described as any movement requiring energy expenditure conducted by skeletal muscles, which includes exercise, work, family, and leisure activities [1]. The reduction in physical activity is rising in many countries around the world, which has a significant influence on health including cardiovascular disease, diabetes, hypertension, and obesity [2]. Overall, a quarter of the world's female population does not reach the recommended levels of physical activity [3]. Pregnancy is a period in a woman's life when her physiological, physical, and psychological systems adapt to meet the growing needs of fetal [4, 5]. These adaptive changes can result in many pregnancy-related health issues such as gestational diabetes, hypertension, preeclampsia, fetal growth restriction, and maternal obesity [6]. For pregnant women, 30 minutes (or more) of moderate daily exercise is suggested by the American College of Obstetricians, and Gynecologists [7]. Pregnant women, who meet the recommended PA levels during their pregnancy, have a lower risk of the health problems listed above [8].

Moderate PA is beneficial for maternal, and fetal health among pregnant women [9]. Physical activity has been linked to several health benefits during pregnancy including the metabolism improvement of both the mother, and fetus, the enhancement of cardiopulmonary function, higher mother-infant immunity, the increase of nervous system function in pregnant mothers, physical fitness improvement or maintenance, the reduction of depression symptoms, gestational diabetes, gestational hypertension, and preeclampsia. Although physical activity has many health benefits during pregnancy, few women engage in regular physical activity during pregnancy [10-12].

Several factors are avoiding PA during pregnancy such as behavioral intention, and attitude, fatigue, self-efficacy for behavior change, change in body shape, pregnancy-related symptoms, the lack of information, lack of time, and social support [13-17].

One of the most potent theories commonly used to anticipate, and show behaviors, is Albert Bandura's social cognitive theory (SCT). SCT emphasizes that personal, and environmental features modify behavior. This theory also considers the two-way interactions of person, behavior, and environment. It provides solutions to change behavior by determining the predictors, and effective principles in shaping behavior [18]. This study aimed to identify the factors affecting the physical activity of pregnant women based on the framework of social cognitive theory, and provide a standard, and practical tool for further research.

Instrument and Methods

The research was conducted in two stages. Items were designed to expand the scale in the initial phase (in the Persian language). Based on the structures of social cognitive theory, a qualitative study was done to develop key suggestions for potential elements of physical activity in pregnant women. After determining the most appropriate phrase for each element, the validity of the face, and content were evaluated.

The items were administered from a new sample in the second phase. To begin, an exploratory factor analysis (EFA) was carried out to determine the major factor structure, and items with insufficient loadings were removed. The confirmatory factor analysis (CFA) was then used to assess the coherence between the data, and the structure. To ensure that the final instrument's factor structure was correct, it was administered to an independent sample. Following that, an independent sample of 30 pregnant women was used to assess test-retest reliability.

Phase 1: Item generation, and instrument development phase

A qualitative study was done to build a scale for measuring physical activity based on structures of social cognitive theory in pregnant women. Two focus group discussions (FGD) among 16 pregnant women (8 members per each group), and 9 semi-structured interviews were done with an emphasis on physical activity based on structures of SCT. Overall, 16 pregnant women (Mean= 28.13, SD=6.48) were recruited who were referred to health centers in Karaj from January through April 2021. To maximize diversity, interviews were performed with women who had different demographic characteristics (age, number of pregnancies, socioeconomic background), and these questions have been asked in group discussions. What is your view on physical activity during pregnancy? Why is physical activity important in pregnancy? What do you think are the important consequences of physical activity in pregnancy? What are the barriers to physical activity during pregnancy? What are the important facilitators of physical activity in pregnancy? What individual factors can contribute to physical activity in pregnancy? How can people around you help you with physical activity during pregnancy? What do you think are the best exercises for pregnancy? This information was utilized to create the item's phrasing.

-Data analysis: Themes were clustered based on SCT structures, and participants' views about physical activity. The primary codes and categories are used to identify themes. As such, the interviews are the analysis units. During the data collection process,

data analysis began. Before proceeding to the next FGD or interview, each FGD, and the individual interview was analyzed. As mentioned above, the findings of the focus groups and individual interviews were used to develop the first draft of the scale. The pre-final draft of the physical activity in pregnant women based on the social cognitive theory Scale (PAP-SCT) contained 36 items (in the Persian language) that could be graded on a 5-point scale. The pre-final version of the scale was then tested for content, and face validity.

-Content validity: For PAP-SCT, we used both qualitative, and quantitative content validity. The instrument was evaluated in terms of wording, item allocation, grammar, and scaling during the qualitative phase. The content validity index (CVI), and the content validity ratio (CVR) were assessed during the quantitative phase. The items' clarity, simplicity, and relevance were determined using a CVI assessment. A Likert-type ordinal scale with four potential responses was used to calculate the CVI. The responses were graded on a scale of 1 (not relevant, not simple, and not clear) to 4 (very relevant, very simple, and very clear). The CVI was calculated as the proportion of items rated 3 or 4 by experts. Each item had to have a CVI score of at least 0.79 to be considered acceptable. In addition, the CVR assessed the essentiality of each item. Experts for measuring the CVR rated each item as 1=essential, 2=useful but not essential, or 3=not essential. Any item with a CVR greater than 0.78 was considered to be satisfactory and was kept [19]. In total, eleven items were deleted, resulting in a 25-item scale.

-Face validity: Qualitative, and quantitative approaches have been utilized to assess the face validity of the PAP-SCT. In the qualitative stage, twelve pregnant women have been requested to assess every item of the PAP-SCT, and whether they found it difficult or ambiguous to respond to the questions. On the first of the views of the participants, vague items have been revised. The impact score (frequency × importance) was generated during the quantitative phase to indicate the percentage of women who identified items on a five-point Likert scale as important or very important. It was regarded appropriate if an item's impact score was 1.5 or above. One item got an impact score of less than1.5, and 24 items had an impact score of 1.8 to 5. As a result, the instrument's original version included 24 items.

Phase 2: Psychometric evaluation of the Physical activity in pregnant women based on the social cognitive theory Scale (PAP-SCT)

A cross-sectional study was done to investigate the psychometric features of PAP-SCT in a larger setting in Karaj, Iran, from January to April 2021. Participants included pregnant women referred to health centers. 300 pregnant women referring to health centers were selected by multistage random sampling method. After providing information about the research objectives, pregnant women who have accepted to participate, have completed the PAP-SCT.

-Statistical analysis: Some statistical methods have been carried out to assess the psychometric properties of the PAP-SCT. All statistical analyses were conducted with SPSS 20 and AMOS 23 software. They are presented as follows.

-Construct validity: Following the item analysis, the final 24 items were utilized to measure construct validity using EFA, and CFA. The EFA was used to determine the main factors of the PAP-SCT. The number of samples required to perform the EFA is 5 to 10 people per item. Since the PAP-SCT has 24 items, 240 pregnant women were recruited for the EFA phase. To determine the sample's adequacy for factor analysis, the Kaiser-Meyer-Olkin (KMO), and Bartlett's sphericity tests were used. For factor extraction, any factor with an eigenvalue greater than one was considered acceptable [20].

-Confirmatory factor analysis: The coherence between the data, and the structure was assessed using a CFA [21]. The model fit was assessed using several fit indices such as chi-square (Chi-Square/df), adjusted goodness of fit index (AGFI), comparative fit index (CFI), the goodness of fit (GFI), normed fit index (NFI), tucker-lewis index (TLI), incremental fit index (IFI), relative fit index (RFI), and root mean square error of approximation (RMSEA). The TLI, CFI, IFI, RFI, and NFI ranged between 0, and 1, but the value of 0.9 or higher are generally considered appropriate. An RMSEA value below 0.08 represents a good fit. The appropriate value for the Chi-square/df index should be less than 3. Also, the GFI and AGFI ranged between 0, and 1, but values of 0.8 or higher are typically regarded as acceptable [22].

-Internal consistency: Cronbach's alpha coefficient was utilized to assess the internal consistency of each subscale of the PAP-SCT (outcome expectations, outcome value, self-efficacy, social support, self-regulation, mutual determinant, and behavior). Alpha values of 0.70 or higher were considered suitable [23].

-Test-retest reliability: The PAP-SCT stability was evaluated via test-retest reliability. Thirty pregnant women participated in this stage; they completed the PAP-SCT questionnaire. After two weeks, they completed the questionnaires again.

Findings

Two hundred-forty pregnant women were participating in the EFA phase. The mean age of the women was 28.11±6.54 years. Almost half of the women were aged between 25, and 34 years, and experiencing their first pregnancy. The demographic properties of pregnant women in the three analyses are described in Table 1.

Exploratory factor analysis

The measurement of the adequacy of the Kaiser-Meyer-Olkin (KMO) was 0.837, and Bartlett's sphericity test was $\chi 2=4410.72$, which indicates that the sample was adequate for EFA. For the 24-item scale, seven factors revealed eigenvalues greater than 1 (Diagram 1).

Subsequently, item loads were measured, and a seven-factor scale was generated. Table 2 shows that seven factors were identified: factor 1 (outcome expectations) included 5 items, factor 2 (outcome value) included 3 items, factor 3 (self-efficacy) included 4 items, factor 4 (social support) included 3 items, factor 5 (self-regulation) included 3 items, factor 6 (mutual determinant included 3 items, and factor 7 (behavior) included 3 items.

Confirmatory factor analysis (CFA)

A CFA was carried out on the 24-item scale to check the fitness of the model derived from the EFA. The measurement model provided a good fit (Figure 1). The $\chi 2/df$ was equal to 1.47, RMSEA=0.045, which was lower than 0.08, thus indicating a good fit of the model. The CFI, TLI, IFI, RFI, and NFI were higher than 0.90 (0.97, 0.96, 0.97, 0.91, and 0.92 respectively). The GFI and AGFI were higher than 0.80 (0.97, and 0.85 respectively).

Reliability

To measure reliability, the Cronbach alpha was calculated for each subscale of the PAP-SCT. Cronbach's alpha coefficient for the PAP-SCT subscales ranged from 0.83 to 0.94. As a result, no items from the questionnaire were removed during this step.

Furthermore, a test-retest analysis was done to check the stability of the instrument. The results indicate satisfactory reliability. The test-retest correlation coefficient was 0.86 for the PAP-SCT, and for the subscales ranged from 0.80 to 0.88. The results of the reliability tests were reported in Table 3.

Table1) Participant's demographic characteristics in three stages (Numbers in parentheses are in percent)

Variables		EFA (n=240)	CFA (n=300)	Test-Retest (n=30)
Age (Years)	15-24	97 (40.4)	102 (34)	9 (30)
	25-34	112 (46.7)	137 (45.7)	14 (46.7)
	35 or older	31 (12.9)	61 (20.3)	7 (23.3)
Number of pregnancies	First	132 (55)	159 (53)	17 (56.7)
	Second	84 (35)	106 (35.3)	9 (30)
	Three	21 (8.7)	29 (9.7)	4 (13.3)
	Four or higher	3 (1.3)	6 (2)	0
Educational Level	Under Diploma	108 (45)	146 (48.7)	13 (43.3)
	Diploma	117 (48.7)	123 (41)	11 (36.7)
	College	15 (6.3)	31 (10.3)	6 (20)
Occupation	Employed	69 (28.7)	77 (25.7)	9 (30)
	Housekeeper	171 (71.3)	223 (74.3)	21 (70)
BMI (kg/m^2)	less than 18.5	0	0	0
	18.5 - 24.9	138 (57.5)	188 (62.7)	20 (66.7)
	25 - 29.9	86 (35.8)	99 (33)	8 (26.7)
	30, and more	16 (6.7)	13 (4.3)	2 (6.6)

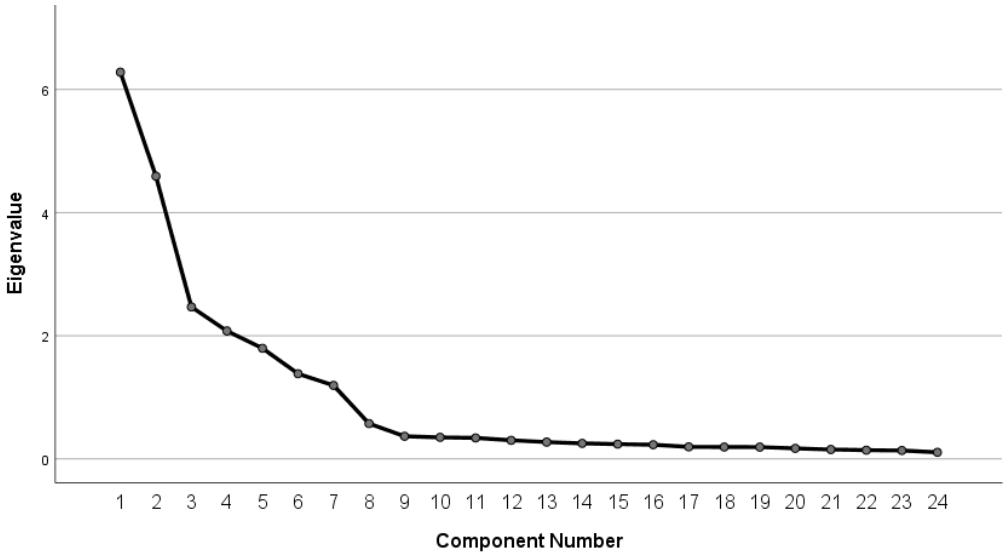

Diagram 1) Scree plot for determining the factors

Table 2) Exploratory factor analysis of the PAP-SCT (n=240)

Questions		OE	SE	OV	MD	SS	SR	BE
Q1	If I have proper physical activity during pregnancy, I will have a child with the appropriate weight.	0.858	-0.018	0.122	0.055	0.077	0.000	-0.039
Q2	If I have proper physical activity during pregnancy, I will not be overweight.	0.884	0.045	0.101	0.078	0.035	-0.035	0.013
Q3	If I have proper physical activity during pregnancy, I will not develop high blood pressure and gestational diabetes.	0.877	-0.088	0.122	0.036	-0.075	-0.046	0.012
Q4	If I have proper physical activity during pregnancy, I will have an easier delivery.	0.898	-0.034	0.078	0.034	0.077	-0.012	-0.014
Q5	If I have proper physical activity during pregnancy, my fitness will be maintained.	0.838	0.002	0.157	0.081	0.004	-0.016	0.076
Q6	It is valuable to me not to be overweight during pregnancy	0.193	0.007	0.908	-0.018	0.043	-0.040	0.016
Q7	It is very good that I do not get high blood pressure by exercising during pregnancy.	0.189	0.020	0.918	0.003	0.006	-0.001	-0.049
Q8	It is important for me that I have a baby with a normal weight.	0.141	0.034	0.904	0.075	0.000	-0.017	0.000
Q9	I am confident in my ability to do physical activity during pregnancy.	-0.025	0.877	0.021	0.031	0.127	0.187	0.184
Q10	I rely on myself to do physical activity during pregnancy.	-0.018	0.857	0.008	0.042	0.107	0.158	0.067
Q11	If a physical activity seems too difficult during pregnancy, I will try again.	-0.055	0.867	0.057	0.025	0.104	0.195	0.192
Q12	I can deal with most obstacles to physical activity during pregnancy.	0.004	0.843	-0.011	-0.001	0.149	0.184	0.087
Q13	When I do physical activity, I try to think about its benefits more than just tiredness.	-0.083	0.284	-0.040	0.024	0.204	0.827	0.215
Q14	I set a specific time for physical activity.	-0.020	0.253	-0.027	0.030	0.210	0.854	0.158
Q15	I try to learn the exercises specific to pregnancy	-0.021	0.262	-0.007	0.056	0.187	0.844	0.204
Q16	I will have good physical activity during pregnancy if I have access to proper sports centers.	0.082	-0.002	0.021	0.912	0.051	0.026	0.082
Q17	I will have good physical activity during pregnancy if I have enough time.	0.077	0.087	0.037	0.918	-0.006	0.030	0.039
Q18	I will have good physical activity during pregnancy if I have the right physical condition to exercise during pregnancy.	0.087	-0.003	0.003	0.907	0.019	0.033	0.112
Q19	My family encourages and supports me to do physical activity.	0.018	0.152	0.005	0.015	0.843	0.178	0.234
Q20	Health workers guide me through physical activity.	0.032	0.136	0.025	0.004	0.888	0.143	0.112
Q21	I have suitable facilities for physical activity during pregnancy.	0.071	0.171	0.023	0.054	0.839	0.211	0.150
Q22	I walk at least twice a week.	0.002	0.188	-0.047	0.113	0.186	0.085	0.809
Q23	I go to the health center twice a month for pregnancy exercises.	0.032	0.200	0.011	0.060	0.131	0.184	0.868
Q24	I go to the pool or the gym at least once a week.	0.014	0.099	0.002	0.091	0.173	0.253	0.838

Table 3) Internal consistency and stability

Factor	Number of items	Cronbach alpha (n=240)	ICC (n=30)
Outcome expectations	5 (1–5)	0.89	0.88
Outcome value	3 (6–8)	0.88	0.81
Self-efficacy	4 (9–12)	0.90	0.80
Social support	3 (19–21)	0.79	0.82
Self-regulation	3 (13–15)	0.94	0.84
Mutual determinant	3 (16–18)	0.83	0.80
Behavior	3 (22–24)	0.89	0.87

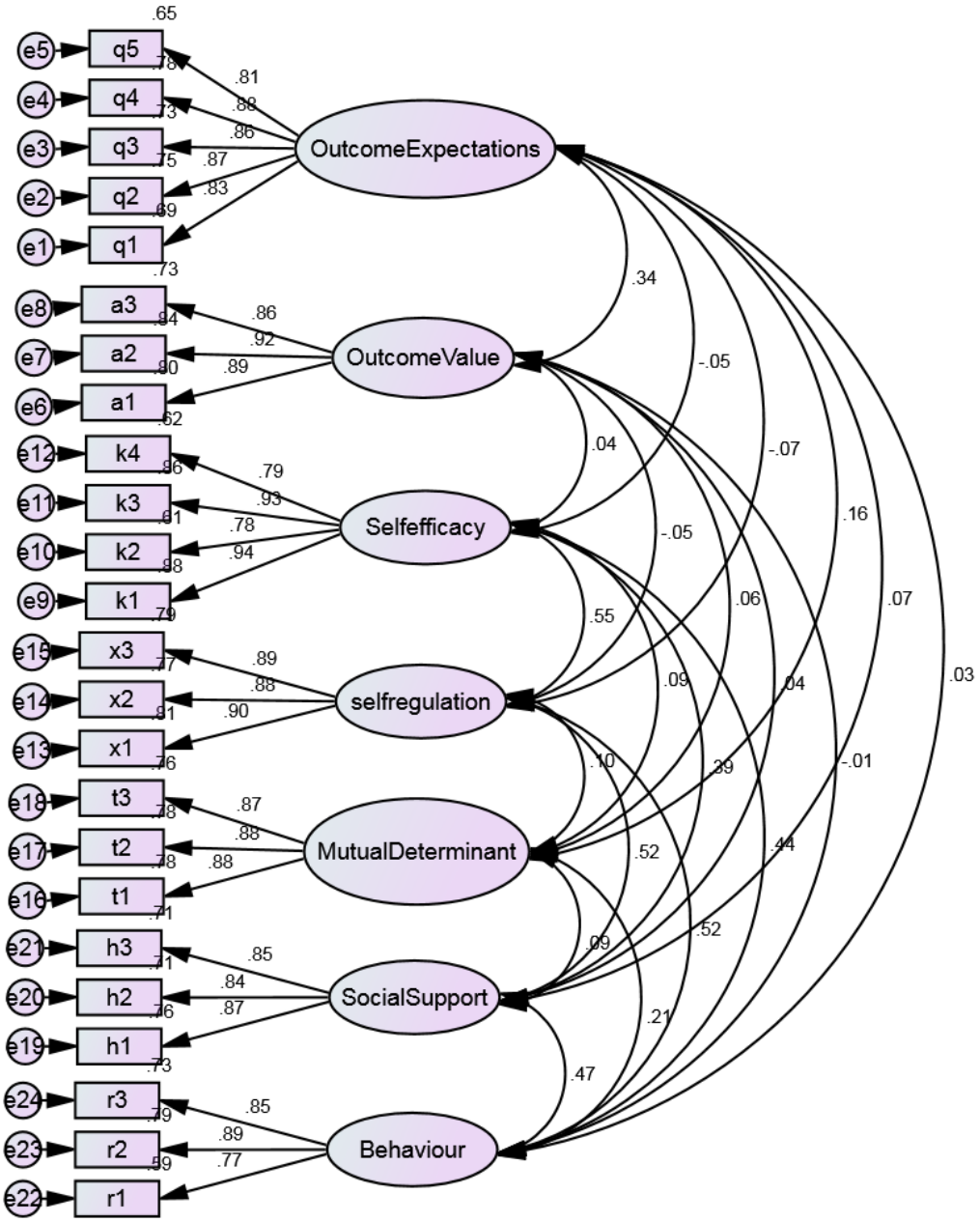

Figure 1) An obtained model for the questionnaire from the confirmatory factor analysis (n=300)

Discussion

In this study, we developed a physical activity scale for pregnant women (PAP-SCT). This is the first study to develop a scale for measuring physical activity based on social cognitive theory in Iranian pregnant women. Results from this study demonstrated that PAP-SCT can predict physical activity during pregnancy; so 52% of the variance of physical activity can be explained by this scale.

The scale's content was originally constructed based on a qualitative investigation to ensure that it encompassed all theoretical topics linked to physical exercise. Following EFA, a seven-domain scale was developed. The fit of the data was acceptable, according to the CFA. As a result, there were 24 items on the final PAP-SCT scale, with 5 items representing outcome expectations, 3 items representing outcome value, 4 items representing self-efficacy, 3 items representing social support, 3 items representing self-regulation, and 3 items representing mutual determinant, and 3 items representing behavior.

Self-efficacy indicates beliefs about personal ability to perform behaviors that bring desired outcomes. People with high self-efficacy show a greater tendency to participate in challenging behaviors [24]. Based on the results of the final model, self-efficacy had the highest effect on physical activity in pregnant women; it predicted a 41% variance in physical activity. This finding is consistent with the assumptions of Bandura's social cognitive theory that self-efficacy is the strongest construct in

predicting individual behavior change [25]. In the study of Mahmoodi *et al*., which examined the factors explaining regular physical activity based on social cognitive theory, self-efficacy is the most important predictor of physical activity [26].

The concept of outcome expectations is the belief about the likelihood, and value of the consequences of behavioral choices [24]. In this study, the outcome expectations were predicted as 18% of the variance of physical activity in pregnant women. Son *et al*. have found that the outcome expectations are most effective in performing physical activities in individuals [27]. In the study of Mirkarimi *et al*., a positive relationship was observed between outcome expectations, and physical activity behavior [28].

According to Bandura, self-regulation is defined as controlling oneself through self-monitoring, goal-setting, feedback, self-reward, self-instruction, and enlistment of social support [24]. In the present study, the self-regulatory predicted 32% of the variance of physical activity behavior in pregnant women. The results of Peyman *et al.* showed that self-regulation has a significant relationship with physical activity [29]. In the study by Wadsworth *et al*., self-regulation was an important predictor of women's physical activity behavior [30]. Joseph *et al.* reported that there was a significant relationship between physical activity and self-regulation in female students [31].

The concept of outcome expectations is defined as environmental factors that influence individuals, and groups, but individuals, and groups can also influence their environments, and regulate their behavior [24]. In the present study, the mutual determinant construct predicted 15% of the variance of physical activity in pregnant women. The study by Bashirian *et al*. Reported that the construct of mutual determinants predicts healthy eating behavior in pregnant women [32].

Social support is the perception, and actuality that one is cared for, has assistance available from other people, and most popularly, that one is part of a supportive social network. These supportive resources can be emotional, informational, or companionship [24]. Studies have shown that social support during pregnancy is associated with better mental health, and these people are better able to adapt to problems. In this study, the social support structure predicted 26% of the variance of physical activity in pregnant women. Taecha showed a positive, and significant effect of social support on physical activity [33]. Hosseini's study showed that increasing social support leads to improved health-promoting behaviors [34].

The concept of outcome value refers to the degree of satisfaction obtained from the outcome of behavior. In the present study, the construct outcome value predicted 12% of the variance of physical activity behavior in pregnancy. In a study of Rajabalipour, the construct of outcome value was the predictor for behavior [35]. In Aghdasi *et al*.'s study, which was conducted to determine the effect of education based on social cognitive theory, the construct of outcome value had a significant relationship with behavior [36].

Ardestani *et al.* investigated the validity, and reliability of a scale based on SCT for assessing adolescent girls' physical activity behavior. They showed a six-factor structure comprising self-efficacy, self-regulation, family support, friend support, outcome expectancy, and self-efficacy in overcoming impediments. The SCT model was fitted to the data based on factor loadings, t-values, and fit indices [37]. Ramirez *et al*. after performing the confirmatory factor analysis, four factors were obtained including self-efficacy, outcome expectations, social support, and barriers. In addition, their findings backed up the usage of SCT components to better understand physical activity behavior [38].

Internal consistency was shown to be excellent in reliability analyses. As a result, we believe a PAP-SCT scale is a novel tool for assessing physical activity in pregnant women. Based on social cognitive theory, Ramirez *et al*. validated the scale with five factors (self-efficacy, outcome expectations, social support, barriers, and goals). The confirmatory factor analyses revealed that the model had a good fit for the data [38].

In general, our findings revealed that the PAP-SCT had acceptable psychometric properties. The content validity was found to be satisfactory using the CVI, and CVR. Furthermore, the CFA showed that the present model had good fit indices. Cronbach's alpha coefficient demonstrated satisfactory reliability in the final scale. In addition, the ICC score demonstrated adequate stability for the scale when it was tested by 30 pregnant women over 2 weeks.

Conclusion

The PAP-SCT is a useful scale for understanding what factors influence pregnant women's physical activity. As a result, we anticipate that this newly established scale will be especially useful for health care teams in analyzing, and designing practical situations.

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Ethical Permissions: This research was accepted by the Ethics Board of the Tehran University of Medical Sciences with the code IR.TUMS.SPH.REC.1397.246. All women were made aware of the goals of the research, and signed the consent form.

Conflicts of Interests: The authors have no conflict of interest to declare

Authors' Contributions: Arefi Z (First author), Introduction writer/Main Researcher/Discussion writer (25%); Sadeghi R (Second author), Introduction Writer/Methodologist (25%), Shojaeizadeh D (Third author), Methodologist (20%); Yaseri M (Fourth author), Statistical Analyst (15%); Shahbazi Sighaldeh Sh (Fifth author), Discussion writer (15%)

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