Design and validation of a Theory-Based Physical Activity Assessment Questionnaire for the Pregnant Women (PA2Q-PW)

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Research Article

Keywords: Physical Activity, Psychosocial Determinants, Pregnant Women, Questionnaires

Posted Date: March 7th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1392512/v1>

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Abstract

Background: There is evidence that physical activity plays an essential role in preventing illnesses during pregnancy. This study aimed to design and validation a theory-based physical activity assessment questionnaire for pregnant women (PA2Q-PW).

Methods: In this exploratory psychometric study, a physical activity assessment questionnaire for Pregnant Women (PA2Q-PW) was designed. Face-to-face interviews were conducted to develop the initial items of PA2Q-PW. The findings from interviews were merged with the literature review. The face, construct, and content validity of PA2Q-PW was assessed by the participation of pregnant women, midwives, and health educationists. Impact Score (IS), Content Validity Index (CVI), and Content Validity Ratio (CVR) and of the items were calculated. Construct validity of PA2Q-PW was calculated through factor analysis. Intra-class correlation coefficient (ICC), Cronbach's alpha, standard error of measurement (SEM), and composite reliability were calculated to assess the reliability of the findings by PA2Q-PW.

Results: The highest score was seen in the Knowledge subscale of PA2Q-PW, and the value of Cronbach's alpha for the subscales was from 0.89 to 0.97, and the value of ICC was from 0.76 to 0.89. The correlation (CVI & CVR indices) between the experts was satisfactory in all items of PA2Q-PW. The minimum loading factor for varimax rotation in the knowledge subscale was 0.41, in attitude was 0.56, in nurtures was 0.38, and in enabling factor was 0.27. The fitness of the proposed model among those constructs was confirmed by Root Mean Square Error of Approximation (RMSEA) < 0.08 , Normed chi-square (χ^2/df) < 5.0 , Comparative Fit Index (CFI) ≥ 0.90 , Tucker-Lewis Index (TLI) ≥ 0.9 .

Conclusion: PA2Q-PW is the first standard tool based on the PEN-3 cultural model that researchers can utilize to gather data and conduct the desired education interventions to change physical activity behavior in pregnant women during pregnancy.

Trial ID: ISRCTN13356179

Background

Pregnancy is an astonishing period of life for a pregnant woman, and her unborn infant, so maternal health is a health priority in the world [1]. There is evidence that physical activity plays an essential role in preventing illnesses like preeclampsia, type 2 diabetes, obesity, and many cancers [2]. Physical activity during pregnancy has further advantages, e.g., a diminished risk of HELLP syndrome, gestational diabetes mellitus, and additional gestational weight gain [3]. This could be individually significant for pregnant women from low and middle-income countries (LMICs), where low socioeconomic status (SES) in transitioning circumference has been presented as a risk factor for numerous outbreaks of lack of physical activity, overweight, GDM, and impaired glucose intolerance [4, 5].

In the United States, in lack of obstetric complications, as per the guidelines of adults, pregnant women must accumulate 30 minutes or more of moderate-severe physical activity on most, all the days a week [6, 7]. The American College of Obstetrics and Gynecology (ACOG) suggested a 30min program of physical activity five days a week for pregnant women [8]. Along with dieting, having activity during pregnancy promises a natural and impressive intervention for infant and maternal health [9, 10]; however, some Iranian pregnant women seem not to

follow these guidelines, and a study in Iran showed that 70% of pregnant women did not have any physical activity [11, 12].

Having physical activity is one of the substantial affecting factors quality of life. Nowadays, It has increasingly specified that assessing the quality of life can predict the health situation in various groups [13]. Regular exercise in the first 20 weeks of pregnancy reduces preeclampsia by up to 34% [14, 15]. One of the approaches to increase physical activity for a lifetime is to use theoretical research to recognize the influences of physical activity on pregnancy theoretically. The lack of success in many exercise promotion endeavors may be due to the lack of recognition of theory-based determinants of health [16]. PEN-3 cultural model is a theory that has been exerted in a study of physical activity determinants in pregnant women [17–20].

There are some theoretical derivative tools to measure the determinant factors of physical activity among pregnant women presented in the literature [21]. Nevertheless, there are no general validated scales to measure perceptions and nurtures and enable pregnant women to exercise during pregnancy. Thus, the designed tool could help to comprehend women's prospects for physical activity and, in turn, plan general interventions for pregnant women. It has been shown that people who recognize themselves as physical activists have more intentions in and employ considerably more physical activity than people who do not [22, 23]. In the United States, 25% of people do not have any exercise in their workplace, and 12% of total mortality was attributed to low mobility [24]; however, this study was limited to a group of nulliparous pregnant women. The information from Iran shows that the outbreak of no mobility and inactive lifestyle in males is less than that of females [25, 26]. In one study, researchers realized that abdominal obesity was approximately six times more common in females than in males [27].

Although physical activity may not be prominent in the first trimester of pregnancy, as the pregnant woman's body varies quickly, it may be valuable yet to recognize the cultural model determinants of physical activity during pregnancy. This study developed a questionnaire to evaluate psychosocial and perceptual determinants based on the PEN-3 cultural model about different physical activity levels in pregnancy for utilization in the second and third periods of pregnancy (PA2Q-PW). This study aimed to develop and design a theory-based physical activity assessment questionnaire for pregnant women (PA2Q-PW).

Methods

Research design, context, and participants

The present exploratory psychometric study was conducted in Tehran City, Iran, from January to March 2019. The sample size was estimated at 440 persons (Confidence=0.95; Power=0.9), and to compensate for loss, 480 nulliparous pregnant women in two or three trimesters of pregnancy that were between 28 to 35 years, having literacy, have no background of severe complications of the disease, and without any physical activity during pregnancy were selected randomly from selected health centers of the 5th district of Tehran City, Iran. Of the 480 participants, 30 dropped out of the study.

Table 1 summarizes the details related to the participants in each phase, which indicates the recruitment of different participants depending on the study phase.

Insert Table 1.

In this study, selecting specialists with valid articles or having high experience in this field is considered important. Therefore, the experts were invited from different groups to help generate items, categorized and finalize the first draft of the questionnaire, and content validity of the items [28, 29]. Additionally, all of the pregnant women were female and the details of their selection for this study in each phase are described as follows.

Developing the first draft of the questionnaire

The first items of PA2Q were achieved through literature review and also interview with all pregnant women. Furthermore, the databases including PubMed, EMBASE, MEDLINE, and Cochrane Library, as well as Allied Health Literature (CINAHL) were searched to find the studies published about physical activity in pregnant women. In this regard, a combination of the keywords of " Physical Activity ", " Psychosocial Determinants " and " Pregnant Women " was utilized to explore in English and Persian. Thus, 714 articles issued between 2006- 2020 were obtained, their abstracts were read. Then, ten Persian and five English questionnaires were obtained by reviewing the articles and contacting the corresponding authors [30–31].

All of the interviews were investigated to identify the factors influencing the physical activity behavior of pregnant women. The conceptual framework was the concepts from the first three phases of the PEN-3 cultural model [16].

The pregnant women, health educationists, midwives, and experts participated in 30-45-min face-to-face interviews in their desired time and place. They were told that their information would be kept confidential and used anonymously. At the end of the interviews, the items obtained from the results of the literature review were combined with the interviews. Furthermore, health educationists, pregnant women, and experts were asked to participate in two focus group discussions. Each session lasted 90 minutes, one member of the research team acted as the coordinator of the sessions, and another took note. In addition, a directed analysis was performed on the content of the interviews and duplicate questions were deleted, and some of the questions were edited. Finally, the first draft of the study questionnaire was confirmed and finalized by the research team members.

Assessment of face and content validity of the questionnaire

The face validity of the intended questionnaire was examined qualitatively and quantitatively by co-operating with pregnant women and health educationists. In qualitative evaluation, any ambiguity in the meaning, wording, and scaling of the items, as well as grammatical errors and those in item allocation were identified and resolved based on the feedback from pregnant women and health educationists. However, the impact score (IS) of each item was calculated for quantitative assessment. To assess the face validity in the questionnaire, the appropriateness of each item was rated by an expert by using a five-point Likert scale, and the IS of each item was calculated by using the formula of $IS = \text{frequency (\%)} \times \text{importance}$ [22, 23]. In the study, the frequency shows the number of the patients rating the appropriateness of the item as 4 or 5 scales.

The relevance of the questions was also evaluated using a four-point scale: "not relevant", "insignificant relevancy", "relevant", and "reliable relevancy". The Content Validity Ratio (CVI) of every item is the ratio of specialists who measure it from 3 or 4 [32]. In this regard, Polite and Beck presented 0.8 for the allowable lower

range of CVI value [33]. An appropriate level of the accordance was determined (CVI=0.91) between panelists proposing that the measure of scale had a well content validity.

The necessity of the questions was evaluated using a three-point scale; "not necessary", "effective but not necessary", and "necessary". Then, a Content Validity Ratio (CVR) was calculated for all scales. If more than half of the panelists represent that each item is necessary, that question has a minimum content validity [34].

Therefore, PA2Q was emailed to 20 midwives and health educationists for evaluating the validity. Two experts failed to complete the questionnaire and one questionnaire was set aside by considering the accuracy of the data. (Response rate= 0.85%).

The CVI and CVR were determined based on the three and four-point Likert scales, respectively. The formula of $(N_e - N/2) / (N/2)$ was used to calculate CVR [23], in which N indicates the total number of panelists and N_e illustrates the number of those rating the item as "essential". However, items with CVR below 0.46 were removed based on the Lawshe table [24].

To compute the CVI of the items, the relevance of each item was rated in a four-point Likert scale by using the formula of CVI (the number of the specialists who assigned scores 3 and 4 to the items/N). However, the items with the CVI of less than 0.79 were eliminated [25, 26].

Assessment of construct validity of the questionnaire

The construct validity of PA2Q was examined through confirmatory factor analysis (CFA) and exploratory factor analysis (EFA). It is recommended to perform each CFA or EFA by participating at least 150 ones from the target group [35]. The sampling framework in this study included 400 pregnant women in Tehran. Due to a 10-15% drop rate in the previous relevant studies, there was a need for 50 more participants [35, 28]. In the stage, 450 pregnant women were randomly selected from Tehran and invited for participation by using (www.randomizer.org software.)

Exploratory Factor analysis (EFA)

The different dimensions of the criterion were specified by implementing exploratory factor analysis (EFA) to apply the oblique rotation and original fundamental factoring [32]. As the correlation between factors was less than 0.3, varimax rotation with Kaiser Normalization was chosen [33]. Because of assessment, sampling efficiency to carry out the satisfactory factor analysis, Kaiser-Meyer Olkin (KMO), Measure of Sampling Adequacy (MSA) for factor analysis, and Bartlett's test was accounted for. To specify the supreme construction, the specific value more significant than one and factor loading equivalent to or larger than 0.4 were used [34].

The validity of convergent was determined to implement correlations of item-scale that reformed for overlaps. It was anticipated that the item scores would correlate greater with a specific assumed scale than other scales. The values of correlation of 0.40 or higher were investigated satisfying ($r \geq 0.81-1$ as supreme and excellent, 0.61-0.80 excellent, 0.41-0.60 good, 0.21-0.40 fair, and 0.00-0.20 poor) [36]. If an item was loaded into different factors, it was related to the factor that the item had the largest factor loading. After completing the analysis, the items

were categorized and every category formed a factor. In the end, the extracted factors were named by members based on the nature of their items, as well as the characteristics proposed by them to measure.

Confirmatory Factor analysis (CFA)

The confirmatory factor analysis results for the four sections of the PA2Q showed a χ^2 value at 3921.78; degrees of freedom 1117, which gave a ratio $\chi^2/\text{dF}=3.51$ ($p<0.0001$). The CFI, NFI, and GFI's Values were 0.90, 0.80, and 0.92 ($p<0.0001$). Concerning the RMSEA, the value was 0.091 ($p<0.0001$). Figure 1 shows the factor weighting value results for the four Knowledge, Attitude, Nurtures, and Enabling subscales in the standard estimation mode.

The minimum loading factor for varimax rotation in the knowledge subscale was 0.45, in attitude was 0.46, in nurtures was 0.45, and in enabling was 0.43 (Table 6).

In fitness indicators of PA2Q-PW, the CFI (0.9), RMSEA (0.091), SFI (0.8), NFI (0.92) and χ^2/dF ratio (3.51) showed a confirmable status ($p<0.0001$).

Scoring

The last version of the PA2Q-PW is present. Additional information about this questionnaire and the type of scoring is also available. Nevertheless, each of these items is from 5 to 1 to create row scores in brief scoring. Like, two of these items on nurtures problem, and susceptibility of doing exercise, and others concerning one's stimulus were nugatory pointed, scoring toward those items (items 28, in the first version and 31 in the last version) was converted.

Assessment of reliability of the questionnaire

The test-retest reliability test was evaluated by an intraclass correlation coefficient (ICC). The criterion was managed to 45 parsons one month since the first supplementation. The following classification was chosen to construe the compromise levels: 0.0-0.20 as low, 0.21-0.40 as fair, 0.41-0.60 as moderate, 0.61-0.80 as significant, and 0.81-1 as nearly complete and perfect [36]. Also, the internal consistency (IC) of PA2Q-PW is accounted for by calculating Cronbachs' alpha coefficient. The alpha amount of 0.70 or higher was noticed as satisfactory [36]. The standard error of measurement (SEM) was calculated to analyze the absolute reliability of the results. Also, IBM SPSS statistics version 24 was utilized to perform data cleaning and compute reliability indices. P values less than 0.05 were considered as significant [35]

Results

After completing the validation process, some of the items were removed. The final questionnaire included 10 questions about baseline characteristics of pregnant women and 39 content-specific questions.

Baseline characteristics of the participants

The mean age of women was 32.4 ± 12.4 years, the average BMI was 26.80 ± 6.25 .Table 2 represents the baseline characteristics of the participants.

Insert [Table 2.](#)

Results of the face validity of the PA2Q-PW

All items of PA2Q-PW became clear and understandable. The impact score (IS) of items ranged between 3.6 and 4.8. IS of all items is shown in [Table 3.](#)

Insert [Table 3.](#)

Results of the content validity of the PA2Q-PW

Table 4 demonstrates the CVI and CVR of the items, which indicates their ranges as 0.80-1.00 and 0.52-1.00, respectively.

Insert [Table 4.](#)

Results of the construct validity of the PA2Q-PW

Among 450 completed questionnaires, 12 incomplete ones were excluded, and EFA and CFA were respectively implemented based on the 212 and 220 completed ones.

Results of the Exploratory Factor analysis

The generalized EFA was performed due to the binary measurement level of the items. EFA is used to determine correlations among a set of binary observed ones. In this study, the factors were extracted by using oblique GEOMIN rotation procedures and the maximum likelihood estimation method. Additionally, binary-type items were loaded in a factor including four sub-scales of awareness, attitude, nurture, and enabling about physical activity in pregnant women, with 20, 7 6, and 6 items respectively. The variations in the preventive behavior of physical activity were predicted by changing their awareness, attitude, nurture and enabling scores. The predictive power of awareness, attitude, nurture, and enabling scales was 38.43, 25.89, and 14.73, 15.81% respectively. Table 5 summarizes the loadings of the extracted factors.

Insert [Table 5.](#)

Results of the confirmatory factor analysis

Confirmatory factor analysis for the 10 Likert-type items and 29 binary items was done. In this process of analysis, 39 remaining items were considered as indicators and 4 latent variables were considered as the constructs. All the relationships between the constructs (awareness, attitude, nurtures, and enabling) and items

(or 39 indicators) were significant (All $P < 0.05$). The results of the model and the loadings of the extracted factors are presented in [Figure 1](#).

Insert [Figure 1](#).

Additionally, the results of CFA, including T-statistics and factor loadings, were reported in [Table 6](#).

Insert [Table 6](#).

Based on the findings from the participation of 450 pregnant women, the data of the descriptive statistics of the KAP analysis of the psychometric study of the Theory-Based Physical Activity Assessment Questionnaire for the Pregnant Women (PA2Q-PW) is shown in [Table 7](#).

Results of the reliability of the questionnaire

The measures of the reliability of the research questionnaire are presented in [Table 7](#).

Insert [Table 7](#).

Discussion

This study aimed to design a criterion for evaluating pregnant women's perceptions concerning physical activity and investigating psychometric attributes and properties. This criterion was designed according to the PEN-3 Theory of cultural model framework. In the PEN-3 cultural model, every predictive determinant could be measured directly, e.g., by investigating participants about all over their tendency, or indirectly, e.g., by investigating participants about particular behavioral perceptions, nurtures, and enabling factors about physical activity during pregnancy. Commonly for designing and developing a questionnaire based on the PEN-3 cultural model, it has been proposed that for direct scales, one could use the similar direct scales designed by Airhihenbuwa [33]. Regarding indirect (based on perceptions) scales, it has been suggested to accomplish an exploitation study to design all of the constructs about predictive factors in the PEN-3 that consist of knowledge, attitude, nurture, and enabling. In this research, various assumptions were created due to direct and indirect views about the fundamental cognitive structures, and neither view is complete. When several procedures are knapping a similar construct, degrees are anticipated to be affirmatively associated, so it is suggested that both of them be contained of a questionnaire with PEN-based [37]. Unfortunately, only direct scores of the theory-based PEN-3 cultural model were used in this study.

For the perceptions, nurtures, and enabling factors, the internal consistency of reliabilities was above 0.80 in the development sample. For the perceptions, nurtures, and enabling factors, the test-retest correlation coefficients were about 0.90 in the Intended sample. These rates are checked sufficiently [38]. Regarding the attitude scale, the correlation coefficients and internal consistency for reliability were slightly mitigating.

This survey used a changeable approach more acceptable for pregnant women. As well as the internal consistency of reliabilities was higher than those received in primary function with first pregnant women that contained perceptions toward consequences [36]. However, the internal consistency reliability of attitude about the purpose of being exercised (0.63) was sufficient, however not broad. However, it is higher than the test-retest

reliability presented in previous work for pregnant women [36]. It should, too, be distinguished that the reliability for the retest–retest in this survey was managed immediately after the first data collection. In this study, the ICC for full scale about physical activity was 0.92, and it shows higher than was used questionnaire those obtained in previous work with pregnant women [36].

This survey's further contributions were used to validate the questionnaire construct and Chartered Financial Analyst (CFA) method, which can be exerted to trial numerous variables while there is a theoretical framework [39]. Moreover, various indicators, such as χ^2/dF ratio, CFI, GFI, and RMSEA, verified the compatibility of the models. The results regarding the (NFI, RMSEA, and CFI) were higher than expected. Additionally, this finding demonstrated that each of the four sub-constructs in the PA2Q had an appropriate fit within the PEN-3 cultural model framework.

Empirical results from the Cronbach's Alpha, test-retest, and interrater reliability confirmed that, within the four subconstructs, the PA2Q shows acceptable internal consistency (ranged from 0.92 to 0.97); provides reliable results over repeated administrations (ranged from 0.97 to 0.99) at the pregnant women during pregnancy. In previous studies, the questionnaires' reliability was evaluated just from the perspective of test-retest stability and internal consistency. For example, Satter *et al.* evaluated different instruments based on previous literature. Their indicated reliability ranged from 0.70 to 0.80 [38]. The recent physical activity questionnaire (RPAQ) demonstrated a good correlation with the accelerometer that was used for physical activity assessments for whole times for being active ($r \geq 0.50$) but not for all of the physical activity energy expenditure (PAEE) and other approximations of physical activity [36]. The findings extracted from studies from the validity of these constructs of the pregnancy, physical activity questionnaire (PPAQ), were inadequate, like that for the Vietnamese versions of the questionnaire [40]. Chasan-Taber *et al.*, who designed the questionnaire, managed the pregnancy physical activity questionnaire (PPAQ) to 54 women with the first pregnancy aged 16 to 40 to evaluate its two-week reliability and determined ICCs 0.78 for total, sedentary [41].

Therefore, according to the authors, the PA2Q is suitable for various potential applications to measure physical activity and its main determinants among pregnant women. Besides, the PA2Q tool may be used with other grade populations and suitable for Non-pregnant women. One unique feature of PA2Q is the reliability and validity of its subscales, which include knowledge and attitude, nurtures, enabling, and physical activity behavior. These sub-constructs may be measured, evaluated, modified by potential change strategies, thereby doing physical activity during pregnancy and, finally, health promotion.

Some limitations of this study must be noted. First, data were only collected from the two and three-trimester pregnant women attending health centers in capital Tehran's region 5; and other independent health centers, other gestational ages during pregnancy, did not enroll to study the generalizability of results to all of the society may be confined. Due to decreased recall bias, the physical activity report was limited within the last week. Subscales of the PA2Q were limited to the main determinants of behavior in the PEN-3 cultural model and the other constructs (psychological determinants of behavior) in order to decrease the questions' burden on participants, did not use. In the nurture items construct validity verification phase, the sample was limited to pregnant women and not their families because of the difficulty of assessing. Notwithstanding the limitations explained, the PA2Q is the instrument of validity and reliability to assess women's exercise behavior through pregnancy. Future studies that apply this questionnaire could assist and help to overcome this kind of problem.

Conclusion

PA2Q-PW is the first standard tool based on the PEN-3 cultural model that researchers can utilize to gather data and conduct the desired education interventions to change physical activity behavior in pregnant women during pregnancy. Co-operating the public and governmental institutions is required to increase physical activity in pregnant women across the world, especially in the Middle East and in different transmission ways. The PA2Q-PW was demonstrated to be consistent and reliable within its knowledge, attitude, nurtures, and enabling subscales. However, future attempts are carried out to assess whether PA2Q-PW is applicable in the first trimester of pregnancy in pregnant women populations attending various community-based settings, including the health services center.

Strengths Of The Study

PA2Q-PW is the first theory-driven questionnaire in the field of physical activity and focuses on real problems, barriers, and facilitators of preventive behavior in pregnant women. In this study, the triangulation method was used to generate the items of the questionnaire. The items were created by the researcher's field experiences, literature review, and interviews with various kinds of stakeholders (experts, health educationists, and midwives).

Limitations Of The Study

In this study, 12% of the participants were uneducated. The researcher had to explain all questions to the pregnant women and complete the research questionnaires by himself.

Each question was read in the language for the pregnant women and the answers were checked with the pregnant women themselves. Therefore, this required more time for an explanation for each participant. Moreover, this study included pregnant women aged 18 to 38 years. However, Smaller participants may have very different experiences and perspectives and may face many obstacles and different perceptions. Unfortunately, we do not have access to this group from the health center.

Implications:

The PA2Q-PW, which was designed and validated, can be employed by all health educationists to develop educational interventions.

Abbreviations

LMICs: Low- and middle-income countries; SES: Socioeconomic status; GDM: Gestational diabetes mellitus; ACOG: American college of obstetrics and gynecology; QOL: quality of life; WHO: World Health Organization

Declarations

Statements of ethical approval:

The Research Ethics Committee approved the research of this study (The ethics code number= IR.MODARES.REC.1397.091). The researchers confirm that all methods were performed in accordance

with the relevant guidelines and regulations. All pregnant women in this trial were informed about participating in the survey and gave written informed consent for the study.

Consent for publication:

Not applicable.

Availability of data and materials:

All data generated during this research are included in this article.

Competing interests:

The authors declare that they have no competing.

Funding:

This study is a part of a Ph.D. dissertation of LK at Tarbiat Modares University. The authors received no financial support for the research, authorship, design, collection, analysis, interpretation of data, and/or publication of this article.

Authors' contributions:

LK conceived the study; collected and analyzed the data; interpreted the findings; wrote the first draft of the manuscript; read and critically revised the first draft and confirmed the final version of the manuscript.

SR conceived the study; analyzed the data; interpreted the findings; contributed to the validation study of the research questionnaire; read and critically revised the first draft and confirmed the final version of the manuscript.

SHN analyzed the data; interpreted the findings; contributed to the validation study of the research questionnaire; read and critically revised the first draft and confirmed the final version of the manuscript.

FSH collected and analyzed the data; interpreted the findings; contributed to the validation study of the research questionnaire; read and critically revised the first draft and confirmed the final version of the manuscript.

All authors have read and approved the final manuscript.

Acknowledgments

We would like to express our gratitude to all pregnant women, health educationists, midwives, and experts, who participated in this study, for the dedication of their invaluable time and experience.

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Tables

Table 1

Details for the participants in each phase of the study

Phase of study		Participants' job and number male(m)+female(f)				Assessment measure or target
		Pregnant Women	Health educationist	Midwives	Experts from a health promotion institute	
Item generation	Interviews	6f	4(1m+3f)	4(f)	4(1m+3f)	Identifying the factors influencing preventive behavior of pregnant women
	Group discussion	0	3f	3f	3f	Finalizing the first draft of the research questionnaire
Assessment of face validity	Qualitative way	15f	7(2m+5f)			Resolving ambiguity in meaning, wording, grammatical errors, and allocation of the items
	Quantitative way	15f	0	0	0	Calculating IS of the items
Assessment of content validity	Qualitative way	0	7(2m+5f)	7f	3f	Calculating CVR of the items
	Quantitative way	0	7(2m+5f)	7f	3f	Calculating CVI of the items
Assessment of construct validity	EFA	225 f	0	0	0	Calculating KMO of the questionnaire; factor loadings
	CFA	225 f	0	0	0	Calculating fit indices of the structural pen-3 model
Reliability assessment		42 f	0	0	0	Calculating Cronbach's α , ICC, SEM, CR of the questionnaire

Table 2

Baseline characteristics of pregnant women divided by each stage of the construct validity of the questionnaire

Characteristics	Total (n=450)	Exploratory Factor analysis data (n=225)	Confirmatory Factor analysis data(n=225)	P- value*
	Number (%)	Number (%)	Number (%)	
Age: Mean ± SD)	52.64±16.50	52.2±16.64	52.84±16.04	0.76
- Gestational age (week)				0.91
12-20	246 (51.3%)	187 (83.1%)	59 (26.2%)	
21-28	112 (28.4%)	76 (33.7%)	36 (16%)	
29-38	92 (20.2%)	42 (18.6%)	50 (22.2%)	
Job				0.74
self-employed	64 (14.2%)	38 (16.8%)	26 (12.4%)	
employee	38 (16.8%)	26 (11.5%)	12 (5.3%)	
Unemployed	112 (49.7%)	84 (37.3%)	28 (12.4%)	
Educational level				0.85
Illiterate	292 (64.8%)	184 (81.7%)	108 (48%)	
Elementary	158 (35.1%)	41 (18.2%)	117 (52%)	
High school	62 (13.7%)	44 (15.5%)	18 (8%)	
Graduate diploma	87 (19.3%)	60 (26.6%)	27 (12%)	
Income				0.79
Less than household expenses	202 (44.8%)	122 (54.2%)	80 (35.5%)	
Equal to household expenses	248 (55.1%)	186 (82.6%)	62 (27.5%)	
Spouse's education level				0.96
Illiterate	124 (27.5%)	74 (32.8%)	50 (22.2%)	
	165 (36.6%)	85 (37.7%)	77 (34.2%)	

Elementary	61 (13.5%)	36 (16%)	25(11.1%)	0.86
High school	100 (22.2%)	62 (27.5%)	38 (16.8%)	
Graduate diploma				
Spouse's job	258 (57.3%)	154 (68.4%)	104 (46.2%)	0.92
self-employed	164(34.4%)	84 (37.3%)	80 (35.5%)	
employee	28 (6.2%)	16 (7.1%)	12 (5.3%)	
Unemployed				0.79
Pre-pregnancy weight	238 (52.8%)	164 (72.8%)	74 (32.8%)	
Less than 110 pound	175(38.8%)	92(40.8%)	83(36.8%)	
110-176 pound	37 (8.2%)	24 (10.6%)	13 (5.7%)	0.92
more than 176 pound				
Kind of Pregnancy	312(69.3%)	192(85.3%)	122(54.2%)	
Wanted	38(8.4%)	24(10.6%)	14(6.2%)	0.92
Unwanted				
Length of marriage No	265 (58.8%)	189 (84%)	76 (33.7%)	
less than 5 years	124(55.1%)	82(36.4%)	42(18.6%)	
5-10 years	61 (13.5%)	34 (15.1%)	27 (12%)	
more than 10 years				

*The relationship between the two nodes of exploratory and confirmatory factor analysis

Table 3

The measures of face items of the physical activity questionnaire (PA2Q-PW)

Items	IS	The source* of the items(Literature/ interviews)
Knowledge		
During pregnancy, you should not exercise severely other than pre-pregnancy.	4	L
Physical activity is essential to prevent overweight due to pregnancy.	4.2	L
Exercise during pregnancy can lead to reduced oxygen supply to the baby.	4.8	L
During pregnancy, you should exercise smoothly and without sloping surfaces.	4.7	L
Pregnant women during exercise should avoid excessive curvature and hang up.	4.8	L
Exercise during pregnancy makes it easy for normal labor.	4.2	L
Exercise in pregnancy reduces the risk of birth in a diabetic neonatal.	4	L
Doing basic exercises daily will not hurt the mother and baby.	4.2	L
Exercise eliminates the risk of possible complications in pregnancy, e.g., back pain, lumbar pain, constipation, and excessive fatigue.	4.8	L
During pregnancy, you should stop doing heavy exercises.	4.2	L
Before starting exercise during pregnancy, you should have a light stroke to warm up.	4.8	L
A physical activity specialist should take stretching and strength during pregnancy.	4.2	L
Exercising in pregnancy prevents blood pressure dangers.	4	L
Exercise during pregnancy can lead to return faster maternal postpartum.	4.2	L
I try to avoid lifting any weight during pregnancy.	4.7	L
Exercising during pregnancy leads to fitness and weight control.	4.7	L
For pre-exercise preparation, 15 minutes of gentle relaxation movements are required.	4.8	L
Before conducting any exercise at this time, consultation with the doctor is required.	4.7	L
Exercise reduces the risk of musculoskeletal discomfort.	4.7	L
In the third period of pregnancy, the intensity of exercise should be reduced.	4.2	L
Attitude		
I believe that with exercise, I can efficiently deal with problems such as gestational diabetes.	4.8	L
I believe that exercising during pregnancy reduces my fatigue due to my pregnancy.	4.2	L
I believe that I can work out stress and anxiety from childbirth during this period.	4	L
I believe exercising during pregnancy helps with my daily activities.	4.2	L

I believe that I can easily maintain my fitness by exercising during pregnancy.	4.8	L
I believe that by exercising, I can reduce postpartum depression.	4.2	L
I believe that if I exercise in pregnancy, I can have a more comfortable delivery.	4	L
Nurtures		
If my wife is in physical education classes in pregnancy, I can more easily convince her to attend pregnancy classes.	4.7	L
If my own family and my wife attend physical education classes in pregnancy, I can persuade them to participate in physical activity classes.	4.2	L
I encourage friends and acquaintances to exercise during pregnancy	4	L
If there is a group discussion to exchange information about pregnant women after a pregnancy class, I have a greater tendency to attend a pregnancy class.	4	L
If my family is in physical education classes ...	4.8	L
If a skilled and informed person answers midwifery questions after a pregnancy class, I would be more eager to participate in pregnancy classes.	4.7	L
If my family would advise me to do exercise ...	3.9	L
If my doctor advises me to do exercise in pregnancy, I will do that.	4	L
Enabling		
If there is an excellent place to exercise, it is easier to exercise in pregnancy.	4.8	L
If classes are held free, I can use these classes more easily.	4.2	L
If there is a physical activity area near my residence, I can get better and more comfortable with pregnancy classes.	3.9	L
If I have a training CD in the centers, I can do more exercise at home.	4.2	L
If there are enough facilities, such as a buffet, a washbasin, etc., in pregnancy classes, I always try to take part in pregnancy classes	4.8	L
If exercise classes occur at different times throughout the day, I can more easily participate in physical activity classes.	4	L

*literature(L) or interview(I)

Table 4

The measures of content validity of the items of the physical activity questionnaire (PA2Q-PW)

Items	CVR (%)	CVI (%)
Knowledge		
During pregnancy, you should not exercise severely other than pre-pregnancy.	84	100
Physical activity is essential to prevent overweight due to pregnancy.	78	92
Exercise during pregnancy can lead to reduced oxygen supply to the baby.	100	100
During pregnancy, you should exercise smoothly and without sloping surfaces.	84	88
Pregnant women during exercise should avoid excessive curvature and hang up.	78	82
Exercise during pregnancy makes it easy for normal labor.	84	100
Exercise in pregnancy reduces the risk of birth in a diabetic neonatal.	82	88
Doing basic exercises daily will not hurt the mother and baby.	82	88
Exercise eliminates the risk of possible complications in pregnancy, e.g., back pain, lumbar pain, constipation, and excessive fatigue.	78	88
During pregnancy, you should stop doing heavy exercises.	82	92
Before starting exercise during pregnancy, you should have a light stroke to warm up.	88	100
A physical activity specialist should take stretching and strength during pregnancy.	92	86
Exercising in pregnancy prevents blood pressure dangers.	84	77
Exercise during pregnancy can lead to return faster maternal postpartum.	82	86
I try to avoid lifting any weight during pregnancy.	88	92
Exercising during pregnancy leads to fitness and weight control.	89	96
For pre-exercise preparation, 15 minutes of gentle relaxation movements are required.	87	92
Before conducting any exercise at this time, consultation with the doctor is required.	92	88
Exercise reduces the risk of musculoskeletal discomfort.	90	100
In the third period of pregnancy, the intensity of exercise should be reduced.	85	88
Attitude		
I believe that with exercise, I can efficiently deal with problems such as gestational diabetes.	100	100
I believe that exercising during pregnancy reduces my fatigue due to my pregnancy.	88	92
I believe that I can work out stress and anxiety from childbirth during this period.	74	88
I believe exercising during pregnancy helps with my daily activities.	84	95
I believe that I can easily maintain my fitness by exercising during pregnancy.	84	98
I believe that by exercising, I can reduce postpartum depression.	84	92
I believe that if I exercise in pregnancy, I can have a more comfortable delivery.	85	98

Nurtures		
If my wife is in physical education classes in pregnancy, I can more easily convince her to attend pregnancy classes.	85	100
If my own family and my wife attend physical education classes in pregnancy, I can persuade them to participate in physical activity classes.	88	92
I encourage friends and acquaintances to exercise during pregnancy	82	8
If there is a group discussion to exchange information about pregnant women after a pregnancy class, I have a greater tendency to attend a pregnancy class.	88	92
If my family is in physical education classes ...	52*	67*
If a skilled and informed person answers midwifery questions after a pregnancy class, I would be more eager to participate in pregnancy classes.	90	100
If my family would advise me to do exercise ...	32*	64*
If my doctor advises me to do exercise in pregnancy, I will do that.	92	88
Enabling		
If there is an excellent place to exercise, it is easier to exercise in pregnancy.	88	92
If classes are held free, I can use these classes more easily.	78	82
If there is a physical activity area near my residence, I can get better and more comfortable with pregnancy classes.	92	100
If I have a training CD in the centers, I can do more exercise at home.	95	88
If there are enough facilities, such as a buffet, a washbasin, etc., in pregnancy classes, I always try to take part in pregnancy classes	86	96
If exercise classes occur at different times throughout the day, I can more easily participate in physical activity classes.	86	92

*These items were omitted

Table 5

The results of the measurement model divided by each construct of the physical activity questionnaire (PA2Q)

Scale	χ^2	χ^2/df	P	CFI	TLI	RMSEA (95% CI)	Eigenvalue	%variance	Cumulative % variance
Awareness	240.18	2.00	<0.001	.940	.932	.079 (.057 ; .081)	9.41	15.89	15.89
Attitude	46.26	1.21	0.183	.990	.987	.038 (.001 ; .061)	4.93	14.81	30.70
Nurtures	221.60	3.06	<0.001	.976	.953	.72 (.064 ; .093)	5.65	12.73	43.43
Enabling	42.45	1.64	0.019	.991	.988	.062 (.023 ; .083)	5.26	15.81	59.24

χ^2 , chi-square; χ^2/df , normed chi-square; CFI, comparative Fit Index; TLI, Tucker, and Lewis Index; RMSEA, root mean square error of approximation

Table 6

The results of the final confirmatory factor analysis of the physical activity questionnaire (PA2Q-PW) (model factor loadings)

Items	F1	F2	F3	F4
During pregnancy, you should not exercise severely other than pre-pregnancy.	0.95	-	-	-
Physical activity is essential to prevent overweight due to pregnancy.	0.79	-	-	-
Exercise during pregnancy can lead to reduced oxygen supply to the baby.	0.45	-	-	-
During pregnancy, you should exercise smoothly and without sloping surfaces.	0.48	-	-	-
Pregnant women during exercise should avoid excessive curvature and hang up.	0.94	-	-	-
Exercise during pregnancy makes it easy for normal labor.	0.94	-	-	-
Exercise in pregnancy reduces the risk of birth in a diabetic neonatal.	0.78	-	-	-
Doing basic exercises daily will not hurt the mother and baby.	0.45	-	-	-
Exercise eliminates the risk of possible complications in pregnancy, e.g., back pain, lumbar pain, constipation, and excessive fatigue.	0.55	-	-	-
During pregnancy, you should stop doing heavy exercises.	0.84	-	-	-
Before starting exercise during pregnancy, you should have a light stroke to warm up.	0.74	-	-	-
A physical activity specialist should take stretching and strength during pregnancy.	0.45	-	-	-
Exercising in pregnancy prevents blood pressure dangers.	0.93	-	-	-
Exercise during pregnancy can lead to return faster maternal postpartum.	0.92	-	-	-
I try to avoid lifting any weight during pregnancy.	0.65	-	-	-
Exercising during pregnancy leads to fitness and weight control.	0.97	-	-	-
For pre-exercise preparation, 15 minutes of gentle relaxation movements are required.	0.85	-	-	-
Before conducting any exercise at this time, consultation with the doctor is required.	0.43	-	-	-
Exercise reduces the risk of musculoskeletal discomfort.	0.90	-	-	-
In the third period of pregnancy, the intensity of exercise should be reduced.	0.93	-	-	-
I believe that with exercise, I can efficiently deal with problems such as gestational diabetes.	-	0.85	-	-
I believe that exercising during pregnancy reduces my fatigue due to my pregnancy.	-	0.89	-	-
I believe that I can work out stress and anxiety from childbirth during this period.	-	0.94	-	-
I believe exercising during pregnancy helps with my daily activities.	-	0.91	-	-
I believe that I can easily maintain my fitness by exercising during pregnancy.	-	0.46	-	-
I believe that by exercising, I can reduce postpartum depression.	-	0.93	-	-

I believe that if I exercise in pregnancy, I can have a more comfortable delivery.	-	0.48	-	-
If my wife is in physical education classes in pregnancy, I can more easily convince her to attend pregnancy classes.	-	-	0.52	-
If my own family and my wife attend physical education classes in pregnancy, I can persuade them to participate in physical activity classes.	-	-	0.78	-
I encourage friends and acquaintances to exercise during pregnancy	-	-	0.83	-
If there is a group discussion to exchange information about pregnant women after a pregnancy class, I have a greater tendency to attend a pregnancy class.	-	-	0.90	-
If a skilled and informed person answers midwifery questions after a pregnancy class, I would be more eager to participate in pregnancy classes.	-	-	0.45	-
If my doctor advises me to do exercise in pregnancy, I will do that.	-	-	0.67	-
If there is an excellent place to exercise, it is easier to exercise in pregnancy.	-	-	-	0.86
If classes are held free, I can use these classes more easily.	-	-	-	0.86
If there is a physical activity area near my residence, I can get better and more comfortable with pregnancy classes.	-	-	-	0.88
If I have a training CD in the centers, I can do more exercise at home.	-	-	-	0.48
If there are enough facilities, such as a buffet, a washbasin, etc. in pregnancy classes, I always try to take part in pregnancy classes	-	-	-	0.60
If exercise classes occur at different times throughout the day, I can more easily participate in physical activity classes.	-	-	-	0.43

F1: Knowledge, F2: Attitude, F3: Nurtures, F4: Enabling

Table 7

Mean of the subscales of PA2Q-PW and its reliability according to Intra-class Correlation Coefficient (ICC) and Cronbach's alpha

Subscales	No of items	Mean±SD	Skewness	Cronbachs alpha	ICC	CR
Knowledge	20	86.8±12.8	-1.71	0.96	0.76	0.98
Attitude	7	78.5±14.7	-0.81	0.97	0.79	0.94
Nurture	6	75.4±16.5	-0.70	0.94	0.83	0.89
Enabling	6	58.1±25.7	-0.40	0.89	0.89	0.90

Figures

χ^2	χ^2/df	P	CFI	TLI	RMSEA (95% CI)
2248.06	1.64	<0.001	.940	.932	.054 (.050 ; .058)

χ^2 , chi-square; χ^2/df , normed chi-square; CFI, comparative Fit Index; TLI, Tucker, and Lewis Index; RMSEA, root mean square error of approximation.

Figure 1

Routing diagrams for generalized validation model for all structures

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [PA2QPWQuestionnaire.docx](#)