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

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Research

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Abstract

Backgrounds & Aims: There is evidence that physical activity plays an essential role in preventing pregnancy-related diseases. This study aimed to develop and design a theory-based physical activity assessment questionnaire for pregnant women (PA2Q-PW).

Methods: The PEN-3 cultural model provided the theoretical foundations for the four subscales of our designed instrument; knowledge, attitude, nurture, and enabling. The primary questionnaire was designed with 41 items, and the questionnaire was modified according to the experts' reviews. At last, a group of 400 pregnant women participated in a study to calculate the psychometrics of the tool.

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; the attitude was 0.56, nurtures were 0.38, and enabling was 0.27.

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.

Introduction

Pregnancy is an astonishing period of life for a pregnant woman and her unborn infant [1]. There is evidence that physical activity plays an essential role in preventing preeclampsia, type 2 diabetes, obesity, and many cancers [2]. Also, it has further advantages during pregnancy and diminishes the risk of HELLP syndrome, gestational diabetes mellitus, and additional gestational weight gain [3, 5]. Having physical activity is also one of the substantial factors affecting the quality of life. Nowadays, It has increasingly specified that assessing the quality of life can predict the health situation in various groups [13, 15].

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].

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]. Some theoretical derivative tools measure the determinant factors of physical activity among

pregnant women presented in the literature [21]. PEN-3 cultural model is a theory that has been exerted in a study of physical activity determinants in pregnant women [17, 20]. 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 available 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 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]. Sarrafzadegan *et al.* realized that abdominal obesity was approximately six times more in females than males [27].

According to the need of developing a questionnaire to evaluate psychosocial and perceptual determinants of physical activity in different levels of pregnancy, this study aimed to develop and design a theory-based physical activity assessment questionnaire for pregnant women (PA2Q-PW) based on the PEN-3 cultural model.

Materials And Methods

Qualitative Section

The PEN-3 cultural model provided the theoretical foundations for the four subscales of our designed instrument, knowledge, attitude, nurture and enabling. These subscales were designed according to "beliefs about the consequences of participating in physical activity", "attitude toward the behavior", and "nurtures of others" components of the PEN-3 cultural model [28].

The primary questionnaire was designed with 41 items and was evaluated by 12 experts in health education and health promotion, gynecology, and physical activity. The items on the questionnaire were modified according to the experts' reviews.

In the next step, 20 experts on health education and health promotion were independently requested to assess the necessity and relevance of the questions. The necessity of the questions was evaluated using a three-point scale, "not necessary", "effective but not necessary", and "necessary". The Content Validity Ratio (CVR) was calculated for all items, and if more than half of the panelists represent that an item is necessary, that item was considered to have the minimum content validity [29]. The relevance of the questions was also evaluated using a four-point scale, "not relevant", "insignificantly relevant", "relevant", and "reliably relevant". The Content Validity Ratio (CVI) was calculated for each item [30, 31].

The instrument went through three pilot tests conducted in one health center in Tehran City, Iran. These three steps were performed on nulliparous pregnant women selected by similar criteria to the main study population. The initial pilot test indicated that pregnant women had difficulty understanding some items, tiny words for reading, and lengthy questionnaire sentences. Changes to the primary instrument

during the first pilot test included selecting short appropriate words and putting the instrument in a visually more appealing format (giant print, more full margins). The subsequent two pilot tests refined and reduced the size of the items that pregnant women did not understand. The administration time of the final instrument was about 20 minutes.

Quantitative Section

a cross-sectional study was performed in health centers of Tehran City, Iran, from January to March 2019. The sample size was estimated at 342 by Cochran formula (Confidence=0.95, Power=0.9), and to compensate the loss, 400 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.

The questionnaires were filled whenever the midwives stayed in the health centers. Evaluations were accomplished anonymously, and nulliparous women had the choice to skip any item using the choice "I choose not to answer". If a sample responded to less than 80% of the questions or items on a subscale or scale, the total score was not computed for that variable. Based on the information provided on these criteria, less than 5% of nulliparous women were missing measure grants for particular variables.

The Ethics Committee of Tarbiat Modares University approved the study. All the pregnant women's written consent was taken, and they could withdraw from the study at any time they wished. All records were preserved private, and the researcher and other staff did not use such records and information for any target other than operating the survey. Pregnant women and their husbands were told at the beginning of each assessment that their responses were confidential and did not have access to each other's answers.

Validity

The different dimensions of the criterion were specified by implementing exploratory factor analysis (EFA) to apply the oblique rotation and original fundamental factoring [32-34]. Varimax rotation with Kaiser Normalization was chosen as the correlation between factors was less than 0.3 [35]. Kaiser-Meyer Olkin (KMO) and Bartlett's test were calculated [36]. The values of correlation of 0.40 or higher were considered satisfying ($r \geq 0.81$ -1 as supreme and excellent, 0.61-0.80 as excellent, 0.41-0.60 as good, 0.21-0.40 as fair, and 0.00-0.20 as poor) [37].

Reliability

The reliability was calculated by the intraclass correlation coefficient (ICC) by a one-month interval (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) [37]. Also, the internal consistency of PA2Q-PW was accounted for by calculating Cronbachs' alpha coefficient. The alpha amount of 0.70 or higher was noticed as satisfactory [37].

Results

The average age of participants was 32.4 ± 12.4 years, the average BMI was 26.80 ± 6.25 , and they had week exercise within gestation (Table 1).

Table 1
Demographic characteristics of the
participants (n=400)

Parameter	Number (Percent)
Education	
Elementary	93 (23.25)
Middle	253 (63.25)
Higher	54 (13.5)
Economic status	
Low income	242 (60.5)
Middle income	76 (19.0)
High income	82 (20.5)
Employment	
Homemaker	232 (58.0)
Employed	148 (37.0)
Student	20 (5.0)

The correlation (CVI & CVR indices) between the experts was satisfactory in all items of PA2Q-PW (Table 2).

Table 2

Report of the panelists rating for four subscales CVR & CVI (N=20). Two items (starred) were removed according to this rating, and the items decreased to 39.

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
*These items were omitted		

Items	CVR (%)	CVI (%)
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		

The highest score was seen in the knowledge subscale, 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 (Table 3).

Table 3
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
Knowledge	20	86.8±12.8	-1.71	0.96	0.76
Attitude	7	78.5±14.7	-0.81	0.97	0.79
Nurture	6	75.4±16.5	-0.70	0.94	0.83
Enabling	6	58.1±25.7	-0.40	0.89	0.89

The assessed KMO was 0.73, and Bartlett's test for sphericity was significant ($p < 0.0001$; Table 4).

Table 4
Findings of the exploratory factor analysis (EFA)

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	-	-	-

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

Items	F1	F2	F3	F4
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				

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, GFI's, and RMSEA values were 0.90, 0.80, 0.92, and 0.091, respectively ($p<0.0001$). 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 0.41, the attitude was 0.56, nurtures was 0.38, and enabling was 0.27 (Table 5).

Table 5
Varimax Rotation in Principal Factor Analysis for the Social Impression Measure

Items	Loading Factors
Knowledge	
During pregnancy, you should not exercise severely other than pre-pregnancy.	0.71
Physical activity is essential to prevent overweight due to pregnancy.	0.70
Exercise during pregnancy can lead to reduced oxygen supply to the baby.	0.63
During pregnancy, you should exercise smoothly and without sloping surfaces.	0.62
Pregnant women during exercise should avoid excessive curvature and hang up.	0.62
Exercise during pregnancy makes it easy for normal labor.	0.57
Exercise in pregnancy reduces the risk of birth in a diabetic neonatal.	0.64
Doing basic exercises daily will not hurt the mother and baby.	0.41
Exercise eliminates the risk of possible complications in pregnancy, e.g., back pain, lumbar pain, constipation, and excessive fatigue.	0.71
During pregnancy, you should stop doing heavy exercises.	0.68
Before starting exercise during pregnancy, you should have a light stroke to warm up.	0.56
A physical activity specialist should take stretching and strength during pregnancy.	1.57
Exercising in pregnancy prevents blood pressure dangers.	2.96
Exercise during pregnancy can lead to return faster maternal postpartum.	1.25
I try to avoid lifting any weight during pregnancy.	0.82
Exercising during pregnancy leads to fitness and weight control.	0.72
For pre-exercise preparation, 15 minutes of gentle relaxation movements are required.	0.67
Before conducting any exercise at this time, consultation with the doctor is required.	0.58
Exercise reduces the risk of musculoskeletal discomfort.	0.63
In the third period of pregnancy, the intensity of exercise should be reduced.	0.85
Attitude	
I believe that with exercise, I can efficiently deal with problems such as gestational diabetes.	0.82
I believe that exercising during pregnancy reduces my fatigue due to my pregnancy.	0.68
I believe that I can work out stress and anxiety from childbirth during this period.	0.56

Items	Loading Factors
I believe exercising during pregnancy helps with my daily activities.	1.26
I believe that I can easily maintain my fitness by exercising during pregnancy.	0.75
I believe that by exercising, I can reduce postpartum depression.	0.69
I believe that if I exercise in pregnancy, I can have a more comfortable delivery.	1.52
Nurture	
If my wife is in physical education classes in pregnancy, I can more easily convince her to attend pregnancy classes.	0.54
If my own family and my wife attend physical education classes in pregnancy, I can persuade them to participate in physical activity classes.	0.44
I encourage friends and acquaintances to exercise during pregnancy	0.66
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.	0.38
If a skilled and informed person answers midwifery questions after a pregnancy class, I would be more eager to participate in pregnancy classes.	0.77
If my doctor advises me to do exercise in pregnancy, I will do that.	1.32
Enabling	
If there is an excellent place to exercise, it is easier to exercise in pregnancy.	0.54
If classes are held free, I can use these classes more easily.	0.44
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.	0.38
If there are enough facilities, such as a buffet, a washbasin, etc., in pregnancy classes, I always try to take part in pregnancy classes	0.77
If exercise classes occur at different times throughout the day, I can more easily participate in physical activity classes.	0.27

Discussion

This study aimed to design a criterion for evaluating pregnant women's perceptions concerning physical activity. 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 [35]. 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 contain a PEN-based questionnaire [35]. Unfortunately, only direct scores of the theory-based PEN-3 cultural model were used in this study.

For the perceptions, natures, and enabling factors, the development sample's internal consistency of reliabilities was above 0.80. For the perceptions, natures, and enabling factors, the test-retest correlation coefficients were about 0.90 in the Intended sample. These rates are checked sufficiently [37]. 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 [38]. It also should 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 [38].

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 fit appropriately 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 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 [40]. 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 [38]. The findings extracted from studies from the validity of these constructs of the pregnancy, physical activity questionnaire (PPAQ), were inadequate for the Vietnamese versions of the questionnaire [41]. 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 [42].

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) 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. The PA2Q-PW was demonstrated to be consistent and reliable within its knowledge, attitude, nurtures, and enabling subscales. However, future attempts are carried 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.

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

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Ethical approval: The Research Ethics Committee of Tarbiat Modares University approved the research of this study. All pregnant women in this trial were informed about participating in the survey, and written informed consent was taken.

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.

Authors' contributions: LK comprehended the trial, completed the collection, categorized the data. SR presented supervision during data collection and collaborated to temporarily and interpret final data. SHN performed management during the development of the study and data collection and participated in analyzing the data. FSH prepared the draft and edited the repetitive draft. All researchers read, concluded, and approved the final draft.

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Figures

Figure 1

Standard estimation model based on binary correlation coefficients of questionnaire structures