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Physical Activity Self-Efficacy Among Pregnant Women at High Risk for Gestational Diabetes Mellitus in China: A Cross-Sectional Study

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Background: Physical activity could decrease the odds of pregnant women at high risk for gestational diabetes mellitus (GDM) developing GDM. Physical activity self-efficacy was the key predictor of physical activity. This study aimed to examine physical activity self-efficacy and identify its predictors among pregnant women at high risk for GDM in mainland China.

Methods: A cross-sectional study was conducted in Zhengzhou, China, from October 2021 to February 2022. Two hundred fifty-two pregnant women at high risk for GDM completed the Pregnancy Physical Activity Self-efficacy Scale, the Social Support for Physical Activity Scale, the Knowledge of Physical Activity Questionnaire, the 7-item Generalized Anxiety Disorder Scale, the Edinburgh Postnatal Depression Scale, and a socio-demographic data sheet. Multiple linear regression was used.

Results: Chinese pregnant women at high risk for GDM reported a moderate level of physical activity self-efficacy. The best-fit regression analysis revealed four predictors. Social support for physical activity was the strongest predictor, followed by knowledge of physical activity, intention to do physical activity, and anxiety symptoms.

Conclusion: The study found that Chinese pregnant women at high risk for GDM had a moderate level of physical activity self-efficacy, which had 4 predictors. Healthcare professionals should make efforts to enhance pregnant women's social support, knowledge, and intention to do physical activity and decrease their anxiety symptoms to improve their physical activity self-efficacy.

Keywords: physical activity, gestational diabetes, self-efficacy, predictors

Introduction

Gestational diabetes mellitus (GDM) is one of the most common pregnancy complications and health problems, which poses long-term and short-term threats to maternal and fetal morbidity.[1] One of the most significant risk factors for GDM is having a history of GDM.[2] Additional risk factors include obesity, being 35 years or older, and a family history of type 2 diabetes.[3] The prevalence of GDM was 15.8% globally in 2021, with an increasing trend over time. In China, the prevalence of GDM was 14.8%.[4] With the "two-child policy" in 2016 and the "three-child policy" in 2021 in mainland China, the proportion of pregnant women 35 years or older with pre-pregnancy overweight or obese status increased dramatically.[5] Consequently, the incidence of GDM will likely increase. There is a high priority to take strategies to prevent the occurrence of GDM, especially among pregnant women at high risk for GDM in mainland China.[6]

Physical activity is "any bodily movement produced by skeletal muscles that results in energy expenditure".[7] Physical activity increases glucose uptake in the skeletal muscle.[8] It has immediate and longer-term effects on insulin sensitivity.[8] The WHO and multiple national guidelines recommend that pregnant women without contraindications should engage in at least 150 minutes of moderate-intensity activity weekly.[9] Evidence indicates that physical activity could decrease the odds of developing GDM,[10–12] in particular for pregnant women at high risk for GDM.[13] However, a recent systematic review indicated that most pregnant women in the world do not meet the current physical activity guidelines.[14] It is

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reported that about half of pregnant women in mainland China do not reach the recommended physical activity levels.[15] Furthermore, pregnant women at high risk for GDM spent most of their time in sedentary behaviors despite a low prevalence of contraindications to be physically active.[16]

Physical activity self-efficacy has been identified as a significant predictor of physical activity, which healthcare professionals can amend.[17,18] According to Bandura,[19,20] self-efficacy is "the belief in one's capabilities to organize and execute the courses of action required in managing prospective situations". Physical activity self-efficacy refers to confidence in one's ability to persist with physical activity in various situations.[21] Physical activity self-efficacy is a modifiable theoretical factor related to pregnant women's physical activity.[22,23] Pregnant women with a higher level of physical activity self-efficacy demonstrated more stability and increased physical activity behavior during pregnancy.[24]

Physical activity self-efficacy may be related to many factors. Firstly, according to Bandura,[19,20] self-efficacy is influenced by individual direct successful experience, vicarious experiences through observing others doing an assignment successfully, verbal persuasion through gaining positive feedback about completing an assignment, and emotional arousal through adjusting their physiological and psychological status. Previous studies in the non-pregnant and general pregnant population revealed that physical activity self-efficacy was positively related to social support,[25–27] knowledge of physical activity,[28] intention to do physical activity[29] and negatively related to anxiety and depressive symptoms.[30]

Previous studies on general pregnant women also showed that physical activity self-efficacy was related to their husband's habit of regular physical activity,[31] and environment being appropriate to do physical activity,[32] demographic characteristics including age,[33] pre-pregnancy body mass index (BMI),[31] perinatal characteristics including gestational age,[26,27,33] mode of conception,[31] and attendance in antenatal classes.[27] The physical activity self-efficacy in pregnant women at high risk for GDM may also be related to culture. In Chinese tradition, rest and recuperation are strongly encouraged once a woman is pregnant.[34] The traditional beliefs and practices related to pregnancy are still popular among many current Chinese women.[35]

Pregnancy is a "teachable moment" during which women are amenable to changing their behaviors to benefit themselves and their baby's health.[36] Physical activity self-efficacy can serve as an indicator for pregnant women at high risk for GDM who require additional intervention to enhance their physical activity.[23] Healthcare professionals need to understand, recognize, and address physical activity self-efficacy and its predictors in pregnant women at high risk for GDM. However, to our knowledge, no study has examined the predictors of physical activity self-efficacy in pregnant women at high risk for GDM in mainland China. Therefore, this study aimed to examine physical activity self-efficacy and identify its predictors in pregnant women at high risk for GDM.

Based on the self-efficacy theory and the literature, we postulated the following assumption: (1) Pregnant women at high risk for GDM had a moderate level of physical activity self-efficacy. (2) Knowledge of physical activity, social support for physical activity, intention to do physical activity, and emotion were predictors for physical activity self-efficacy.

Methods

Study Design, Setting, and Participants

This was a cross-sectional study that examined physical activity and physical activity self-efficacy among Chinese pregnant women at high risk for GDM. The paper about physical activity and its predictors was published elsewhere.[37] This paper focused on physical activity self-efficacy and its predictors. This study was conducted and reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist (Supplementary File 1).

This study was conducted in Zhengzhou, China, between October 2021 and February 2022. Zhengzhou is a sub-provincial city located in the central plains of China. It is the capital of Henan Province and has approximately 13 million people. The participants were recruited from the antenatal clinic in a regional teaching hospital that has more than 6,000 births annually. Pregnant women usually take oral glucose tolerance test at 24–28 gestational weeks to diagnose GDM.

Eligible pregnant women were Zhengzhou citizens who were: (1) 18 years and older; (2) gestational age no more than 28 weeks; (3) have at least one risk factor for GDM, including (a) age ≥ 35 years; (b) pre-pregnancy body mass index (BMI) ≥24 kg/m^2; (c) polycystic ovary syndrome; (d) family history of diabetes; (e) history of unexplained stillbirth,

miscarriage, or neonatal death; (f) history of delivering a large baby (birth weight ≥ 4000g); or (g) history of GDM.[38,39] Women were excluded if they had any contraindications to physical activity, including unexplained persistent vaginal bleeding; severe cardiovascular, respiratory, or systemic disease; incompetent cervix; multiple pregnancies; recurrent miscarriage; symptomatic anemia; type 1 diabetes; uncontrolled hypertension and thyroid disease.[9]

The present study aimed to conduct multiple linear regression analyses to explore the predictors of physical activity self-efficacy in pregnant women at high risk for GDM. According to Green (1991),[40] the minimum required sample size for multiple linear regression can be estimated using the formula of $n > 50 + 8$ m, where m is the number of predictors. Based on the literature review, we assumed there may be 20 predictors of physical activity self-efficacy. Thus, in the present study, m is 20. Therefore, we needed at least 210 participants for sufficient statistical power for each multiple linear regression.

Measures

The Pregnancy Physical Activity Self-Efficacy Scale (P-PASES) measured physical activity self-efficacy in the present study.[41] The original P-PASES was in English and translated and validated in Chinese pregnant women.[42] The P-PASES is a 10-item instrument with each item rating on a 5-point Likert scale ranging from 5 points (strongly agree) to 1 point (strongly disagree). Higher scores indicate a greater level of self-efficacy to engage in physical activity. Physical activity self-efficacy can be divided into high (41–50 points), moderate (21–40 points), and low levels (10–20 points).[41,42] The Chinese version of P-PASES has good psychometric properties, with a Cronbach's alpha value of 0.80 and a test-retest reliability coefficient of 0.53.[42] The Cronbach's alpha value of P-PASES was 0.95 in the present study.

The Social Support for Physical Activity Scale (SSPAS) measured the social support for physical activity in the present study.[43] The original SSPAS was in Chinese and for adults. The original SSPAS was adapted for Chinese pregnant women.[43] The SSPAS was a 24-item instrument consisting of four subscales: emotional support, informative support, instrumental support, and peer support. Each item is rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate a higher level of social support for physical activity. The SSPAS has good psychometric properties, with Cronbach's alpha value of 0.95 and a test-retest reliability coefficient of 0.88.[43] The Cronbach's alpha value of SSPAS was 0.98 in the present study.

The knowledge of pregnancy physical activity is a 7-item Chinese questionnaire and was used in the present study.[44] The total scores range from 0 to 7. A score of 5 or more indicates a high awareness of pregnancy physical activity knowledge. The reported psychometric property of this questionnaire was suitable.[44] The Cronbach's alpha value of this questionnaire was 0.88 in the present study.

The 7-item Generalized Anxiety Disorder scale (GAD-7) was used to measure anxiety symptoms.[45] Each item is rated on a 4-point Likert scale ranging from 0 to 3 with a total score of 0–21. Higher scores indicate a higher level of anxiety symptoms. The pregnant women who had a score ≥15 were referred to have further examination. The original GAD-7 was in English and has been validated in Chinese populations. The Chinese version of GAD-7 has good psychometric properties.[46] The Cronbach's alpha value of GAD-7 was 0.95 in the present study.

The Edinburgh Postnatal Depression Scale (EPDS) was used to measure depressive symptoms.[47] The EPDS is a 10-item questionnaire. Each item is rated on a 4-point Likert scale ranging from 0 to 3 with a total score of 0–30. Higher scores indicate a higher level of depressive symptoms. The EPDS was originally in English and developed to measure postnatal depressive symptoms. It has been validated to measure antenatal depressive symptoms in Chinese pregnant women.[48] Pregnant women with a score ≥13 were referred for further examination. The Cronbach's alpha value of EPDS was 0.85 in the present study.

Intention to do physical activity was measured by a question with two options (yes or no). Firstly, all pregnant women were informed of the WHO pregnancy physical activity guideline, which states they should have at least 150 minutes of moderated physical activity weekly. Then, they were asked whether or not they intended to achieve the recommended level of physical activity during pregnancy (yes or no).

The sociodemographic and perinatal characteristics data sheet collected data, including maternal age, marital status, education, occupation, monthly household income; gestational age, parity, planned pregnancy, mode of conception, attending antenatal classes, having a habit of regular physical activity before pregnancy, already begun regular physical

activity during this pregnancy, husband having a habit of regular physical activity, and environments or facilities around the community or work unit being appropriate for pregnant women to do physical activity.

Ethical Considerations and Procedure

Ethical approval was obtained from the Institutional Review Board of the Sixth Affiliated Hospital of Sun Yat-sen University (approval no. L2021ZSLYEC-098) on February 26, 2021 and the School of Nursing of Sun Yat-Sen University (no. L2022SYSU-HL-004) on January 13, 2022. The study conformed to the Code of Ethics of the World Medical Association (Declaration of Helsinki). All participants were assured that their participation was voluntary and that their data would be kept confidential. Pregnant women with a GAD-7 score ≥ 15 or EPDS score ≥ 13 were referred to a doctor or psychiatrist for further evaluation, but it would be up to the pregnant women to decide whether they would accept these services. This study did not envisage further follow-up of these women.

Four research assistants (RAs) who were nurses working in the antenatal clinic were selected to recruit and collect data. A training session was provided to ensure consistency. A pilot study was conducted on 10 pregnant women to assess the logistic issues and feasibility of the questionnaire. No problems were reported. The data of these pregnant women in the pilot study were not included in the present study.

The RAs checked all the medical records of those who had booked antenatal care in the study hospital and identified the eligible pregnant women. The RAs invited all eligible pregnant women to the antenatal clinic to participate in the study. After explaining the study's purpose, women who signed an informed consent document were asked to fill in the questionnaires in a quiet room. The RAs stayed nearby to answer questions, if any, and received the returned questionnaires.

Data Analysis

Data were analyzed with SPSS v25.0 (IBM Corporation, Armonk, NY, USA). Statistical significance was set at 0.05. Descriptive statistics were used for demographic and obstetric characteristics and the study variables. Differences in physical activity self-efficacy among demographic and obstetric sub-groups were compared using the independent-sample *t*-test or one-way analysis of variance (ANOVA). Pearson's correlation analysis was used to examine correlations between the study variables. All the variables with $P < 0.05$ in the above tests were inputted into a multivariate linear regression analysis to identify the predictors of physical activity self-efficacy. "Intention to do physical activity", "Having already begun regular physical activity during pregnancy", "Having attended antenatal classes", and "Environment or facilities around the community or work unit being appropriate for pregnant women to do physical activity" were adjusted in multivariable analyses for physical activity self-efficacy.

Results

Of the 268 eligible pregnant women at high risk for GDM, 256 agreed to participate in the study. Four did not complete the questionnaires. Therefore, 252 pregnant women at high risk for GDM were included in this study, with a response rate of 94.0%.

Table 1 presents the pregnant women's demographic characteristics. All pregnant women were married. The average age of the pregnant women was 30.81 ± 4.66 years old. Almost half of the pregnant women (44.8%) were overweight or obese with pre-pregnancy BMI above 24 Kg/m^2. One hundred and forty- three pregnant women (56.7%) had an education level of junior college degree or below.

Table 2 presents the pregnant women's perinatal characteristics. The average gestational age was 18.43 ± 4.56 weeks. About half of the pregnant women (45.2%) were nulliparous. Most (n = 239, 94.8%) have not begun regular physical activity during this pregnancy. Over one-third (35.9%) of pregnant women intended to do physical activity during pregnancy. One hundred and seventy-one pregnant women (67.9%) have not attended antenatal classes on physical activity. Internet (47.6%) was the most popular way to obtain knowledge of pregnancy physical activity. One hundred eighty-seven (74.2%) women's husbands did not have regular physical activity habits.

Table 3 presents the scores of each item of P-PASES in descending order. The mean total score of physical activity self-efficacy was 33.37 (SD = 7.51, range = 10–50). The items that had the lowest scores, suggesting the pregnant women

Table 1 Demographic Characteristics of Pregnant Women at High Risk for GDM (N = 252)

Characteristics	*n*	%
Age (Years)		
<35	193	76.6
≥35	59	23.4
Pre-pregnancy BMI (Kg/m^2)		
<18.5	17	6.8
18.5–23.9	122	48.4
24–27.9	93	36.9
≥28	20	7.9
Education		
Junior college degree or below	143	56.7
Bachelor degree or above	109	43.3
Occupation		
Housewife	84	33.3
Part time	13	5.2
Full time	155	61.5
Monthly household income (per person per month)		
<¥5000 (about US$747)	103	40.9
¥5000-9000 about US$747–US$1344)	103	40.9
≥¥9000 (aboutUS$1344)	46	18.2

Table 2 Perinatal Characteristics of Pregnant Women at High Risk for GDM (N = 252)

Characteristics	*n*	%
Parity		
Nulliparity	114	45.2
Multiparity	138	54.8
Number of living children		
0	114	45.2
1	119	47.2
2	17	6.8
3	2	0.8
Planned pregnancy		
Yes	178	70.6
No	74	29.4
Mode of conception		
Natural	246	97.6
Artificial	6	2.4
Having a habit of regular physical activity before pregnancy		
Yes	54	21.4
No	198	78.6
Having the intention to do physical activity		
Yes	88	35.9
No	164	64.1
Having already begun regular physical activity during pregnancy		
Yes	13	5.2
No	239	94.8

(*Continued*)

Table 2 (Continued).

Characteristics	*n*	%
Having attended antenatal classes		
No	171	67.9
Yes	81	32.1
From whom to learn the knowledge of pregnancy physical activity		
Antenatal classes	81	32.1
Other pregnant women	22	8.7
Internet	120	47.6
Telecourse	3	1.2
Family members or friend	31	12.3
Books	34	13.5
None	17	6.7
Husband having a habit of regular physical activity		
No	187	74.2
Yes	65	25.8
Environments or facilities around the community or work unit being appropriate for pregnant women to do physical activity		
No	88	34.9
Yes	164	65.1

Table 3 The Scores on Physical Activity Self-Efficacy Listed by Item (N = 252)

Item No.	P-PASES Items	Mean(SD)
	I am confident that I can:	
1	Overcome barriers and challenges to do physical activity if I try hard enough.	3.60(0.92)
2	Find the means and ways to do physical activity during pregnancy.	3.58(0.83)
3	Accomplish my physical activity goals that I set.	3.55(0.82)
4	Confronted with a barrier to do physical activity, I can find several solutions to overcome this barrier.	3.47(0.85)
9	Motivate myself to start physical activity again after I have stopped for a while.	3.32(0.89)
10	Do physical activity even if I had no access to a gym, physical activity, training, or rehabilitation facility.	3.32(0.91)
7	Do physical activity when my family or friends do not support me.	3.28(0.89)
5	Do physical activity when I am tired.	3.10(0.94)
6	Do physical activity even when I am feeling depressed.	3.09(0.95)
8	Do physical activity without the consult of my physician.	3.07(0.97)
	Total score of P-PASES	33.37(7.51)

Abbreviations: P-PASES, The Pregnancy Physical Activity Self-efficacy Scale; SD, Standard Deviations.

felt least confident in physical activity, were "Do physical activity without consultation of my physician" and "Do physical activity even when I am feeling depressed". The two items with the highest score were "Overcome barriers and challenges to do physical activity if I try hard enough"; and "Find the means and ways to do physical activity during pregnancy". Most of them (n = 213, 84.5%) had a moderate level of physical activity self-efficacy, followed by a high level of physical activity self-efficacy (n =21, 8.3%), and a low level of physical activity self-efficacy (n = 18, 7.2%).

Table 4 presents the mean score on social support for physical activity, knowledge of physical activity, anxiety and depressive symptoms. The mean score on social support for physical activity was 83.93 (SD = 16.79), suggesting the pregnant women had a moderate level of social support for physical activity. The highest level of social support for physical activity the pregnant women received was emotional support. The mean score of knowledge of physical activity in pregnancy was 3.13 (SD = 2.59) indicating a low level. More than half (n=167, 66.3%) of the pregnant women had a low level on awareness of pregnancy physical activity knowledge. The lowest awareness of the item on knowledge questionnaires was contraindications on physical activity for pregnant women (24.2%), followed by warning signs for

Table 4 Means, Standard Deviations, and Prevalence in Social Support for Physical Activity, Knowledge of Physical Activity, Anxiety and Depressive Symptoms (N = 252)

Variable	Mean (SD)	n (%)
Social support for physical activity	83.93 (16.79)	
Emotional support subscale	21.98 (4.52)	
Peer support subscale	20.98 (4.79)	
Informative support subscale	20.56 (4.87)	
Instrumental support subscale	20.06 (5.12)	
Knowledge of physical activity	3.13 (2.59)	
High (scores ≥ 5)		85 (33.7%)
Low (scores<5)		167 (66.3%)
Anxiety symptoms	2.93 (4.21)	
Depressive symptoms	6.65 (5.49)	

Abbreviation: SD, Standard Deviations.

pregnant women to stop physical activity (31.1%), the benefits of physical activity for the fetus (44.4%), the benefits of physical activity for pregnant women (49.2%), the mode of physical activity for pregnant women to avoid (47.6%), the benefits of physical activity for natural delivery (53.6%), and suitable modes of physical activity for pregnant women (62.3%). The mean score on anxiety and depressive symptoms was 2.93 (*SD* = 4.21) and 6.65 (*SD* = 5.49), respectively, which were in the normal value.

Table 5 presents the differences in physical activity self-efficacy among sociodemographic and perinatal characteristic sub-groups. Pregnant women who intended to do physical activity ($t = 3.342$, $p < 0.01$), had already begun regular physical activity during this pregnancy ($t = 2.301$, $p < 0.05$), had attended the antenatal classes ($t = 3.369$, $p < 0.01$), and lived in the community or work unit having the environments or facilities appropriate for pregnant women to engage in physical activity ($t = 2.110$, $p < 0.05$) reported higher scores in physical activity self-efficacy.

Table 6 presents the correlations between physical activity self-efficacy and social support for physical activity, knowledge of physical activity, anxiety and depressive symptoms. Physical activity self-efficacy was positively related to social support for physical activity ($r = 0.30$, $p < 0.001$), knowledge of physical activity ($r = 0.26$, $p < 0.001$), and

Table 5 Differences in the Physical Activity Self-Efficacy Among Various Socio-Demographic, and Perinatal Sub-Groups (N = 252)

Domain	Score on P-PASES Mean(SD)	*t*	*p*
Having the intention to do physical activity		3.342	0.001**
Yes	35.49 (6.81)		
No	32.24 (7.64)		
Having already begun regular physical activity during pregnancy		2.301	0.022*
Yes	38.00 (5.48)		
No	33.12 (7.53)		
Having attended antenatal classes		3.369	0.001*
Yes	35.64 (6.42)		
No	32.30 (7.76)		
Environments or facilities around the community or work unit being appropriate for pregnant women to do physical activity		2.110	0.036*
Yes	34.03 (7.30)		
No	31.97 (7.58)		

Notes: *p<0.05; **p<0.01.
Abbreviations: P-PASES, The Pregnancy Physical Activity Self-efficacy Scale; SD, Standard Deviations.

Table 6 Associations Among Physical Activity Self-Efficacy, Social Support for Physical Activity, Knowledge of Physical Activity, Anxiety Symptoms, and Depressive Symptoms (N = 252)

	Physical Activity Self-Efficacy
1. Physical activity self-efficacy	1
2. Social support for physical activity	0.30***
3. Knowledge of physical activity	0.26***
4. Anxiety symptoms	−0.19**
5. Depressive symptoms	−0.01

Notes: **p<0.01, ***p<0.001.

Table 7 Predictors of the Physical Activity Self-Efficacy by Multivariate Linear Regression (N = 252)

Independent Variables	*B*	Standard Error-*B*	*β*	t	*p*	95% CI for *β*	
						Lower	Upper
Constant	27.49	2.94		9.364	0.000	21.705	33.268
Social support for physical activity	0.11	0.03	0.24	4.032	0.000	0.054	0.157
Knowledge of physical activity	0.55	0.17	0.19	3.241	0.001	0.217	0.888
Intention to do physical activity[a]	−2.49	0.92	−0.16	−2.721	0.007	−4.298	−0.688
Anxiety symptoms	−0.22	0.10	−0.13	−2.123	0.035	−0.426	−0.016

Notes: overall R^2=0.175; model fit: F=13.007, p<0.001. [a] Intention to do physical activity: 1= Yes, 2= No. Statistically significant at p<0.05.
Abbreviation: CI, Confidence intervals.

negatively related to anxiety symptoms (r = −0.19, p = 0.003). Depressive symptoms were not significantly related to physical activity self-efficacy.

Table 7 presents the predictors of physical activity self-efficacy. Variables that had a significant correlation with physical activity self-efficacy scores were included in the regression model. The best-fit regression model revealed four predictors that explained 17.5% of the variance in physical activity self-efficacy. The four predictors were social support for physical activity, knowledge of physical activity, intention to do physical activity, and anxiety symptoms.

Discussion

To our knowledge, this was the first study to examine physical activity self-efficacy and identify its predictors among pregnant women at high risk for GDM in mainland China. As the physiological and psychological changes during pregnancy, pregnant women may need a higher level of physical activity self-efficacy to achieve the recommended level of physical activity. Unfortunately, the present study found that as much as 91.7% of pregnant women in the present study had a low or moderate level of physical activity self-efficacy which was consistent with a previous study on pregnant women at low risk for GDM in mainland China.[49] The physical activity self-efficacy in the present study was lower than that in American pregnant women at low risk for GDM in rural areas,[33] and Danish pregnant women at low risk for GDM.[50] The lower physical activity self-efficacy in the present study may be related to the traditional Chinese cultures.[34] To avoid spontaneous miscarriage, Chinese pregnant women tend to obey traditional taboos such as “no jumping”, “no moving heavy objects”, “no fast walking”, and “not too much walking”.[34] The findings suggested that most pregnant women at high risk for GDM in mainland China may need interventions to enhance their physical activity self-efficacy.

Further examining the items of P-PASES, we found that pregnant women were least confident in physical activity without consulting their physician. It may be because pregnant women regard the advice from their healthcare providers as reliable and credible.[51] A previous study demonstrated that perinatal physical activity advice and counseling were crucial to promoting physical activity adherence during pregnancy.[52]

Unfortunately, nearly half the pregnant women in the present study attained information on physical activity from the internet, which could be inaccurate, confusing, and overwhelming.[53] It may be because providing counseling on physical activity for pregnant women was not a routine service in the current antenatal care in mainland China as well as in Western countries such as the United Kingdom.[54] Furthermore, healthcare professionals perceived promoting physical activity as being a burden due to a lack of training, knowledge, and resources.[55] In fact, some pregnant women reported receiving incorrect or incomplete advice on the frequency, intensity, and type of physical activity, which did not follow updated evidence-based physical activity guidelines for pregnant women.[56,57] A continued education program on current physical activity guidelines for pregnant women may encourage and help local healthcare providers provide expert counseling.

The present study found that social support was the strongest predictor of physical activity self-efficacy in pregnant women at high risk for GDM. Cheng et al,[26] also found that greater social support was significantly associated with increased self-efficacy to engage in physical activity in pregnant women with low risk for GDM. This result supports Bandura's self-efficacy theory, which states that social support is a resource for self-efficacy.[19] The present study's findings suggested that healthcare professionals should provide pregnant women with social support. They could provide information and emotional support, such as encouragement, positive feedback, and insurance on their physical activity. The previous study also indicated that pregnant women preferred to meet other women in the same situation to help normalize concerns following the ongoing pregnancy periods in the antenatal classes.[58] In addition, perceiving others' successful engagement in the targeted activity could help them enhance their self-efficacy to do physical activity during pregnancy.[59] Providing opportunities for pregnant women to get peer support from other pregnant women may be helpful. Besides peer support, healthcare professionals could invite husbands/partners to participate in pregnant women's physical activity.

The present study also found that knowledge of physical activity predicted physical activity self-efficacy. Women with a higher level of pregnancy physical activity knowledge were more confident in persisting in physical activity during pregnancy. However, 66.3% of pregnant women in the present study had a low awareness of pregnancy physical activity knowledge, which was higher than that in Ethiopia (44.2%).[60] Antenatal classes are practical approaches to enhance pregnant women's pregnancy physical activity knowledge. However, only one-third of the pregnant women in the present study attended the antenatal classes. A previous study also indicated that the use of the Internet as a source of health information has become increasingly popular among pregnant women.[61] Considering the high prevalence of GDM in mainland China, online antenatal classes focused on physical activity during pregnancy should be developed for pregnant women at high risk for GDM.

This study also found that anxiety symptoms were a predictor of physical activity self-efficacy, which was consistent with the results of the study in non-pregnant women.[30] This result also supports Bandura's self-efficacy theory that negative emotion was a barrier to self-efficacy.[19] The present study also found that the intention to do physical activity during pregnancy predicted physical activity self-efficacy. This result agreed with the literature that intention to do physical activity and physical activity self-efficacy were highly correlated in college students.[29] However, over half of the pregnant women (64.1%) in the present study did not intend to engage in physical activity during pregnancy. Furthermore, a previous study showed that most (73.5%) of women who were already physically inactive reported no intention to engage in physical activity during pregnancy.[16] Pregnant women reported that they did not plan to engage in physical activity during pregnancy due to a lack of counseling or guidance.[62] Thus, professional knowledge and guidance regarding physical activity during pregnancy were urgent issues in the antenatal care system. Perhaps it is effective to encourage the whole society to engage in physical activity to enhance pregnant women's physical activity.

Limitations

This study had some limitations. First, it was conducted in one hospital, and most participants had a high level of education. Our findings may not be transferable to other settings or those less educated. Second, the best-fit regression analysis revealed only 17.5% of the variance explaining physical activity self-efficacy. Further study is suggested to explore more factors related to physical activity self-efficacy among pregnant women at high risk for GDM.

Conclusions

The present study found that Chinese pregnant women at high risk for GDM had a moderate level of physical activity self-efficacy. Social support, knowledge, intention to do physical activity and anxiety symptoms were predictors of physical activity self-efficacy in pregnant women at high risk for GDM in mainland China.

Implications for Practice and Research

The present study suggested that most pregnant women at high risk for GDM need interventions for their physical activity self-efficacy. Healthcare professionals may use strategies to enhance pregnant women's social support, knowledge of physical activity, and intention to do physical activity, as well as decrease their anxiety symptoms to enhance their physical activity self-efficacy. Online antenatal classes may be a practical approach to enhance pregnant women's physical activity self-efficacy.

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References

1. Murray SR, Reynolds RM. Short- and long-term outcomes of gestational diabetes and its treatment on fetal development. *Prenat Diagn*. 2020;40(9):1085–1091. doi:10.1002/pd.5768
2. Artzi NS, Shilo S, Hadar E, et al. Prediction of gestational diabetes based on nationwide electronic health records. *Nat Med*. 2020;26(1):71–76. doi:10.1038/s41591-019-0724-8
3. Zhang Z, Yang L, Han W, et al. Machine learning prediction models for gestational diabetes mellitus: meta-analysis. *J Med Internet Res*. 2022;24(3):e26634. doi:10.2196/26634
4. Gao C, Sun X, Lu L, Liu F, Yuan J. Prevalence of gestational diabetes mellitus in mainland China: a systematic review and meta-analysis. *J Diabetes Investig*. 2019;10(1):154–162. doi:10.1111/jdi.12854
5. Ji HP, Wang YH, Dong W, et al. An ecological study of the willingness to have the third child and its influencing factors among women of childbearing age in Henan Province. *Chin J Reprod Health*. 2022;33(2):109–113.
6. Guo XY, Shu J, Fu XH, et al. Improving the effectiveness of lifestyle interventions for gestational diabetes prevention: a meta-analysis and meta-regression. *BJOG*. 2019;126(3):311–320. doi:10.1111/1471-0528.15467
7. World Health Organization. Physical activity. World Health Organization. Available from: https://www.who.int/news-room/fact-sheets/detail/physical-activity. Accessed November 13, 2022.
8. Bird SR, Hawley JA. Update on the effects of physical activity on insulin sensitivity in humans. *BMJ Open Sport Exerc Med*. 2016;2(1):e000143. doi:10.1136/bmjsem-2016-000143
9. Yang X, Li H, Zhao Q, Han R, Xiang Z, Gao L. Clinical practice guidelines that address physical activity and exercise during pregnancy: a systematic review. *J Midwifery Women's Health*. 2022;67(1):53–68. doi:10.1111/jmwh.13286
10. Herzberger V, Bäz E, Kunze M, Markfeld-Erol F, Juhasz-Böss I. Exercise during pregnancy: effects on birth weight and on the risks of gestational diabetes and preterm delivery. *Dtsch Arztebl Int*. 2022;119:793–797. (Forthcoming). doi:10.3238/arztebl.m2022.0305
11. Tang Q, Zhong Y, Xu C, Li W, Wang H, Hou Y. Effectiveness of five interventions used for prevention of gestational diabetes: a network meta-analysis. *Medicine*. 2022;101(15):e29126. doi:10.1097/md.0000000000029126
12. Martínez-Vizcaíno V, Sanabria-Martínez G, Fernández-Rodríguez R, et al. Exercise during pregnancy for preventing gestational diabetes mellitus and hypertensive disorders: an umbrella review of randomised controlled trials and an updated meta-analysis. *BJOG*. 2022;130:264–275. doi:10.1111/1471-0528.17304
13. Tsironikos GI, Perivoliotis K, Bargiota A, Zintzaras E, Doxani C, Tatsioni A. Effectiveness of exercise intervention during pregnancy on high-risk women for gestational diabetes mellitus prevention: a meta-analysis of published RCTs. *PLoS One*. 2022;17(8):e0272711. doi:10.1371/journal.pone.0272711
14. Silva-Jose C, Sánchez-Polán M, Barakat R, Gil-Ares J, Refoyo I. Level of physical activity in pregnant populations from different geographic regions: a systematic review. *J Clin Med*. 2022;11(15):4638. doi:10.3390/jcm11154638

15. Lü Y, Feng Y, Ma S, Jiang Y, Ma L. Changes in physical activity across pregnancy among Chinese women: a longitudinal cohort study. *BMC Women's Health*. 2021;21(1):236. doi:10.1186/s12905-021-01377-3
16. Bianchi C, de Gennaro G, Romano M, et al. Exercise during pregnancy: how much active are pregnant women at risk of gestational diabetes despite few contraindications? *Gynecol Endocrinol*. 2021;37(2):101–104. doi:10.1080/09513590.2020.1775196
17. Gothe NP. Correlates of physical activity in urban African American adults and older adults: testing the social cognitive theory. *Ann Behav Med*. 2018;52(9):743–751. doi:10.1093/abm/kax038
18. Hamilton K, Warner LM, Schwarzer R. The role of self-efficacy and friend support on adolescent vigorous physical activity. *Health Educ Behav*. 2017;44(1):175–181. doi:10.1177/1090198116648266
19. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev*. 1977;84(2):191–215. doi:10.1037//0033-295x.84.2.191
20. Bandura A. *Social Foundation of thought and Action: A Social Cognition Theory*. Prentice Hall; 1986.
21. Marcus BH, Selby VC, Niaura RS, Rossi JS. Self-efficacy and the stages of exercise behavior change. *Res Q Exerc Sport*. 1992;63(1):60–66. doi:10.1080/02701367.1992.10607557
22. Thompson EL, Vamos CA, Daley EM. Physical activity during pregnancy and the role of theory in promoting positive behavior change: a systematic review. *J Sport Health Sci*. 2017;6(2):198–206. doi:10.1016/j.jshs.2015.08.001
23. Garland M, Wilbur J, Semanik P, Fogg L. Correlates of physical activity during pregnancy: a systematic review with implications for evidence-based practice. *Worldviews Evid Based Nurs*. 2019;16(4):310–318. doi:10.1111/wvn.12391
24. Yu P, Zhou L, Meng F, Xu Y, Jiang Y, Zhou Y. Developmental trajectories of health-promoting behaviours among pregnant women: a longitudinal study. *J Clin Nurs*. 2022. doi:10.1111/jocn.16214
25. Boggs AE, Schlaff RA, Baruth M, Deere S. The relationships among social support and self-efficacy on physical activity during pregnancy. *Med Sci Sports Exercise*. 2017;49(5):982. doi:10.1249/01.mss.0000519681.48729.c1
26. Cheng YZ, Cai LN, Li TY, Qi MJ, Zhang XX, Zhang LX. Exercise self-efficacy of pregnant women and its influencing factors. *Chongqing Yixue*. 2019;48(05):848–850+855.
27. Liang Y, Chen J. Investigation of exercise self-efficacy and its influencing factors in pregnant women. *Hebei Yiyao*. 2018;40(15):2368–2370.
28. Jiang J, Zhang YJ, Xue GF. Study on the correlation between exercise self-efficacy and exercise knowledge and level in maintenance hemodialysis patients. *J Nurs Train*. 2019;34(8):678–684.
29. Hou B, Li L, Zheng L, Qi Y, Zhou S. Linking exercise intention to exercise action: the moderating role of self-efficacy. *Front Psychol*. 2022;13:921285. doi:10.3389/fpsyg.2022.921285
30. Giezeman M, Theander K, Zakrisson AB, Sundh J, Hasselgren M. Exploration of the feasibility to combine patients with chronic obstructive pulmonary disease and chronic heart failure in self-management groups with focus on exercise self-efficacy. *Scand J Prim Health Care*. 2022;40(2):208–216. doi:10.1080/02813432.2022.2073961
31. Wang J, Zhang XD. Current status and influencing factors of exercise self-efficacy of pregnant women in Nanjing. *Chin Gen Pract Nurs*. 2022;20(27):3851–3855.
32. Guzman-Ortiz E, Cardenas-Villarrea VM, Ramirez-Silva CI, Alvarez-Aguirre A. Barriers and self-efficacy for healthy eating and physical activity in pregnant women. *Eureka-Revista Cientifica De Psicologia*. 2021;18:80–99.
33. Melton B, Marshall E, Bland H, Schmidt M, Guion WK. American rural women's exercise self-efficacy and awareness of exercise benefits and safety during pregnancy. *Nurs Health Sci*. 2013;15(4):468–473. doi:10.1111/nhs.12057
34. Lee DT, Ngai IS, Ng MM, Lok IH, Yip AS, Chung TK. Antenatal taboos among Chinese women in Hong Kong. *Midwifery*. 2009;25(2):104–113. doi:10.1016/j.midw.2007.01.008
35. Withers M, Kharazmi N, Lim E. Traditional beliefs and practices in pregnancy, childbirth and postpartum: a review of the evidence from Asian countries. *Midwifery*. 2018;56:158–170. doi:10.1016/j.midw.2017.10.019
36. Kebbe M, Flanagan EW, Sparks JR, Redman LM. Eating behaviors and dietary patterns of women during pregnancy: optimizing the universal 'Teachable moment'. *Nutrients*. 2021;13(9):3298. doi:10.3390/nu13093298
37. Yang X, Han R, Song Y, et al. The mediating role of physical activity self-efficacy in predicting moderate-intensity physical activity in pregnant people at high risk for gestational diabetes. *J Midwifery Women's Health*. 2024;69(3):403–413. doi:10.1111/jmwh.13589
38. McIntyre HD, Catalano P, Zhang C, Desoye G, Mathiesen ER, Damm P. Gestational diabetes mellitus. *Nat Rev Dis Primers*. 2019;5(1):47. doi:10.1038/s41572-019-0098-8
39. Plows JF, Stanley JL, Baker PN, Reynolds CM, Vickers MH. The Pathophysiology of Gestational Diabetes Mellitus. *Int J Mol Sci*. 2018;19(11):3342. doi:10.3390/ijms19113342
40. Green SB. How many subjects does it take to do a regression analysis. *Multivariate Behav Res*. 1991;26(3):499–510. doi:10.1207/s15327906mbr2603_7
41. Bland HW, Melton BF, Marshall ES, Nagle JA. Measuring exercise self-efficacy in pregnant women: psychometric properties of the pregnancy-exercise self-efficacy scale (P-ESES). *J Nurs Meas*. 2013;21(3):349–359. doi:10.1891/1061-3749.21.3.349
42. Yang HM, Deng YF, Gao LL. Reliability and validity of the Chinese version of the pregnancy exercise self-efficacy scale. *Chin J Nurs*. 2017;52(5):632–636.
43. Xiang ZX, Han RR, Zhao Q, Yang X, Gao LL. Adaptation and psychometric evaluation of the social support scale for exercise among pregnant women. *Chin Nurs Manage*. 2022;22(7):998–1002.
44. Yao SS, Duan XQ, Zhang L, Wang JM, Liu XH. The investigation of knowledge, attitudes and behavior for physical activity during pregnancy of pregnant women. *Chin J Fam Plan*. 2018;26(7):559–562.
45. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med*. 2006;166(10):1092–1097. doi:10.1001/archinte.166.10.1092
46. Gong Y, Zhou H, Zhang Y, et al. Validation of the 7-item Generalized Anxiety Disorder scale (GAD-7) as a screening tool for anxiety among pregnant Chinese women. *J Affect Disord*. 2021;282:98–103. doi:10.1016/j.jad.2020.12.129
47. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh postnatal depression scale. *Br J Psychiatry*. 1987;150:782–786. doi:10.1192/bjp.150.6.782
48. Wang Y, Guo X, Lau Y, Chan KS, Yin L, Chen J. Psychometric evaluation of the Mainland Chinese version of the Edinburgh postnatal depression scale. *Int J Nurs Stud*. 2009;46(6):813–823. doi:10.1016/j.ijnurstu.2009.01.010

49. Yang HM, Deng YF, Gao LL. Correlation of exercise, self-efficacy and knowledge among pregnant women. *Chin J Prac Nurs*. 2017;33(23):1785–1788.
50. Bendix EJ, Holmberg Krøner F, de Place Knudsen S, Bendix JM, Molsted S. Cross-cultural adaption, translation and reliability tests of the Danish version of the pregnancy exercise self-efficacy scale. *Sex Reprod Healthc*. 2020;26:100542. doi:10.1016/j.srhc.2020.100542
51. Leiferman J, Sinatra E, Huberty J. Pregnant women's perceptions of patient-provider communication for health behavior change during pregnancy. *Open J Obst Gynecol*. 2014;04:672–684. doi:10.4236/ojog.2014.411094
52. Okafor UB, Goon DT. Physical activity advice and counselling by healthcare providers: a scoping review. *Healthcare*. 2021;9(5):609. doi:10.3390/healthcare9050609
53. Gao LL, Larsson M, Luo SY. Internet use by Chinese women seeking pregnancy-related information. *Midwifery*. 2013;29(7):730–735. doi:10.1016/j.midw.2012.07.003
54. Hopkinson Y, Hill DM, Fellows L, Fryer S. Midwives understanding of physical activity guidelines during pregnancy. *Midwifery*. 2018;59:23–26. doi:10.1016/j.midw.2017.12.019
55. De Vivo M, Mills H. "They turn to you first for everything": insights into midwives' perspectives of providing physical activity advice and guidance to pregnant women. *BMC Pregnancy Childbirth*. 2019;19(1):462. doi:10.1186/s12884-019-2607-x
56. Hayman M, Reaburn P, Alley S, Cannon S, Short C. What exercise advice are women receiving from their healthcare practitioners during pregnancy? *Women Birth*. 2020;33(4):e357–e362. doi:10.1016/j.wombi.2019.07.302
57. Evins C, Dennis J, Mostert K, et al. Exercise counseling in pregnancy: do women perceive receiving the information they need? *Am J Lifestyle Med*. 2021;15(4):441–452. doi:10.1177/1559827621991851
58. Spiby H, Stewart J, Watts K, Hughes AJ, Slade P. The importance of face to face, group antenatal education classes for first time mothers: a qualitative study. *Midwifery*. 2022;109:103295. doi:10.1016/j.midw.2022.103295
59. Kim J, Eys M, Robertson-Wilson J. 'If they do it, so can I': a test of a moderated serial mediation model of descriptive norms, self-efficacy, and perceived similarity for predicting physical activity. *Psychol Health*. 2021;36(6):701–718. doi:10.1080/08870446.2020.1789641
60. Bayisa D, Waltengus F, Lake S, et al. Pregnant women's knowledge, attitudes, and associated factors toward physical exercise during pregnancy among those attending antenatal care at Bahir Dar city, Northwest Ethiopia. *SAGE Open Med*. 2022;10:20503121221115252. doi:10.1177/20503121221115252
61. Sayakhot P, Carolan-Olah M. Internet use by pregnant women seeking pregnancy-related information: a systematic review. *BMC Pregnancy Childbirth*. 2016;16:65. doi:10.1186/s12884-016-0856-5
62. Nelson RK, Hafner SM, Cook AC, et al. Exercise during pregnancy: what do OB/GYNs believe and practice? A descriptive analysis. *Women's Health Rep*. 2022;3(1):274–280. doi:10.1089/whr.2021.0132