Relationships between Selected Variables and Physical Activities Among Low-risk Pregnant Women in China: A Cross-sectional Study

นิพนธ์ต้นฉบับ

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Original Article

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บทคัดย่อ

วัตถุประสงค์: เพื่อประเมินระดับกิจกรรมทางกายระหว่างตั้งครรภ์และปัจจัยที่สัมพันธ์กับ PAP ได้แก่ อายุ, จำนวนครรภ์ทั้งหมด, สภาพแวดล้อม, การรับรู้ความเปราะบาง, การรับรู้ความรุนแรง, การรับรู้ประโยชน์, การรับรู้อุปสรรค, และสิ่งชักนำให้ปฏิบัติ **วิธีการศึกษา:** ผู้ร่วมการวิจัย 170 รายจากการสุ่มอย่างง่ายเป็นหญิงตั้งครรภ์ที่ฝากครรภ์ที่คลินิกฝากครรภ์ของโรงพยาบาลของมหาวิทยาลัยการแพทย์ Wenzhou ประเทศจีน ในช่วงเมษายนถึงพฤษภาคม 2565 รวบรวมข้อมูลเชิงประชากรศาสตร์ ประเมินกิจกรรมทางกายในถิ่นอาศัย กิจกรรมการทางกายตามความเชื่อทางสุขภาพ กิจกรรมทางกายนานาชาติ โดยทั้งหมดเป็นภาษาจีน ทดสอบความสัมพันธ์ระหว่าง PAP กับปัจจัยต่าง ๆ โดยใช้ค่าความสัมพันธ์พอยท์ไบเซอเรียล **ผลการศึกษา:** ผู้ร่วมการวิจัยน้อยกว่าครึ่งมี PAP ระดับเพียงพอ (ร้อยละ 45.9) การรับรู้ความเปราะบางและการรับรู้ประโยชน์สัมพันธ์ทางบวกกับกิจกรรมทางกายระหว่างตั้งครรภ์อย่างมีนัยสำคัญทางสถิติ (r = 0.166, P-value < 0.05 และ r = 0.210, P-value < 0.01 ตามลำดับ) **สรุป:** หญิงตั้งครรภ์ควรได้รับการประเมินด้านการรับรู้ความเปราะบาง การรับรู้ประโยชน์ และกิจกรรมทางกายภาพระหว่างตั้งครรภ์ โดยมีประโยชน์ทั้งสุขภาพของแม่และลูกในครรภ์ และผลดีต่อสุขภาพหลังคลอดและพัฒนาการของลูก

คำสำคัญ: กิจกรรมทางกาย, หญิงตั้งครรภ์, การรับรู้ความเปราะบาง, การรับรู้ความรุนแรง, การรับรู้ประโยชน์

Abstract

Objective: To determine physical activity during pregnancy (PAP) in low-risk pregnant women and examine relationship among selected variables (age, parity, environment, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action) and PAP in Wenzhou, China. **Methods:** Simple random sampling was used to recruit 170 participants who visited the general obstetric clinic of the second affiliated hospital of Wenzhou Medical University during the months of April to May 2022. Data were collected by using demographic record form, Chinese version of Physical Activity Neighborhood Environment Scale, Physical Activity Health Belief Scale during Pregnancy, Chinese version of International Physical Activity Questionnaire Short Form. Data were analyzed using point biserial correlation. **Results:** Less than half achieved adequate levels of physical activity during pregnancy (45.9%). Perceived susceptibility and perceived benefit were positively correlated to physical activity (r = 0.166, P-value < 0.05 and r = 0.210, P-value < 0.01, respectively). **Conclusion:** Pregnant women should be assessed for perceived susceptibility, perceived benefits, and physical activity. It can impact not only the maternal and fetal health during pregnancy, but also have a long-term impact on mother's postpartum recovery and infant development.

Keywords: physical activity, low risk pregnancy, perceived susceptibility, perceived severity, perceived benefits

Introduction

The amendment to the population and family planning law of the People's Republic of China, which was deliberated and passed National People's Congress Standing Committee in 2015, stipulates that the "comprehensive two child" policy will be implemented nationwide from January 1, 2016. [1] In 2021, China began to implement the policy that a couple can have three children and supporting measures[2], which means that the number of pregnant women will increase under the promotion of the policy. At the same time, the National Population Development Plan (2016-2030) points out that it is necessary to improve maternal and child health and family planning service system to achieve the goal of further reducing maternal and infant mortality.[3,4] The health of pregnant women and newborns is directly related to the harmony of family, land, society, economic, and the future of the country. If low-risk pregnant women do not pay attention to their health care, it will directly affect women's health, embryo and fetal development, and the health of the next generation.[5]

Physical activity (PA), an important aspect of life, plays a vital role in women health during preconception, antenatal, intrapartum, and postpartum.[6] However, rates of physical activity during pregnancy (PAP) over countries are varied. In

various countries around the world, only about 23% to 30% of pregnant women meet the guidelines for physical activity. In the South Africa, only 25.7% of 1,082 pregnant women could achieve at least 150 minutes of moderate intensity PA per week.[7] In Hispanic people, it showed that only 31.9% of pregnant women reached the recommended level of PA while 25.9% of pregnant women had less PAP.[8] Only 23% to 29% of pregnant women at any gestational stage in the United States met the minimum physical activity guidelines.[9] A comparison of cross-sectional data from multiple countries found that South Asian women were less likely to achieve moderate to vigorous levels of physical activity during pregnancy relative to pregnant women in Western countries.[10] The overall rates of PA in Chinese pregnant women are low. Under the influence of Chinese traditional ideas, people attach great importance to pregnant women. Usually, while providing comprehensive nutritional support to pregnant women, they will reduce their physical activities to prevent accidents. More than 90% of women during second or third trimester of pregnancy spent their time in rest-activity.[11] Also, studies in 2005 and 2015 found that energy consumed in resting and light PAP accounted for more than 80% of all energy consumption.[12,13]

PAP is beneficial for both pregnant women and their child. It suggests that pregnant women should have moderate-intensity PAP for no less than 20 - 30 min/d and at least 3 days a week[14-16] or total minutes PAP not less than 150 min/wk.[17-19] Regular PA promotes lower body fat percentage, strengthens skeletal muscle, improves respiratory capacity, increases serum high density lipoprotein (HDL) cholesterol, ameliorates glucose tolerance and endothelial function, optimizes autonomic balance with increasing parasympathetic tone.[20-22] Appropriate PAP has effects on promoting fetal growth and development, controlling excessive weight gain during pregnancy, preventing pregnancy related complications, improving pregnant women's mental health, accelerating postpartum recovery, and improving maternal and infant long-term health status.[23-26] It can also promote labor progress.[27] Positive effects on the additional metabolic stress occur during pregnancy or on maternal mental health at times of depressive episodes.[20,28] However, performing PAP as one of health behaviors can be explained by the Health Belief Model.[29]

According to health belief model (HBM), each person has one own demographic, psychological characteristics and subjective perception which are related to the motivation to change bad behaviors.[29] Associated variables chosen include demographic variables (age and parity), psychosocial characteristic (environment), perceived threat (perceived susceptibility and perceived severity), evaluation to counteract threat (perceived benefits and perceived barriers), and cues to action. Age of pregnant women is positively correlated with PA in some studies[25,30] but is negatively correlated with PA in some studies.[31,32] Number of parity is positively associated with PAP.[32-36] Environment in term of man-made or built environment is related to PAP.[37,38] Perceived barriers of PA and perceived susceptibility to fetal complications are negatively associated with PAP[39-41] while perceived benefits of PA and perceived severity of without PA harm are positively correlated with PAP.[40] Regarding cues to action, information from healthcare professional, family, or media encouraging PA in pregnant women.[41,42]

Although increased research in the field of PA as one aspect of health promotion during pregnancy in the world generates perfect guidelines of PAP, a small number of pregnant women following the guidelines.[43,44] Only 22.6% pregnant women met the standard in China.[38] In addition, some previous studies focused on the socio demographic characteristics with the lack of theoretical basis. Furthermore, PA of pregnant women in China is not standardized from different concepts or theories, which state that PA consists of four categories: Occupational PA, transport-related PA, housework PA, and leisure time PA.[45,46] However, most studies only focus on leisure time PA.[11,32,47,48] Therefore, the research objectives were to determine physical activity during pregnancy in low-risk pregnant women and to examine relationships among selected variables. The hypothesis of this study was age, parity, environment, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action were associated with PAP. This study based on HBM could have found some potential adjustable variables that could affect PAP. Consequently, this study could lay a foundation for fundamentally improving the current situation of pregnant women's PAP in China in the future.

Methods

In the cross-sectional correlational study, the sample size was calculated by the formula of the sample size (N) = 10x(number of independent variables) + 50.[49] In this study,

with 8 variables (8 selected variables and 1 focal variable), a sample size of 130 cases was required. To compensate for a 20% incomplete rate, a total of 170 participants were required.

Study population was women with low-risk pregnancy visiting the general obstetric clinic of the second affiliated hospital of Wenzhou Medical University (WMU). The study sample was those in the study population who met the eligibility criteria. Inclusion criteria were those with 18 - 35 years of old, Body Mass Index (BMI) of 18.0 - 24.0 kg/m^2, no abnormal pregnancy history or complications during pregnancy, no obstetric and uterine operation history, no infertility treatment of pregnancy, no exposure to a large number of radiations, and no history of toxic substances or taking drugs affecting the fetus. They were also willing to participate in the study. Exclusion criteria were those having contraindications to physical activity and having communication barrier.

The study was conducted at the outpatient fetal heart rate monitoring unit of the second affiliated hospital of WMU located in Wenzhou, China. Approximately, the clinic provides antenatal care for 100 pregnant women each day. Pregnant women receive antenatal care service at this hospital represented most pregnant women in Wenzhou. All prospective participants were listed and randomly selected.

Research instruments

The first part of the questionnaire collected demographic characteristics of the participants including age, occupation, marital status, residence, education, delivery mode preference, gestational age (GA), gravidity, and parity.

Chinese version of Physical Activity Neighborhood Environment Scale (PANES-CHN) was used to measure environment.[49] It has 17 items to evaluate seven main attributes of human settlements including residential density, destination accessibility, community infrastructure, aesthetic value, social environment, street connection, and community safety. Item 11 (an environment characteristic) is a non-count score item, the remaining items have two scoring systems: 0 and 1 score, and 5-point Likert Type scale. Items were summed, and the total score interval was from 0 to 61. The higher the total score, the higher the support of built environment to PA. For its validity, it was compared with NEW-A and found that the Spearman's correlations ranged from 0.27 to 0.81 for which all were significant at the 0.01 level.[50] About its reliability, the intra-class correlation (ICC) valued

from 0.36 to 0.98.[51,52] Regarding reliability of the PANES-CHN, its ICC values ranged from 0.66 (item 3: destination accessibility) to 0.95 (item 1: residential density, and item 11: household car ownership).[53] Internal consistency reliability was high with a Cronbach's alpha coefficient of 0.83.

Physical Activity Health Belief Scale during Pregnancy (PAHBS) was used to measure individual perception (perceived susceptibility, perceived severity, perceived benefits, and perceived barriers) and cues to action (activated strategies).[36] It was based on the Physical Exercise Health Belief Scale[54] and the "2019 Canadian Physical Activity Guidelines for Pregnancy."[14] It consists of 38 items with 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). This instrument has five subscales namely perceived susceptibility (of insufficient PAP, 6 items), perceived severity (of consequence of get sick due to insufficient PAP, 6 items), perceived benefits (of PAP, 10 items), perceived barriers (of PAP, 10 items), and behavioral cues (as activated strategies encouraging PAP, 6 items). Possible total scores of each subscale are different based on number of items. Possible total score ranges of 'perceived susceptibility,' 'perceived severity,' and 'behavioral cues' are 6 – 30 points; for those of 'perceived benefits' and 'perceived barriers' are 10 – 50 points. The higher total score indicates the stronger perception and behavioral cues to PAP. Related to validity, its construct validity by factor analysis showed that all subscales explained 70.717% of the total variance. For reliability, it had good test-retest correlation with a coefficient of 0.97 in this study. Internal consistency reliability was acceptable to high with Cronbach's alpha coefficients of 0.79 - 0.98 for individual dimensions.[36]

Chinese version of International Physical Activity Questionnaire Short Form (IPAQ-SF) was used to measure physical activities during pregnancy.[55] It was originally expanded by the International Consensus Group on Physical Activity Measurement[56], then translated into Chinese and modified by Qu and Li.[55] It had good validity by comparing with the three-axis accelerometer (Omron HJA-350IT) (ρ = 0.771).[57] Test-retest reliability value (ICC) was 0.63 - 0.89 for overall activity.[57] The subjects recalled the physical activities in the last week and filled in according to subjective feelings. It calculates the individual's weekly physical activity level (MET· min/wk) through the corresponding MET assignment of each physical activity. According to the calculation results, the level of physical activity is divided into light, moderate and

vigorous. Scoring of Chinese version of IPAQ-SF for this study has two systems into three-levels and two-levels. Regarding the three-levels, they include light (1), moderate (2), and vigorous (3). According to the two-levels, they include insufficient PAP meaning having light or vigorous PAP intensity level (0) and sufficient PAP meaning having moderate PAP intensity level (1). The higher the energy consumption indicates the higher the PAP intensity level.

Ethical considerations

The study was approved by Burapha University Ethics Committee on Human Research (BUU EC) (approval number: MHESI8137/1584) in Thailand and the Institution Review Board (IRB) of the second affiliated hospital of WMU in China (approval number: 2021-K-50-02). During data collection, participants had the right to withdraw from the study at any time with no consequence on healthcare service they received. Results would be presented as a summary not individual participants' information.

Data collection procedure

Data were collected in April - May 2022. Researcher followed the registration records to select pregnant women meeting inclusion criteria and used simple random sampling technique for recruiting eligible participants who visited the general obstetric clinic of the Second Affiliated hospital of WMU. After being informed of the relevant procedures of the study, the selected participants decided whether to participate and sign the consent form. The researcher collected data by giving participants QR Code to answer the self-administered questionnaire which took about 30 minutes.

Data analysis

Descriptive statistics including frequency with percentage and men with standard deviation (SD) were used to summarize demographic characteristics and study factor scores of the participants. Associations among studied variables were analyzed by point biserial correlation analysis. Statistical significance was set a type I error of 5% (or P-value < 0.05). All statistical analyses were performed using the software program SPSS 24.0.

Results

Of the 170 participants, more than half of them lived in city (55.3%), were aged between 25 - 30 years old (52.4%), had nuclear family (66.5%), had a monthly income of 10,000 - 50,000 Chinese Yuan (64.1%), and education higher than high school (77.1%). All of them were married. The mean of education was 12.92 ± 4.13 years and family monthly income was 26431.18 ± 52599.61 Chinese Yuan (Table 1).

Table 1 Demographic characteristics of participants (N = 170).

Characteristics	N	%
Age (year) (mean 29.14 ± 3.27)		
18 - 24	15	8.8
25 - 30	89	52.4
30 - 34	66	38.8
Residential area		
City	94	55.3
Town	41	24.1
Rural	35	20.6
Occupation		
Unemployed	55	32.4
Mainly professional work	80	47.1
Mainly labor work	5	2.9
Both professional and labor work	30	17.6
Education (year) (range = 6-19, mean = 12.92 ± 4.13)		
Primary school	2	1.2
Junior school	18	10.6
High school	19	11.2
Vocational school	61	35.9
Baccalaureate degree and higher	70	41.2
Family type		
Nuclear	113	66.5
Extended	57	33.5
Family monthly income (Chinese yuan (range = 3000 - 400000, mean = 26431.18 ± 52599.61)		
< 10,000	43	25.3
10,000 - 50,000	109	64.1
50,000 - 100,000	7	4.1
> 100000	11	6.5

Almost half of the participants were primigravida (49.4%) (mean = 1.77 ± 0.949). About half of them had "0" parity (54.7%) (mean = 0.53 ± 0.645). More than half had no child (59.4%) (mean = 0.44 ± o0.565). The majority of them were in the third trimester (95.3%) (mean = 35.43 ± 4.0), attending every appointed visit (85.9%), and expecting to have vaginal delivery (88.2%) (Table 2).

All variables in this study including age, parity, environment, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and physical activities during pregnancy were investigated by descriptive statistical analysis (**Error! Reference source not found.**). The average age was 29.11 ± 3.207, parity was 0.53 ± 0.645, environment was 41.61 ± 10.721, perceived susceptibility was 20.78 ± 5.947, perceived severity was 22.56 ± 5.705, perceived benefits was 41.32 ± 7.223, perceived

barriers was 33.04 ± 8.113 and cues to action was 22.44 ± 4.286. Less than half achieved moderate PAP (54.1%).

Table 2 Clinical characteristics of participants (N = 170).

Obstetrical data	N	%
Gravida (times) (range = 1 – 6, mean = 1.77 ± 0.949)		
1	84	49.4
2	54	31.8
3	22	12.9
> 3	10	5.9
Parity (times) (range = 0 - 4, mean = 0.53 ± 0.645)		
0	93	54.7
1	65	38.2
> 2	12	7.1
Number of living child (range = 0 - 4, mean 0.44 ± 0.565)		
0	101	59.4
1	63	37.1
> 2	6	3.5
Gestational age (weeks) (range = 16 - 41, mean = 35.43 ± 4.0)		
14 - 28	8	4.7
> 28	162	95.3
Frequency of attending appointed visits		
Sometimes	10	5.9
Most times	14	8.2
Every time	146	85.9
Expected mode of delivery		
Vaginal birth	150	88.2
Cesarean section	20	11.8

Table 3 Scores of study factors (N = 170).

Variable	N	%	Range Possible	Range Actual	Mean	SD
Age (years)	-	-	-	21 - 34	29.11	3.207
Parity (times)	-	-	-	0 - 3	0.53	.645
Environment	-	-	0 - 61	11 - 60	41.61	10.721
Perceived susceptibility	-	-	6 - 30	6 - 30	20.78	5.947
Perceived severity	-	-	6 - 30	6 - 30	22.56	5.705
Perceived benefits	-	-	10 - 50	24 - 50	41.32	7.223
Perceived barriers	-	-	10 - 50	10 - 50	33.04	8.113
Cues to action	-	-	6 - 30	14 - 30	22.44	4.286
Physical activity during pregnancy						
Light	75	44.1	-	-	-	-
Moderate	78	45.9				
Vigorous	17	10.0				
Sufficient	78	45.9	-	-	-	-
Insufficient	92	54.1				

Majority of pregnant women moved greater than or equal to 3d/wk (83.5%), but only 9.4% got the standard that is ≥ 150 min/wk and ≥ 3d/wk (Table 4). The average energy consumption of pregnant women was 1110.89 ± 1,513.09 MET/wk. The main form of PAP in China is walking.[58] Constituent ratios of weekly energy consumption of various types of PAP were 64.76% walking, 14.46% moderate PA and 20.79% vigorous PA (Table 5). The highest PA exceeding 3 hours per week was walking (38.8%), followed by moderate PA (6.5%), and vigorous PA (5.3%) (Table 6).

Table 4 Characteristics of physical activity of pregnant women (N = 170).

	Moderate PA, N (%)	
	≥ 150 min/wk	< 150 min/wk
PA ≥ 3d/wk	16 (9.4)	126 (74.1)
PA < 3d/wk	0 (0)	28 (16.5)

Table 5 PA energy consumption of pregnant women (N = 170).

	M	P25	P50	P75	Min	Max	Mean ± SD	Constituent ratio (%)
Total energy consumption (MET/wk)	1,110.89	330	621.75	1,376.25	0	8,757	1110.89±1,513.09	100.00
Walk	719.38	247.5	462	792	0	8,316	719.38±942.37	64.76
Moderate	160.59	0	0	120	0	2,520	160.59±394.02	14.46
Vigorous	230.92	0	0	0	0	4,320	230.92±721.60	20.79

Table 6 Weekly time of PA for pregnant women (N = 170).

	0.5		1		1.5		2		2.5		3		> 3	
	n	%	n	%	N	%	N	%	n	%	n	%	n	%
Walk	19	11.2	19	11.2	17	10.0	23	13.5	20	11.8	6	3.5	66	38.8
Moderate	130	76.5	12	7.1	6	3.5	6	3.5	3	1.8	2	1.2	11	6.5
Vigorous	143	84.1	13	7.6	0	0.0	3	1.8	0	0.0	2	1.2	9	5.3

Perceived susceptibility and perceived benefit had a positive significant correlation at with physical activity during pregnancy (r = 0.166, P-value < 0.05 and r = 0.210, P-value < 0.01, respectively). Age, parity, environment, perceived severity, perceived barriers and cues to action had no statistically significant correlations with physical activity during pregnancy (Table 7).

Table 7 Point biserial correlation coefficients (r) among study variables (N = 170).

Variable	1	2	3	4	5	6	7	8	9
1. Age	1.000	-	-	-	-	-	-	-	
2. Parity	0.330[†]	1.000	-	-	-	-	-	-	
3. Environment	-0.020	0.009	1.000	-	-	-	-	-	
4. Perceived susceptibility	0.033	-0.166*	0.093	1.000	-	-	-	-	
5. Perceived severity	0.006	-0.178*	0.033	0.605[†]	1.000	-	-	-	
6. Perceived benefits	-0.047	-0.190	0.011	0.368[†]	0.406[†]	1.000	-	-	
7. Perceived barriers	-0.105	-0.181*	-0.010	0.434[†]	0.425[†]	0.382[†]	1.000	-	
8. Cues to action	-0.037	-0.072	0.098	0.351[†]	0.366[†]	0.629[†]	0.552[†]	1.000	
9. Physical activity during pregnancy	-0.097	-0.005	-0.010	0.166*	-0.029	0.210[†]	0.023	0.115	1.00

* P-value < 0.05; [†] P-value < 0.01.

Discussions and Conclusion

Based on the 2019 Canadian Guidelines for PAP[14], 3 day/wk and 150 min/wk of PA is used for the standard. In this study, 16.5% pregnant women met this standard that was lower than Chen study[35], which is 28.44% pregnant women meeting the standard. The 9.4% PAP standard-achieving rate of pregnant women in this study is similar to the current domestic research reports[38], but was lower than the previous studies in other countries.[7-9] Generally, Chinese belief that PAP might cause injury and pregnant women should pay attention of rest and nutrition and despise appropriate PA.[59] There is no PAP guideline or standard for pregnant women in China. The current PAP is unreasonable, manifested in a single form, insufficient PA time and intensity.[60] The composition ratio of energy consumption of moderate intensity PA and high-intensity PA during pregnancy is similar to the research level now.[61] The result that pregnant women rarely participated in high-intensity activities during pregnancy is similar to previous results in China.[61-63] The main form of activity for participants in this study was walking, with an average of 30 min/d. Walking is the most important activity mode for pregnant women[64-68], because it is not limited by venues and so on. However, the range of PAP is small. Most PAP intensity during walking can't reach medium intensity activities.

The analysis displayed that only perceived susceptibility and perceived benefits had positive relationship with PAP. The results confirm the Health Belief Model (HBM),[48] psychosocial environment and personal factors are the basis for the formation of health problem perception. Perceived susceptibility and benefit together drive individuals to change health behaviors including PAP. However, individuals must believe that the perceived benefits outweigh the perceived barriers [69]. Action cues (external or internal) stimulate individuals to think about initiating health change decisions or taking specific health change actions[70]. With the opening of China's three child policy, the number of pregnant women is increasing. The problem caused by participants' lack of PAP is that the earlier they carry out PA, the more effectively they can avoid it. Then the higher the perception of it, the higher the practice rate of PAP.[41] Perceived benefits can provide motivation for health-related behaviors. In order to ensure the health of the fetus and mother, every family will focus on all aspects. The perceived benefits of PAP happen to be the motivation for participants to pursue health.[41,71]

Age, parity, environment, perceived severity, perceived barriers, and cues to action were not significantly correlated with PAP. When HBM was used to describe a health behavior, the role of perceived severity was weak.[72] Illness due to lack of PAP will cause pregnant women a lot of trouble, but family and society will provide help in time to alleviate the troubles. Therefore, it cannot directly stimulate pregnant women to think highly of PAP. According to the structure of HBM, perceived barrier was the most important predictor of PAP.[41,72] In this study, the evaluation of participants' perceived benefits far exceeded the perceived behavioral barriers. Pregnant women may often weaken the obstacles to PAP. Compared with the general population, PA in pregnant women is more specific, and environmental interventions are often seen as a facilitator of PAP.[36,38,74] Most of the participants in this study lived in cities or towns, where they were more likely to be exposed to scientific information about PAP, but some cities with heavy traffic and limited living conditions limited PAP.

The distribution of age was uneven in this study, and the average was relatively large. Older pregnant women are more concerned about the outcome of childbirth. Influenced by traditional Chinese thought, it would hope that pregnant women reduce their activities to achieve the purpose of protecting the fetus.[36] Therefore, the effect of age on PAP is still worth considering. Previous studies revealed that multiparous women were more likely to participate than "0-parity."[32,35,36] Although proper PAP will not increase the adverse pregnancy outcomes such as premature rupture of membranes, abortion and premature delivery[76], it is generally believed that multiparous women should pay more attention to rest. Those with "0-parity" have less risk of abortion, but it has no experience with pregnancy, so it is also problematic to change behavior by PAP.

In spite of everyone can fully understand PAP in different ways, there are no clear guidelines in China,[75] which means that the understanding of PAP among Chinese pregnant women is still lack of recognition. Although participants could understand PAP, they still didn't know how to correctly and effectively participate in PAP.

However, in hospitals or communities, pregnant women are only told to maintain a certain amount of PAP, ignoring the improvement of perceived susceptibility and perceived benefits related to PAP. Therefore, nurses and midwifes

should help pregnant women to understand the problems easily caused by insufficient PAP and the benefits of PAP, and guide them to carry out appropriate PAP. It can't only impact maternal and fetal health during pregnancy, but also have a long-term impact on maternal postpartum recovery and infant development. At present, China has no physical activity guidelines for pregnant women.[36] Future research could pay more attention to the physical activity level of pregnant women and formulate physical activity guidelines for pregnant women in China. It is recommended to establish and improve the PAP self-assessment scale of pregnant women throughout pregnancy to judge whether there is insufficient PAP, and timely avoid the health problems, so as to improve the level of PAP.

The weakness of this study was that it was conducted at only one hospital, which might weaken the generalization of the study results. Future research should be conducted with participants from the broader geographical area, and a bigger sample size to generalize the study results.

In conclusion, the perceived susceptibility and perceived benefits related to PAP had a positive impact on PAP. In hospitals or communities, pregnant women should be assessed for PAP, perceived susceptibility and perceived benefits related to PAP. Therefore, nurses and midwifes should help pregnant women understand the problems easily caused by insufficient PAP and the benefits of PAP, and guide them to carry out appropriate PAP. It would impact not only maternal and infant health during pregnancy, but also have a long-term impact on maternal postpartum recovery and infant development. At present, China has no physical activity guidelines for pregnant women. Relevant researchers could pay more attention to the physical activity level of pregnant women and formulate physical activity guidelines for pregnant women in China.

Conflicts of interest

All the contributing authors declare no conflicts of interest.

Acknowledgments

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