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Social Support and Physical Activity in Pregnant Women With Gestational Diabetes Mellitus: Exploring the Mediating Role of Fear of Falling

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Received: 5 September 2023 | **Revised:** 28 October 2024 | **Accepted:** 18 February 2025

Funding: This study was funded by the Medical Science and Technology Project of Zhejiang Province (grant number: 2022KY855).

Keywords: fear of falling | gestational diabetes mellitus | mediation analysis | nursing | physical activity | social support

ABSTRACT

Aim: This study aims to ascertain whether social support exerts an indirect influence on physical activity through the mediation of fear of falling in pregnant women with gestational diabetes mellitus (GDM).

Design: A questionnaire-based, descriptive cross-sectional study was conducted.

Methods: A total of 385 participants were collected from May to August 2023 from a tertiary maternity hospital in China using a convenience sampling method. Measures included the Social Resource Support Scale for Pregnant Women with Gestational Diabetes, Chinese translations of the Falls Efficacy Scale International, and the Pregnancy Physical Activity Questionnaire.

Results: Both social support and fear of falling were significantly correlated with physical activity. The indirect effect of social support on physical activity through the fear of falling was positive, accounting for 62.40% of the total effect.

Patient or Public Contribution: A total of 385 pregnant women with gestational diabetes mellitus were invited to complete the questionnaire.

1 | Introduction

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with one set of symptoms or first recognition during pregnancy (Juan and Yang 2020). It is one of the most common complications in pregnancy and is associated with an elevated risk of fetal macrosomia, polyhydramnios, preeclampsia, postpartum diabetes, and a higher rate of caesarean sections (Mistry et al. 2021). Recently, the prevalence of GDM has increased in China and worldwide. A systematic review that included data from 20 Asian countries reported a pooled GDM prevalence of 11.5% (Lee et al. 2018). In 2019, China had a higher GDM prevalence of 14.8% (Gao et al. 2019). Many studies (Rasmussen et al. 2020; Yew et al. 2021; Oskovi-Kaplan and Ozgu-Erdinc 2021) have demonstrated that adverse pregnancy outcomes can be reduced through healthy lifestyle behaviours in pregnant women with GDM.

2 | Background

Engagement and adherence to physical activity are pivotal components of glycemic control and overall health management (Gilbert et al. 2019). Physical activity results from the contraction of skeletal muscles and consumes energy. It includes household, occupational, and transportation activities, as well as structured and planned exercise, among others (Cauley and Giangregorio 2020). The World Health Organisation, U.S. Department of Health and Human Services, and Society of Obstetricians and Gynaecologists of Canada have

issued evidence-based recommendations for at least 150 min of moderate-intensity physical activity per week during pregnancy, without obstetric or medical complications or contraindications (Bull et al. 2020; Mottola et al. 2018; ACOG 2020). Observational studies of women who exercise during pregnancy have demonstrated multiple benefits, including improved physical fitness, a lower risk of obesity, less low-back pain, better sleep, less anxiety and depressive symptoms, and better health perception and self-reported body image (Krzepota et al. 2018). Physical activity during pregnancy as a controllable factor in reducing adverse pregnancy outcomes has attracted increasing attention from numerous scholars worldwide. Previous studies have established that the levels of physical activity among ordinary pregnant women are insufficient worldwide (Harrison et al. 2018). However, few studies have investigated the physical activity levels in pregnant women with GDM. Pregnant women with GDM are a uniquely vulnerable group, and the prevalence of GDM is increasing worldwide (Sweeting et al. 2022); there is a growing need to explore the levels and influencing factors of physical activity in pregnant women with GDM given the benefits of physical activity.

Social support represents aid and resources provided by others, comprising structural (social support network size, range, and interconnectedness) and functional components, such as emotional, instrumental, and informational support (Lindsay Smith et al. 2017). It is an important construct that contributes to better health behaviours and alleviates the negative effects of stress and anxiety on the physical and mental health of pregnant women (Bedaso et al. 2021). Various hypotheses and models have been used to explain physical activity behaviour, including the concept of social support, such as social cognitive theory (Jeng et al. 2022), the theory of planned behaviour (Cheng et al. 2019), health belief model (Khodaveisi et al. 2021), and social ecological model (Hu et al. 2021). Several systematic evaluations of predictors of physical activity in pregnant women have revealed that social support is positively associated with physical activity (Chan et al. 2019; McKeough et al. 2022). Pregnant women must overcome multiple barriers to physical activity, such as avoiding excessive bodily exertion, lack of time and related knowledge, and limited places (Harrison et al. 2018). Social support plays a crucial role in this process. Besides, strong social support may safeguard pregnant women from mental disorders such as depression, phobias, and insomnia (Bedaso et al. 2021).

Fear of falling is a psychological trait associated with the loss of confidence in avoiding falls, which is sufficient to impede one's participation in everyday activities (Gazibara et al. 2017). Atay and Başalan Iz (2015) investigated the prevalence rates of fear of falling among pregnant women for the first time. They observed that approximately half of the pregnant women were afraid of falling, likely restricting physical activity to a greater extent than among those with a history of falling. Falls are prevalent in pregnant women and can have serious consequences, such as fractures, muscle contusions, abortion, preterm labour, and intrauterine fetal death (Krkeljas 2018). The fear of falling, particularly among pregnant women, is associated with injuries caused by falls, especially for foetuses in the uterus. Inoue-Hirakawa et al. (2021) suggested that excessive fear of falling limits normal activities, increases psychological burden, reduces quality of life, and increases the incidence of pregnancy complications. The level of fear of falling directly affects the psychological health and physiological functions of women during pregnancy. This influences the development and delivery of the fetus, which in turn affects the health status of mothers and infants throughout the perinatal period. Many previous studies (Kruisbrink et al. 2021; Wang et al. 2021), taking the elderly as the main subject, have confirmed the complex relationship between fear of falling and physical activity. To date, only a few articles have examined this issue among pregnant women. Therefore, much related research needs to be conducted.

Based on the above literature, social support and the fear of falling are likely reliable predictors of physical activity. However, most of the current studies have only focused on the association between social support or fear of falling and physical activity (Wang, Hu and Feng 2022; Kowalska et al. 2022; Kowalska 2023). The relationship between these three is not yet sufficiently clear. The purpose of this study is to evaluate the level of physical activity among pregnant women with GDM and the relationship between social support, fear of falling, and physical activity to provide practical evidence to establish physical activity-promoting interventions for pregnant women with GDM.

2.1 | Theoretical Framework

Social cognitive theory (SCT), first proposed by Bandura (2001), has been widely used by researchers to analyse the factors influencing individual behaviour (Arefi et al. 2022; Yang and Zhang 2022). The central insight of this theory is triadic reciprocal determinism, which posits that person, behaviour, and environment are interconnected and influence each other (Jeng et al. 2022). The generation and change of individual behaviours are influenced by external socioenvironmental and internal personal cognitive factors. Socioenvironmental factors mainly include social support and barriers. In addition to the cognitive element of self-efficacy, there are multiple personal factors related to behaviour, such as knowledge, individual characteristics, experiences, goals, and psychological features. According to the SCT, physical activity is influenced by these factors (Figure 1).

In this study, SCT was employed as the theoretical foundation to explore the effects of external environmental factors (social support) and internal psychological factors (fear of falling) on individual behaviours (physical activity) in pregnant women with GDM. To this end, the following hypotheses were formulated: H1: the more social support, the more physical activity; H2: the higher the fear of falling, the less physical activity; H3: fear of falling is either a complete or partial mediator between social support and physical activity in pregnant women with GDM.

3 | Methods

3.1 | Objectives

This study aimed to explore the relationship between social support, fear of falling, and physical activity in women with GDM and the mediating effect of fear of falling on the relationship

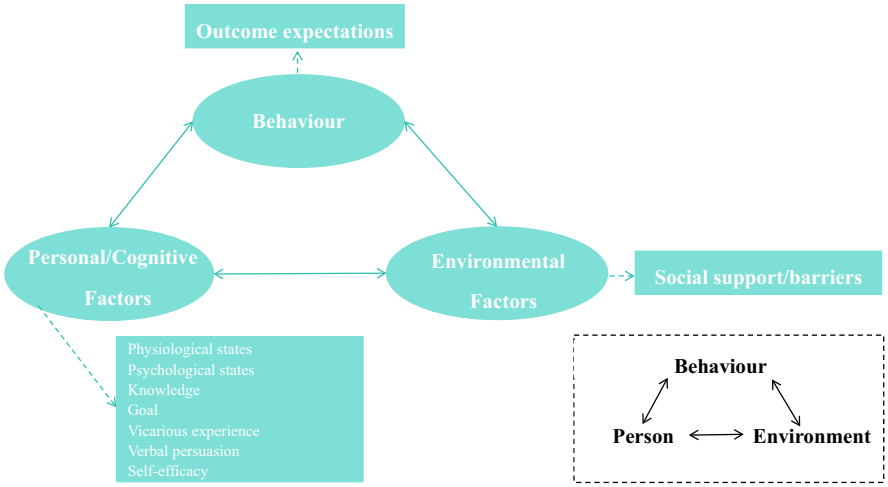

FIGURE 1 | Theoretical framework of the study.

between social support and physical activity, which facilitates effective physical activity intervention by nurses and clinicians, drawing on pathway relationships.

3.2 | Design and Setting

A cross-sectional correlation study was employed to test the mediating effect of fear of falling based on SCT. The recruited pregnant women were enrolled in the obstetric outpatient clinic of a ranked tertiary maternity hospital in Zhejiang Province, China, using a convenience sampling method. The hospital has the highest level of medical care, education, and research and is among the top three obstetrics and gynaecology-specialised hospitals in China, with a large number of outpatients, especially high-risk pregnant women. Pregnant women with GDM can receive individualised health education, which includes diet guidance, weight management, blood glucose management, exercise protocol, emotion regulation, and pelvic floor training.

3.3 | Participants

From May to August 2023, 385 participants completed the questionnaires. Doctors working in the obstetrics clinics took part in evaluating the eligibility of all participants through a thorough examination. The inclusion criteria were as follows: (a) current pregnancy diagnosed with GDM; (b) over 20 years old; (c) no limited normal activity due to mental or physical reasons; (d) no communication barrier. We framed normal activity as any voluntary, corporal movement that induces energy expenditures, such as labour, domestic, and leisure activities. The exclusion criteria were as follows: (a) participants with contraindications to exercise during pregnancy, such as premature rupture of membranes, cervical insufficiency, unexplained persistent vaginal bleeding, placenta previa, preeclampsia, preterm labour, threatened abortion, and other serious cardiovascular, respiratory, or systemic diseases (Mottola et al. 2018); (b) participants with obstetric emergencies, such as eclampsia, convulsions, and hypoglycaemia; (c) participation in other exercise interventions.

3.3.1 | Sample Size

In the study, 20 measured variables were included (17 items related to participants' demographic and obstetric characteristics, one to social support, one to fear of falling, and one to physical activity). Considering the suggestion of 15 participants per variable and 20% of invalid questionnaires (Hoyle and Gottfredson 2015), at least 360 participants were required to be surveyed. Therefore, a sample size of 385 was sufficient.

3.4 | Procedures

Two experienced researchers received uniform training before the official start of the survey, which included mastering the topic, process, and communication skills of this investigation. Participants were screened strictly according to the inclusion and exclusion criteria. Then a face-to-face questionnaire survey (taking about 20 min) was performed by trained researchers in maternity outpatient clinics in the hospital. After fully understanding the purpose and process of the study, each participant voluntarily completed the questionnaires. A total of 385 out of the recruited 400 women with GDM completed the questionnaire in a normative manner, yielding an effective response rate of 96.25%.

3.5 | Measures

3.5.1 | General Information Questionnaire

The following contents mainly included the demographic and obstetric characteristics of the participants: age, educational level, marital status, residence, household monthly income (RMB), work participation, gestational weeks, pre-pregnancy body mass index (BMI), mode of conception, childbirth experience, unintended pregnancy (yes/no), GDM specialty clinic visits (yes/no), history of falls during pregnancy, singleton or multiple pregnancies, history of GDM, family history of diabetes, and history of adverse pregnancy. BMI was calculated as the weight in kilograms divided by the height

in meters squared (kg/m^2). Educational level was divided into three categories: junior college or below, undergraduate, and graduate or above. The modes of conception included natural conception and assisted reproductive technologies. The childbirth experience was divided into two categories: at least once and never.

3.5.2 | Social Support

The Social Resource Support Scale for Pregnant Women with Gestational Diabetes (SRSS-GDM) was used to evaluate the level of social support (Yang et al. 2022). The scale is composed of 45 items divided into seven dimensions: (a) healthcare workers (five items), (b) family (eight items), (c) self-regulation (seven items), (d) friends and neighbourhood (eight items), (e) media policy (four items), (f) social groups (two items), and (g) workplace (four items). Finally, seven items were designed to evaluate the importance of each dimension, which are not included in the calculation of the scores. Each item was rated on a 5-point Likert-type scale (1 = not at all to 5 = very much), and the scale scores ranged from 38 to 190 points. The higher the score, the higher the level of social support. The coefficient of Cronbach's α for the SRSS-GDM was 0.938, with retest reliability and content validity indices of 0.724 and 0.970, respectively (Yang et al. 2022).

3.5.3 | Fear of Falling

Fear of falling was assessed using the Chinese version of the Fall Efficacy Scale International (FES-I), a cross-cultural debugging of the original scale, which is composed of 16 items and comprises two dimensions: indoor activity (10 items) and outdoor activity (6 items). Each item was scored from 1 to 4 on a 4-point Likert scale, ranging from 'not at all' to 'very much', with a total score ranging from 16 to 64 (Guo et al. 2015). A higher score indicates a greater fear of falling. The FES-I has been shown to be a reliable and valid measure in Chinese pregnant women (Wang et al. 2023). The coefficient of Cronbach's α for the FES-I was 0.929, and the half reliability was 0.806 (Wang et al. 2023).

3.5.4 | Physical Activity

The amount of physical activity was evaluated using the Pregnancy Physical Activity Questionnaire (PPAQ). This questionnaire demonstrated good validity and reliability in Chinese pregnant women (Zhang et al. 2013). The length, frequency, and intensity of activities during pregnancy were evaluated. This instrument includes 31 items related to household/caregiving (14 items), transportation (4 items), sports/exercise (5 items), and occupation (5 items). The 31 items were divided into six levels with corresponding time-weighted coefficients based on their frequency and duration. In addition, each activity was classified in terms of its intensity: sedentary (< 1.5 METs), light (1.5– < 3.0 METs), moderate (3.0–6.0 METs), or vigorous (> 6.0 METs), and the average number of MET·hours per week (MET-h/week) expended in each intensity level was calculated. The average weekly energy expenditure (MET-h/week) related to each activity was calculated by multiplying the self-reported time spent in each activity by its intensity. International guidelines (ACOG 2020; Mottola et al. 2018) recommend that pregnant women without contraindications should perform at least 150 min of moderate-intensity physical activity every week (including various aerobic exercises and weight training). Attaining the required physical activity standard was considered 'complying with the aforementioned requirement'.

3.6 | Data Analysis

After data collection, SPSS version 26 (SPSS Inc., Chicago, IL, USA) and Hayes' process macro version 4.1 (Hayes 2013) were employed for statistical analysis.

1. Descriptive analysis: Numerical data were first tested for normality. Normally distributed data were described in terms of the mean values, whereas categorical data were described using numbers and percentages.
2. Univariate analysis: In this study, the dependent variable was the amount of physical activity calculated using PPAQ, which is normally distributed data. Independent t-test and one-way ANOVA were employed to identify the differences in physical activity among the categorical groups.
3. Correlation analysis: Correlations between social support, fear of falling, and physical activity were analysed using Pearson's correlation coefficient.
4. Mediation analysis: Hierarchical multiple regression (HMR) analyses were conducted to identify the mediating effects of fear of falling on the relationship between social support and physical activity in pregnant women with GDM. The amount of physical activity during pregnancy was used as the dependent variable, with the following independent variables: Model 1 included demographic and obstetric characteristics that exhibited statistical significance in univariate analysis, Model 2 added social support, and Model 3 added fear of falling. Subsequently, the mediation effect test was performed using process macro model 4 proposed by Hayes (2013), based on regression analysis. In the statistical analysis, 5000 bootstrapping samples were selected, and the bootstrapping method through the 95% confidence interval was used, and a two-sided p-value of 0.05 was considered statistically significant. The test of assumptions conducted for the mediation analyses of the fear of falling was confirmed.

3.7 | Ethics Approval and Consent to Participate

This investigation was performed in accordance with the Declaration of Helsinki. The study was approved by the Women's Hospital School of Medicine's Ethics Committee of REDACTED (IRB no. 20230192). Each participant received information on the study's objectives, a guarantee of the privacy of their personal data, and the freedom to leave the study at any

time without penalty. Informed consent was obtained from all participants in the study.

4 | Results

4.1 | Demographic and Obstetric Characteristics

This study included 385 participants, aged 22–47 years, with an average age of 32.36 (SD = 4.27) years. Among them, 375 (97.40%) were married, and 311 (80.78%) lived in urban communities. The average gestational week was 36.05 (SD = 3.28) weeks. Other demographic and obstetric characteristics are listed in Table 1. It was found that pregnant women with GDM who had a bachelor's degree or above, were at work during pregnancy, had post-term pregnancy, natural conception, unintended pregnancy, singleton pregnancy, and a family history of diabetes were involved in more physical activity (all $p < 0.05$).

4.2 | Physical Activity During Pregnancy, Social Support, and Fear of Falling

The average amount of physical activity (defined in terms of total energy expenditure) during pregnancy was 71.87 MET-h/week (SD = 63.69), and 17.66% of the participants reached the guidelines' standard. The energy expenditures of household/caregiving, transportation, sports/exercise, and occupation accounted for approximately 45.31%, 9.97%, 5.98%, and 38.74% of overall physical activity, respectively, indicating that pregnant women with GDM had insufficient physical activity and did not exercise with the recommended intensity, frequency, and duration. The mean total score of their social support was 102.82 (SD = 6.76), and that for fear of falling was 40.94 (SD = 12.62), indicating that the level of social support must be improved and that there is a need for interventions on fear of falling.

4.3 | Correlation Analysis of Social Support, Fear of Falling, and Physical Activity

According to the results of the correlation analyses (Table 2), social support was negatively correlated with fear of falling ($r = -0.656$, $p < 0.001$) and positively correlated with physical activity during pregnancy ($r = 0.484$, $p < 0.001$). Fear of falling was negatively associated with physical activity during pregnancy ($r = -0.579$, $p < 0.001$).

4.4 | The Mediating Effect of Fear of Falling Between Social Support and Physical Activity

The hierarchical regression model was used to explore the fear of falling's mediating effects in the process of social support influencing physical activity during pregnancy (Table 3). The results of Model 1 indicated that the control variables significantly affected physical activity (education level, B = 9.659, $p = 0.037$; work participation, B = 30.736, $p < 0.001$; gestational week, B = 17.910, $p = 0.004$; unintended pregnancy or not, $B = -22.037$, $p = 0.005$; family history of diabetes, $B = 21.634$, $p = 0.002$). The results of Models 2 and 3 suggested that the independent variable (social support, $B = 0.308$, $p = 0.004$) and the mediator variable (fear of falling, $B = -2.156$, $p < 0.001$) significantly affected physical activity. In addition, fear of falling mediated social support on physical activity (standardised regression coefficient β reduced from 0.418 to 0.155).

Based on the above results, Model 4 of Hayes's PROCESS macro was used to test the mediating effect (Table 4, Figure 2). Within the 95% confidence interval, social support had a significant direct effect of 0.182 on physical activity during pregnancy. According to the bootstrap test, social support exerted a significant indirect effect on physical activity during pregnancy, as much as 0.302 (-0.656×-0.460) through fear of falling, with the mediating effect accounting for 62.40% of the total effect.

5 | Discussion

Maintaining target moderate levels of physical activity in pregnant women with GDM has reached a wide consensus on a global scale. However, the physical activity levels in this population are not promising. The results of this study revealed that the average total energy expenditure was 71.87 MET-h/week, and only 17.66% of the participants met the recommended levels of physical activity, consistent with the results of da Silva et al. (2022) on the behaviour of pregnant women regarding physical activity in gestational diabetes mellitus. According to Mbada et al. (2022) and Yang et al. (2017), these values are 118.66 and 22.6% in normal pregnant women, respectively. In addition, our study found that the energy consumed by exercise accounted for the smallest proportion of the total energy, only 5.98%, which is in line with the results of Freitas et al. (2022). These findings imply that pregnant women with GDM have a lower average energy expenditure in the physical activity domains than normal pregnant women, with mainly light physical activity and very little exercise. This highlights the need for management regimens for physical activity to improve the health of pregnant women, especially among high-risk pregnant women.

Multiple factors promote or hinder these pregnant women from continuing physical activity (Nascimento et al. 2015). Social cognitive theory focuses on environmental and psychological factors (Bandura 2001). In psychology, fear of falling refers to negative emotions about falling, such as anxiety and worry, or even limitations in the activities of daily life. In this study, the mean total score of fear of falling was 40.94, which is similar to the findings of Wang, Hu, Wu, et al. (2022) in the general population of pregnant women. In addition, the level of fear of falling was negatively correlated with the amount of physical activity in women with GDM ($r = -0.579$, $p < 0.001$). These suggest that fear of falling is at the upper-middle level and should be addressed to improve the amount of physical activity.

Meulders et al. (2011) developed a pain-relevant fear paradigm using movement as the conditioned stimulus, which explained the mechanism by which the psychological impact of 'fear' affects individual behaviours from the perspective of physiological function based on the principle of conditioned reflexes. They discovered that the body has a memory for various adverse stimuli and reacts accordingly when such a stimulus is perceived again. These movements may cause pain, such as falls, and hence start

TABLE 1 | Demographic and obstetric characteristics and differences in the amount of physical activity during pregnancy with GDM ($N = 385$).

Variables	Number (N)	Percent (%)	Physical activity (METs/h/week)				
			Mean	SD	t	F	p
Age (years)					0.869		0.385
< 35	278	72.21	73.62	66.63			
≥ 35	107	27.79	67.32	55.36			
Education level						5.830	**0.003**
Junior college and below	153	39.74	60.52	50.95			
Undergraduate	178	46.23	75.15	60.43			
Graduate and above	54	14.03	93.18	94.25			
Marital status					−0.742		0.458
Unmarried or divorced or widowed	10	2.60	57.10	36.54			
Married	375	97.40	72.26	64.24			
Residence					0.224		0.823
Rural villages	74	19.22	70.38	81.98			
Urban communities	311	80.78	72.22	58.67			
Household monthly income, RMB						1.592	0.191
< 10,000	64	16.62	73.25	85.24			
10,000~15,000	146	37.92	66.62	55.51			
15,000~20,000	92	23.90	67.71	66.50			
> 20,000	83	21.56	84.64	53.14			
Work participation					−5.234		**< 0.001**
No	110	28.57	45.88	35.62			
Yes	275	71.43	83.26	69.29			
History of falls					1.510		0.132
Yes	50	12.99	59.20	50.16			
No	335	87.01	73.76	65.32			
Pre-pregnancy BMI (kg/m^2)						0.618	0.604
Underweight	37	9.61	66.68	53.46			
Normal	256	66.50	72.88	68.31			
Overweight	70	18.18	66.51	50.61			
Obesw	22	5.71	85.81	61.96			
Gestational weeks					−3.567		**< 0.001**
< 37	180	46.75	59.69	57.98			
≥ 37	205	53.25	82.56	66.64			
Mode of conception					2.281		**0.023**
Spontaneous pregnancies	326	84.68	75.00	64.91			
ART	59	15.32	54.55	53.72			
Childbirth experience					−0.939		0.348
No	253	65.71	74.07	63.75			

(Continues)

TABLE 1 | (Continued)

Variables	Number (*N*)	Percent (%)	Physical activity (METs/h/week)				
			Mean	SD	*t*	*F*	*p*
Yes	132	34.29	67.65	63.60			
Unintended pregnancy					2.671		**0.008**
Yes	76	19.74	89.21	76.39			
No	309	80.26	67.60	59.53			
Singleton or multiple pregnancy					2.128		**0.034**
Singleton pregnancy	365	94.81	73.48	64.26			
Multiple pregnancy	20	5.19	42.49	43.74			
History of GDM					−0.119		0.905
Yes	76	19.74	71.09	50.42			
No	309	80.26	72.06	66.62			
GDM specialty clinic visits					0.023		0.982
No	224	58.18	71.93	66.65			
Yes	161	41.82	71.78	59.54			
Family history of diabetes					−2.951		**0.003**
No	279	72.47	66.02	58.98			
Yes	106	27.53	87.25	72.78			
Adverse maternity history					1.757		0.080
No	318	82.60	74.48	67.15			
Yes	67	17.40	59.47	41.90			

Note: Bold values indicate to highlight statistically significant variables in the univariate analysis.
Abbreviations: 1 BMB, 0.1573$; ART, assisted reproductive technology; BMI, body mass index..

to elicit defensive fear responses (e.g., avoidance behaviour). In another study, Scheffer et al. (2008) found that fear of falling existed not only among people who had previously fallen but also among those who had not experienced falls. One study showed that after falling, pregnant women were prone to remaining in a negative psychological state, including anxiety and fear. They were concerned about the outcome of childbirth, family members' views, and the fear of falling again, regardless of whether there were substantial fall-related injuries (Atay and Başalan Iz 2015). Pregnant women who had never fallen were also more likely to experience psychological stress due to potential threats. Individuals tend to engage in some degree of avoidance when facing injuries and stress (Lethem et al. 1983). A certain degree of avoidance behaviour can reduce the risk of falling and protect an individual's psychological status. However, excessive avoidance can eventually lead to inadaptability, including health damage, changes in mood state, and loss of self-efficacy (Peter et al. 2017). Individuals with low self-efficacy lack confidence in effectively coping with risks (Adamczewska and Nyman 2018). They tend to amplify the severity of risks and feel anxious about potential risks that do not occur (Polsook et al. 2016). Consequently, pregnant women with a lower level of fear of falling exhibit greater confidence in performing various physical activities. They maintain a positive and optimistic attitude and believed that they could complete their activities without falling. However, pregnant women with higher levels of fear of falling have insufficient confidence. As a result, they engage in avoidance behaviours that actively restrict their daily activities (Atay and Başalan Iz 2015). This leads to decreased muscular strength and balance, resulting in a negative feedback loop of falling more easily (Peeters et al. 2020). Therefore, nursing interventions that help pregnant women with GDM decrease their fear of falling, risk of falling, and limitations in daily activities are necessary.

As expected, social support was a positive factor associated with physical activity during pregnancy in women with GDM ($r=0.484$, $p<0.001$). The mean total score for social support was 102.82, which is at a medium level and still needs improvement. Notably, the tool used to assess the social support level in this study was SRSS-GDM (Yang et al. 2022), which was designed specifically for pregnant women with GDM based on the social ecological model and considers seven sources of social support, namely, healthcare workers, family, self-regulation, friends, media policy, social groups, and the workplace, compared with previous studies. The study results also revealed that social support had a significant negative correlation with fear of falling, and fear of falling had a partial mediation effect between social support and physical activity in pregnant women with GDM. Social support is well known to play an indispensable role in the mental health management of pregnant women, but only a few studies have investigated the association between social support and fear of falling among pregnant women. However, significant relationships have been

reported in older patients (Okoye et al. 2022; Vo et al. 2020). These two constructs provided similar explanations and logical correlations in pregnant women. In pregnant women with a higher level of social support, negative emotions and physiological status can be regulated in a timely manner to adapt to social role transitions, thereby alleviating the fear of falling. Furthermore, social support can offer material and spiritual help for pregnant women, improve tolerance for pain and stress, and increase self-confidence in avoiding falls when they participate in physical activity (Okafor and Goon 2020; Wang, Hu, Wu, et al. 2022). Accordingly, it can be inferred that good social support is valuable for eliminating the fear of falling and promoting more participation in physical activity during pregnancy. Consequently, interventions targeting social support systems are important for boosting motivation for physical activity in pregnant women with GDM.

TABLE 2 | Correlation among study variables ($N = 385$).

Variables	1	2	3
1. Physical activity during pregnancy	1.000		
2. Social support	0.484***	1.000	
3. Fear of falling	−0.579***	−0.656***	1.000

***$p < 0.001$.

5.1 | Strength and Limitations

To the best of our knowledge, this is the first study on the mediating effect of the fear of falling on social support and physical activity during pregnancy. A large representative sample of Chinese pregnant women was included in this study, with a high response rate and an appropriate sampling method. In addition, various standardised and validated scales have been utilised to measure social support, fear of falling, and physical activity during pregnancy.

Meanwhile, this study also has a few limitations. First, the sample was from a certain region of China and may not be representative of the targeted population. Second, all participants were assessed only at a certain point during pregnancy. However, the level of fear of falling and physical activity may change as pregnancy progresses. Third, a cross-sectional study cannot explore causal relationships. Future studies are encouraged to consider more methods, such as longitudinal, multi-centre, multi-regional, and qualitative research, which will contribute to making the results more representative.

TABLE 3 | Factors influencing physical activity during pregnancy with GDM ($N = 385$).

	Model 1			Model 2			Model 3		
Variables	***B***	***β***	***p***	***B***	***β***	***p***	***B***	***β***	***p***
BLOCK 1 Basic characteristics									
Constants	10.132	—	0.712	−50.034	—	0.051	96.089	—	0.001
Education level (0 = Junior college and below)	9.659	0.104	0.037	8.778	0.095	0.036	9.457	0.102	0.015
Work participation (0 = No)	30.736	0.218	< 0.001	23.911	0.170	< 0.001	22.132	0.157	< 0.001
Gestational weeks (0 = < 37)	17.910	0.140	0.004	11.290	0.089	0.044	4.000	0.031	0.447
Mode of conception (0 = Spontaneous pregnancies)	−8.901	−0.050	0.325	−4.016	−0.023	0.623	−0.684	−0.004	0.928
Unintended pregnancy (0 = Yes)	−22.037	−0.138	0.005	−15.644	−0.098	0.027	−10.901	−0.068	0.097
Singlenton or multiple pregnancy (0 = Singlenton)	−12.204	−0.043	0.392	−17.150	−0.060	0.183	−16.962	−0.059	0.155
Family history of diabetes (0 = No)	21.634	0.152	0.002	10.689	0.075	0.090	7.932	0.056	0.175
BLOCK 2 Social support				0.832	0.418	< 0.001	0.308	0.155	0.004
BLOCK 3 Fear of falling							−2.156	−0.427	< 0.001
R^2		0.151			0.312			0.410	
R^2 change		0.151			0.161			0.098	

Abbreviations: β, standardised regression coefficient; B, unstandardised regression coefficient.

TABLE 4 | Results of mediating effect of fear of falling ($N = 385$).

Effect	Variables	β	SE	t	p	95% CI		Proportions
						LLCL	ULCL	
Direct effect	SS → PA(c)	0.182	0.109	3.338	0.001	0.149	0.576	37.60%
Indirect effect	SS → FOF(a)	−0.656	0.015	−17.020	< 0.001	−0.779	−0.229	
Indirect effect	FOF → PA(b)	−0.460	0.275	−8.434	< 0.001	−0.861	−0.379	
Indirect effect	SS → FOF → PA(ab)	0.302	0.037			0.232	0.378	62.40%
Total effect	SS → PA(c + ab)	0.484	0.089	10.810	< 0.001	0.138	0.584	100%

Abbreviations: β, standardised regression coefficient; CI, confidence interval; FOF, fear of falling; LLCL, the lower limit of β in 95% confidence interval; PA, physical activity; SS, social support; ULCL, the upper limit of β in 95% confidence interval.

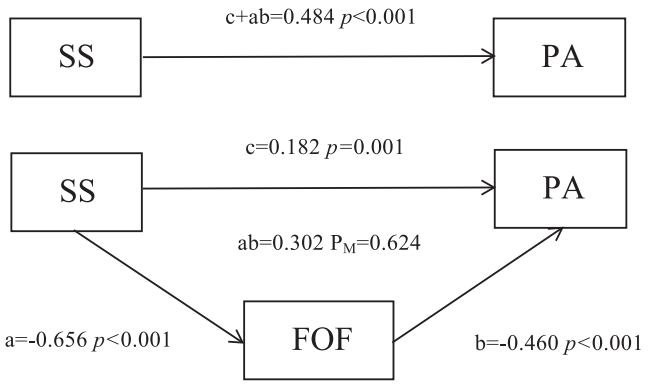

FIGURE 2 | Mediating effect of fear of falling on the relationship between social support and physical activity during pregnancy. FOF, fear of falling; PA, physical activity; PM, proportion mediated; SS, social support, ratio of the mediating effect to the total effect.

5.2 | Implication to Practice

This study highlights the important implications of social support and fear of falling for women with GDM taking part in physical activity during pregnancy. Social support and fear of falling were significantly correlated with physical activity. Therefore, clinical nursing staff should further evaluate the fear of falling and fall-related knowledge among pregnant women with GDM to increase their confidence in preventing falls. Various fall prevention strategies combined with programmes to increase physical activity are required to improve adherence to physical activity without the incidence of falls.

In addition, active mobilisation of pregnant women with GDM social support systems by medical institutions is essential. Clinical medical staff should provide guidance and management on physical activity for pregnant women with GDM, following the principles of individuation and a stepwise pattern. Family members, especially spouses, as the reliable backbone of the social support system, should be included in the target of physical activity-related education. Moreover, their self-confidence can be enhanced through groups of healthy pregnant women, such as encouraging pregnant women with good exercise habits to impart knowledge.

6 | Conclusions

This study showed that the fear of falling mediates the relationship between social support and physical activity in pregnant women with GDM. This finding can be used as functional evidence to confirm that improving social support and intervening against the fear of falling may be beneficial in terms of increasing physical activity during pregnancy. This suggests that medical and health personnel should create and implement interventions to enhance social support, such as emotional support, informational support, instrumental support, and companion support, thereby reducing fear of falling and increasing physical activity among pregnant women with GDM.

Author Contributions

Yupeng Wang had a role in study design, data collection and analysis, decision to publish, and preparation of the manuscript. Rong Zhang participated in data collection and analysis. Suwen Feng contributed to the planning of the study and reviewed the draft and the final article. All authors read and approved the final manuscript.

Acknowledgements

The authors are indebted to all participants for their contribution to the study: the pregnant women who agreed to participate in this study; all our colleagues for their support for this study; the Researchers editorial team (www.home-for-researchers.com) for language editing service.

Ethics Statement

Ethical approval was gained from the ethics committee of the Women's Hospital, Zhejiang University School of Medicine (no.: IRB-20230192-R). We confirm that all methods were carried out in accordance with relevant guidelines and regulations.

Consent

All participants provided written informed consent before the study.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The datasets analysed during the current study are available from the corresponding author upon reasonable request.

Patient or Public Contribution

385 pregnant women with gestational diabetes mellitus were invited to complete the questionnaire.

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