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A causal model of eating behaviors among Thai pregnant women working in industrial factories

Original article

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Abstract: **Objective:** This study aimed to examine the causal model of eating behaviors among pregnant women working in industrial factories. **Methods:** This cross-sectional study was conducted on 210 participants, attending 4 healthcare centers, at a tertiary care hospital in Chonburi province, Thailand. Data were collected using 7 questionnaires: demographic form, eating behavior questionnaire, perceived benefits of the healthy eating questionnaire, perceived barriers to the healthy eating questionnaire, perceived self-efficacy questionnaire, social support questionnaire, and accessibility to healthy foods questionnaire. Descriptive statistics and path analysis were used for data analysis. **Results:** The participants had relatively high mean scores for eating behaviors. The final model fitted well with the data $\chi^2 = 12.86$, df = 10, $P = 0.23$; $\chi^2/df = 1.29$; comparative fit index (CFI) = 0.98; goodness-of-fit index (GFI) = 0.98; adjusted goodness-of-fit index (AGFI) = 0.95; root mean square error of approximation (RMSEA) = 0.04. Four factors—perceived benefits ($\beta = 0.13$, $P < 0.05$), perceived self-efficacy in healthy eating ($\beta = 0.22$, $P < 0.001$), pregnancy planning ($\beta = 0.28$, $P < 0.001$), and accessibility to healthy foods in the factory ($\beta = 0.12$, $P < 0.05$)—positively affected eating behavior, while only perceived barriers to healthy eating had a negative effect on eating behavior ($\beta = -0.24$, $P < 0.001$). All the above factors explained 27.2% of the variance in eating behaviors. **Conclusions**: Nurses or healthcare providers can apply these findings to create an eating behavior modification program, focusing on pregnancy planning, behavior-specific variables, and interpersonal and situational influence, to promote the nutritional status of pregnant women working in industrial factories.

Keywords: eating behaviors • industrial factories • perceived barriers • pregnant women • Thailand
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1. Introduction

Over the last decade, the number of female workers in industries has increased steadily. Female factory workers are prone to be stressed due to prolonged working hours and constant fear of dismissal.[1] Moreover, they do not meet their nutritional requirements due to low socioeconomic status, long commute time to work, low wages, domestic problems, less accessibility to healthy food, work constraints, and stringent workplace regulations.[2] It is essential to pay attention to the eating behaviors of pregnant women working in factories, as it could greatly influence pregnant women and their fetal health.[3] According to the World

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Health Organization, about half of pregnant women have micronutrient deficiencies globally.[4] It was found that females from developing countries were at risk of malnutrition, ranging from 13% to 38%.[5,6] An estimated 3.5 million deaths occurred due to maternal malnutrition, accounting for 14% of fetuses with intrauterine growth restriction.[7] In Thailand, 66.43% of pregnant women had unhealthy eating behaviors.[8] Most pregnant women had poor dietary practices, such as frequent snacking, fast food consumption, low-energy food choice, and higher fat and sugar diet.[9] Low intake of micro- and macro-nutrients and regular caffeine consumption could lead to deleterious health outcomes, including gestational weight gain, diabetes mellitus and hypertension, anemia, fetal macrosomia, spina bifida, and low birth weight.[10] Around 34.3% of the Thai pregnant women reported of gestational weight gain.[8] Moreover, pregnant women should be encouraged to consume dense nutrition without exceeding the requirement level.[11]

The existing literature indicates various influencing factors on eating behaviors. Primarily, pregnancy symptoms itself could influence the food practices of pregnant women. For instance, a study found that physiological changes influence dietary preferences.[12] Apart from that, internal and external factors play a vital role in the eating behaviors of pregnant women. A high social support can promote good mental health and increases the likelihood of healthy behaviors among pregnant women, thereby increasing their well-being.[13] Accessibility to healthy food and self-efficacy are indicators of dietary habits.[14] Moreover, the unavailability of healthy foods could result in barriers, including a lack of food literacy.[15] Perceived barriers refer to an individual's evaluation of physical and psychosocial barriers that prevent him or her from adhering to health-related practices.[16] Pregnant women with perceived benefits receive more social support and engage in health-promoting behaviors.[17] In terms of individual factors, self-efficacy in and perceived benefits of behavioral change must be enhanced, along with the interpersonal and situational influences.

Some studies found lifestyle interventions as an effective way to modify dietary patterns and in reducing gestational weight gain.[18,19] In addition, studies on workplace nutrition interventions also exist.[20,21] Most studies have examined the related factors to a person's health behaviors and dietary patterns of pregnant women,[9,22] although there is limited evidence in industrial environments. Hence, there is an extensive need to identify the influencing factors of eating behaviors among pregnant factory workers. By underpinning Pender's health promotion model, this study aimed to examine the various factors.[23] Promoting healthy eating behaviors among pregnant women is vital in prenatal care, and

understanding various factors may aid in optimizing the maternal diet and reduce pregnancy complications. In Thailand, limited studies exist on the dietary patterns of pregnant female workers in factories. Besides, this study sought to examine the maternal, social, and contextual factors, specifically the pregnancy intention, mothers' perceptions of eating behaviors, the barriers and benefits of healthy eating, and the accessibility to healthy food. Understanding these factors is significant, as they play an important role in improving women's eating behaviors during pregnancy and providing them with essential welfare facilities in the workplace. Moreover, this will inform future tailored intervention programs that are more effective for working pregnant women. Therefore, this study aimed to develop and examine the causal model of eating behaviors and their related factors among pregnant women working in industrial factories.

2. Methods

2.1. Study design and sampling

Cross-sectional design was used in this study. Participants were pregnant women, working in industrial factories, registered to receive antenatal care in the healthcare center at a tertiary care hospital in an eastern part of Thailand. The sample size was determined based on the estimated parameters. As a rule of thumb, a sample size of 100–400 is considered sufficient, and a model with 6–7 factors requires at least 150 subjects.[24] The estimated sample size was 210, which indicates sufficient power of the model.

The inclusion criteria were participants aged 18–35 years, having a gestational age of 28 weeks or higher, with no complications. The exclusion criteria were: (1) the participants who refused to give informed consent and (2) those who cannot speak, read, and write Thai. Four health centers were purposively selected to recruit participants, since they were close to the industrial factories. The participants were recruited proportionally and randomly from each healthcare center using simple random sampling.

2.2. Instruments

2.2.1. Demographic form

The demographic form comprised age, marital status, education level, family income, type, number of working hours, pregnancy planning, healthy foods usually consumed before pregnancy, and information about food the participant received during pregnancy. Obstetric

status characteristics comprised gravidity, current gestational age, pre-pregnancy body mass index (BMI), and gestational weight gain.

2.2.2. Eating behavior questionnaire

The Thai version of the eating behavior questionnaire was used.[25] This comprises 19 items in a 4-point rating scale ranging from 0 (never practice) to 3 (practice regularly). The negative items were reverse-scored. Total scores range from 0 to 57, with higher scores indicating better healthy eating behaviors. The Cronbach's alpha reliability in this study is 0.82.

2.2.3. Perceived benefits of the healthy eating questionnaire

The Thai version of the perceived benefits of the healthy eating questionnaire was used.[25] This scale comprises 9 items of positive statements. The response format was a 4-point Likert scale ranging from 1 (disagree) to 4 (highly agree). Scores range from 9 to 36, with higher scores indicating greater perceived benefits. The Cronbach's alpha reliability in this study is 0.84.

2.2.4. Perceived barriers to healthy eating questionnaire

The Thai version of the perceived barriers to the healthy eating questionnaire was used.[25] This 12-item scale comprises 3 domains: food beliefs and preferences, inconvenience in accessing or buying food, and economic limitations. It is a 4-point Likert scale ranging from 1 (disagree) to 4 (highly agree). Total scores range from 12 to 48, with higher scores reflecting more perceived barriers. The Cronbach's alpha reliability in this study is 0.85.

2.2.5. Perceived self-efficacy questionnaire

Perceived self-efficacy in the healthy eating questionnaire was developed by the researchers. This comprises 19 positive items and is a 4-point rating scale ranging from 1 (not confident) to 4 (highly confident). Total scores range from 19 to 76, with higher scores indicating a higher perceived self-efficacy in performing healthy eating behavior. The Cronbach's alpha reliability in this study is 0.90.

2.2.6. Social support questionnaire

The social support questionnaire was used.[26] This 10-item scale has 4 dimensions: emotional support, information support, appraisal support, and instrumental support. The scale is a 4-point rating scale ranging from 1 (never support) to 4 (highly support). Total scores range from 10 to 40, with higher scores indicating higher social support in engaging in healthy eating. The Cronbach's alpha reliability in this study is 0.86.

2.2.7. Accessibility to healthy foods questionnaire

The researchers developed the accessibility to healthy foods questionnaire. This scale comprised 11 items and is a 4-point Likert scale ranging from 1 (not at all true) to 4 (absolutely true). Total scores range from 11 to 44, with higher scores reflecting increased accessibility to healthy foods for pregnant women. The Cronbach's alpha reliability in this study is 0.81.

The questionnaires were reviewed for content validity by 5 experts (2 in maternal and newborn nursing, 2 in community nursing, and 1 nutritionist). Upon the expert's review, all the questionnaires had an acceptable Content Validity Index (CVI) of 0.82–1.00. The reliability was pretested with 30 individuals having similar characteristics as the prospective participants.

2.3. Data collection procedures

Formal approval from the ethics committee and hospital board was obtained. This study was approved by the ethics committee of Burapha University (IRB approval number: 1-080/2564).

The participants were screened for eligibility criteria. The recruited participants were individually approached and explained about the study objectives and process, participation rights, voluntary nature, and anonymity. Written informed consent was obtained. The researcher prepared a private room for the participants to answer the questionnaires. The data were collected through self-administered questionnaires that lasted approximately 30 min. The obtained data were kept confidential. A total of 210 questionnaires were administered to the participants, and all the respondents filled and returned them. The questionnaires were checked for completeness. All the obtained questionnaires had valid responses.

2.4. Data analysis

The data were analyzed using SPSS and AMOS software version 27 (IBM Corporation, Armonk, New York, United States). Descriptive statistics were used to analyze the demographic and obstetric characteristics of the participants. Assumptions underlying the path analysis were met. Path analysis was used to examine the eating behaviors of pregnant women working in industrial factories. The significance level was set at 0.05.

2.5. Ethical principle

This study received ethical approval from the Central Research Ethics Committee for Human Research of Burapha University (IRB#HS059/2564). Prospective participants were screened for eligibility based on medical charts and history-taking interview data. Participants were informed of study objectives, participant protection, the voluntary nature of the study, and the right to withdraw at any time. After providing written consent, the participants filled out the questionnaire.

3. Results

3.1. Demographic and obstetric characteristics

In total, 210 pregnant women were included in the study; their mean age was 28.78 years. Most participants (49.05%) attended senior high school. Nearly all (98.57%) were married and living with their husband. Nearly half (55.24%) consumed low-fat or skim milk before pregnancy. Almost all (92.38%) participants received information about healthy eating behaviors during pregnancy. Regarding obstetric history, two-thirds (67.14%) had planned pregnancies, and 34.76% were primigravida. The mothers had a mean gestational age of 31.38 ± 3.24 weeks. Based on their BMI, nearly 20% of the participants were obese, and 12.38% were overweight. Around 47.62% gained weight above the recommended levels during pregnancy (Table 1).

3.2. Eating behaviors and associated factors

The participants had relatively high mean scores for eating behavior. They were similar to those of perceived benefits of healthy eating, perceived self-efficacy in healthy eating, and social support. The mean scores of perceived barriers to healthy eating and accessibility to healthy foods in the factory to healthy eating were relatively low (Table 2).

3.3. Model testing and modification

The hypothesized causal model of eating behavior among pregnant women working in industrial factories and its influencing factors were examined. The modification indices were based on recommendations[24]: χ^2/df <5.0, RMSEA <0.08, CFI, GFI, and AGFI >0.90. The hypothesized model fitted well with the empirical data with χ^2/df = 1.17, RMSEA = 0.03, CFI = 0.99, GFI = 0.99, and AGFI = 0.96, and the goodness of fit values were acceptable. However, 2 paths, social support with

perceived barriers to healthy eating and eating behavior, had non-significant associations and were deleted (β = 0.11 and β = 0.07, respectively). After deletion, the model was further modified, and the final model fitted well with the empirical data, with all indices at an acceptable level. All the path coefficients between latent variables were significant.

The modified causal model explained 27.2% of the variance in eating behaviors among pregnant women working in industrial factories. Perceived barriers to healthy eating negatively directly influenced eating behavior (β = –0.24). Perceived self-efficacy had a negative direct effect (DE) on perceived barriers to healthy eating and a positive DE on eating behavior (β = –0.21 and β = 0.22, respectively). Perceived benefits of healthy eating had a positive DE on perceived self-efficacy in healthy eating and eating behavior (β = 0.17 and β = 0.13, respectively). Social support was found to have a positive DE on perceived benefits and perceived self-efficacy in healthy eating (β = 0.27 and β = 0.29, respectively). Planned pregnancy had a positive DE on perceived self-efficacy in healthy eating and eating behavior (β = 0.21 and β = 0.28, respectively). Finally, accessibility to healthy foods in the factory positively affected eating behavior (β = 0.12) (Table 3 and Figure 1).

4. Discussion

This study found that factors, namely, perceived benefits, perceived barriers, and perceived self-efficacy in healthy eating, social support, pregnancy planning, and accessibility to healthy foods, influenced the eating behaviors among pregnant women working in industrial factories.

In this study, perceived barriers to healthy eating directly and negatively influenced eating behaviors (β = –0.24, $P < 0.001$) and were consistent with Pender's health promotion model.[23] This could encourage a person to avoid unhealthy behaviors associated with unreadiness, inconvenience, expenditures, and difficulties.[23] Our findings are in line with previous studies, which revealed that perceived barriers had a negative DE on health-promoting behavior (B = –1.28; β = –0.13),[27,28] the likelihood of healthy eating (β = –0.31),[29] and blood pressure controlling behavior (β = –0.49).[30] This study also revealed a mediating role of perceived barriers between perceived self-efficacy and health-promoting lifestyle.[23,31]

Perceived benefits and perceived self-efficacy, directly and positively, influenced eating behaviors (β = 0.13, $P < 0.05$ and β = 0.22, $P < 0.001$, respectively). Perceived benefit is a cognition factor that refers to the belief in positive outcomes resulting from performing

Characteristics	Frequency	%
Age (years) (M = 28.78, SD = 4.70, range = 20–41)		
20–24	36	17.14
25–29	84	40.00
30–35	76	36.19
>35	14	6.67
Education level		
Uneducated	2	0.95
Primary school	6	2.86
Junior high school	54	25.71
Senior high school	103	49.05
Diploma or high vocational school	27	12.86
Bachelor's degree	18	8.57
Marital status		
Married	207	98.57
Divorced	3	1.43
Monthly income (Baht)		
10,000–20,000	28	13.33
20,000–30,000	104	49.53
>30,000	78	37.14
Working hours per week (h) (M = 45.35, SD = 6.48, range = 34–80)		
<40	2	0.95
40–48	194	92.38
>48	14	6.67
Foods consumed before pregnancy		
Whole grain rice and flour	58	27.62
Low-fat or skim milk	116	55.24
Health education regrading healthy diet during pregnancy		
Received	198	92.38
Did not received	16	7.62
Pregnancy planning		
Planned	141	67.14
Unplanned	69	32.86
Gravida		
Primigravida	73	34.76
Multigravida	137	65.24
Gestational age in weeks (week) (M = 31.38, SD = 3.24, range = 28–39)		
28–32	131	62.38
33–36	64	30.48
>36	15	7.14
Pre-pregnancy BMI (kg/m²)		
<18.5	24	11.43
18.5–22.9	118	56.19
23–24.9	26	12.38
>25	42	20.00

(*Continued*)

Table 1. Continued

Characteristics	Frequency	%
Gestational weight gain		
Less than recommended level	15	7.14
Normal	95	45.24
Higher than recommended level	100	47.62

Note: BMI, body mass index.

Table 1. Demographic and obstetric characteristics of the participants (*n* = 210).

health-promoting behavior. This finding could be explained by the fact that if pregnant women realize the benefits of healthy eating, they could more likely practice healthy dietary patterns. This is consistent with previous studies that found that perceived benefits directly and positively influenced the likelihood of healthy eating (β = 0.23),[31] health-promoting behavior (β = 0.63),[27] pregnancy care behavior (β = 0.25),[32] and blood pressure controlling behavior (β = 0.62).[30] Moreover, perceived benefits of healthy eating had a positive indirect influence through perceived self-efficacy.[29] Perceived self-efficacy is a psychosocial factor, in which a person is determined to modify or maintain their health-promoting behaviors.[33] Similarly, another study in the other population found perceived self-efficacy's direct and positive influence on health-promoting behaviors (β = 0.38),[34] self-management behaviors (β = 0.26),[34] and the likelihood of healthy eating (β = 0.37).[29] Perceived self-efficacy also acted as a mediating factor between social support and health behavior.[34–36]

Planned pregnancy positively affected the perceived self-efficacy and eating behavior of pregnant women working in industrial factories (β = 0.21, *P* < 0.01, and β = 0.28, *P* < 0.001, respectively). One possible explanation is that pregnant women with planned pregnancies are more likely to have increased perceived self-efficacy, and it may encourage them to adhere to adaptive eating behaviors. Moreover, planned pregnancies could influence women's thoughts and feelings. They may motivate them to maintain an optimal nutritional status.[37,38] These findings agreed with another study that found pregnant women with planned pregnancies had healthier eating behaviors than those with unplanned or unwanted pregnancies.[39]

Accessibility to healthy foods in the factory had a direct, positive influence on eating behavior in pregnant women working in industrial factories (β = 0.12, *P* < 0.05). The availability of healthy foods in the factory canteens, reasonable food prices, and workplace environments could highly promote dietary changes among pregnant women. Also, accessibility to healthy food is a situational

Variables	Score range		Mean	SD
	Possible	Actual		
Eating behavior	0–57	25–48	37.33	4.46
Perceived benefits of healthy eating	9–36	19–36	31.00	3.85
Perceived barriers to healthy eating	12–48	12–48	28.33	7.24
Perceived self-efficacy in healthy eating	19–76	40–76	60.00	7.45
Social support	10–40	19–40	31.34	4.77
Accessibility to healthy foods in the factory	11–44	16–36	26.24	3.70

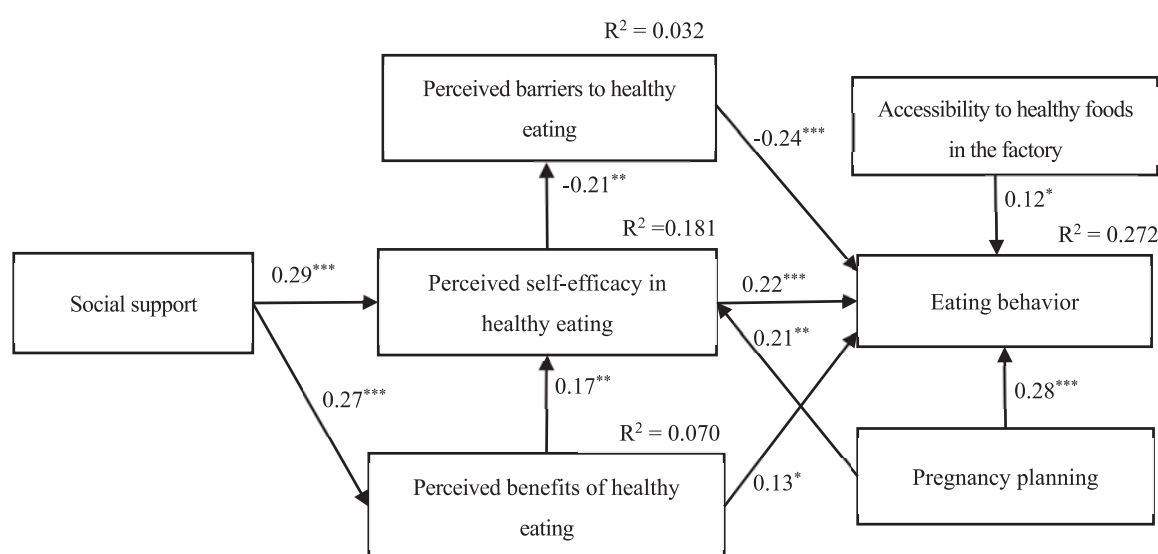**Table 2.** Mean scores of study variables ($n = 210$).

Figure 1. Modified causal model of the eating behavior among pregnant women working in industrial factories.

Note: *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

factor that directly influences health-promoting behavior.[18] This was consistent with the findings of another study that indicated a positive influence of workplace nutrition environment and administrator's attitude on eating habits[1] and situational influence on health-promoting behaviors.[28,30] However, food choices vary based on workplace nature and nutrition policy. Most factories have a few healthy food facilities inside, and the policies and plans for nutrition promotion are quite low, thus posing negative health impacts among pregnant workers.[40]

Social support had a positive DE on perceived benefits and perceived self-efficacy ($\beta = 0.27$, $P < 0.001$, and $\beta = 0.29$, $P < 0.001$, respectively) and a positive indirect effect (IE) on eating behaviors to healthy eating. Enhancing favorable environmental conditions and satisfying social relationships could strengthen individuals and create positive attitudes toward healthy eating behaviors. Pregnant women who receive informational support may easily be equipped with knowledge and

understanding about appropriate eating behaviors; other supports, such as emotional, instrumental, and appraisal, could help them adjust to physical and psychosocial changes. The influence of social support on eating behavior in pregnant women is supported by previous studies that found an indirect, positive influence on health behavior through self-efficacy.[33,34]

The major strength is that this is the first study to examine the simultaneous relationship of multiple factors related to the eating behaviors of pregnant industrial workers. Furthermore, it emphasized the eating behaviors of pregnant workers at the individual, interpersonal, and workplace levels. The limitation is that since the study was conducted in only 1 province in Thailand, it may limit the representativeness of samples and the generalizability of findings. Secondly, some factors were not examined, including demographic characteristics such as types of residential areas (urban or rural), health literacy level, pre-pregnancy healthy

Variables	Perceived benefits of healthy eating			Perceived self-efficacy in healthy eating			Perceived barriers to healthy eating			Eating behavior		
	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE
Social support	0.27	-	0.27	0.29	0.04	0.33	-	−0.07	−0.07	-	0.13	0.13
Perceived benefits of healthy eating	-	-	-	0.17	-	0.17	-	−0.04	−0.04	0.13	0.05	0.18
Perceived self-efficacy in healthy eating	-	-	-	-	-	-	−0.21	-	−0.21	0.22	0.05	0.27
Perceived barriers to healthy eating	-	-	-	-	-	-	-	-	-	−0.24	-	−0.24
Pregnancy planning	-	-	-	0.21	-	0.21	-	−0.04	−0.04	0.28	0.06	0.34
Accessibility to healthy foods in the factory	-	-	-	-	-	-	-	-	-	0.12	-	0.12
Coefficient of prediction (R^2)	0.070			0.181			0.032			0.272		

Note: DE, direct effects; IE, indirect effects; TE, total effects.

Table 3. DE, IE, and TE of the modified model.

lifestyle behaviors, and availability of healthy workplace policies. Exploring the influence of the combination of these factors in future investigations may provide further insights into the eating behaviors of pregnant women. Lastly, the eating behaviors of pregnant female workers in their first and second trimesters warrant further investigation. The findings of this article are imperative, as they enhance our understanding of the situational and social factors that contribute to the well-being of pregnant women working in industries. Gaining knowledge regarding the dietary patterns of pregnant women may guide nurses and other healthcare professionals in conducting future educational activities and cultivating awareness about the deleterious effects of unhealthy eating habits that could impede fetal growth and development.

5. Conclusions

This study revealed that perceived self-efficacy, perceived benefit, planned pregnancy, and accessibility to healthy foods positively influenced eating behaviors, while perceived barriers to healthy eating negatively influenced eating behaviors among pregnant factory workers. The findings of this study will provide baseline information for community-based initiatives. They may guide the healthcare providers in primary health centers in formulating health-related policies and identifying the potential barriers related to healthy eating practices of the workers in industries situated in the eastern province of Thailand. This study suggests that improving canteen facilities and factory nutritional policies could promote pregnant women's health status. Also, work-based health promotion strategies could also be implemented, such as proper dietary management, improving safety measures, adequate wages, flexible schedules, and paid medical leave. In addition, since social support directly influences self-efficacy, family members or workplace support could increase pregnant women's beliefs and dietary practices. Furthermore, these findings could guide future experimental studies in designing individual-based interventions among pregnant women working in industrial factories. Lastly, this study, by providing a comprehensive understanding of influencing factors based on health promotion models, could aid in creating various awareness programs for pregnant women who work in industrial settings.

Ethical approval

This study was approved by the Central Research Ethics Committee for Human Research of Burapha University (No. HS059/2564).

Conflicts of interest

All contributing authors declare no conflicts of interest.

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