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Factors Associated With Gestational Weight Gain Among Nurses in Korea

Sook Jung Kang, Woon Young Hwang, Hyunju Dan, Sue Kim, and Kwang-Pil Ko

Correspondence
Woon Young Hwang, MSN, RN, College of Nursing, Ewha Womans University, 52 Ewhayeodae-gil, Seodaemun-gu, Seoul, Korea.
wyhwang616@gmail.com

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ABSTRACT

Objective: To identify risk factors associated with inadequate and excessive gestational weight gain (GWG) among nurses in Korea.

Design: Secondary analysis of data from the Korea Nurses' Health Study, a nationwide prospective cohort study.

Setting: Online surveys distributed from 2014 to 2023 in Korea.

Participants: Nurses ($N = 296$) who gave birth in the past year.

Methods: We categorized GWG using guidelines from the Institute of Medicine and conducted bivariate and logistic regression analyses to identify factors associated with inadequate and excessive GWG.

Results: Among participants, 40.2% had inadequate GWG, 36.1% had adequate GWG, and 23.7% had excessive GWG. We found significant differences in GWG based on pre-pregnancy body mass index (BMI) and weekly overtime hours worked. As age increased, the odds of excessive GWG decreased (odds ratio (OR) = 0.89, 95% confidence interval (CI) [0.79, 0.99]), whereas higher levels of fatigue were associated with increased odds (OR = 1.08, 95% CI [1.01, 1.15]) of excessive GWC.

Conclusion: Our study suggests that health care providers should consider ethnicity, pre-pregnancy BMI, overtime work hours, age, and fatigue levels when educating and caring for pregnant nurses. Although the findings reflect a specific maternal population of Korean nurses, they may inform care for similar working women. We recommend that information about GWG be incorporated into prenatal education, visits, checklists, and counseling for women who are pregnant or planning to become pregnant.

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Sook Jung Kang, PhD, FNP-C, is an associate professor, College of Nursing, Ewha Womans University, Seoul, Korea.
https://orcid.org/0000-0002-1668-0392

Woon Young Hwang, MSN, RN, is a PhD candidate, College of Nursing, Ewha Womans University, Seoul, Korea.
https://orcid.org/0000-0002-4407-0540

Hyunju Dan, PhD, RN, FNP, is an assistant professor, Department of Nursing, Hwasung Medi-Science University, Gyeonggi-Do, Korea.
https://orcid.org/0000-0002-1864-7967

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Gestational weight gain (GWG) refers to the amount of weight gained during pregnancy and is a crucial indicator for maternal and fetal health (Yan et al., 2025). In a meta-analysis of 23 studies that included 1,309,136 women, those who had inadequate GWG were at increased risk of preterm birth, and their newborns were at risk of being small for gestational age. Excessive GWG was related to increased risk of cesarean, fetal macrosomia, and large-for-gestational-age newborns (Goldstein et al., 2017). Gestational weight gain affects fetal growth and development and the body composition of the child in childhood and later life (Arora & Aeri, 2019). In a study of 200 women at one hospital in India, Pal et al. (2017) reported a higher incidence of gestational diabetes mellitus in women with excessive GWG (26.1%) than in women with inadequate GWG (13.6%) and a higher incidence of gestational hypertension in women with excessive GWG (21.7%) than in women with adequate GWG (6.8%).

The prevalence of GWG varies by racial groups. Guo et al., (2019) conducted a meta-analysis of retrospective cohort study among 74,424 women and reported that the distribution of inadequate, adequate, and excessive GWG differed among White, Asian, and Black women and that Asian women had a higher risk of inadequate GWG than White women. In a study of 150,674 Asian American women, Cheng et al. (2015) found that many Asian women in the United States experienced inadequate GWG, similar to those living in Asian countries. Therefore, the ethnicity of pregnant women should be considered when examining inadequate GWG.

In 2009, the Institute of Medicine (IOM) updated guidelines on GWG to mitigate the potential

Risk factors for inadequate or excessive weight gain among Korean women remain underexplored.

health risks that inadequate and excessive GWG may pose to maternal and fetal health. However, these guidelines are based primarily on data from White and Black women living in the United States, and they may have limited applicability to European and Asian women (Goldstein et al., 2018). Asian American women had a higher risk for inadequate GWG than White women (Guo et al., 2019). The American Diabetes Association (2022) defined a body mass index (BMI) greater than or equal to 25 kg/m^2 as overweight and proposed a BMI greater than or equal to 23 kg/m^2 as an alternative for Asians. However, specific GWG recommendations have not been provided for Asian populations. In South Korea, the Korean College of Obstetricians and Gynecologists applies the Asia–Pacific BMI criteria and the IOM GWG recommendations in clinical practice (Kim & Ahn, 2024). We applied the IOM guidelines to facilitate comparisons with previous studies.

Several risk factors for excessive and inadequate GWG are known. Inadequate GWG was associated with pre-pregnancy underweight (Suliga et al., 2018) and maternal diabetes, shorter maternal height, smoking, higher parity, and living in crowded households as reported in a Brazilian study (Victor et al., 2024). Risk factors for excessive GWG include being overweight or obese before pregnancy, nulliparity, smoking, unemployment, being unmarried, and younger age (Zhou et al., 2022). Psychological factors, such as negative body image, concerns about weight gain, and lack of knowledge about weight gain recommendations were also associated with excessive weight gain during pregnancy (Kapadia et al., 2015). In recent studies on GWG, researchers continued to focus primarily on non-Hispanic White women or Hispanic women living in the United States (Booman et al., 2025; Kracht et al., 2025; Zheng et al., 2019), whereas less is known about Asian women.

Although our study focused on women living in Korea, the findings may be applicable to Korean women in the United States and elsewhere who share similar genetic, cultural, and health-related characteristics despite environmental differences. We aimed to identify risk factors associated with inadequate and excessive GWG among Korean nurses.

Sue Kim, PhD, RN, is a professor, College of Nursing, Yonsei University, Seoul, Korea.
https://orcid.org/0000-0003-3785-2445

Kwang-Pil Ko, MD. PhD, is a professor, Clinical Preventive Medicine Center, Seoul National University Bundang Hospital, Gyeonggi-do, Korea.
https://orcid.org/0000-0002-7788-2887

Methods

Design

Our study was a secondary analysis of data from the Korea Nurses' Health Study (KNHS), a nationwide prospective cohort study initiated in 2013. Because we used existing KNHS data, institutional review board approval was not required. The purpose of the primary study, the KNHS, was to investigate the effects of environmental, occupational, and lifestyle characteristics on women's health. The KNHS began in 2013 and was conducted at approximate 6- to 8-month intervals for Surveys 1 through 4. Subsequently, the survey was conducted annually.

Setting

In the primary study, the study team sent informational text messages to eligible nurses to invite them to participate through the KNHS website using their personal computers or mobile phones. In this secondary analysis, the second author (W.Y.H.) and third author (H.D.) of the current study accessed and analyzed the dataset from the primary study.

Participants

For the primary study, the original study team recruited a nationwide sample of Korean female nurses aged 20 to 45 years. For this secondary study, we included nurses who responded to the early pregnancy and postpartum surveys from 2014 to 2023 and had data confirming their BMI within 1 year before pregnancy. The inclusion criteria were women who gave birth within the past year. We excluded women who were currently pregnant, gave birth more than 1 year ago, or had GWG of less than 2.2 kg or more than 32 kg. We implemented these exclusion criteria to minimize recall bias, eliminate data entry mistakes, and exclude women with atypical clinical conditions. Finally, we analyzed data from 296 nurses (see Figure 1).

Data Collection

For the primary study, the study team collected data through an online survey administered via the KNHS platform. A total of 20,613 nurses participated in the first survey (Kim et al., 2017), after which they were sent informational texts asking them to participate in subsequent online surveys. As of 2024, the 13th survey was in progress. Additional text messages were sent to respondents in the early pregnancy and postpartum periods to invite them to participate in the early pregnancy and postpartum surveys. Participants responded to the

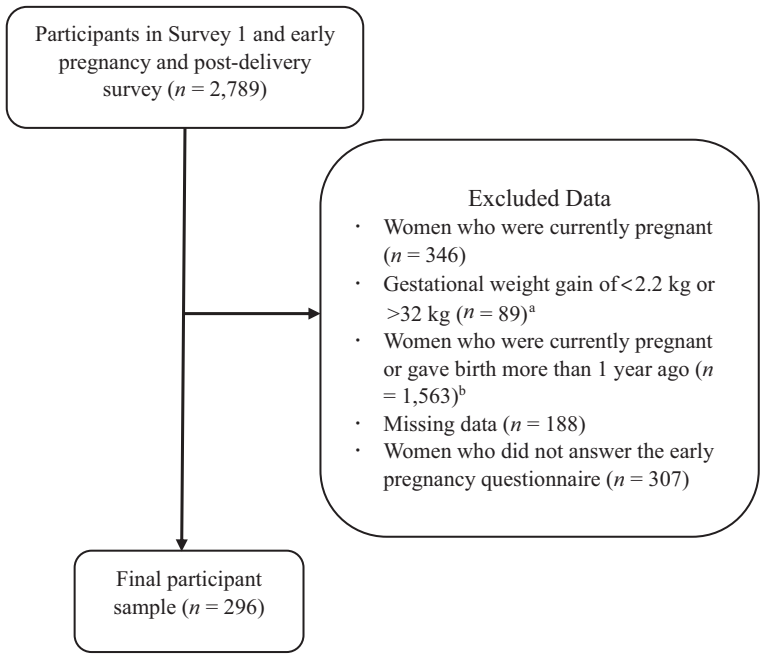

Figure 1. Participant selection process. [a]Gestational weight gains of less than 2.2 kg and more than 32 kg were considered outliers or inaccurate data. [b]This was confirmed by verifying survey and delivery dates.

questionnaire by accessing the KNHS homepage through a link in the text message or by directly using a personal computer.

Measures

Gestational weight gain. We divided GWG into three categories for this study according to the IOM (2009) criteria: inadequate, adequate, and excessive. Following the IOM guidelines, we classified GWG based on pre-pregnancy BMI, calculated as body weight (kg) divided by height squared (m^2). The IOM categorized pre-pregnancy BMI into four categories (World Health Organization, 2020): underweight (<18.5), normal (18.5–24.9), overweight (25.0–29.9), and obese (≥30). Table 1 shows the IOM's recommended GWG range for each category. For respondents in the underweight, normal, overweight, and obese

Table 1: Pre-Pregnancy BMI by Gestational Weight Gain

	IOM-Recommended GWG		Gestational weight gain							
			Inadequate		Adequate		Excessive			
Pre-pregnancy BMI (kg/m^2)	Range, kg	Range, lb	*n*	%	*n*	%	*n*	%	χ^2	*P*
Underweight	12.5–18	28–40	23	19.3	14	13.1	0	0.0	18.22	<.01
Normal	11.5–16	25–35	91	76.5	84	78.5	61	87.1		
Overweight	7–11.5	15–25	5	4.2	9	8.4	9	12.9		
Obese	5–9	11–20								

Note. *N* = 296 (*n* = 119 for inadequate, *n* = 107 for adequate, *n* = 70 for excessive). BMI = body mass index; IOM = Institute of Medicine; GWG = gestational weight gain.

Table 2: Participant Characteristics by Gestational Weight Gain

			Gestational weight gain							
	Total		Inadequate		Adequate		Excessive			
Characteristic	*N*	%	*n*	%	*n*	%	*n*	%	*F* or χ^2	*p*
Education level										
3-year college	1s25	42.2	58	48.7	38	35.5	29	41.4	4.71	.32
4-year university	148	50.0	54	45.4	58	54.2	36	51.4		
Master's degree or higher	2	7.8	7	5.9	11	10.3	5	7.1		
Annual income (USD)										
<30,000	107	36.1	52	43.7	35	32.7	20	28.6	6.29	.18
30,000–39,999	124	41.9	46	38.7	44	41.1	34	48.6		
≥40,000	65	22.0	21	17.6	28	26.2	16	22.9		
Parity ($n = 294$)										
0	219	74.5	90	76.3	80	75.5	49	70.0	0.99	.61
≥1	75	25.5	28	23.7	26	24.5	21	30.0		
Pregnancy intention ($n = 294$)										
Yes	236	80.3	87	73.7	91	85.8	58	82.9	5.57	.06
No	58	19.7	31	26.3	15	14.2	12	17.1		
Gestational hypertension										
Yes	9	3.0	3	2.5	5	4.7	1	1.4	1.69	.43
No	287	97.0	116	97.5	102	95.3	69	98.6		
Gestational diabetes										
Yes	14	4.7	6	5.0	3	2.8	5	7.1	1.81	.40
No	282	95.3	113	95.0	104	97.2	65	92.9		
Nausea and vomiting ($n = 295$)										
No	93	31.5	42	35.3	28	26.4	23	32.9	2.12	.35
Yes	202	68.5	77	64.7	78	73.6	47	67.1		
Shift work										
Yes	133	44.9	44	37.0	56	52.3	33	47.1	5.55	.06
No	163	55.1	75	63.0	51	47.7	37	52.9		
Night shift work										
Yes	65	22.0	22	18.5	27	25.2	16	22.9	1.54	.46
No	231	78.0	97	81.5	80	74.8	54	77.1		
Average overtime hours per week ($n = 295$)										
None	112	38.0	51	42.9	33	31.1	28	40.0	10.41	.03
1–20	156	52.9	58	48.7	67	63.2	31	44.3		
≥21	27	9.2	10	8.4	6	5.7	11	15.7		

(Continued)

Table 2: Continued

			Gestational weight gain							
	Total		Inadequate		Adequate		Excessive			
Characteristic	*N*	%	*n*	%	*n*	%	*n*	%	*F* or χ^2	*p*
Average standing working hours per day										
0–4	187	63.2	84	70.6	63	58.9	40	57.1	4.76	.09
≥5	109	36.8	35	29.4	44	41.1	30	42.9		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Age	29.1	4.0	28.7	3.9	29.4	4.4	29.1	3.5	0.89	.41
Fatigue	18.1	6.4	18.4	6.4	17.1	6.2	19.2	6.4	2.54	.08
Sleep	6.7	5.2	7.3	5.7	6.1	4.8	6.6	4.9	1.34	.26

Note. $N = 296$ ($n = 119$ for inadequate, $n = 107$ for adequate, $n = 70$ for excessive).

categories for pre-pregnancy BMI, GWG of less than 12.5 kg, 11.5 kg, 7.0 kg, and 5.0 kg, respectively, was classified as inadequate GWG. If a respondent's GWG exceeded 18.0 kg, 16.0 kg, 11.5 kg, or 9.0 kg, respective to their pre-pregnancy BMI category, it was classified as excessive GWG.

Demographic and socioeconomic factors. We included age (years), education level (3-year college, 4-year university, and master's degree or higher), and annual income (<$30,000, $30,000–$39,999, and ≥$40,000) as demographic and socioeconomic factors.

Pregnancy-related factors. Parity, pregnancy intention, gestational hypertension, gestational diabetes, nausea and vomiting, fatigue, and sleep during early pregnancy were included as pregnancy-related factors. Participants' number of previous pregnancies were categorized as *none* or *one or more*. Participants who provided responses of "I made an active effort to become pregnant" or "I did not try to become pregnant, but I was happy to be pregnant" were considered to have pregnancy intention, whereas those who responded with "I wanted to be pregnant, but not now" or "I did not want to be pregnant" were not. Participants were asked whether they had been diagnosed with gestational hypertension or diabetes mellitus. We classified participants as having experienced nausea and vomiting if they reported symptoms more than once per week during the first 20 weeks of pregnancy.

We used the Chalder Fatigue Scale (Chalder et al., 1993) to assess respondents' fatigue levels during the first 20 weeks of pregnancy. The Chalder Fatigue Scale includes 11 questions, and total scores range from 0 to 33; higher scores indicate higher levels of fatigue. Cronbach's α was .89 in the original study and was .92 in this study, demonstrating high internal consistency.

We measured sleep disturbance during the first 20 weeks of pregnancy using the Jenkins Sleep Evaluation Questionnaire (Jenkins et al., 1988), which comprises four questions used to assess sleep problems experienced over the last 4 weeks. The range of possible scores is 0 to 20; higher scores indicate more sleep problems. Cronbach's α ranged from .63 to .79 in the original study and was .88 in this study, indicating good internal consistency.

Work-related factors. We included shift work, night shift work, overtime hours, and standing working hours as work-related factors in early pregnancy. Participants were asked whether they worked in shifts or night shifts in the first 20 weeks of pregnancy. Overtime hours per week were categorized as *none, 1–20,* and *21 or more*. Hours spent walking or standing per shift were categorized as *4 hours or less* and *5 hours or more*.

Analysis

We calculated frequencies and percentages for general characteristics and pregnancy- and work-related factors. We conducted chi-square tests to determine the relationship between participants'

Women in Western countries are at risk for excessive gestational weight gain, whereas women in Asia are more susceptible to inadequate gestational weight gain.

pre-pregnancy BMI and IOM's GWG recommendations. We performed analyses of variance and chi-square tests to determine the differences in participants' GWG categories according to general characteristics, pregnancy-related factors, work-related factors, and perinatal outcomes. Before conducting the logistic regression analysis, we assessed multicollinearity to ensure that the predictor variables were not highly correlated. We conducted logistic regression analysis for the inadequate versus adequate and adequate versus excessive groups to identify factors that influence GWG. We used SPSS (Version 24.0) for data analysis.

Results

Pre-pregnancy BMI and GWG

Of the 296 participants, we classified 119 (40.2%) as having inadequate GWG, 107 (36.1%) as having adequate GWG, and 70 (23.7%) as having excessive GWG (Table 1). Gestational weight gain differed significantly according to pre-pregnancy BMI ($\chi^2 = 18.22$, $p < .01$). Participants in the underweight pre-pregnancy group gained less than or equal to the IOM recommendations, whereas most of those in the overweight and obese pre-pregnancy groups gained equal to or more than the recommendations. For demographic characteristics of participants, see Table 2.

General Characteristics, Pregnancy- and Work-Related Factors, and GWG

Gestational weight gain differed significantly according to average overtime hours per week ($p = .03$). In a post hoc analysis, we conducted additional chi-square tests for the inadequate versus adequate, inadequate versus excessive, and adequate versus excessive groups. Bonferroni and Dunn corrections resulted in $p = .017$. The results of the post hoc analysis were not significant.

Factors Associated With GWG

In the logistic regression analysis to compare adequate versus excessive GWG, we used the adequate group as the reference group (Table 3). Age and fatigue were factors significantly associated with excessive versus adequate GWG (Table 3). Each 1-year increase in age was associated with lower odds of excessive GWG (odds ratio (OR) = 0.89, 95% confidence interval (CI) [0.79, 0.99]). The odds of excessive GWG were higher among participants who experienced higher levels of fatigue than among those who experienced lower levels (OR = 1.08, 95% CI [1.01, 1.15]). The results were not statistically significant in the logistic regression analysis comparing inadequate versus adequate GWG (data not shown).

Discussion

We used data from the KNHS to examine factors related to excessive and inadequate GWG among Korean nurses. In a recent population-based study conducted in the United States, Cao et al. (2022) reported that 2.9%, 40.7%, and 56.4% of pregnant women had inadequate, adequate, and excessive GWG, respectively, which indicated that more than half exceeded the recommended weight gain. In contrast, we found that 40.2%, 36.1%, and 23.7% of participants experienced inadequate, adequate, and excessive GWG, respectively. In a meta-analysis of 63 studies from 29 countries, researchers found that North American countries had the highest prevalence of excessive GWG, whereas Asian countries had the highest prevalence of inadequate GWG (Martinez-Hortelano et al., 2020). Although the participants in our study were generally healthy nurses who did not experience pregnancy complications and were active rather than sedentary, our finding that nearly half gained less than the recommended weight during pregnancy is a concern. More studies among Korean women with various occupations and socioeconomic statuses need to be conducted in the future to understand the trends and the modifiable factors in GWG.

The participants in this study were Korean nurses; however, Asian women in other countries or settings may share similarities with the Korean population (Cho & Kang, 2025; Shin & Kim, 2019). Compared with nurses in the United States, Korean nurses had lower intentions to stay at their current workplaces, were less satisfied with their professions, and evaluated their job-related conditions significantly lower (Han et al., 2024). The shift work environment of South Korean nurses can impose significant challenges and health risks during pregnancy. Begtrup et al. (2019) investigated a large cohort of 22,744 Danish hospital-based employees, including nurses and physicians, and reported an increased risk of miscarriage among pregnant workers engaged in night shifts. Furthermore, clinical duties that require constant standing increase the risk of pregnancy

complications, and nurses and midwives who were pregnant had higher rates of preterm birth, miscarriage, and cesarean than women in other professions (Celikkalp & Yorulmaz, 2017). Therefore, considering nurses' work environment as a potential risk factor is essential for understanding the phenomenon of GWG.

In our study, 40.2% of the participants gained an inadequate amount of weight during pregnancy. Choi et al. (2020) conducted a retrospective study of Korean women and found that inadequate GWG was related to preterm premature rupture of membranes, small-for-gestational-age infants, and NICU admission in women considered underweight before pregnancy. We are unaware of how knowledgeable nurses or women in Korea are about adequate GWG and these potential effects on maternal and fetal health. Further research is needed to assess women's knowledge about recommendations for GWG, and it is important to allow women to make decisions about diet, nutrition, and activity level after they learn about healthy weight gain before and during pregnancy. Thus, more information on healthy weight gain and related outcomes must be made available and disseminated through health care providers; community health care services; and well-trusted, evidence-based health information resources such as government-supported websites.

In our study, the GWG groups differed depending on average overtime hours worked per week. Although post hoc analyses did not show significant differences, we can infer that working overtime affects GWG among nurses. In a previous meta-analysis of 29 studies that included 374,863 participants, Zhu et al. (2020) found that long working hours can be a risk factor for weight-related outcomes such as weight gain, overweight, and obesity. Given that staff nurses provide direct hands-on care and patient education rather than working at a desk, overtime can extend their working hours and increase physical strain. Furthermore, most nurses in Korea work in shifts, meaning that their working hours are unlikely to be flexible. Although Korea has policies to protect pregnant women, such as reduced working hours and restrictions on night shifts, whether these polices are fully implemented is not clear.

We found that older age and higher levels of fatigue were factors significantly associated with excessive GWG. Specifically, the odds of excessive GWG were higher among women with greater fatigue, whereas older age was associated with lower odds of excessive GWG. Additional research is required to elucidate why age and fatigue are associated with excessive GWG. For example, pre-pregnancy BMI may be a confounding variable for age, and emotional or binge eating could be moderating or mediating factors for the risk associated with fatigue. However, health care providers must remain attentive to the risk factors for excessive GWG when supporting women who are pregnant or planning to become pregnant. Furthermore, stakeholders of hospitals and health care institutes must improve flexibility for pregnant nurses, including working hours and schedules.

Approximately 40% of Korean nurses had inadequate gestational weight gain, whereas 23.7% had excessive weight gain.

We did not identify any significant predictors of inadequate GWG. This aligns with the recent findings of Cho and Kang (2025), who reported no significant predictors for inadequate GWG despite examining a range of potential factors, including self-efficacy, attitudes toward weight gain, body image, feelings about the motherhood role, and stress coping. Gestational weight gain is a multifaceted phenomenon influenced by anthropometric, psychosocial, and cultural factors. Given that more Korean women experience inadequate rather than excessive GWG, this issue requires reexamination through in-depth qualitative research. This approach could offer new insights into culturally appropriate interventions for Korean women.

Limitations

Our study had several limitations. First, as a secondary analysis, we could not evaluate missing data such as infant weight, social support, and information regarding the working environment. In addition, all data in this study were self-reported by the participants, which can introduce bias from factors such as social desirability, memory limitations, and misinterpretation of questions. Therefore, future researchers should consider more objective data collection methods to enhance accuracy. Behavioral factors such as alcohol consumption, smoking, drug abuse, and physical exercise should also be considered in future studies of inadequate and excessive GWG among Korean women. When more data are accumulated, the optimal criteria for GWG among Korean women should be reassessed as in studies conducted in Japan (Shindo et al.,

Table 3: Summary of Logistic Regression of Factors Associated With Excessive Weight Gain

				95% CI		
Variable	*B*	*SE*	OR	LL	UL	*p*
Age, years	−.120	.057	0.89	0.79	0.99	.037
Education level						
3-year college			Reference			
4-year college	−.018	.381	0.98	0.47	2.07	.962
Master's degree or higher	−.220	.714	0.80	0.20	3.25	.758
Annual income (USD)						
<30,000			Reference			
30,000–39,999	.667	.433	1.95	0.84	4.55	.123
≥40,000	.722	.529	2.06	0.73	5.81	.172
Parity						
0			Reference			
≥1	.703	.451	2.02	0.84	4.89	.119
Pregnancy intention						
No			Reference			
Yes	−.253	.500	0.78	0.292	2.069	.613
Nausea and vomiting						
No			Reference			
Yes	−.502	.405	0.61	0.27	1.34	.215
Shift work during early pregnancy						
No			Reference			
Yes	−.236	.393	0.79	0.37	1.71	.549
Average overtime hours per week during early pregnancy						
None			Reference			
1–20	−.767	.452	0.46	0.19	1.13	.090
≥21	.540	.667	1.72	0.46	6.34	.418
Average standing working hours per day during early pregnancy						
0–4			Reference			
≥5	.186	.401	1.20	0.55	2.64	.643
Pre-pregnancy BMI						
Normal			Reference			
Overweight/Obese	.392	.551	1.48	0.50	4.35	.476
Fatigue	.077	.033	1.08	1.01	1.15	.018
Sleep	−.007	.043	0.99	0.91	1.08	.875

Note. $N = 161$. B = unstandardized regression coefficient; OR = odds ratio; CI = confidence interval; LL = lower limit; UL = upper limit; BMI = body mass index. $p < .05$ values are considered statistically significant.

2019) and China (Tan et al., 2018). We did not identify any factors associated with inadequate GWG, even though 40.2% of the participants fell into this category. Thus, researchers need to further explore factors that may influence inadequate GWG among Korean women.

Implications

Health care providers should carefully consider a woman's age, fatigue level, and pre-pregnancy BMI when planning a comprehensive health promotion strategy for pregnancy. For women, greater awareness is needed regarding the importance of appropriate GWG for health and its long-term effects on mothers and infants. Information regarding GWG should be included in all prenatal education, prenatal visits and checklists, and counseling programs with clinicians who care for pregnant women or women who are planning to become pregnant. Targeted interventions and supportive work environments are required to address these risks.

Conclusion

Our results emphasize the importance of recognizing GWG as a maternal and infant health indicator, although caution is needed when generalizing these findings beyond the study population. Counseling on appropriate GWG should be included in pre-pregnancy education and prenatal care. Moreover, policies designed to protect pregnant workers, such as limits on night shifts and reduced working hours, must be actively enforced to safeguard maternal and fetal well-being. Further research is needed to explore culturally and occupationally relevant risk factors for GWG in diverse populations.

CONFLICT OF INTEREST

The authors report no conflicts of interest or relevant financial relationships.

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