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Original article

Women's Employment in Industries and Risk of Preeclampsia and Gestational Diabetes: A National Population Study of Republic of Korea

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ABSTRACT

Background: Some working conditions may pose a higher physical or psychological demand to pregnant women leading to increased risks of pregnancy complications.
Objectives: We assessed the association of woman's employment status and the industrial classification with obstetric complications.
Methods: We conducted a national population study using the National Health Information Service database of Republic of Korea. Our analysis encompassed 1,316,310 women who experienced first-order live births in 2010–2019. We collected data on the employment status and the industrial classification of women, as well as their diagnoses of preeclampsia (PE) and gestational diabetes mellitus (GDM) classified as A1 (well controlled by diet) or A2 (requiring medication). We calculated odds ratios (aORs) of complications per employment, and each industrial classification was adjusted for individual risk factors.
Results: Most (64.7%) were in employment during pregnancy. Manufacturing (16.4%) and the health and social (16.2%) work represented the most prevalent industries. The health and social work exhibited a higher risk of PE (aOR = 1.11, 95% confidence interval [CI]: 1.03–1.21), while the manufacturing industry demonstrated a higher risk of class A2 GDM (1.20, 95% CI: 1.03–1.41) than financial intermediation. When analyzing both classes of GDM, women who worked in public administration and defense/social security showed higher risk of class A1 GDM (1.04, 95% CI: 1.01, 1.07). When comparing high-risk industries with nonemployment, the health and social work showed a comparable risk of PE (1.02, 95% CI: 0.97, 1.07).
Conclusion: Employment was associated with overall lower risks of obstetric complications. Health and social service work can counteract the healthy worker effect in relation to PE. This highlights the importance of further elucidating specific occupational risk factors within the high-risk industries.

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1. Introduction

In most industrial countries, much of the young workforce consists of women in their reproductive age. Because workers are more likely to be exposed to long working hours, prolonged standing, heavy lifting, or unusual workloads than nonemployed people, which may pose a higher physical demand to pregnant women, working during pregnancy has been presumed to be associated with increased risks of pregnancy complications [1,2]. Employers are required to minimize reproductive hazards in the workplaces and protect pregnant women workers.

Preeclampsia (PE) and gestational diabetes mellitus (GDM) are obstetric complications characterizing a major cause of maternal and perinatal morbidity and mortality [3]. Both complications develop in the middle or late stage of gestation. PE affects pregnancies after 20 weeks of gestation posing a higher risk of perinatal complications for mothers and their babies [4]. Most cases of PE are mild and resolve soon after the delivery, but 5–10% of affected women suffer from fatal complications or maternal near-miss event [5]. Nulliparity, advanced age (≥40 years), obesity, family history, underlying medical conditions, and multiple gestations are associated with higher risk of PE [6].

GDM is defined as hyperglycemia newly detected during pregnancy and occurs in 1–25% of all pregnancies varying across ethnic groups [7]. GDM increases risk of late onset PE and shares a common set of risk factors such as prepregnancy obesity with PE [8], indicating an interrelated etiology. When blood glucose is controlled adequately without medication, it is categorized as class A1 GDM. If hypoglycemic treatment to regulate the blood glucose is required, class A2 GDM is assigned [9]. GDM poses elevated risks of macrosomia of the offspring and contributes to the escalating prevalence of childhood obesity and cardiometabolic disorders among women [10].

The causes of both PE and GDM are not fully understood, and whether nonmedical conditions such as occupational status affect them is still poorly defined. Exposure to toxic chemicals, lifting, prolonged standing, and extended working hours during pregnancy may increase some inflammatory responses induced by stress hormones and contribute to the development of PE or GDM [11]. Given that 67% of workforce are women worldwide [12], identifying high-risk industries would be necessary to develop effective interventions minimizing the risk of obstetric complications. The epidemiological studies showed conflicting results, limited by the low prevalence of occupational risk factors in the study populations [13]. This study was to assess the association of women's employment status and the industrial classification, where the woman is employed with the risk of PE and GDM, using a national population cohort data.

2. Materials and methods

2.1. Data

This is a retrospective observational study using the customized research database from the National Health Information (NHI) Service of Republic of Korea (https://nhiss.nhis.or.kr). The characteristics of the NHI database is described elsewhere [14]. Briefly, this database contains general demographics, including employment status (based on the type of NHI subscription), industry classification of the employment, household income in percentiles, residential district, and clinical information on diagnoses, prescribed medications, procedures, and treatments covered by the NHI for every visit to a health institution. The NHI covers 97.7% of the Korean population as a universal health insurance system managed by the government of Republic of Korea, and the rest of the population are medical aid beneficiaries [15]. Medical aid program is a public program that covers health services needed for those with the lowest income (30% of national median), unable to work, or with serious illnesses [16]. The treatment codes for obstetric delivery in the NHI database specify the parity of women and plurality of the pregnancy (Table S1). We identified a national cohort of 2,053,234 live births between January 2010 and December 2019, based on treatment codes. The study population included those who had ever taken health examination at least once in the period and thus had baseline clinical data. In cases where multiple health examination data were available prior to pregnancy, we opted to select the one that was closest in time to the onset of pregnancy. We restricted our analysis to those with the health check-up data prior to the pregnancy. Medical aid beneficiaries and multiparous women were further excluded to minimize possible confounding by maternal general health status and prior history of obstetric outcomes. Including only primiparous women validates single episode of childbirth in each woman. This yielded the final study population of 1,316,310 pregnant women (Fig. 1). Given that approximately 56% of all births are first-order babies in Republic of Korea, this is 90% of all births from primiparous women recorded in the national vital statistics for the same period [17].

2.2. Exposures

Employment status and industry classification of the company at the time of childbirth were recorded based on the industrial codes of the NHI subscription data of the same year. We divided the study population into employed and nonemployed (dependent of employee NHI subscribers and NHI subscription as business owners or their dependents). Then, we further classified the employed population by industry classifications based on the International

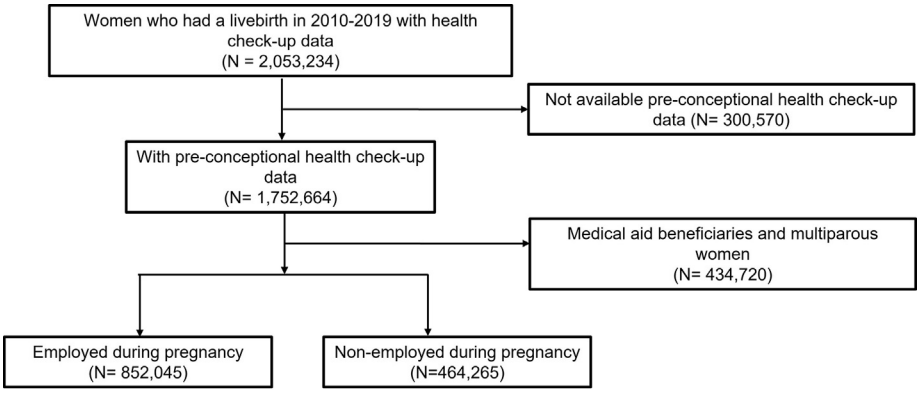

Fig. 1. Selection flow of the study population.

Standard Industrial Classification of All Economic Activities (ISIC) Revision (Rev) 3.0.13 adopted by the NHI database [18]. The industrial classifications that employ more than 5% of all women in the workforce were considered common and were selected for analysis of employed women.

2.3. Outcomes

We identified those who had ever been diagnosed with PE and GDM during pregnancy based on the presence of the International Classification of Disease-10th Revision (ICD-10) codes. Those for PE were O14.0 (mild to moderate PE), O14.1 (severe PE), O14.2 (Hemolysis, Elevated Liver enzymes and Low Platelets [HELLP] syndrome), and O14.9 (unspecified PE) during the pregnancy, which is defined as 280 days within the date of delivery [19]. Women who progressed to eclampsia were included who also had the diagnostic codes for PE. Women with GDM were identified based on the presence of diagnostic code for GDM (O24.4 or O24.9) [20]. Given the favorable prognosis of class A1 GDM, which is well controlled by diet, we analyzed the risk of class A2 GDM that requires medications for glucose control [8]. Those with class A2 GDM were identified based on the copresence of diagnostic code and prescription of insulin or oral hypoglycemic medications under the diagnosis of GDM.

2.4. Covariates

We included maternal age at birth, relative level of income (in deciles), living in the Seoul capital area, prepregnancy body mass index (BMI), smoking, fasting blood glucose, plurality, and year of childbirth in the explanatory model. The variables were selected according to prior knowledge and availability in the NHI database. The age of pregnant women at the time of childbirth, which is grouped by a five-year interval. The income decile was further divided into four groups (1st quartile [most deprived]: 0–30%, 2nd quartile: 40–60%, 3rd quartile: 60–80%, and 4th quartile [richest]: 80–100%) for analytical convenience. We coded living in the Seoul Metropolitan Area, which includes Seoul, Incheon, and Gyeonggi province as a proxy for high socioeconomic status because they are central urban areas with relatively high costs of living and better accessibility to healthcare services [21]. Clinical data of prepregnancy BMI (classified as underweight, normal weight, overweight, and obesity), fasting blood glucose (normal, impaired glucose tolerance, diabetic), and multiple gestation (multiple, singleton) were included as categorical variables.

2.5. Statistical analysis

This study comprises a four-step analysis. First, we compared the demographic and clinical characteristics of mothers according to employment status and industrial classification. In the analysis to identify the high-risk industry, eight prevalent industrial classifications were examined, encompassing over 95% of the study population who were employed. Second, odds ratios adjusted for covariates (aORs) of PE and class A2 GDM were computed per employment status and industrial classifications. Our logistic regression model included financial intermediation as a reference because women employed in this industry showed lowest incidence of adverse pregnancy outcomes and can be assumed to be with least physical hazard, which is associated with obstetric complications [22]. Class A2 GDM rather than all GDM was selected for the primary analysis because the incidence of class A2 GDM was comparable to that of PE. Third, multinomial logistic regression analysis to further examine the risk for class A1 and A2 GDM. Fourth, we compared the risk of obstetric complications between the high-risk industry and nonemployment to assess whether the risks for those industries are higher than those of nonemployment, counteracting the healthy worker effect. In all the analyses of GDM, we excluded those with fasting blood glucose ≥126 mg/dl who are supposed to have pre-existing diabetes. In our explanatory models, BMI can be both confounder and mediator. We thus presented two sets of risk estimates: one set without adjustment for prepregnancy BMI and another set adjusted for all covariates including BMI. This study was conducted using the SAS statistical program (version 9.4, SAS institute, Cary, NC). The study protocol was reviewed and approved by the Institutional Review Board of Republic of Korea University (IRB-2020-0285).

3. Results

Among the 1,316,310 women, 64.7% (852,045) were employed at the time of childbirth (Table 1). Majority of women were aged under 35 years (72.4%) and had singleton pregnancy (97.9%). Almost a half of women were living outside of Seoul capital area (47.4%) and with lower than national median income (45.0%). Employed women were more likely to be younger, having lower income, and experiencing singleton pregnancy. The prevalence of underweight (BMI: <18.5kg/m^2) was higher among employed women, whereas impaired glucose intolerance and history of preconceptional smoking were more common among nonemployed women.

Table 1
Demographic and clinical characteristics of mothers according to employment status (n = 1,316,310)

Variables	Employed	Nonemployed	P for difference
	n = 852,045	n = 464,265	
Maternal age (years)			
20–24	15,939 (1.9)	10,335 (2.2)	<.001
25–29	227,344 (26.7)	106,521 (22.9)	
30–34	460,563 (54.1)	223,190 (48.1)	
35–39	131,218 (15.4)	98,095 (21.1)	
40–44	16,339 (1.9)	24,883 (5.4)	
≥45	549 (0.1)	1142 (0.2)	
Residence			
Outside of the Seoul Metropolitan Area*	615,127 (72.2)	359,937 (77.5)	<.001
Income Level			
1Q (lowest)	154,486 (18.1)	76,243 (16.4)	<.001
2Q	258,189 (30.3)	101,051 (21.8)	
3Q	325,854 (38.2)	174,583 (37.6)	
4Q (richest)	113,516 (13.3)	112,388 (24.2)	
Disability Status			
Disability	3164 (0.4)	2412 (0.5)	<.001
Plurality			
Multiple gestation	19,578 (2.3)	14,557 (3.1)	<.001
Pre-conceptional BMI (kg/m^2)			
<18.5	363,512 (42.7)	171,338 (36.9)	<.001
18.5–25	416,556 (48.9)	258,183 (55.6)	
25–30	60,871 (7.1)	28,308 (6.1)	
>30	11,106 (1.3)	6436 (1.4)	
Pre-conceptional fasting blood glucose			
Normal (<100 mg/dl)	805,147 (94.5)	428,805 (92.4)	<.001
Impaired glucose tolerance (100–125 mg/dl)	43,878 (5.2)	33,145 (7.1)	
Diabetes (≥126 mg/dl)	3020 (0.4)	2315 (0.5)	<.001
Pre-conceptional smoking	33,348 (3.9)	43,522 (9.4)	<.001

1Q, lowest quartile; 2Q, 2nd lowest quartile; 3Q, third quartile; 4Q, fourth (highest quartile). BMI, body mass index. All compositions were significantly different between the two groups due to differences in size and the large sample size.

* Seoul capital area includes Seoul, Incheon, and Gyeonggi Province, located in northwestern Republic of Korea.

Table 2
Number and percentage of employed women by industrial classifications (n = 852,045)

Industrial classification	Frequency	Percentage
Agriculture, hunting, and forestry	940	0.1%
Fishing	480	0.1%
Mining and quarrying	333	0.0%
Manufacturing	140,020	16.4%
Electricity and gas and water supply	2896	0.3%
Construction	19,672	2.3%
Wholesale and retail trade	81,592	9.6%
Hotels and restaurants	13,373	1.6%
Transport, storage, and communications	25,364	3.0%
Financial intermediation	61,156	7.2%
Real estate, renting, and business activities	102,940	12.1%
Public administration and defense/social security	46,933	5.5%
Education	101,172	11.9%
Health and social work	138,177	16.2%
Community, social, and personal service activities	49,173	5.8%
Private households with employed persons	1800	0.2%
Extraterritorial organizations and bodies	563	0.1%
Others	65,461	7.7%
Total	852,045	100.0%

The industrial classifications that employ more than 5% of all women in the workforce were bolded.

Among the employed women, manufacturing (16.4%) and health and social work (16.2%) were two most frequent industrial classifications. (Table 2). In the eight common industrial classifications, public administration and defense/social security showed highest proportion of women aged 35 or older (23.5%, Table S2). Those aged 35 years or older were lowest in health and social work (13.5%) and manufacturing (14.3%). Financial intermediation exhibited the highest prevalence of richest national income quartile and lowest obesity rate, whereas those with the lowest national income quartile were most frequent in education. Preconceptional smoking was more common in the wholesale and retail trade, and real estate, renting, and business activities.

Overall incidence of PE and class A2 GDM were 1.6% (21,172/1,316,310) and 0.7% (9,068/1,310,975), respectively. Employed women showed lower risk of PE (aOR = 0.91, confidence interval [CI]: 0.88, 0.93) and class A2 GDM (0.80, 95% CI: 0.75, 0.85) than nonemployed women with and without adjusting for prepregnancy BMI (Table 3). In the eight common industrial classifications, health and social work was associated with higher odds of PE (1.11, 95% CI: 1.03, 1.21, Fig. S1) than financial intermediation. Public administration and defense/social security (0.88, 95% CI: 0.79, 0.98) and education (0.91, 95% CI: 0.83, 0.99) showed lower risk of PE. Community, social, and personal service activities were associated with higher odds of PE when not adjusted for BMI but the positive association (1.11, 95% CI: 1.00, 1.22), which became close to null when further adjusted for BMI. For class A2 GDM, manufacturing industry was associated with higher risk than financial intermediation with or without adjustment for prepregnancy BMI (1.20, 95% CI: 1.03, 1.41). Real estate, renting, and business activities (1.19, 95% CI: 1.01, 1.40 when not adjusted for prepregnancy BMI), and community, social, and personal service activities (1.22, 95% CI: 1.00, 1.47) were associated with higher risk of class A2 GDM, which became close to null when adjusted for BMI. The pattern of association was different between class A1 and class A2 GDM for most industrial classifications (Table S3). For example, manufacturing, wholesale and retail trade, and real estate, renting, and business activities were associated with lower risk of class A1 GDM, whereas those industries were associated generally higher risk of class A2 GDM. On the other hand, there was an inverse association between health and social work and class A1 GDM, which was not evident for class A2 GDM. When comparing the two high-risk industrial classifications with nonemployment, a similar risk of PE (1.02, 95% CI: 0.97-1.07; Fig. 2) was observed for women employed in the health and social work industry (n = 138,177) compared to nonemployed women (n = 464,166). Those in manufacturing industry (n = 140,020) showed lower risk of class A2 GDM (0.88, 95% CI: 0.79, 0.97) than nonemployed women.

4. Discussion

We observed lower overall risk of PE and GDM requiring medication in employed women than in nonemployed women in a national population of Korean women. When stratified by eight ISIC industrial classifications; the risks of PE and of GDM were different across the categories among employed women. Compared to financial intermediation, employment in the health and social work or manufacturing industry were associated with higher risks of PE and GDM requiring medical treatments, respectively. The association between industrial classifications and GDM exhibited some inconsistent pattern for class A1 and A2 GDM. The risk of PE in the health and social service work industry was found to be comparable to that of nonemployment. Using a large population data, this finding revealed a healthy worker effect in pregnant women for obstetric complication, and being employed in the high-risk industry can counteract the healthy worker effect regarding PE.

The relationship of employment status with pregnancy outcomes in PE and GDM is largely unknown and inconsistent. In a large population cohort study in the Netherlands, there were no statistically significant differences in risks of PE and GDM between employed and unemployed groups, which included housewives or students [23]. On the other hand, risk of change in mean arterial pressure (≥20 mm Hg after 20 weeks gestation from baseline) was more than doubled in working women during pregnancy than in their counterparts [24]. Other pregnancy outcomes, such as preterm birth or low birth weight, were often more favorable for employed women than for unemployed women. This can be explained by the heterogenicity in unemployed/employed groups and the pathophysiology of the outcomes of interest. Historically, the favorable health outcomes in workers have been interpreted as a 'healthy worker effect' where those in better health status are more likely to remain in paid employment than unhealthy people [25]. Similarly, we observed lower risk of class A2 GDM in those employed in manufacturing industry than in nonemployed women. The similar risk of PE between health and social work and nonemployment may be translated into higher risk of PE among women in the health and social work.

Several work-related risk factors for PE, which are expected to be prevalent in health and social service work or manufacturing works, have been suggested. Women in an occupation with lower levels of decision authority had higher risk of PE and GDM than those in occupations with the highest levels of decision authority [26]. Job strain including heavy lifting was associated with an increase in the odds of PE in a study [27], whereas job strain measured with postpartum questionnaires was not found to be associated with PE [28]. Prolonged working hours were associated with higher risk of PE in a Canadian study [29], which was not replicated in other populations [30]. Unusual or physically

Table 3
Adjusted odds ratio of preeclampsia and class A2 gestational diabetes for women's employment status and eight common industrial classifications

Employment status of women	Preeclampsia (n = 21,172)			Class A2 gestational diabetes (n = 9,068)		
	N	Not adjusted for BMI	Fully adjusted*	N	Not adjusted for BMI	Fully adjusted†
Nonemployed (n = 464,166)	8221	1.00 (reference)	1.00 (reference)	4123	1.00 (reference)	1.00 (reference)
Employed (n = 851,952)	12,951	0.92 (0.89, 0.94)	0.91 (0.88, 0.93)	4945	0.8 (0.75, 0.85)	0.80 (0.75, 0.85)
Industrial classification‡						
Financial intermediation (n = 61,156)	849	1.00 (reference)	1.00 (reference)	355	1.00 (reference)	1.00 (reference)
Manufacturing (n = 140,020)	2134	1.05 (0.97, 1.14)	0.99 (0.91, 1.07)	1571	1.27 (1.08, 1.49)	1.20 (1.03, 1.41)
Wholesale and retail trade (n = 81,592)	1249	0.99 (0.91, 1.09)	0.97 (0.88, 1.06)	772	1.17 (0.98, 1.39)	1.13 (0.95, 1.34)
Real estate, renting and business activities (n = 102,940)	1542	0.99 (0.90, 1.07)	0.95 (0.87, 1.04)	894	1.19 (1.01, 1.40)	1.15 (0.98, 1.36)
Public administration and defense/social security (n = 46,933)	676	0.88 (0.79, 0.98)	0.88 (0.79, 0.98)	287	0.90 (0.73, 1.11)	0.93 (0.75, 1.14)
Education (n = 101,172)	1496	0.92 (0.85, 1.01)	0.91 (0.83, 0.99)	486	0.93 (0.78, 1.10)	0.92 (0.77, 1.09)
Health and social work (n = 138,177)	2376	1.16 (1.07, 1.25)	1.11 (1.03, 1.21)	682	1.13 (0.96, 1.33)	1.07 (0.91, 1.26)
Community, social and personal service activities (n = 49,173)	857	1.11 (1.00, 1.22)	1.06 (0.96, 1.17)	446	1.22 (1.00, 1.47)	1.18 (0.98, 1.43)

BMI, body mass index.
* adjusted for maternal age at birth, relative level of income (in deciles), employment status, living in the Seoul Metropolitan Area, pre-pregnancy body mass index (BMI), past smoking, fasting blood glucose, plurality, and year of childbirth.
† adjusted for maternal age at birth, relative level of income (in deciles), living in the Seoul capital area, pre-pregnancy body mass index (BMI), pre-conceptional smoking history, plurality, and year of childbirth.
‡ Eight from the 18 industrial classifications based on the International Standard Industrial Classification of All Economic Activities (ISIC) Revision (Rev) 3.0.13 adopted by the NHI database. Numbers in parentheses are 95% confidence intervals of risk estimates. Estimates with P value < 0.05 are bolded.

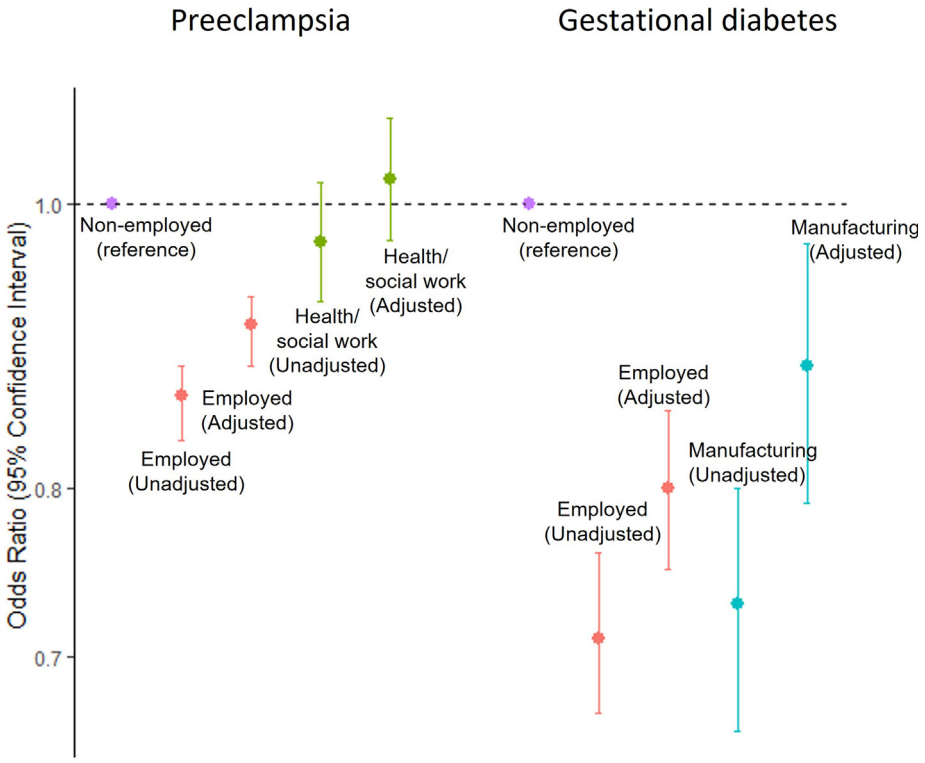

Fig. 2. Unadjusted and adjusted odds ratios of preeclampsia and class A2 gestational diabetes mellitus based on employment status and employment in health/social work and manufacturing industries. Risk estimates were adjusted for maternal age at birth, relative level of income (in deciles), living in the Seoul Capital Area, prepregnancy body mass index, past smoking, plurality, and year of childbirth. In the analysis of gestational diabetes mellitus, those with fasting glucose ≥126 mg/dl who are supposed to have pre-existing diabetes were excluded.

demanding conditions in the workplace seem to increase the risk of PE in pregnant workers. For example, the risk of severe PE was a two-fold increase in moderate/high physical activity at work compared to mild activity, even though pregnant workers were at significantly lower risk of severe PE than nonworkers [31]. The doctors, nurses, and other health care providers comprise health and social workers who are likely to experience prolonged work hours, overnight shifts, low authority, and occupational hazard

[32,33]. Compared to bank workers, healthy workers continued their work until the last month of pregnancy and had shorter maternity leaves with a significantly higher risk of preterm deliveries and lower birth weight babies [33]. PE occurred more frequently among female medical residents with longer work time or more physically demanding work than the wives of medical residents [34] or the general population [35]. Considering the inherent limitations and variabilities in measuring occupational exposures, it is crucial to identify high-risk occupational groups and subsequently focus on pinpointing specific individual risk factors within those occupations. This approach can lead to more consistent and comparable conclusions.

For GDM, a few large cohort studies have found the impact of job exposure in pregnancy on GDM. In Sweden's population-based studies, pregnant workers with low decision authority [26], exposure to whole-body vibration during full-time work [36], and exposure to noise [37], particularly in primipara who work full-time, were related to increased risk for GDM. Moreover, lack of sleep during pregnancy also increased random blood glucose significantly and exhibited elevated risk for GDM [38].

Several mechanisms of how work activity could lead to PE or GDM during pregnancy have been suggested. Firstly, multiple maternal occupational factors (heavy physical workload, long working hours, and psychological stress) may interact and increase catecholamine levels [39] that have been present in pregnancies complicated by PE [40]. High-level catecholamines may lead to decrease blood flow to the uterus and reduce placental function, which is proposed as the main pathophysiology of PE. Secondly, shift work, sleep abnormality, and stress may lead to changes in hormone regulation. Increasing corticotropin-releasing hormones have been found in women with PE [41], and increasing cortisol as an insulin antagonist and adipogenesis-regulating signal can contribute to insulin resistance [42]. With reduced secretion of melatonin due to circadian disruption and sleep deprivation [43], stress can also increase oxidative stress and pro-inflammatory cytokines, which are associated with an increased risk of developing PE and GDM [44]. However, all these hypotheses remain unclear and need further investigation.

Our study needs caution in interpretation due to several limitations. First, direct comparing of our results with prior findings may be inappropriate because this study used industrial classification rather than individual occupation. In addition, our measurement of occupational exposure based on the industrial classification may be too broad to make inferences about specific occupations within each category. As an explorative study of occupational risk factors for PE and GDM, which has not been much studied, our findings can provide background knowledge to identify industries that may pose a higher risk for obstetric complications. For those working in the high-risk industries, further research will be needed to elucidate the specific mechanisms and effective interventions required to mitigate these risks. Second, our analysis did not consider possible confounding in the association occupation and PE including pregnancy following assisted reproductive technology, undiagnosed chronic hypertension, and autoimmune disease. Our analysis is restricted to nulliparous pregnant women, which could have minimized the effect of confounders related with previous pregnancy. Third, because of different policy of maternity leave or misclassification of women in the part-time jobs, our risk estimation could have been biased. Considering the female employment rate in 2019 among Korean women aged between 20 and 44 years ranged from 59.9% to 71.1%, which aligns closely with the employment rate (64.7%) in our study population, the likelihood of significant misclassification or selection bias would be minimal. In the specific context of our study conducted in Republic of Korea, women employees were permitted to take a maximum of 45 days of leave before childbirth during the study period [45]. Thus, we believe the potential confounding effect by the maternity leave would have been minimal. For part-time work, those in part-time employment subscribe to the NHI as non-employed individuals because they are not eligible for the NHI for employees. In addition, because the NHI database provides the information of employment status and industrial classification as of January 1st each year, it remains uncertain whether their employment status was consistent throughout the entire period of pregnancy. Considering the potential misclassification of employment status or industrial classification, estimating the risk of obstetric complications using more detailed occupational exposure would be the subject of future studies.

In conclusion, this study provides empirical evidence of differential risk of maternal complications across women's employment and occupational categories to prevent and reduce the incidence of PE and GDM in women workers, considering workplace environment.

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Conflicts of interest

All authors declare that they have no conflict of interest.

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This study used the customized research database from the National Health Insurance Data Sharing Service (NHIS-2021-1-211). The conclusion of this study is not related with these institutions.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.shaw.2023.08.002.

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