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Workplace Stress And Pregnancy Complications: A Cross-Sectional Study Among Working Pregnant Women

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Abstract

Background: Workplace stress during pregnancy contributes to adverse maternal-fetal outcomes, including preterm birth, low birth weight, and pregnancy-induced hypertension. Limited research has examined this relationship in the Indonesian population. Objective: This study examined associations between workplace stress levels and pregnancy complications among working pregnant women. Methods: Cross-sectional study involving 160 pregnant women in urban Indonesia using the Work Stress Assessment Scale (WSAS), Pregnancy Experience Scale (PES), and comprehensive demographic questionnaires. Multivariable logistic regression analyzed relationships between workplace stress and pregnancy complications, adjusting for demographic and environmental factors. Results: Participants had an average work stress score of 79.52±11.87, pregnancy experience score of 81.88±11.84, and lifestyle and work environment factors of 80.04±11.60. There was a strong positive correlation between all work stress variables (r=0.818-0.961, p<0.001). Work stress was significantly associated with pregnancy complications in the initial model (OR=0.077; 95% CI: 0.031-0.190; p<0.001); however, the OR below 1.0 likely reflects healthy worker survivor bias rather than a true protective effect. Work stress lost statistical significance in the final model (OR=0.500; p=0.325) after inclusion of lifestyle and work environment factors, which emerged as the sole independent predictor (OR=0.080; 95% CI: 0.018-0.349; p=0.001). Conclusions: While initial models showed significant associations between work stress and pregnancy complications, the final model indicated that concrete work environment factors—such as working hours, rest periods, and physical hazards—were the dominant predictors, mediating the perceived stress-complication relationship. The counterintuitive OR direction and the loss of significance for work stress in the fully adjusted model highlight important methodological limitations of the cross-sectional design. Healthcare providers should incorporate occupational exposure assessment into routine antenatal care, with emphasis on modifiable working conditions.

Keywords: *Occupational Health, Pregnancy Complications, Prenatal Care, Working Pregnant Women, Workplace Stress*

Abstrak

Stres kerja selama kehamilan berkontribusi terhadap luaran maternal-fetal yang merugikan, namun bukti empiris dari konteks Indonesia masih terbatas. Penelitian potong lintang ini melibatkan 160 ibu hamil yang bekerja di perkotaan Bandung menggunakan skala penilaian stres kerja, skala pengalaman kehamilan, dan kuesioner gaya hidup terstruktur. Analisis regresi logistik multivariabel hierarkis menunjukkan korelasi positif kuat pada seluruh variabel stres (r=0,818–0,961, p<0,001). Stres kerja menunjukkan asosiasi signifikan pada model awal (OR=0,077; p<0,001), namun nilai

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OR di bawah 1,0 kemungkinan besar mencerminkan bias seleksi pekerja sehat (healthy worker survivor bias), bukan efek protektif yang sesungguhnya. Pada model akhir, stres kerja kehilangan signifikansi statistik (OR=0,500; p=0,325), sementara faktor gaya hidup dan lingkungan kerja muncul sebagai satu-satunya prediktor independen (OR=0,080; p=0,001). Temuan ini mengindikasikan bahwa kondisi kerja konkret memediasi hubungan antara persepsi stres dan komplikasi kehamilan, meskipun keterbatasan desain cross-sectional perlu diperhatikan dalam interpretasi. Penilaian paparan okupasional perlu diintegrasikan ke dalam pelayanan antenatal rutin dengan penekanan pada modifikasi kondisi kerja.

Kata Kunci: Ibu Hamil Bekerja, Kesehatan Kerja, Komplikasi Kehamilan, Pelayanan Antenatal, Stres Kerja

Introduction

Contemporary workforce participation among women has increased substantially, with many continuing professional duties during pregnancy. This demographic shift raises critical concerns about occupational responsibilities affecting maternal health outcomes. Workplace stress, characterized by psychological and physiological responses to work-related demands exceeding individual adaptive capacity, has emerged as a significant factor potentially affecting pregnancy outcomes and maternal well-being. Recent epidemiological evidence suggests work stress during pregnancy contributes to adverse maternal and fetal outcomes, including premature birth, low birth weight, pregnancy-induced hypertension, and gestational diabetes mellitus. Pathophysiological mechanisms underlying these associations involve complex interactions between stress-induced hormonal cascades, inflammatory responses, and behavioral modifications that collectively harm maternal and fetal health. Chronic workplace stress exposure activates the hypothalamic-pituitary-adrenal axis, leading to elevated cortisol levels and impaired placental functioning, subsequently affecting fetal developmental trajectories (Lissåker et al., 2022).

Contemporary research by Adane et al. (2025) demonstrated that extended working hours (>40 hours per week) initially showed increased preterm birth risk among Australian women, though this association attenuated after adjusting for health and obstetric factors, highlighting the complex interplay between occupational conditions and pregnancy outcomes. Large-scale investigations by Lissåker et al. (2022) involving 1,102,230 singleton births in Sweden revealed that occupations with lower decision authority were associated with 12-23% increased risks for hypertensive disorders and preeclampsia, and 36-58% increased risks for gestational diabetes compared to occupations with the highest decision authority levels. Despite growing recognition of workplace stress as a modifiable risk factor globally, comprehensive research examining this phenomenon in Indonesian contexts remains severely limited. Indonesia, as a lower-middle-income country with suboptimal occupational safety enforcement and inadequate maternity leave policies (International Labour Organization, 2022), requires context-specific empirical data. Research in Indonesia shows preeclampsia prevalence in working pregnant women reaches 12-18%, higher than non-working mothers (8-10%) (Agarwal et al., 2023). Data from the Indonesian Ministry of Health (2023) indicates that 54.2% of maternal complications occur among women of productive working age, with occupational factors increasingly recognized as contributing determinants. A study in Bandung City reported that 67% of working pregnant women in the informal sector lack access to adequate rest facilities, and only 23% receive workplace accommodations during pregnancy. Furthermore, Indonesian labor regulations (PP No. 78/2015) provide limited enforcement mechanisms for pregnant worker protections, particularly in the informal economy where nearly

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half of female workers are employed. Despite these concerning contextual factors, comprehensive studies examining multidimensional relationships between occupational stress and pregnancy outcomes in Indonesian settings remain very limited, with most existing studies focusing on single complication types or employing retrospective designs with high recall bias potential.

Dutch prospective cohort findings by (Vrijkotte et al., 2021) showed prolonged standing/walking during the first trimester associated with increased preterm birth risk (OR=1.5; 95% CI: 1.0-2.3), with highest risk observed for combinations of long workweeks with high physical workload (OR=3.42; 95% CI: 1.04-8.21). Current literature presents inconsistent findings regarding magnitude and direction of relationships between occupational stressors and pregnancy outcomes. These inconsistencies stem from methodological limitations, including cross-sectional designs, retrospective data collection, and inadequate confounding variable control (Nakamura et al., 2022). This knowledge gap is particularly concerning given increasing prevalence of non-standard work arrangements, including shift work, long hours, and job insecurity, which can amplify stress-related pregnancy complication risks (Corchero-Falcón et al., 2023).

This cross-sectional study's primary objective was examining associations between workplace stress levels and pregnancy complications, with specific hypotheses: (1) significant positive correlation exists between workplace stress scores and pregnancy complication incidence (target correlation $r>0.5$; $p<0.05$); (2) pregnant women with high job stress have odds ratio ≥2.0 for experiencing pregnancy complications compared to low stress group after controlling for demographic variables; (3) specific work environment factors (working hours, rest periods, physical hazards) mediate relationships between subjective stress perceptions and pregnancy complications. This investigation addresses critical gaps by employing comprehensive multidimensional approaches, combining validated instruments capturing various work stress dimensions, thereby contributing to evidence on occupational health risks during pregnancy by providing empirical data from Indonesian contexts (Lissåker et al., 2022).

Method

Study Design and Setting

This cross-sectional analytical study investigated relationships between workplace stress and pregnancy complications among pregnant women in Bandung City, West Java Province, Indonesia. This design enabled systematic examination of workplace stress patterns while minimizing participant burden (Biresaw et al., 2022). Bandung City was selected due to its high proportion of reproductive-age women employed in both formal and informal sectors in urban settings, as well as adequate access to antenatal care (ANC) facilities for verification of pregnancy complication data. The study was conducted at primary healthcare centers (puskesmas) and independent midwifery practices (praktik mandiri bidan/PMB) within the Bandung City health service area. Data collection occurred May–August 2025, capturing second and third trimesters when stress manifestations and complications are more clinically identifiable.

Population and Sampling

Sample size formula: $n = [Z^2\alpha \times P(1-P)] / d^2$, with P=15%, Zα=1.96, d=5%, power=80% for OR≥2.0, yielding n=196. After adjusting for design effect (deff=1.2) and non-response (15%), target was 276. Of 188 eligible women approached, 160 agreed to participate (response rate 85%), while 28 declined primarily due to time constraints related to work schedules (n=16), fatigue during ANC visits (n=8), or concerns about confidentiality of workplace-related information (n=4). The final sample of 160 fell short of the calculated target of 276 due to the limited data collection

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window (4 months) and restricted number of participating health facilities (5 puskesmas and 3 PMB). Post-hoc power analysis indicated 78% power to detect OR≥2.5 at α=0.05, which is below the conventional 80% threshold and represents a study limitation. This non-probability sampling potentially introduces selection bias limiting generalizability (Agarwal et al., 2023). Inclusion: ages 20-45 years, trimester 2-3 (13-40 weeks), working ≥20h/week, regular ANC. Exclusion: prior complications, chronic conditions (diabetes, hypertension), multiple pregnancy.

Data Collection Instruments

Work Stress Assessment Scale (WSAS): 30 items, 5 dimensions (workload, job control, social support, role conflict, job insecurity), Likert 1-5, range 30-150, transformed to 0-100 via [(raw-30)/120×100], current range 40-100. Pregnancy Experience Scale (PES) (Liu et al., 2020): 20 items assessing emotional/physical experiences. Complications were verified through structured medical record review and physician diagnosis. Operational definitions: Preeclampsia (BP≥140/90 mmHg twice ≥4h apart + proteinuria ≥300mg/24h or dipstick≥1+ after 20 weeks) (Corchero-Falcón et al., 2023); Gestational diabetes (IADPSG criteria: fasting≥92, 1h≥180, 2h≥153 mg/dL) (American Diabetes Association, 2024); Threatened preterm labor (WHO, 2023) was identified by contractions at intervals ≤10 minutes with concurrent cervical changes before 37 weeks; IUGR (weight<10th percentile, serial ultrasound) (Corchero-Falcón et al., 2023). Content validity: expert panel (CVR>0.80); reliability: WSAS α=0.89, PES α=0.86. Pilot: n=15. Among respondents, 38% reported low workplace social support (Delva et al., 2023).

Quality Control

Double data entry on 20% random sample. Inter-rater reliability: kappa>0.85 (Corchero-Falcón et al., 2023). Missing data: Little's MCAR test, <5% used complete case analysis (Ma et al., 2023).

Table 1. Operational Definition of Variables and Measurement Instruments

Variable	Instruments	Number of Items & Dimensions	Scoring	Categorization	Validity & Reliability
Work Stress	Work Stress Assessment Scale (WSAS)	30 items, 5 dimensions: (1) Workload; (2) Work control; (3) Social support; (4) Role conflicts; (5) Job insecurity	Likert Scale 1-5Range: 30-150Transformation: [(raw-30)/120×100]Current: 40-100	Low: 30-69Medium: 70-109High: 110-150	Cronbach's α = 0.89CVR = 0.82
Pregnancy Experience	Pregnancy Experience Scale (PES)	20 items covering emotional and physical experiences during pregnancy	Likert Scale 1-5Range: 20-100	Positive: 20-46Neutral: 47-73Negative: 74-100	Cronbach's α = 0.86CVR = 0.84
Lifestyle &	Structured	25 items	Likert Scale 1-	Good: 25-	Cr

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Work Environment	questionnaire (developed by researchers, adapted from OSI-R)	include: working hours, rest periods, exposure to physical hazards, ergonomics	5Range: 25-125	58Medium: 59-92Poor: 93-125	onbach's α = 0.87CVR = 0.80
Pregnancy Complications	Medical Record Review + Physician Diagnosis	Binary (Present/Absent)	—	Preeclampsia: TD ≥140/90 mmHg (2× examination, distance ≥4 hours) + proteinuria ≥300mg/24 hours or dipstick ≥1+ Gestational Diabetes: Based on IADPSG criteria (GDP ≥92 mg/dL, 1-hour OGTT ≥180 mg/dL, 2-hour ≥153 mg/dL) Threat of Preterm Labor: Regular contractions (intervals ≤10 minutes) + cervical changes before 37 weeks IUGR: Estimated fetal weight <10th percentile for gestational age (serial ultrasound confirmation)	Int er-rater reliability (Kappa) = 0.85

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Description: CVR = Content Validity Ratio; TD = Blood Pressure; GDP = fasting blood sugar; OGTT = Oral Glucose Tolerance Test; IADPSG = International Association of Diabetes and Pregnancy Study Groups; IUGR = Intrauterine Growth Restriction; ultrasound = ultrasound; OSI-R = Occupational Stress Inventory-Revised.

Statistical Analysis

SPSS version 25. Descriptive statistics summarized characteristics (Nakamura et al., 2022). Normality: Kolmogorov-Smirnov test. Bivariate: Spearman correlations (Khouj et al., 2022). Multivariable logistic regression (hierarchical): Model 1 (stress only); Model 2 (+demographics: age, education, employment); Model 3 (+lifestyle/environment). Diagnostics: VIF<5.0; Hosmer-Lemeshow test; Nagelkerke R^2. Subgroup analyses by trimester and occupation (Lissåker et al., 2022). Significance: $\alpha=0.05$.

Ethics

Ethical approval: TEDC Polytechnic Bandung (079PKE-020425), following Declaration of Helsinki and Indonesian guidelines (Biresaw et al., 2022).

Result

Respondent Demographics

This study involved 160 pregnant women employed in urban areas of Bandung City, Indonesia. All participants met the inclusion criterion of being gainfully employed for a minimum of 20 hours per week; the employment sector classification in Table 2 distinguishes between formal sector workers (n=82, 51.3%) and informal sector workers (n=78, 48.7%). The age distribution showed that the majority of respondents were aged 25–29 years (n=68, 42.5%), followed by the 20–24 years age group (n=52, 32.5%), and the 30–34 years age group (n=40, 25.0%). Based on education level, most respondents had secondary education (n=75, 46.9%), followed by higher education (n=54, 33.7%) and elementary education (n=31, 19.4%).

Blood pressure assessment revealed that 136 respondents (85.0%) had normal blood pressure, while 24 respondents (15.0%) had hypertension. Regarding pregnancy complications, the majority had normal pregnancies (n=115, 71.9%), while 24 respondents (15.0%) were diagnosed with preeclampsia, 9 (5.6%) had threatened preterm labor, 8 (5.0%) had gestational diabetes, and 4 (2.5%) had intrauterine growth restriction (IUGR).

Table 2. Respondent Demographics

Characteristic	Category	n	Percentage (%)
Age	20–24 years	52	32.5
	25–29 years	68	42.5
	30–34 years	40	25.0
Education	Elementary	31	19.4
	Secondary	75	46.9
	Higher Education	54	33.7
Employment Sector	Formal sector	82	51.3
	Informal sector	78	48.7
Blood Pressure	Normal	136	85.0
	Hypertensive	24	15.0
Pregnancy Complications	Normal	115	71.9

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	Preeclampsia	24	15.0
	Gestational Diabetes	8	5.0
	Threatened Preterm Labor	9	5.6
	IUGR	4	2.5
Total		**160**	**100.0**

Descriptive Analysis of Research Variables

The average work stress score was 79.52 (SD=11.87), indicating moderate to high stress levels with scores ranging from 40.00 to 100.00. The pregnancy experience variable showed a mean score of 81.88 (SD=11.84), with scores ranging from 41.00 to 100.00. Lifestyle and work environment factors had a mean score of 80.04 (SD=11.60), with scores ranging from 37.00 to 100.00.

Table 3. Descriptive Analysis

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Work Stress	160	40.00	100.00	79.5187	11.86982
Pregnancy Experience	160	41.00	100.00	81.8813	11.83555
Lifestyle and work environment	160	37.00	100.00	80.0438	11.60478

Data Normality Test

Normality testing of the data using the Kolmogorov-Smirnov test showed that all the main variables were not normally distributed. The work stress variable produced a statistical value of 0.103 with a significance value of 0.000 ($p<0.05$). The pregnancy experience variable showed a statistical value of 0.105 with a significance of 0.000 ($p<0.05$). Similarly, the variables of lifestyle and work environment obtained a statistical value of 0.127 with a significance of 0.000 ($p<0.05$). These three results indicate the rejection of the null hypothesis, so it is concluded that the data are not normally distributed and the subsequent analysis uses non-parametric statistical methods.

Table 4. Normality Test

Normality Test			
	Kolmogorov-Smirnova		
	Statistics	**Df**	**Sig.**
Work Stress	.103	160	.000
Pregnancy Experience	.105	160	.000
Lifestyle and work environment	.127	160	.000
a. Correction of Lilliefors' Significance			

Bivariate Correlation Analysis

Correlation analysis using the Spearman test revealed a very strong and significant relationship between all the research variables. The correlation coefficient between work stress and lifestyle and work environment reached 0.961 with a significance value of 0.000 ($p<0.001$), indicating a very strong positive relationship. The correlation between work stress and pregnancy experience showed a coefficient of 0.818 with a significance of 0.000 ($p<0.001$), indicating a strong positive association where higher work stress corresponded with more negative pregnancy experiences. The association between pregnancy experiences and lifestyle and work environment

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resulted in a correlation coefficient of 0.864 with a significance of 0.000 (p<0.001), suggesting a very strong positive relationship.

Table 5. Bivariate Correlation Analysis (Spearman)

Correlation			Work Stress	Pregnancy Experience	Lifestyle and work environment
Rho Spearman	Work Stress	Correlation Coefficients	1.000	.818**	.961**
		Sig. (2 tails)	.	.000	.000
		N	160	160	160
	Pregnancy Experience	Correlation Coefficients	.818**	1.000	.864**
		Sig. (2 tails)	.000	.	.000
		N	160	160	160

**. The correlation was significant at the level of 0.01 (2-tailed).

Multivariate Logistic Regression Analysis

Multivariate logistic regression analysis was performed through a hierarchical approach with three progressive models to test the independent effects of work stress on pregnancy complications. Model 1 included the work stress variable as the main predictor, resulting in an odds ratio of 0.077 (95% CI: 0.031-0.190) with a significance value of p<0.001 for the high-stress category compared to the low-stress group. Notably, the OR value below 1.0 does not indicate a true protective effect of workplace stress; rather, it most likely reflects methodological artifacts inherent to the cross-sectional design, including healthy worker survivor bias and selection effects, as discussed further below. Model 2 added demographic characteristics as covariates, resulting in an odds ratio of 0.079 (95% CI: 0.031-0.201) for the high-stress category with a sustained significance of p<0.001. The age variable yielded an odds ratio of 2.298 for the age group of 20-24 years with a significance of 0.128 (p>0.05), indicating a non-significant association. Education produced an odds ratio of 1.139 for the basic education category with a significance of 0.807 (p>0.05), while Employment Sector produced an odds ratio of 1.135 for the informal sector category with a significance of 0.775 (p>0.05).

Lifestyle and work environment factors emerged as independent predictors with an odds ratio of 0.080 (95% CI: 0.018-0.349) and significance of 0.001 (p<0.05). In Model 3, age produced an odds ratio of 1.967 (p=0.239), education produced an odds ratio of 1.186 (p=0.758), and employment sector produced an odds ratio of 1.169 (p=0.741).

A critical methodological note regarding the direction of odds ratios is warranted. The OR values below 1.0 for the high-stress category (e.g., OR=0.077 in Model 1) appear counterintuitive, as higher stress would logically be expected to increase complication risk. This pattern most likely reflects healthy worker survivor bias: women experiencing severe stress-related symptoms or early complications may have already reduced working hours or ceased employment entirely, thereby self-selecting out of the study sample. Additionally, highly stressed women attending regular ANC (an inclusion criterion) may represent a health-conscious subgroup whose proactive care-seeking behavior reduces measurable complication rates at assessment. The cross-sectional design cannot capture this temporal dynamic. Consequently, the OR values should not be interpreted as evidence that workplace stress is protective; rather, they reflect methodological constraints inherent to the study design. Future prospective longitudinal studies with repeated stress measurements are essential to clarify the true direction of this association.

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Table 6. Multivariable Logistic Regression - Model 1

Variable	Category	OR	95% CI	p-value
Work Stress (ref: Low)	Moderate	1.76E-20	0.000 – *	0.999
	High	**0.077**	**0.031 – 0.190**	**<0.001**

Table 7. Multivariable Logistic Regression - Model 2

Variable	Category	OR	95% CI	p-value
Work Stress (ref: Low)	High	0.079	0.031-0.201	<0.001
Age (ref: 30-34 years)	20-24 years	2.298	0.787-6.710	0.128
	25-29 years	1.144	0.429-3.053	0.788
Education (ref: Higher)	Elementary	1.139	0.402-3.228	0.807
	Secondary	1.185	0.440-3.190	0.737
Employment Sector (ref: Formal)	Informal sector	1.135	0.477-2.699	0.775

Table 8. Multivariable Logistic Regression - Model 3 (Final Model)

Variable	Category	OR	95% CI	p-value
Work Stress (ref: Low)	High	0.500	0.126-1.988	0.325
Age (ref: 30-34 years)	20-24 years	1.967	0.637-6.072	0.239
	25-29 years	0.900	0.314-2.581	0.844
Education (ref: Higher)	Elementary	1.186	0.400-3.521	0.758
	Secondary	1.192	0.414-3.432	0.744
Employment Sector (ref: Formal)	Informal sector	1.169	0.463-2.950	0.741
Lifestyle & Work Environment (ref: High)	Moderate	0.080	0.018-0.349	0.001

Sensitivity Analysis and Model Diagnostics

Sensitivity analysis was performed by excluding participants who had a borderline diagnosis to assess the robustness of regression findings. The results showed consistency of direction and magnitude of the association, with adjusted odds ratios for work stress ranging from 0.074 to 0.532 across different models, confirming the stability of the observed relationship. Multicollinearity diagnostics revealed acceptable variance inflation factors (VIFs) for all predictors, with values below 2.5, confirming that the regression estimates were not unduly influenced by overlapping predictor variables. Goodness-of-fit evaluation of the model using the Hosmer-Lemeshow test yielded χ^2=4.23 with p=0.836, indicating adequate model calibration. The Nagelkerke R^2 values increased progressively across models, with Model 1 reaching 0.412, Model 2 reaching 0.438, and Model 3 reaching 0.521, demonstrating incremental explanatory capacity with the addition of successive variables.

The subgroup analysis examined whether the association of work stress varied across different occupational and gestational categories and trimesters. The strongest association was observed among shift workers and healthcare professionals (OR=0.42, p<0.05), who reported higher stress scores and greater exposure to irregular work hours as well as emotional demands. As with the main analysis, the OR below 1.0 in this subgroup should be interpreted with caution given the likely influence of healthy worker bias. Women who worked in flexible or freelance positions showed weaker associations. When stratified by trimester, the association between stress and complications was more pronounced in the third trimester than in the second trimester, suggesting a cumulative stress burden effect over time.

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Discussion

Principal Findings and Clinical Significance

This cross-sectional study of 160 pregnant workers provides empirical evidence of statistically significant associations between workplace stress and pregnancy complications in urban Indonesia. Multivariate logistic regression analysis through three progressive models revealed that work stress was significantly associated with pregnancy complications in Models 1 and 2 ($p<0.001$). However, the observed OR values were below 1.0 (e.g., OR=0.077 in Model 1), which does not represent a true protective effect of stress. As discussed in the limitations, this counterintuitive direction most likely reflects healthy worker survivor bias and selection effects inherent to the cross-sectional design. The associations underwent substantial attenuation in Model 3 (OR=0.500, p=0.325) after the inclusion of lifestyle and work environment factors, indicating both a strong mediating effect and the loss of statistical significance for the work stress variable itself. The consistently elevated scores across all stress dimensions indicate that occupational stress burden among working pregnant women in this sample transcends traditional socioeconomic boundaries, affecting women across age groups and education levels. The prevalence of preeclampsia of 15% in this sample substantially exceeded the typical population level, supporting the hypothesis of a connection between occupational stressors and hypertensive pregnancy complications.

Correlation Patterns and Mechanistic Implications

Correlation analysis revealed a very strong positive association between all work stress variables ($r=0.818$-0.961, $p<0.001$), providing robust evidence that work stress operates through interrelated pathways. A very strong correlation between work stress and lifestyle and work environment factors ($r=0.961$) indicates that occupational stressors create a cascading effect that penetrates various dimensions of pregnant women's well-being. This correlation pattern is consistent with established pathophysiological mechanisms that link chronic stress exposure to adverse pregnancy outcomes. Prolonged activation of the hypothalamic-pituitary-adrenal axis in response to workplace stressors leads to sustained elevation of cortisol, which compromises placental function and increases systemic inflammation (Lissåker et al., 2022). These mechanistic pathways are further supported by Kader et al. (2021), whose findings among Swedish healthcare employees confirmed that irregular shift patterns during early pregnancy substantially elevate preterm birth risk, reinforcing our observation that specific occupational exposures exert direct physiological effects beyond subjective stress perceptions.

The exceptionally high correlation between work stress and lifestyle/work environment factors ($r=0.961$, $p<0.001$) warrants critical methodological consideration. This near-unity association raises important questions about discriminant validity: whether these constructs represent overlapping dimensions of the same underlying occupational exposure rather than conceptually distinct phenomena. High-stress occupations inherently involve adverse working conditions—long hours, physical demands, inadequate breaks—indicating that perceived stress and concrete workplace hazards co-occur systematically. While variance inflation factor analysis ($VIF<2.5$) confirmed the absence of problematic statistical multicollinearity, the conceptual overlap is substantial enough that the lifestyle/work environment variable may function as a mediator of work stress effects rather than as an independent construct. In hierarchical regression, this means the attenuation of work stress in Model 3 could reflect either genuine mediation (stress operates through environmental pathways) or statistical redundancy between near-identical constructs. This interpretation aligns with the Model 3 findings, where lifestyle/work environment factors emerged as the dominant predictor while work stress became non-significant. Researchers should therefore exercise caution in treating these as separate predictors, and future studies should employ confirmatory factor analysis to establish discriminant validity prior to multivariate modeling.

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Interpretation of Regression Models and Mediation Effects

This mediating pattern reveals a critical clinical insight: the relationship between perceived workplace stress and pregnancy complications operates primarily through concrete occupational conditions rather than through psychological stress pathways alone. Specifically, measurable workplace factors including working hours exceeding 40 hours per week, inadequate rest periods (less than 30 minutes per 4-hour shift), and exposure to physical hazards such as prolonged standing or repetitive lifting demonstrated stronger direct effects on pregnancy outcomes than subjective stress perceptions. This finding suggests that workplace interventions should prioritize modification of tangible working conditions over stress management training alone. Healthcare providers conducting antenatal assessments should systematically screen for specific occupational exposures (shift patterns, physical demands, ergonomic hazards) rather than relying solely on general stress questionnaires. The emergence of lifestyle and work environment factors as significant independent predictors (OR=0.080, p=0.001) in the final model indicates that these tangible workplace elements exert physiological effects more directly than perceived stress alone. This interpretation aligns with Vrijkotte et al. (2021), who demonstrated in a Dutch prospective cohort that combinations of physical workload and extended working hours posed substantially greater pregnancy risks than either factor alone, thereby corroborating our finding that concrete environmental conditions carry stronger predictive value than psychological stress measures.

The non-significance of demographic variables in the final model suggests that the associations between occupational factors and pregnancy complications transcend traditional socioeconomic stratification. These findings are consistent with emerging evidence that occupational stressors affect pregnant women universally across diverse backgrounds. Comparative analysis from Japan by Nakamura et al. (2022) demonstrated that pregnant women show significantly higher work productivity loss, especially in the domain of physical tasks, accompanied by elevated physical stress response, regardless of demographic characteristics.

Occupational Risk Stratification

Subgroup analysis revealed an important pattern of occupational stratification, with the strongest statistical association observed among shift workers and healthcare professionals (OR=0.42, $p<0.05$), who reported the highest stress scores and greater exposure to irregular working hours. The OR below 1.0 in this subgroup, consistent with the main analysis, likely reflects the same healthy worker bias rather than a protective effect. These findings align with Lissåker et al. (2022), who confirmed in a large Swedish cohort that occupations with lower decision authority carry substantially elevated risks for both hypertensive disorders and gestational diabetes. Temporal patterns identified through trimester stratification analysis showed a more pronounced stress-complication association in the third versus second trimester, suggesting a cumulative stress burden. However, first-trimester exposure may exert a distinct developmental impact, as demonstrated by Swedish healthcare employee data from Kader et al. (2021), who reported the most pronounced effects of night shift work during early pregnancy, indicating that different gestational periods present unique vulnerabilities.

The dominance of lifestyle and work environment factors as mediators in the Indonesian context warrants specific contextual interpretation. Unlike Scandinavian countries where occupational health regulations and maternity protections are well-established, working pregnant women in Bandung face distinct structural challenges. First, Indonesia's informal economy, which employs nearly half of female workers, operates largely outside regulatory oversight, meaning protections such as reduced working hours, mandatory rest periods, and ergonomic accommodations are rarely enforced (International Labour Organization, 2022). Second, cultural norms around work ethic in Javanese and Sundanese communities often discourage pregnant women from requesting workplace

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accommodations, leading to prolonged exposure to physical hazards such as extended standing in retail settings, repetitive manual tasks in manufacturing, and insufficient break facilities. Third, only 23% of workplaces in our study area provided dedicated rest spaces for pregnant employees, and none of the informal sector workplaces offered formal maternity risk assessments. These contextual factors likely amplify the mediating role of concrete working conditions in the stress-complication pathway, explaining why environmental factors eclipsed subjective stress perceptions in our final model. This finding carries important policy implications: workplace interventions in the Indonesian context should prioritize structural environmental modifications rather than individual-level stress management programs.

Comparison with International Evidence

The findings demonstrate consistency with international epidemiological evidence while revealing context-specific patterns relevant to Indonesia's healthcare system and labor market. A Danish workforce analysis by Begtrup et al. (2025), involving 884,616 pregnancies, documented that 48% experienced at least one week of registered absence, with the highest frequency among painters (75%) and meat product manufacturing workers (68%), while technical professionals showed the lowest rate (30%). This occupational gradient parallels the observation that concrete workplace conditions mediate the stress-complication relationship. A systematic review by Corchero-Falcón et al. (2023), incorporating 38 studies, identified chemical, psychosocial, and physical-ergonomic-mechanical factors as the main risk factors, with major adverse consequences including low birth weight, preterm birth, miscarriage, hypertension, and preeclampsia. These findings support a multidimensional stress assessment approach and validate the inclusion of lifestyle and work environment factors as critical components of occupational risk evaluation during pregnancy.

Recent investigation by Januario et al. (2025) demonstrated that telework conditions significantly impact stress levels, with high telework allowance associated with reduced physiological stress, while high utilization paradoxically increases perceived stress levels. Gash and Blom (2025) found that workplace violence increases the risk of common mental disorders by 40%, with fear of violence doubling the risk, underscoring the complexity of psychosocial stressors. Taouk et al. (2025) demonstrated through the Swedish Longitudinal Occupational Survey of Health that work interfering with family and family interfering with work significantly increased depressive symptoms, with a magnified effect among individuals with greater childcare responsibility, emphasizing the importance of the work-family interface in maternal well-being.

Study Limitations

This study has several limitations. First, the non-probability sampling and failure to achieve the full target sample size (160 of 276 planned) may introduce selection bias and reduce statistical power, limiting generalizability to all pregnant workers in Indonesia. Second, the cross-sectional design prevents establishing causality between workplace stress and pregnancy complications; reverse causation is plausible where complications alter work conditions and stress levels. Third, self-reported stress measures may introduce recall and social desirability biases, though validated instruments ($\alpha>0.85$) were used to minimize this. Fourth, the odds ratio values below 1.0 for the high-stress category require cautious interpretation and may reflect healthy worker selection bias or differential health-seeking behavior rather than a true protective effect of stress. Fifth, the very high correlation between work stress and lifestyle/work environment variables ($r=0.961$) raises questions about the discriminant validity of these constructs. Future prospective cohort studies with random sampling, repeated measurements, and objective stress biomarkers are needed to establish causal pathways and enhance external validity.

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Conclusion

This cross-sectional study of 160 pregnant workers identified statistically significant associations between occupational stressors and pregnancy complications in the bivariate and initial regression models; however, these findings require cautious interpretation due to methodological limitations. Correlation analysis established strong positive associations between all work stress variables (r=0.818-0.961, p<0.001). While work stress was significantly associated with pregnancy complications in initial models (p<0.001), the OR values below 1.0 (OR=0.077–0.500) do not indicate a true protective effect; rather, they most likely reflect healthy worker survivor bias and selection effects inherent to the cross-sectional design. Critically, work stress lost statistical significance in the final model (Model 3: OR=0.500, p=0.325) after the inclusion of lifestyle and work environment factors, which emerged as the only independent predictor (OR=0.080, p=0.001). These findings suggest that the relationship between perceived work stress and pregnancy complications is substantially mediated by tangible workplace conditions, although the very high inter-construct correlation (r=0.961) means mediation and statistical redundancy cannot be definitively distinguished in this study design.

Based on these findings, several evidence-based recommendations are proposed to improve maternal health protection in the workplace setting. First, healthcare providers should integrate workplace stress screening into routine antenatal care protocols using validated instruments such as the Work Stress Assessment Scale, especially during the second trimester when physiological vulnerability to stress increases. Second, employers should establish comprehensive occupational risk assessment procedures for pregnant workers, especially in high-stress sectors including healthcare, manufacturing, and service industries, accounting for psychosocial and environmental risk factors. Third, flexible work arrangements should be prioritized for pregnant employees, especially during the third trimester or for those diagnosed with pregnancy-related complications, including reduced working hours, remote work options, and temporary role reassignment.

Future investigations should prioritize longitudinal prospective designs to establish causal relationships between workplace stress exposure and pregnancy outcomes. Research should incorporate objective stress biomarkers, including cortisol patterns and inflammatory markers, to elucidate the mechanistic pathways linking occupational exposure to specific pregnancy complications. Additionally, intervention studies evaluating targeted workplace accommodation programs across various employment settings are essential to determine the effectiveness of evidence-based risk reduction strategies. The development of culturally adapted stress measurement instruments validated specifically for pregnant populations in diverse socioeconomic contexts represents a critical research priority. Furthermore, economic evaluations assessing the cost-effectiveness of workplace intervention programs compared to standard care are needed to support policy implementation. Finally, investigation of the long-term effects of prenatal workplace stress on child development outcomes and maternal postpartum mental health (Zhao & Zhang, 2024) is essential.

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