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Associations Between Physical Activity and Multiple Maternal Health Outcomes Among Pregnant Women: A Cross-Sectional Study

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Abstract

Background: Physical activity during pregnancy plays an important role in maintaining maternal health. However, inappropriate activity levels may be associated with various adverse maternal outcomes. Previous studies have often focused on single health outcomes, limiting understanding of how physical activity relates to multiple maternal conditions within the same population.
Objective: This study aimed to comprehensively examine the associations between physical activity levels and multiple maternal health outcomes, including constipation, low back pain (LBP), blood pressure, chronic energy deficiency (CED), and anemia, among pregnant women.
Methods: This cross-sectional correlational study involved 251 pregnant women consecutively recruited from two community health centers. Physical activity was assessed using the Pregnancy Physical Activity Questionnaire (PPAQ), while constipation, LBP, blood pressure, CED, and anemia were measured using the Constipation Assessment Scale (CAS), Numeric Rating Scale (NRS), and a standardized checklist form. Data were analyzed using Chi-square and Fisher's exact tests, with odds ratios (ORs) and 95% confidence intervals (CIs) calculated for significant associations.
Results: Most respondents reported moderate levels of physical activity. Physical activity level was significantly associated with LBP severity (p = 0.020), with women engaging in vigorous activity showing higher odds of severe LBP compared with those performing sedentary to moderate activity (OR = 1.83; 95% CI: 0.94–3.54). No statistically significant associations were observed between physical activity level and constipation, blood pressure, CED, or anemia.
Conclusion: Low back pain was the only maternal health outcome significantly associated with physical activity level in this study. These findings highlight the importance of antenatal care interventions that prioritize screening for LBP, assessment of physical workload patterns, and guidance on safe and balanced physical activity to prevent severe LBP during pregnancy.

Keywords: Physical activity, constipation, pain, blood pressure, CED, anemia, pregnancy

INTRODUCTION

Pregnancy is a physiological period marked by significant physical, hormonal, and psychological adaptations that support fetal growth and development (1). Alongside these changes, pregnant women commonly experience health problems such as constipation, low back pain (LBP), elevated blood pressure, Chronic Energy Deficiency (CED), and anemia (2–4). These conditions may worsen when healthy lifestyle behaviors—particularly appropriate physical

activity—are insufficient or poorly managed during pregnancy.

Physical activity is widely recognized as an essential component of maternal health promotion. Public health guidelines recommend regular, moderate-intensity activity during pregnancy to maintain musculoskeletal function, cardiovascular health, and metabolic balance (5). However, many pregnant women in Indonesia engage in low levels of physical activity. Haryanti et al. reported that among 95 pregnant women, 49.5% performed light activity, 47.4% moderate activity, and only 3.1% high-intensity activity (6). Similarly, Ikhsan et al. found that among 110 pregnant women, 49.1% engaged in light activity, 25.5% were inactive, 14.5% performed moderate activity, and 10.9% engaged in high-intensity activity (7). In primary healthcare settings such as Puskesmas, antenatal care (ANC) counseling often focuses on fetal monitoring, nutritional supplementation, and detection of danger signs, while structured guidance on safe and balanced physical activity remains limited.

Physiologically, physical activity may influence multiple maternal health outcomes through interconnected mechanisms. Changes in posture and musculoskeletal load associated with physical activity can contribute to LBP (8). Activity levels may also affect gastrointestinal motility, which is relevant to constipation (3). Furthermore, physical activity plays a role in vascular function and weight regulation, which are important for blood pressure control (9). In terms of nutritional status, physical activity is linked to energy balance and may influence the risk of CED, while its relationship with anemia is more indirect and likely mediated by dietary intake, supplement adherence, and overall maternal health behaviors (10).

Previous studies examining these relationships have reported inconsistent findings. Sabonyte-Balsaitiene et al. found an association between physical activity and constipation, whereas Li et al. reported no consistent relationship (11,12). Elkhapi et al. identified an association between physical activity and low back pain (13). Zhu et al. reported a relationship between physical activity and maternal blood pressure, while Fitri et al. found no such association (9,14). Mahmudah et al. observed a link between physical activity and CED risk, whereas Haryanti reported no association (15,6). Harahap found no relationship between physical activity and anemia in pregnant women (16). Most of these studies examined individual outcomes separately, and comprehensive analyses of multiple maternal outcomes within the same population—particularly in routine primary healthcare settings—remain limited.

Therefore, this study aimed to comprehensively examine the associations between physical activity and multiple maternal health outcomes, including constipation, LBP, blood pressure, CED, and anemia, among pregnant women in primary healthcare settings. By adopting an integrated approach within a single population, this study seeks to provide evidence to support more holistic antenatal counseling and monitoring strategies that address physical activity, nutritional status, and overall maternal well-being.

METHODS

Study Design and Setting

This study employed a cross-sectional design and was conducted at Cileunyi Community Health Center and Ibrahim Community Health Center, Indonesia. These primary healthcare facilities provide antenatal care (ANC) services according to standards, including examination of weight and height, upper arm circumference, blood pressure, uterine fundal height, Fetal Heart Rate (FHR), tetanus toxoid immunization, iron tablet supplementation, laboratory tests, case management, and counseling.

Population, Sampling, and Eligibility

The study population consisted of pregnant women receiving antenatal care (ANC) services within the working areas of Cileunyi Community Health Center and Ibrahim Community Health Center. Respondent recruitment was conducted using consecutive sampling over a one-month period. To maximize coverage and representativeness, data collection was carried out not only at the community health centers but also at affiliated Posyandu (integrated community health posts), where routine maternal health services are provided.

All pregnant women encountered during ANC or Posyandu activities within the data collection period were invited to be respondents. There were no restrictions based on gestational age, maternal age, or pregnancy-related conditions. Eligibility was determined primarily by the availability of complete data for the variables under study. Pregnant women were included if

they attended ANC or Posyandu services during the study period and excluded if they were unable to complete the research instrument. Of the pregnant women approached, 3 declined participation and 21 were excluded due to incomplete haemoglobin data, resulting in a total sample of 251 in this study.

Data Collection Procedures

Data collection was conducted by the research team with the assistance of two trained enumerators. All enumerators received standardized training prior to data collection to ensure consistency in administering questionnaires and taking the necessary measurements (blood pressure, mid-upper arm circumference).

Instruments

Physical activity was assessed using the Pregnancy Physical Activity Questionnaire (PPAQ), which measures the type, frequency, and duration of activities performed during the previous seven days. Physical activity intensity was calculated in metabolic equivalents (METs) and categorized as inactive/sedentary (<1.5 METs), light (1.5–≤3.0 METs), moderate (3.0–≤6.0 METs), and vigorous (>6.0 METs) (18). The PPAQ consists of 32 activities, including household and caregiving (13), work (5), sports or recreation (8), transportation (3), and inactivity (3) (17). The Indonesian version of the PPAQ has demonstrated acceptable validity and reliability in previous validation studies (Cronbach's alpha = 0.88), although the validity coefficients reflect moderate construct validity (0.449-0.598) (18).

Constipation was assessed using the Constipation Assessment Scale (CAS), which evaluates constipation symptoms based on 8 items rated from 0 (no problem), 1 (slight problem), to 2 (severe problem). Total scores were categorized as no constipation (0), mild constipation (1–8), and severe constipation (9–16). The CAS has demonstrated good internal consistency (Cronbach's alpha = 0.768) and high criterion validity (r 0.98; p 0.0001) in previous studies (19).

Pain was assessed using the Numeric Rating Scale (NRS) to evaluate LBP intensity at the time of assessment. Respondents rated their pain from 0 (no pain) to 10 (worst pain imaginable). For analysis, pain was categorized into mild (1–3), moderate (4–6), and severe (7–10) (20). The "no pain" category was excluded from bivariate analysis due to a very small cell count, which did not meet the assumptions of categorical statistical testing.

Blood pressure was measured during visits by trained healthcare staff and enumerators using a calibrated sphygmomanometer. Measurements were taken in a sitting position after a period of rest, following routine clinical procedures. Hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg.

Chronic Energy Deficiency (CED) was assessed using Mid-Upper Arm Circumference (MUAC), measured by trained staff using a standardized non-elastic measuring tape. CED was defined as MUAC <23.5 cm.

Anemia status is determined based on hemoglobin (Hb) values recorded in the ANC medical record/pink book (maternal and child health book). Anemia is defined as Hb <11 g/dL, according to national and international guidelines.

Data Analysis

The collected data were then processed and analyzed univariately, and the results are presented in a frequency distribution table. Bivariate analyses were conducted to examine the association between physical activity levels and maternal outcomes using the Chi-square test. Fisher's Exact test or Monte Carlo exact test was applied when expected cell counts were less than five. Linear-by-linear association tests were performed to assess trends across ordered categories of physical activity.

For outcomes showing statistically significant associations, odds ratios (ORs) with 95% confidence intervals (CIs) were calculated after collapsing physical activity and pain scale into 2 categories (dichotomized). This category merging was applied to ensure adequate cell numbers and facilitate the estimation of effect sizes. These analyses were intended to estimate the strength of association and not to infer causality.

Ethical Considerations

This study has received ethical approval from the Health Research Ethics Commission-Bhakti Kencana University and adhered to research ethics, namely respect for human dignity, beneficence and non-maleficence, and justice.

RESULTS

Most respondents were within the non-risk reproductive age range of 20–35 years (84.1%), multigravida (55.4%), in the third trimester (43.4%), had senior high school education (63.7%), and were not employed (80.5%) (Table 1).

Table 2 presents the distribution of physical activity levels among pregnant women. Most respondents reported moderate physical activity (37.2%), followed by vigorous activity (30.5%), light activity (27.5%), and sedentary behavior (5.2%) (Table 2).

The distribution of maternal health risk factors is shown in Table 3. Most respondents experienced mild constipation (76.1%) and mild pain (47.0%). Only 3.2% had hypertension, while 23.9% experienced chronic energy deficiency (CED) and 20.3% were anemic (Table 3).

The associations between physical activity levels and maternal health outcomes, including constipation, blood pressure, chronic energy deficiency, and anemia, are presented in Table 4. No statistically significant relationships were observed between physical activity and any of these outcomes (all $p > 0.05$).

Table 5 shows the association between physical activity levels and low back pain severity. A statistically significant relationship was observed (Chi-square $p = 0.020$; Monte Carlo $p = 0.021$), indicating that pain severity differed across physical activity categories. The Linear-by-Linear Association test was also significant ($p = 0.020$), suggesting a graded trend in pain severity as physical activity intensity increased. Pregnant women who engaged in vigorous activity demonstrated a higher proportion of moderate-to-severe pain compared with those who performed sedentary, light, or moderate activities.

To further examine this relationship, physical activity was dichotomized into lower activity (sedentary, light, and moderate) and higher activity (vigorous), as shown in Table 6. Pregnant women who performed vigorous physical activity had higher odds of experiencing severe low back pain compared with those in the lower activity group (OR = 1.83; 95% CI: 0.94–3.54; $p = 0.020$) (Table 6).

Table 1. Frequency Distribution of Pregnant Women's Characteristics

Characteristics	Frequency (f)	Percentage (%)
Age		
At Risk (< 20 and > 35 years)	40	15,9
Not at-Risk (20-35 years)	211	84,1
Gravidity		
Primigravida	104	41,4
Multigravida	139	55,4
Grandemultigravida	8	3,2
Gestational Age		
Trimester I	41	16,3
Trimester II	101	40,2
Trimester III	109	43,4
Education		
Elementary School	3	1,2
Junior High School	39	15,5
Senior High School	160	63,7
Higher Education	49	19,5
Occupation		
Not Working	202	80,5
Employed	49	19,5
Total	251	100

Table 2. Frequency Distribution of Physical Activity of Pregnant Women

Physical Activity	Frequency (f)	Percentage (%)
Sedentary	13	5,2
Light	69	27,5
Moderate	93	37,2
Vigorous	76	30,5
Total	251	100

Table 3. Frequency Distribution of Risk Factors of Pregnant Women

Risk Factors	Frequency (f)	Percentage (%)
Constipation		
No Constipation	48	19,1
Mild Constipation	191	76,1
Severe Constipation	12	4,8
Pain Level		
Mild	128	47,0
Moderate	87	34,7
Severe	46	18,3
Blood Pressure		
Normal	243	96,8
Hypertension	8	3,2
CED		
Yes	60	23,9
No	191	76,1
Anemia		
Yes	51	20,3
No	200	79,7
Total	251	100

Table 4. The Correlation between Physical Activity and Constipation, Blood Pressure, CED, anemia in Pregnant Women

Maternal Health Outcoomes	Physical Activity								Total		*P-Value*
	Sedentary		Light		Moderate		Vigorous				
	f	%	f	%	f	%	f	%	F	%	
Constipation											
No	4	1,6	12	4,8	19	7,6	13	5,2	48	19,1	0,871*)
Mild	9	3,6	54	21,5	68	27,1	60	27,5	191	76,1	
Severe	0	0	3	1,2	6	2,4	3	37,1	12	4,8	
Blood Pressure											
Normal	13	5,2	65	25,9	91	36,3	74	29,5	243	96,8	0,606*)
High Blood Pressure	0	0	4	1,6	2	0,8	2	0,8	8	3,2	
CED											
Yes	6	2,4	16	6,4	20	8,0	18	7,2	60	23,9	0,278**)
No	7	2,8	53	21,1	73	29,1	58	23,1	191	76,1	
Anemia											
Yes	2	0,8	14	5,6	17	6,8	18	7,2	51	20,3	0.809**)
No	11	4,4	55	21,9	76	30,3	58	23,1	200	79,7	
Total	13	5,2	69	27,5	93	37,1	76	30,3	251	100	

*)Fisher's Exact
**)Chi-Square

Table 5. The Correlation between Physical Activity and Pain Levels in Pregnant Women

Maternal Health Outcoomes	Physical Activity								Total		*P-Value*
	Sedentary		Light		Moderate		Vigorous				
	f	%	f	%	f	%	f	%	F	%	
Pain Levels											
Mild	8	3,2	40	15,9	44	17,5	26	10,4	118	47,0	0,020**)
Moderate	2	0,8	16	6,4	38	15,1	31	12,4	87	34,7	
Severe	3	1,2	13	5,2	11	4,4	19	7,6	46	18,3	
Total	13	5,2	69	27,5	93	37,1	76	30,3	251	100	

**)Chi-square = 15.026; df = 6; p = 0.020
Monte Carlo exact p-value (2-sided) = 0.021
Linear-by-Linear Association χ^2 = 5.375; df = 1; p = 0.020

Table 6. The Correlation between Dichotomized Physical Activity and Pain Levels in Pregnant Women

Pain Levels	Physical Activity						OR	CI (95%)	*P-Value*
	Sedentary-Light-Moderate		Vigoroud		Total				
	f	%	f	%	F	%			
Mild-Moderate	148		57		205	81,7	1.00	0.94-3.54	0,020**)
Severe	27		19	7,6	46	18,3	1.83		
Total	175		76	30,3	251	100			

OR = odds ratio from binary logistic regression
CI = confidence interval
**)p-value from Chi-square test

DISCUSSION

Overall, low back pain was the only maternal health outcome significantly associated with physical activity level in this study, while no significant associations were observed for constipation, blood pressure, chronic energy deficiency, or anemia. These findings indicate that musculoskeletal discomfort during pregnancy is more sensitive to variations in physical workload than other physiological or nutritional outcomes.

Regarding constipation, most respondents reported moderate physical activity (37.1%), followed by vigorous (30.3%), light (27.5%), and sedentary activity (5.2%). The majority experienced mild constipation (76.1%), while severe constipation was uncommon (4.8%). Fisher's Exact test showed no significant association between physical activity and constipation (p = 0.871). Across all activity categories, mild constipation predominated, and severe constipation occurred only in small proportions. This consistent pattern suggests that constipation in pregnancy is influenced more by hormonal changes, dietary intake, hydration status, and uterine enlargement than by physical activity level. Elevated progesterone and estrogen reduce intestinal motility, prolong gastric emptying, and increase water absorption from stool, leading to constipation regardless of activity intensity (21). Although physical activity can enhance bowel motility, the predominantly household-based activities reported in this study may have been insufficient to produce meaningful gastrointestinal effects. These findings are consistent with Li et al., who reported no clear association between physical activity and constipation (12), although other studies have shown mixed results, possibly due to differences in dietary patterns, iron supplementation, and activity measurement methods (23). Mudlikah et al. stated that light and moderate physical activity of less than 30 minutes per day increases the risk of constipation, and recommended at least 30 minutes of daily activity accompanied by adequate fiber and fluid intake (23).

In contrast, a significant association was observed between physical activity level and pain severity (p = 0.020). Pregnant women engaging in vigorous activity had higher proportions of moderate-to-severe pain, while mild pain was

more common among those performing light to moderate activity. Dichotomized analysis showed that women with higher physical activity levels had 1.83 times higher odds of severe low back pain, although the confidence interval crossed unity (OR = 1.83; 95% CI: 0.94–3.54), indicating limited precision. This suggests that pain during pregnancy is associated not simply with activity volume but with the type and physical burden of daily activities.

Physiologically, pregnancy-related increases in the hormone relaxin lead to ligament laxity, reduced joint stability, and altered spinal biomechanics, making the musculoskeletal system more vulnerable to strain (25). Excessive physical load, particularly on the lumbar spine, can exacerbate musculoskeletal stress. While sedentary behavior may cause muscle stiffness and reduced circulation, overly strenuous activity increases mechanical stress on an already compromised musculoskeletal system. De Sousa et al. reported that inactive pregnant women have a 30% greater risk of experiencing severe pain compared with physically active women (24). Conversely, excessive workload may also increase pain risk. Previous studies have similarly reported that both insufficient and excessive physical activity can increase musculoskeletal discomfort, while balanced, controlled activity offers protective benefits (13, 26).

Analysis of PPAQ domain contributions showed that most physical activity came from household and caregiving tasks (8 METs), followed by work activities (2.8 METs), exercise (1.2 METs), and transportation (1.5 METs). These unstructured daily activities may impose sustained physical strain without ergonomic support, contributing to low back pain. Because this study used a cross-sectional design, reverse causality cannot be excluded; women experiencing pain may also modify their activity patterns. Unmeasured factors such as occupational workload, caregiving responsibilities, posture, and pain tolerance likely influenced the observed association.

Blood pressure was normal in 96.8% of respondents, and no significant relationship with physical activity was found (p = 0.606). The low prevalence of hypertension limited statistical power. Moreover, most activities were domestic rather than structured cardiovascular exercise, which may explain the absence of blood pressure effects. These findings align with Fitri et al., who reported no relationship between physical activity and blood pressure in women of reproductive age (14), and Va'iza et al., who found no association between physical activity and preeclampsia severity (27). However, Rustan reported that low physical activity increased the risk of hypertension in pregnant women (28), highlighting contextual and methodological differences across studies.

No significant association was observed between physical activity and chronic energy deficiency (CED) (p = 0.278). CED is primarily influenced by energy intake, dietary quality, metabolic status, and pre-pregnancy nutrition rather than physical activity alone. Although women with moderate and vigorous activity had slightly higher CED proportions, these differences were not statistically meaningful. Rangkuti and Haryanti similarly reported no association between physical activity and CED but found dietary restrictions to be significantly related to CED (29). Mahmudah et al., however, reported a significant association (p = 0.035) (15), suggesting that socioeconomic and nutritional contexts may modify this relationship.

Anemia was also not associated with physical activity (p = 0.809). Anemia occurred across all activity levels, reflecting its multifactorial etiology, including increased iron requirements, hemodilution, nutritional intake, and iron supplementation adherence. These findings are consistent with Fajria et al. (30) and Harahap (16), who found no association between physical activity and anemia in pregnant women. Routine iron supplementation during antenatal care likely reduced variability in hemoglobin levels, masking any potential activity-related effects.

Clinically, these findings emphasize the importance of individualized antenatal counseling. Rather than indiscriminately promoting increased activity, healthcare providers should assess the type, context, and physical burden of daily activities, especially household and caregiving tasks. Pregnant women should be guided toward safe, structured activities such as walking, prenatal yoga, or pregnancy-specific exercise, while avoiding excessive physical strain. Ergonomic education, workload modification, and adequate rest are essential to reduce musculoskeletal discomfort and support maternal well-being during pregnancy.

Study Limitations and Implications

This study has several limitations. The cross-

sectional design prevents causal inference, and reverse causality between physical activity and maternal outcomes cannot be excluded. Physical activity was assessed using self-reported questionnaires, which may be affected by recall and social desirability bias, and measurement time frames differed across variables. Several potential confounders, including dietary intake, hydration, iron supplementation, BMI, workload, and comorbidities, were not measured, limiting multivariable adjustment. In addition, some outcomes, particularly hypertension, had low event counts, reducing statistical power. Finally, data were collected from only two health centers, which may limit generalizability to other settings.

CONCLUSION

This study found that physical activity level was significantly associated with pain severity among pregnant women, whereas no significant associations were observed with constipation, blood pressure, Chronic Energy Deficiency (CED), or anemia. Severe pain was more common among women engaging in vigorous physical activity. These findings indicate that the relationship between physical activity and maternal pain warrants particular attention in antenatal care, while other maternal outcomes may be more strongly influenced by physiological changes during pregnancy and nutritional factors than by activity level alone. Future longitudinal studies incorporating dietary intake, supplementation adherence, workload characteristics, and body composition measures are needed to clarify the temporal and causal pathways underlying these associations. From a clinical perspective, antenatal care providers should prioritize screening for pain and physical workload patterns when counseling pregnant women about physical activity. General health promotion messages emphasizing balanced nutrition, adequate rest, and safe activity remain important but should be interpreted as supportive guidance rather than definitive conclusions from this study.

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Author Contributions

TNJ : Study conception and design, data collection, drafting and finishing of the article
RNR : Statistical analysis and interpretation
ID : Critical revision of the article

Conflict of Interest

The authors have no conflicts of interest related to this research and publication.

Data Availability Statement

The data are not publicly available due to ethical restrictions related to participant confidentiality, but are available from the corresponding author upon reasonable request.

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