

Socioeconomic vulnerability and risk of preterm birth and short birth length: a cross-sectional study

Rina OKTASARI^{1,2}, Hadi RIYADI³, Ali KHOMSAN³, Katrin ROOSITA³, Yulin LESTARI⁴

1 Postgraduate in Nutrition Science, Department of Community Nutrition, Faculty of Human Ecology, IPB University, Bogor, Indonesia.

2 Nutrition Department, Health Polytechnic Ministry of Health Yogyakarta, Yogyakarta, Indonesia.

3 Department of Community Nutrition, Faculty of Human Ecology, IPB University, Bogor, Indonesia.

4 Department of Biology, Faculty of Mathematics and Natural Sciences, IPB University, Bogor, Indonesia.

Recibido: 25/diciembre/2025. Aceptado: 29/enero/2026.

ABSTRACT

Objective: To examine the association between household socioeconomic vulnerability and adverse birth outcomes among pregnant women in an urban Indonesian setting.

Methods: This cross-sectional observational comparative analytical study recruited 120 pregnant women from public primary health centers and private maternity clinics in Yogyakarta, Indonesia. Household socioeconomic vulnerability was defined based on eligibility for the national Integrated Social Welfare Data system (DTKS). Birth outcomes, including preterm birth and short birth length, were collected postpartum using a structured online questionnaire distributed via WhatsApp, with guidance from enumerators and reference to available official documents when possible. Group comparisons between socioeconomically vulnerable and non-vulnerable households were conducted using chi-square tests and independent-samples t-tests, followed by multivariable logistic regression adjusting for maternal age.

Results: Preterm birth occurred in 7.5 % of pregnancies, and short birth length (< 48 cm) was observed in 33.3% of newborns. The proportion of short birth length was higher among socioeconomically vulnerable households compared with non-vulnerable households (42.9 % vs 28.2 %; $p = 0.104$). The prevalence of preterm birth was similar between groups (7.1 % vs 7.7 %; $p = 1.000$). Mean birth length and mean birth weight did not differ significantly by socioeconomic status ($p > 0.05$).

Conclusion: Although differences did not reach statistical significance, a higher proportion of short birth length was observed among infants born to socioeconomically vulnerable households. These findings suggest that socioeconomic vulnerability may influence fetal growth patterns and underscore the importance of addressing social determinants within antenatal care services in urban Indonesian settings.

KEYWORDS

Social determinants of health, neonatal anthropometry, linear fetal growth, antenatal care, urban poverty.

ABBREVIATIONS

ANC: Antenatal Care.

BMI: Body Mass Index.

DTKS: Integrated Social Welfare Data.

IPI: Interpregnancy Interval.

LMICs: Low- and Middle-Income Countries.

INTRODUCTION

Low birthweight and other adverse birth outcomes remain major global public health concerns because they increase neonatal mortality, impair child growth and development, and elevate the risk of chronic diseases later in life¹⁻³. Recent global estimates indicate that low birthweight and preterm birth continue to disproportionately affect populations in low- and middle-income countries (LMICs), including urban settings undergoing rapid social and nutritional transitions¹. In Indonesia, adverse birth outcomes persist despite improvements in maternal health services, with pronounced dispari-

Correspondencia:

Hadi Riyadi

rina.rina@apps.ipb.ac.id

ties across socioeconomic groups, reflecting unequal living conditions and access to health-promoting resources^{4,5}.

Reproductive factors such as interpregnancy interval and parity are well-established determinants of perinatal outcomes⁶⁻⁸. Beyond biological factors, socioeconomic vulnerability has been widely recognized as a key social determinant of maternal and perinatal health, contributing to inequalities in preterm birth and impaired fetal growth across diverse settings^{9,10}. Socioeconomic disadvantage may constrain access to adequate living conditions and essential resources, increase the risk of maternal undernutrition, and heighten psychosocial stress during pregnancy, all of which can adversely affect gestational duration and fetal linear growth¹¹.

Evidence from national surveys in Indonesia highlights the roles of maternal education, household poverty, and birth spacing in shaping patterns of low birthweight, with differences observed between urban and rural populations^{4,5}. However, most available evidence remains cross-sectional, limiting causal inference. Prospective cohort studies examining the relationship between socioeconomic vulnerability and specific birth outcomes, particularly preterm birth and birth length, remain scarce in urban Indonesian contexts, where social inequality and rapid urbanization coexist.

Understanding how socioeconomic vulnerability during pregnancy relates to adverse birth outcomes is essential for informing effective maternal health strategies in urban LMIC settings. Therefore, this study aimed to examine patterns of preterm birth and short birth length by household socioeconomic vulnerability in an urban Indonesian population using a cross-sectional analytic approach.

METHODS

Study design and setting

This study employed an observational cross-sectional comparative analytical design and was conducted in Yogyakarta, Indonesia, between August and December 2024. Participants were recruited from selected public primary health centers (puskesmas) and private maternity clinics providing antenatal care (ANC) services. The study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) and STROBE-nut guidelines for nutritional epidemiology^{12,13}.

Participants, eligibility, and sampling

Pregnant women were recruited consecutively from antenatal care registers at participating facilities. Eligible participants were women aged 20–35 years who were non-smokers, gestational age 26–35 weeks, and were registered for routine antenatal care at the study sites. Women with acute illness at the time of data collection, those planning to relocate outside the study area before delivery, or those who declined to provide informed consent were excluded.

Purposive sampling was applied to ensure representation of households classified as socioeconomically vulnerable and non-vulnerable. Women from socioeconomically vulnerable households were primarily recruited from public health centers, while women from non-vulnerable households were predominantly recruited from private maternity facilities.

Sample size

A total of 120 pregnant women were included in the study. The sample size was determined pragmatically based on the availability of eligible participants at the study sites and the study timeline. Given the exploratory nature of the study and the relatively low frequency of adverse birth outcomes, a formal a priori sample size calculation was not performed. Analyses therefore focused on descriptive and comparative approaches.

Exposures and key variables

Primary exposure

The primary analytic exposure was household socioeconomic vulnerability, defined based on household poverty status using eligibility for the national Integrated Social Welfare Data system (DTKS). Participants were categorized as socioeconomically vulnerable (DTKS beneficiaries) or non-vulnerable (non-beneficiaries).

Outcomes

The primary outcomes were preterm birth and short birth length. Preterm birth was defined as delivery occurring before 37 completed weeks of gestation. Short birth length was defined as a birth length < 48 cm, based on commonly used clinical thresholds to indicate impaired fetal linear growth in the absence of nationally standardized reference values for birth length in Indonesia. Low birth weight, defined as birth weight < 2,500 g, was recorded for descriptive purposes.

Data collection procedures

Maternal sociodemographic and obstetric characteristics were obtained through a combination of secondary data extraction and primary data collection. Secondary data were extracted from antenatal care registers maintained at participating health facilities, including information on maternal age, parity, interpregnancy interval, and gestational age at enrollment. Primary data were collected through face-to-face interviews using a structured questionnaire to obtain household and socioeconomic characteristics.

Pregnancy outcome data, including gestational age at delivery, birth weight, and birth length, were collected postpartum using a structured Google Form distributed via WhatsApp. Enumerator staff and the research team provided real-time assistance during questionnaire completion to minimize report-

ing errors and recall bias. Participants were instructed to complete the form by referring to available official documents, particularly the Maternal and Child Health (Buku KIA) book or facility-issued birth records.

The use of online data collection was selected due to limited access to comprehensive medical records and because postpartum women were no longer consistently engaged in scheduled ANC services, making direct facility-based outcome data collection logistically infeasible. To enhance data quality, submitted responses were reviewed for completeness and plausibility. Incomplete or inconsistent entries were clarified through follow-up communication with participants prior to analysis.

Statistical analysis

Descriptive statistics were used to summarize participant characteristics and birth outcomes, including means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Group comparisons between socioeconomically vulnerable and non-vulnerable households were conducted using chi-square or Fisher's exact tests for categorical variables and independent-samples t-tests for continuous variables.

To account for potential confounding, a multivariable logistic regression analysis was performed to examine the association between socioeconomic vulnerability and short birth length after adjustment for maternal age. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were reported. Statistical significance was set at $p < 0.05$. All analyses were conducted using SPSS.

Ethical Consideration

The study was approved by the Ethics Committee of the Ministry of Health, Republic of Indonesia (No. DP.04.03/2-KEPK.2/709/2024). All participants were informed about the study objectives and procedures, and written informed consent was obtained prior to participation. Confidentiality of participant data was strictly maintained.

RESULTS

Baseline characteristics of study participants

A total of 120 pregnant women were included in the analysis, comprising 42 women from socioeconomically vulnerable households (DTKS beneficiaries) and 78 from non-vulnerable households. Baseline maternal and obstetric characteristics according to socioeconomic status are presented in Table 1.

Maternal age distribution differed significantly between the two groups ($p = 0.019$), with a higher proportion of younger women in the socioeconomically vulnerable group. In contrast, parity, interpregnancy interval (IPI), gestational age at enrollment, and pre-pregnancy body mass index (BMI) were

Table 1. Baseline maternal and obstetric characteristics of study participants by socioeconomic status (poor vs non-poor)

Variable	Poor (n = 42) n (%)	Non-poor (n = 78) n (%)	p-value
Maternal age (years)			0.019
< 25	12 (28.6)	7 (9.0)	
25–30	16 (38.1)	39 (50.0)	
> 30	14 (33.3)	32 (41.0)	
Parity			0.077
Nulliparous	12 (28.6)	39 (50.0)	
Primiparous	22 (52.4)	29 (37.2)	
Multiparous (2–4)	8 (19.0)	10 (12.8)	
Interpregnancy interval			0.418
Primigravida	12 (28.6)	32 (41.0)	
< 6 months	0 (0.0)	2 (2.6)	
6–17 months	7 (16.7)	7 (9.0)	
18–59 months	10 (23.8)	19 (24.4)	
≥ 60 months	13 (31.0)	18 (23.1)	
Gestational age at data collection			0.543
Second trimester	16 (38.1)	24 (30.8)	
Third trimester	26 (61.9)	54 (69.2)	
Pre-pregnancy BMI			0.774
Underweight	9 (21.4)	14 (17.9)	
Normal	24 (57.1)	40 (51.3)	
Overweight	3 (7.1)	7 (9.0)	
Obese	6 (14.3)	17 (21.8)	

* Chi-square test; $p < 0.05$ indicates statistical significance.

comparable between groups, with no statistically significant differences observed (all $p > 0.05$).

Birth outcomes

Among the 120 women included in the analysis, preterm birth occurred in 9 cases (7.5%), short birth length in 40 cases (33.3%), and low birth weight in 15 cases (12.5%). Pregnancy

and birth outcomes stratified by socioeconomic status are presented in Table 2.

The proportion of infants with short birth length was higher among women from poor households compared with non-poor households (42.9% vs 28.2%); however, this difference did not reach statistical significance ($p = 0.104$). The prevalence of low birth weight and preterm birth was similar between socioeconomic groups. Mean birth length and mean birth weight did not differ significantly by socioeconomic status.

Table 2. Pregnancy and birth outcomes by socioeconomic status

Outcome	Poor (n = 42) n (%)	Non-poor (n = 78) n (%)	p-value
Birth length			0.104 ^a
Normal	24 (57.1)	56 (71.8)	
Short	18 (42.9)	22 (28.2)	
Mean $\pm$ SD (cm)	47.79 $\pm$ 5.90	46.93 $\pm$ 7.94	0.499 ^d
Birth weight			0.664 ^a
Low birth weight	6 (14.3)	9 (11.5)	
Normal birth weight	36 (85.7)	69 (88.5)	
Mean $\pm$ SD (g)	3042.56 $\pm$ 498.62	2947.07 $\pm$ 542.72	0.334 ^d
Maternal complications			0.274 ^b
None	37 (88.1)	74 (94.9)	
Preeclampsia	5 (11.9)	4 (5.1)	
Timing of delivery			1.000 ^c
Term	38 (90.5)	71 (91.0)	
Preterm	3 (7.1)	6 (7.7)	
Miscarriage	1 (2.4)	1 (1.3)	

^a Chi-square test; ^b Fisher's exact test; ^c Fisher-Freeman-Halton exact test;

^d Independent-samples t-test.

Multivariable analysis

In multivariable logistic regression analysis adjusting for maternal age, socioeconomic vulnerability was associated with higher odds of short birth length (aOR = 1.96; 95% CI: 0.88–4.36), although the association did not reach statistical significance ($p = 0.101$).

Table 3. Multivariable logistic regression analysis of factors associated with short birth length

Variable	aOR	95% CI	p-value
Socioeconomic vulnerability	1.96	0.88–4.36	0.101
Maternal age (years)	0.92	0.53–1.60	0.759

Multivariable logistic regression including all participants ($n = 120$); adjusted for maternal age.

DISCUSSION

This study examined the association between household socioeconomic vulnerability and adverse birth outcomes among pregnant women in an urban Indonesian setting. Overall, higher proportions of short birth length were observed among women from socioeconomically vulnerable households compared with those from non-vulnerable households, although these differences did not reach statistical significance. In contrast, the prevalence of preterm birth and low birth weight was similar between socioeconomic groups. While statistical significance was not consistently observed, the direction of these associations suggests that socioeconomic disadvantage may be linked to impaired fetal growth in urban contexts.

The observed pattern for birth length is consistent with a substantial body of evidence indicating that socioeconomic disadvantage is associated with impaired fetal growth and adverse neonatal anthropometry. Previous studies have demonstrated that social and economic constraints during pregnancy contribute to suboptimal intrauterine growth through cumulative exposures rather than acute obstetric events^{9,11}. A systematic review has further shown that socioeconomic disparities are consistently associated with a range of adverse birth outcomes across different settings, including low- and middle-income countries¹⁴.

In this study, maternal age differed significantly between socioeconomic groups, indicating a potential confounding factor. To address this, multivariable logistic regression analysis adjusting for maternal age was conducted. After adjustment, socioeconomic vulnerability remained positively associated with short birth length, with nearly twofold higher odds among infants from vulnerable households, although the confidence interval included the null value. This finding suggests that the observed association was not solely explained by differences in maternal age distribution and aligns with epidemiological evidence emphasizing the

independent contribution of social determinants to fetal growth outcomes^{9,10}.

These findings are also consistent with previous research highlighting the role of reproductive and socioeconomic factors in shaping pregnancy outcomes. Meta-analyses and large observational studies have shown that short interpregnancy intervals, parity, and constrained maternal conditions are associated with increased risks of adverse perinatal outcomes, including impaired fetal growth and preterm birth^{6,7,11}. Evidence from Indonesia similarly indicates that maternal poverty, lower educational attainment, and limited access to quality antenatal care contribute to disparities in birth outcomes such as low birth weight and preterm birth^{4,5}. In the present study, these reproductive factors did not differ significantly between groups, suggesting that the observed pattern of short birth length may be more strongly related to broader socioeconomic and contextual influences rather than obstetric characteristics alone.

Clinical nutrition evidence from *Nutrición Clínica y Dietética Hospitalaria* further supports the interpretation of these findings, showing that maternal diet quality during pregnancy is significantly associated with neonatal anthropometric outcomes, including birth length and birth weight, highlighting the importance of adequate maternal nutrition for optimal fetal linear growth¹⁵. In addition, a cross-sectional study among pregnant women published in the same journal demonstrated that household food insecurity, a key manifestation of socioeconomic vulnerability was prevalent and associated with poorer maternal nutritional conditions that may predispose to adverse pregnancy outcomes¹⁶. Together, these findings provide clinically relevant evidence linking socioeconomic and nutritional constraints during pregnancy with suboptimal fetal growth.

In contrast to birth length, no clear association was observed between socioeconomic vulnerability and preterm birth in this study. This finding may reflect the relatively low prevalence of preterm delivery in the study population, which limited statistical power and precluded multivariable analysis for this outcome. Previous research suggests that socioeconomic gradients in preterm birth are often context-specific and more evident in larger population-based studies^{1,5}. Birth length may therefore represent a more sensitive marker of chronic intrauterine growth restriction related to long-term social and nutritional conditions during pregnancy, particularly in urban low- and middle-income settings.

Several biological and behavioral mechanisms may underlie the observed associations. Socioeconomic disadvantage may restrict access to adequate and diverse diets, increasing the likelihood of maternal undernutrition and micronutrient deficiencies essential for placental function and fetal growth. In addition, chronic psychosocial stress related to financial insecurity may influence neuroendocrine and inflam-

matory pathways that affect fetal development and gestational processes¹¹.

From a public health perspective, these findings underscore the importance of incorporating the assessment of socioeconomic vulnerability into routine antenatal care. Even in urban settings with relatively good access to maternal health services, underlying social and economic inequalities may contribute to suboptimal fetal growth. Integrating nutrition-sensitive interventions and social protection approaches within antenatal care programmes may help identify women at higher risk and support improved maternal and neonatal outcomes^{10,11}.

STRENGTHS AND LIMITATIONS

This study contributes evidence from an urban Indonesian context, where data on socioeconomic vulnerability and birth outcomes remain limited, particularly with respect to birth length as an outcome. However, the modest sample size limited statistical power, especially for relatively infrequent outcomes such as preterm birth. Although a multivariable analysis adjusting for maternal age was conducted, the sample size precluded more complex modelling. Pregnancy outcome data were collected postpartum using an online questionnaire distributed via WhatsApp and partly relied on maternal self-report rather than complete medical record extraction, which may have introduced reporting bias despite enumerator assistance and reference to available facility-issued records, including the Maternal and Child Health (Buku KIA) book when available.

POLICY IMPLICATIONS

Despite these limitations, the findings have important implications for maternal and child health policy. Routine identification of socioeconomic vulnerability during antenatal care may help identify women at higher risk of adverse birth outcomes in urban settings. Integrating nutrition-sensitive and social protection interventions, such as linkage to existing poverty alleviation or maternal support programmes, into maternal health services may help mitigate the effects of socioeconomic vulnerability on pregnancy outcomes.

CONCLUSIONS

Socioeconomic vulnerability during pregnancy was associated with patterns of preterm birth and short birth length in this urban Indonesian population. Although differences between socioeconomic groups did not reach statistical significance for all outcomes, higher proportions of short birth length were observed among women from socioeconomically vulnerable households. These findings underscore the importance of addressing socioeconomic vulnerability within antenatal care, particularly in urban settings where social disadvantage and nutritional constraints coexist. Integrating social and nutrition-sensitive approaches into maternal health ser-

vices may help identify at-risk women and inform targeted interventions in low- and middle-income country contexts.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the support of the Ministry of Health of the Republic of Indonesia and the Neys-van Hoogstraten Foundation (NHF), the Netherlands. We also thank the study participants, enumerators, and staff at participating public health centers and the private maternity hospital for their cooperation and support.

REFERENCES

- Okwaraji, Y. B., Krasevec, J., Bradley, E., Conkle, J., Stevens, G. A., & Gatica-Domínguez, G. (2024). National, regional, and global estimates of low birthweight in 2020, with trends from 2000: A systematic analysis. *The Lancet*, 403(10432), 212–223. [https://doi.org/10.1016/S0140-6736\(23\)01198-4](https://doi.org/10.1016/S0140-6736(23)01198-4)
- UNICEF (2023) *Low birthweight*. New York: UNICEF Data. Available at: <https://data.unicef.org/topic/nutrition/low-birth-weight/> (Accessed: 23 December 2025).
- World Health Organization. (2023). *Joint low birthweight estimates*. Geneva: World Health Organization. <https://www.who.int/teams/nutrition-and-food-safety/monitoring-nutritional-status-and-food-safety-and-events/joint-low-birthweight-estimates> (Accessed: 23 December 2025).
- Wulandari, F., Mahmudiono, T., Rifqi, M. A., Helmyati, S., Dewi, M., & Yuniar, C. T. (2022). Maternal characteristics and socio-economic factors as determinants of low birth weight in Indonesia: Analysis of the 2017 Indonesian Demographic and Health Survey. *International Journal of Environmental Research and Public Health*, 19(21), 13892. <https://doi.org/10.3390/ijerph192113892>
- Rahmawati, R., Titaley, C. R., Irwanto, et al. (2022). Determinants of low birth weight in Indonesia: Findings from the Demographic and Health Survey 2017. *BMC Pregnancy and Childbirth*, 22, 407. <https://doi.org/10.1186/s12884-022-04746-5>
- Conde-Agudelo, A., Rosas-Bermúdez, A., & Kafury-Goeta, A. C. (2006). Birth spacing and risk of adverse perinatal outcomes: A meta-analysis. *JAMA*, 295(15), 1809–1823. <https://doi.org/10.1001/jama.295.15.1809>
- Ni, W., Zhang, X., Zhang, T., Liang, L., Zhou, J., Zhou, G., et al. (2023). Birth spacing and risk of adverse pregnancy outcomes: A systematic review and meta-analysis. *PLOS ONE*, 18(11), e0294077. <https://doi.org/10.1371/journal.pone.0294077>
- Xu, T., Miao, H., Chen, Y., Luo, L., Guo, P. and Zhu, Y. (2022). Association of interpregnancy interval with adverse birth outcomes in a large sibling-pair cohort in China. *JAMA Network Open*, 5(6), e2216658. <https://doi.org/10.1001/jamanetworkopen.2022.16658>
- Kramer, M. S., Séguin, L., Lydon, J., & Goulet, L. (2000). Socio-economic disparities in pregnancy outcome: Why do the poor fare so poorly? *Paediatric and Perinatal Epidemiology*, 14(3), 194–210. <https://doi.org/10.1046/j.1365-3016.2000.00266.x>
- World Health Organization. (2022). *Social determinants of maternal health*. Geneva: World Health Organization.
- Victora, C.G., Christian, P., Vdaletti, L.P., Gatica-Domínguez, G., Menon, P. and Black, R.E. (2021). Revisiting maternal and child undernutrition in low-income and middle-income countries: Variable progress towards an unfinished agenda. *The Lancet*, 397(10290), pp. 1388–1399. [https://doi.org/10.1016/S0140-6736\(21\)00394-9](https://doi.org/10.1016/S0140-6736(21)00394-9)
- von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., & Vandenbroucke, J. P.; STROBE Initiative. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *PLoS Medicine*, 4(10), e296. <https://doi.org/10.1371/journal.pmed.0040296>
- Lachat, C., Hawwash, D., Ocké, M. C., Berg, C., Forsum, E., Hörnell, A., et al. (2016). STROBE-nut: An extension of STROBE for nutritional epidemiology. *PLoS Medicine*, 13(6), e1002036. <https://doi.org/10.1371/journal.pmed.1002036>
- Blumenshine P, Egerter S, Barclay CJ, Cubbin C, Braveman P. Socioeconomic disparities in adverse birth outcomes: a systematic review. *Am J Prev Med*. 2010;39(3):263–272. <https://psycnet.apa.org/doi/10.1016/j.amepre.2010.05.012>
- Hartono, R., Azizah, A. N. S., Tamrin, A., Fanny, L., & Amir, A. (2024). Maternal diet during pregnancy: Implementation on the length and birth weight of the baby. *Nutrición Clínica y Dietética Hospitalaria*, 44(4), pp. 281–288. <https://doi.org/10.12873/444hartono>
- Oktasari, R., Riyadi, H., Khomsan, A., Roosits, K., & Lestari, Y. (2025). Predictors of household food insecurity among pregnant women: A cross-sectional study. *Nutrición Clínica y Dietética Hospitalaria*, 45(3), pp. 68–73. <https://doi.org/10.12873/453oktasari>