

Parity, Interpregnancy Interval, and Socioeconomic Status in Relation to Low Birth Weight: A Prospective Cohort in Yogyakarta

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ORIGINAL ARTICLES

Submitted: 22 September 2025

Accepted: 07 December 2025

Keywords:

Low Birth Weight, Parity, Interpregnancy Interval, Socioeconomic Factors, Prospective Studies

OPEN ACCESS



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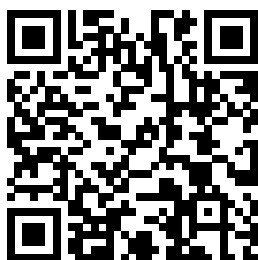
ABSTRACT

Low birth weight (LBW, <2,500 g) remains a critical public health problem, contributing to neonatal mortality and long-term risk of non-communicable diseases, and national estimates in Indonesia indicate a prevalence ranging from approximately 6.2% to 11.7%. Parity and interpregnancy interval (IPI) are important reproductive determinants of perinatal outcomes, and their effects may be modified by socioeconomic status (SES). This study aimed to investigate the association between parity and IPI with LBW and to assess whether SES modifies these associations in a prospective cohort of pregnant women in Yogyakarta, Indonesia. A total of 120 women (poor households n=48; non-poor households n=72) were recruited purposively from community health centers and a maternity hospital/clinic. Inclusion criteria were gestational age 26–35 weeks, maternal age 20–35 years, parity 1–2, non-smoker, and provision of informed consent. Pre-pregnancy BMI was obtained through maternal recall of the last measured height and weight before conception. Data were analyzed using Pearson's χ^2 tests for baseline comparisons and stratified logistic regression models to estimate adjusted odds ratios (aORs) with 95% confidence intervals. The prevalence of LBW was higher among women with non-optimal IPI (<24 or >60 months and primigravida) compared to those with optimal IPI (24–60 months). Multiparity showed a protective tendency against LBW, particularly among non-poor women. SES significantly modified the association between IPI and LBW (p for interaction <0.05). These findings suggest that multiparity may reduce LBW risk, whereas non-optimal IPI increases it, with SES acting as an effect modifier. Strengthening preconception counseling on birth spacing and targeted support for low-SES families are warranted.

Key Messages:

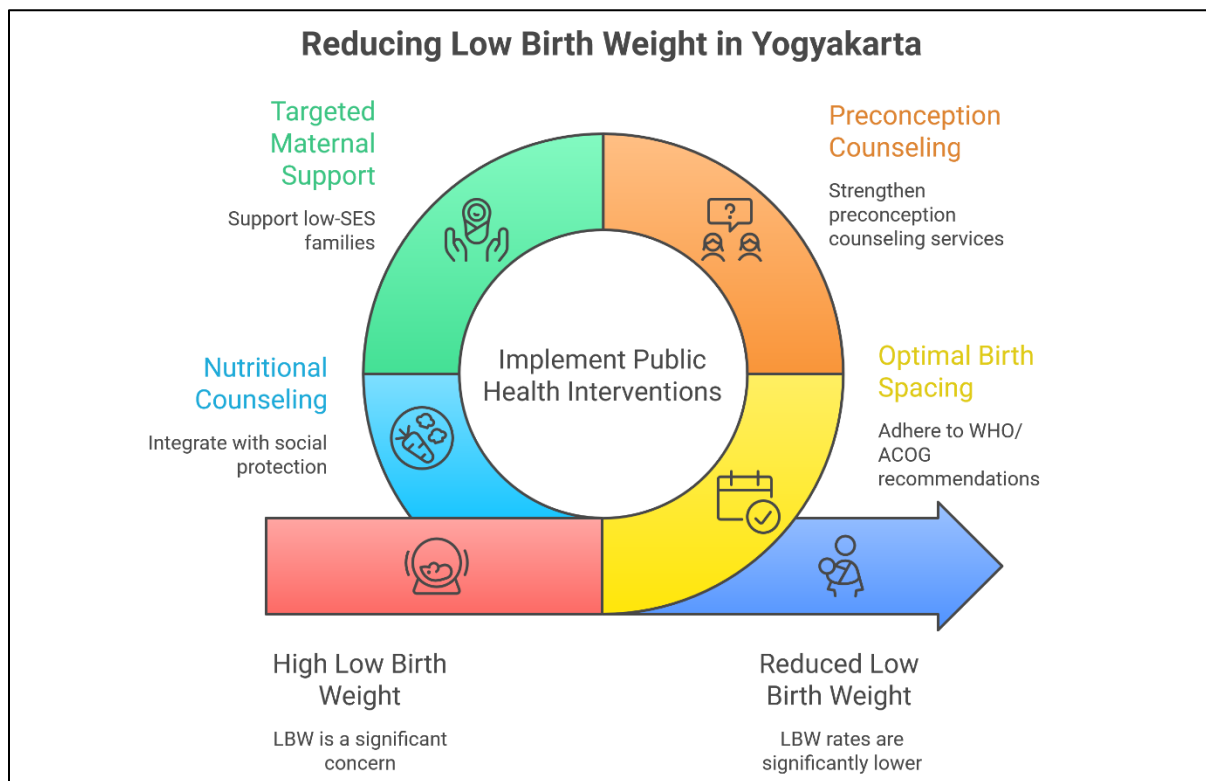
- SES modifies the impact of interpregnancy interval on LBW, underscoring social inequities in maternal–child health.
- Multiparity was protective against LBW, especially in urban non-poor households.
- Findings emphasize the applicability of WHO and ACOG recommendations on optimal birth spacing in the Indonesian urban context.

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GRAPHICAL ABSTRACT



INTRODUCTION

Low birth weight (LBW; <2,500 g) continues to warrant priority public-health attention, owing to its associations with neonatal death, suboptimal growth and development, and elevated risk of chronic disease across the life course (1–3). Among the reproductive determinants linked to LBW, parity has been widely examined as a key factor influencing neonatal outcomes. Evidence indicates that nulliparous women have a higher likelihood of LBW, preterm birth, and small-for-gestational-age infants compared with multiparous women, possibly due to less efficient uteroplacental adaptation during the first pregnancy (4). In contrast, the negative consequences of parity tend to emerge primarily at the extreme end; grand multiparity has been associated with obstetric complications such as anemia, hypertensive disorders, and placental abnormalities, which may increase the risk of adverse birth outcomes (5). In 2020 there were ~19.8 million LBW births globally, and declines have been modest; the 30% reduction target for 2025 is unlikely to be achieved (1,3). At the national level, Indonesia continues to face a considerable LBW burden, with the 2018 National Health Survey (Riskesmas) reporting a prevalence of 6.2%, increasing to 8.3% in the Special Region of Yogyakarta among births with documented birth weight records (6).

Within reproductive biology and behavior, parity and the interpregnancy interval (IPI) are repeatedly implicated in perinatal risk. The World Health Organization (WHO) advises a minimum 24-month gap before the next conception to reduce preterm and LBW risks, and the American College of Obstetricians and Gynecologists (ACOG) clarifies the relevant terminology and clinical application in obstetric practice (7,8). Recent evidence syntheses suggest a U-shaped association, meaning that the risk of adverse outcomes increases at both very short (<24 months) and very long (>60 months) interpregnancy intervals. Elevated odds of LBW, preterm birth, and small-for-gestational-age (SGA) outcomes reported across multiple settings (9–11).

For parity, cohort studies and systematic reviews generally report higher risk of adverse neonatal outcomes among nulliparous women compared with multiparous women. In contrast, the negative effects of parity tend to emerge again at the extreme end, where grand multiparity is associated with increased obstetric complications and poorer birth outcomes (4,5,13).

In Indonesia's urban settings, national-survey analyses identify maternal education, household poverty, and suboptimal birth spacing as salient correlates of LBW; some analyses also report higher LBW odds among urban residents compared with rural peers (AOR \approx 1.20) (14,15). Yet, whether socioeconomic status (SES) modifies the parity- or IPI-LBW associations is not well studied. This study addresses that gap by analyzing a prospective cohort of pregnant women in Yogyakarta to (i) quantify the associations of parity and IPI with LBW and (ii) test SES modification of these associations. Reporting adheres to STROBE and STROBE-nut guidelines (16,17).

METHODS

Study design and setting

We conducted a prospective cohort of pregnant women attending public primary-care facilities (puskesmas) and a maternal hospital/clinic (RSKIA) in urban Yogyakarta, Indonesia, from August to December 2024. The study followed the STROBE/STROBE-nut reporting guidance.

Subjects, eligibility criteria, and sampling

Participants were recruited consecutively from ANC registers at participating sites. Inclusion criteria: (1) registered at a Puskesmas (Community Health Center) or RSKIA (Maternity and Children's Hospital); (2) gestational age 26–35 weeks; (3) maternal age 20–35 years; (4) underwent an oral examination and no systemic antibiotics during the study period; (5) parity 1–2 pregnancies; (6) non-smoker; (7) provided written informed consent. Exclusion criteria: acute illness at data collection, change of residence, or loss to follow-up. Parity was restricted to 1–2 pregnancies to improve comparability across participants and reduce heterogeneity, as nulliparity and grand multiparity are associated with distinct obstetric risk profiles that could introduce confounding effects in the analysis.

We enrolled N=120 women and classified socioeconomic status (SES) into two categories: poor (n=42) and non-poor (n=78). Poor status was defined as being listed in the national Data Terpadu Kesejahteraan Sosial (DTKS), Indonesia's official social assistance eligibility registry, and these participants were predominantly recruited through Puskesmas. In contrast, non-poor women were typically recruited from a maternity hospital or private clinic. This operational definition reflects national policy classifications and aligns with routine health system practices, ensuring consistency with existing Indonesian population-based research.

Sample size and sampling

The sample size of 120 pregnant women was determined pragmatically, considering site capacity, recruitment feasibility, and study timelines. While not powered for very small subgroup effects, this number is adequate for stratified logistic regression, ensuring sufficient events per variable for stable model estimation. Sampling followed a purposive approach at the facility level, with consecutive recruitment of eligible women until quotas for poor and non-poor households were reached. This approach reflects real-world antenatal care attendance and allows meaningful comparisons across socioeconomic strata.

Data collection

Data were collected at baseline via structured interviews on sociodemographic characteristics and socioeconomic status (SES). Pre-pregnancy BMI was derived from maternal recall of the last measured height and weight before conception. To minimize recall bias, respondents were encouraged to reference documented values in their KIA book where available. Birth outcomes (birth weight and delivery details) were collected postpartum using a standardized Google Form, with mothers verifying data against their KIA book or facility discharge records. Approximately 10% of records were randomly selected for double-entry verification, and routine range and logic checks were applied to identify implausible values and ensure data consistency and reliability.

Statistical analysis

Baseline characteristics were compared across SES strata using Pearson's χ^2 tests. Stratified binary logistic regression models were applied to estimate adjusted odds ratios (aORs) with 95% confidence intervals for parity and interpregnancy interval (IPI) in relation to LBW. Effect modification by SES was tested using product-term interactions. Model diagnostics included checks for multicollinearity and Hosmer–Lemeshow goodness-of-fit. All analyses were conducted using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA).

CODE OF HEALTH ETHICS

This study involved human participants and was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of the Indonesian Ministry of Health (No. DP.04.03/2-KEPK.2/709/2024). All participants provided written informed consent prior to enrollment. No experimental animals were involved in this research.

RESULTS

Baseline characteristics

Baseline characteristics were broadly similar across SES strata for maternal age, parity, interpregnancy interval (IPI), gestational age at assessment, and pre-pregnancy BMI (all $p > 0.05$). Details are presented in Table 1.

Table 1. Baseline characteristics by socioeconomic status (SES)

Variable	Poor n (%)	Non-poor n (%)	p-value
Maternal age			
<30 years	25 (59.5)	37 (47.4)	0.206
≥30 years	17 (40.5)	41 (52.6)	
Parity			
≤1	34 (81.0)	68 (87.2)	0.362
≥2	8 (19.0)	10 (12.8)	
IPI			
Optimal (24–60 months)	13 (31.0)	19 (24.4)	0.461
Non-optimal	17 (40.5)	28 (35.9)	
Primigravida	12 (28.6)	31 (39.7)	
Gestational age at baseline			
2nd trimester (13–28 weeks)	16 (38.1)	24 (30.8)	0.417
3rd trimester (≥29 weeks)	26 (61.9)	54 (69.2)	
Pre-pregnancy BMI			
Underweight (<18.5)	9 (21.4)	14 (17.9)	0.545
Normal (18.5–24.9)	24 (57.1)	40 (51.3)	
Overweight/Obese (≥25)	9 (21.4)	24 (30.8)	

The distributions of maternal age, parity, IPI, gestational age at baseline, and pre-pregnancy BMI were not significantly different between poor and non-poor households. Multiparity (≥2) tended to be less frequent in both groups, while primigravida status was somewhat more common in the non-poor group. No SES differences emerged for maternal age or BMI status.

Factors associated with LBW (SES-stratified models)

Multiparity (≥2) was protective against LBW, with statistical significance in the non-poor group. In contrast, the association of IPI with LBW differed by SES, as shown in Table 2. Multiparity significantly reduced the odds of LBW in the non-poor group (OR=0.30, 95% CI: 0.17–0.65, $p=0.0029$), and a similar protective trend was observed in the poor group, though not statistically significant. Non-optimal IPI was associated with increased LBW risk among non-poor households (OR=1.42), but the opposite trend was seen among poor households (OR=0.26, $p=0.06$), with a significant SES interaction ($p=0.014$). These findings suggest differential reproductive and health care dynamics across socioeconomic strata. Other

covariates (maternal age, baseline trimester, pre-pregnancy BMI) showed biologically plausible directions but were not statistically significant.

Table 2. Relationship between maternal characteristics and low birth weight across socioeconomic status

Predictor (reference)	Non-poor OR (95% CI)	p-value	Poor OR (95% CI)	p-value	p- interaction
Maternal age ≥ 30 vs < 30	0.673 (0.179–1.534)	0.3000	1.712 (0.202–4.704)	0.6343	0.2171
Parity ≥ 2 vs ≤ 1	0.301 (0.165–0.651)	0.0029 ^a	0.262 (0.071–1.510)	0.1343	0.7571
Baseline trimester: 2nd vs 3rd	1.101 (0.445–4.053)	0.7971	2.298 (0.550–11.180)	0.2200	0.2800
Non-optimal/ Primigravida vs Optimal IPI	1.420 (0.644–3.114)	0.4429	0.263 (0.091–1.285)	0.0600	0.0143 ^b
Pre-pregnancy BMI non-normal vs normal	2.342 (0.874–7.603)	0.0914	2.269 (0.503–7.718)	0.2457	0.8314

^a Significant SES group difference (logistic regression, $p < 0.05$).

^b Significant SES–predictor interaction (Wald test, $p < 0.05$).

DISCUSSION

This prospective cohort contributes important evidence on the interaction between reproductive factors and socioeconomic status in shaping neonatal outcomes in an Indonesian urban context. Our findings that non-optimal interpregnancy interval (IPI) is associated with a higher risk of LBW are consistent with recent systematic reviews showing that very short (< 24 months) and very long (> 60 months) intervals increase risks of LBW, preterm birth, and small-for-gestational-age infants (9). Biologically, short intervals may limit maternal nutritional replenishment, shorten uterine recovery time, and increase the risk of infection or inflammation, while very long intervals may lead to a loss of maternal physiological readiness for pregnancy. These mechanisms are highly relevant in low- and middle-income countries where maternal undernutrition and gaps in antenatal care persist (18).

In addition to reproductive factors, local evidence highlights the role of maternal nutritional determinants in LBW. A study in Indonesia showed that chronic energy deficiency, anemia, and poor adherence to iron supplementation significantly increased the risk of LBW (19). Moreover, maternal nutritional status has been linked to indicators of fetal well-being, such as the severity of morning sickness ($p=0.005$) and overall fetal health ($p=0.003$) (20). Taken together, these findings suggest that both reproductive and nutritional dimensions contribute to the biological pathways underlying LBW, reinforcing the need for integrated interventions that address parity, interpregnancy interval, and maternal nutrition.

The observation that multiparity showed a protective tendency against LBW aligns with earlier Southeast Asian cohort studies (21, 22), which reported that nulliparous women had significantly higher risks of adverse outcomes compared with women with one or two prior births. Mechanistically, multiparous mothers may benefit from improved uteroplacental circulation and greater psychological readiness. However, caution is warranted, as grand multiparity has been linked to obstetric complications and perinatal mortality in other settings (23). Thus, our findings underscore the nuanced role of parity across different ranges.

A novel contribution of this study lies in demonstrating the modifying role of socioeconomic status (SES). The observed SES×IPI pattern is consistent with evidence that social disadvantage constrains antenatal care use and is linked with LBW and neonatal risks in Indonesia (24, 25). By contrast, non-poor households may buffer biological risks of suboptimal spacing through better diet, health literacy, and service access. This aligns with global literature showing socioeconomic gradients in adverse birth outcomes including in urban contexts (26–28). National Indonesian analyses further highlight socioeconomic (and some geographic) inequalities in perinatal outcomes (14, 15). Meanwhile, our IPI findings are consistent with meta-analytic evidence that very short and very long intervals raise risks of LBW, preterm birth, and SGA (29).

Policy and program implications are significant. First, strengthening family planning and counseling to ensure optimal interpregnancy intervals (≥ 24 months before the next conception) is vital,

with priority to low-income households where risks concentrate. Second, preconception care should be emphasized—including nutrition counseling and pre-pregnancy weight management to reach a normal BMI to reduce modifiable risks carried into pregnancy. Third, integrating food-security and maternal health services may help narrow SES-related disparities; evidence from cash transfer programs shows improvements in upstream social determinants that shape perinatal risk (30). Finally, urban health systems should expand ANC coverage and quality, including dietary counseling and early risk identification, to comprehensively address LBW prevention (7,8,31).

Strengths of this study include its prospective design, stratified SES analysis, and systematic data quality procedures. Nonetheless, the number of LBW cases was relatively small, particularly when stratified by SES, which may reduce statistical power and result in wide confidence intervals. In addition, the distribution of maternal characteristics across SES categories was not balanced across all analytical strata, limiting the evaluation of interaction effects in some subgroups. As a facility-based cohort with purposive recruitment, generalizability may be restricted to similar urban antenatal populations. Despite these limitations, the observed associations are biologically plausible and broadly consistent with evidence from comparable settings, supporting the interpretive value of the findings.

CONCLUSION

This prospective cohort study in urban Yogyakarta demonstrates that reproductive determinants, specifically parity and interpregnancy interval (IPI), are pivotal in shaping neonatal outcomes. The findings establish that multiparity (parity 1–2) serves as a protective factor against Low Birth Weight (LBW), particularly within non-poor households, likely due to more efficient uteroplacental adaptation compared to primigravida pregnancies. Conversely, non-optimal IPI (<24 or >60 months) is associated with an increased risk of LBW, though this relationship is significantly modified by socioeconomic status (SES). The significant interaction between IPI and SES ($p < 0.05$) suggests that social stratification alters the biological impact of birth spacing, with non-poor households potentially buffering reproductive risks through superior nutritional status and healthcare access. From a public health perspective, these results underscore the necessity of strengthening preconception counseling and family planning services to promote the WHO-recommended birth interval of at least 24 months.

Furthermore, interventions must prioritize equitable access to antenatal care and integrated social protection for low-SES families to address the social inequities that exacerbate perinatal risks. Future research should utilize larger cohorts and biomarkers to further elucidate the complex mechanisms through which socioeconomic contexts and reproductive patterns jointly influence maternal and child health trajectories.

FUNDING

This research was funded by the Indonesia Ministry of Health and the Neys-van Hoogstraten Foundation (NHF), the Netherlands.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the enumerators from the Nutrition Department, who conducted data collection with dedication and professionalism. We also thank the participating pregnant women for their willingness to share their time and information. Appreciation is extended to the staff of puskesmas and maternity clinics in Yogyakarta for facilitating coordination and supporting recruitment logistics. Administrative and technical support during fieldwork and data management is also sincerely acknowledged.

CONFLICTS OF INTEREST

The authors declare no conflict of interest

REFERENCES

1. Okwaraji YB, Krasevec J, Bradley E, Conkle J, Stevens GA, Gatica-Domínguez G, et al. National, regional, and global estimates of low birthweight in 2020, with trends from 2000: a systematic analysis. *Lancet*. 2024;403(10432):ePub ahead of print. doi:10.1016/S0140-6736(23)01198-4.
2. UNICEF. Low birthweight. New York: UNICEF Data; 2023. Available from: <https://data.unicef.org/topic/nutrition/low-birthweight/>
3. World Health Organization. Joint low birthweight estimates. Geneva: WHO; 2023. Available from: <https://www.who.int/teams/nutrition-and-food-safety/monitoring-nutritional-status-and-food-safety-and-events/joint-low-birthweight-estimates>
4. Shah PS; Knowledge Synthesis Group on Determinants of LBW/PT Births. Parity and low birth weight and preterm birth: a systematic review and meta-analyses. *Acta Obstet Gynecol Scand*. 2010 Jul;89(7):862-875. doi:10.3109/00016349.2010.486827.
5. Mgaya AH, Massawe SN, Kidanto HL, Mgaya HN. Grand multiparity: is it still a risk in pregnancy? *BMC Pregnancy Childbirth*. 2013;13:241. doi:10.1186/1471-2393-13-241.
6. Ministry of Health Republic of Indonesia. National Report: Riset Kesehatan Dasar (Riskesdas) 2018. Jakarta: National Institute of Health Research and Development; 2019.
7. World Health Organization. Report of a WHO Technical Consultation on Birth Spacing. Geneva: WHO; 2007. Available from: <https://apps.who.int/iris/handle/10665/69855>
8. American College of Obstetricians and Gynecologists. Interpregnancy Care. *Obstet Care Consensus*. 2019;OC 8. Available from: <https://www.acog.org/clinical/clinical-guidance/obstetric-care-consensus/articles/2019/01/interpregnancy-care>
9. Ni W, Gao X, Su X, Cai J, Zhang S, Zheng L, Liu J, Feng Y, Chen S, Ma J, Cao W, Zeng F. Birth spacing and risk of adverse pregnancy and birth outcomes: a systematic review and dose–response meta-analysis. *Acta Obstet Gynecol Scand*. 2023;102(12):1377-1393. doi:10.1111/aogs.14648.
10. Beyene FY, Wudineh KG, Bantie SA, Tesfu AA. Effect of short inter-pregnancy interval on perinatal and maternal outcomes among pregnant women in sub-Saharan Africa: a systematic review and meta-analysis. *PLoS One*. 2025 Jan 7;18(1):e0294747. doi:10.1371/journal.pone.0294747.
11. Wen X, Liang W, Zhai J, Wang Y, Zheng P, Wang S. The association between interpregnancy intervals and preterm birth: a systematic review and meta-analysis. *BMC Pregnancy Childbirth*. 2025;25:226. doi:10.1186/s12884-025-07259-y.
12. Li S, Li J, Du L, Wang X, Zhang Y, Xiao Y, Pan C, Huo Y. Association between parity and adverse maternal and neonatal outcomes: a population-based cross-sectional study. *Front Med*. 2025;12:1697655. doi:10.3389/fmed.2025.1697655.
13. Muniro Z, Tarimo CS, Mahande MJ, Maro E, Mchome B. Grand multiparity as a predictor of adverse pregnancy outcome among women who delivered at a tertiary hospital in Northern Tanzania. *BMC Pregnancy Childbirth*. 2019;19:222. doi:10.1186/s12884-019-2377-5.
14. Wulandari F, Mahmudiono T, Rifqi MA, Helmyati S, Dewi M, Yuniar CT. Maternal characteristics and socio-economic factors as determinants of low birth weight in Indonesia: analysis of the 2017 Indonesian Demographic and Health Survey (IDHS). *Int J Environ Res Public Health*. 2022 Oct 26;19(21):13892. doi:10.3390/ijerph192113892.
15. Ekoriano M, Widiyanto A, Muthmainnah M, Devi YP, Cahyono BE, Nafsi I, Widodo T. Profile and factors associated with low birth weight in Indonesia: a national data survey. *Rural Remote Health*. 2025 Feb;25(1):9170. doi:10.22605/RRH9170.
16. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol*. 2008 Apr;61(4):344–349. doi:10.1016/j.jclinepi.2007.11.008.
17. Lachat C, Hawwash D, Ocké MC, Berg C, Forsum E, Hörnell A, Larsson C, Sonestedt E, Wirfält E, Åkesson A, et al. Strengthening the Reporting of Observational Studies in Epidemiology—Nutritional

- Epidemiology (STROBE-nut): an extension of the STROBE statement. *PLoS Med.* 2016 Jun 7;13(6):e1002036. doi:10.1371/journal.pmed.1002036.
18. Victora CG, Christian P, Vidaletti LP, Gatica-Domínguez G, Menon P, Black RE. Revisiting maternal and child undernutrition in low-income and middle-income countries: variable progress towards an unfinished agenda. *Lancet.* 2021;397(10290):1388-1399. doi:10.1016/S0140-6736(21)00394-9.
 19. Yanti FD, Ginting RMS, Susanti E. The effect of chronic energy deficiency, anemia, and compliance with iron supplement consumption in pregnant women on low birth weight. *J Health Nutr Res.* 2024;3(1):68-73. doi: 10.56303/jhnresearch.v3i1.201.
 20. Suriati I, Juliani R. Impact of maternal nutritional status on morning sickness severity and fetal health: a correlational study. *J Health Nutr Res.* 2025;4(2):435-443. doi: 10.56303/jhnresearch.v4i2.396.
 21. Lin L, Lu C, Chen W, Li C, Guo VY, et al. Parity and the risks of adverse birth outcomes: a retrospective study among Chinese. *BMC Pregnancy Childbirth.* 2021;21:257. doi:10.1186/s12884-021-03718-4.
 22. Sutan R, Mohtar M, Mahat AN, Tamil AM. Determinant of low birth weight infants: a matched case-control study. *Open J Prev Med.* 2014;4(3):91-99. doi:10.4236/ojpm.2014.43013.
 23. Muniro Z, Tarimo CS, Mahande MJ, Maro E, Mchome B. Grand multiparity as a predictor of adverse pregnancy outcome among women who delivered at a tertiary hospital in Northern Tanzania. *BMC Pregnancy Childbirth.* 2019;19:222. doi:10.1186/s12884-019-2377-5.
 24. Titaley CR, Mu'asyaroh A, Que BJ, Tjandrarini DH, Ariawan I. Determinants of early neonatal mortality: secondary analysis of the 2012 and 2017 Indonesia Demographic and Health Survey. *Front Pediatr.* 2024 Jan 18;12:1288260. doi:10.3389/fped.2024.1288260.
 25. Titaley CR, Tjandrarini DH, Malakauseya MLV, Ariawan I, Iwan RF, Istia SS, et al. Determinants of non-use of antenatal care services in eastern Indonesia: analysis of the 2023 Indonesia Health Survey. *Front Glob Womens Health.* 2025 Aug 18;6:1649276. doi:10.3389/fgwh.2025.1649276.
 26. Blumenshine P, Egerter S, Barclay CJ, Cubbin C, Braveman PA. Socioeconomic disparities in adverse birth outcomes: a systematic review. *Am J Prev Med.* 2010;39(3):263-272. doi:10.1016/j.amepre.2010.05.012.
 27. Ospina MB, Voaklander D, Senthilselvan A, Osornio-Vargas A, Mganga E. Socioeconomic gradients of adverse birth outcomes and related maternal factors in Alberta, Canada: a retrospective cohort study. *BMJ Open.* 2020;10(6):e033296. doi:10.1136/bmjopen-2019-033296.
 28. Sow M, Gonçalves AN, Corman J. Associations between socioeconomic status and adverse pregnancy outcomes in Brussels and Montreal: a cross-sectional analysis. *BMC Public Health.* 2022;22:910. doi:10.1186/s12889-022-13165-1
 29. Kozuki N, Lee ACC, Silveira MF, Victora CG, Adair L, Humphrey J, et al.; Child Health Epidemiology Reference Group Small-for-Gestational-Age-Preterm Birth Working Group. The associations of birth intervals with small-for-gestational-age, preterm, and neonatal and infant mortality: a meta-analysis. *BMC Public Health.* 2013;13(Suppl 3):S3. doi:10.1186/1471-2458-13-S3-S3.
 30. Owusu-Addo E, Renzaho AMN. The impact of cash transfers on social determinants of health and health inequalities in Sub-Saharan Africa: a systematic review. *Health Policy Plan.* 2018;33(5):675-696. doi: 10.1093/heapol/czy020.
 31. Neupane S, Scott S, Piwoz E, Kim SS, Menon P, Nguyen PH. More is not enough: High quantity and high quality antenatal care are both needed to prevent low birthweight in South Asia. *PLOS Glob Public Health.* 2023;3(6):e0001991. doi:10.1371/journal.pgph.0001991