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Maternal and Perinatal Factors Associated with Undernutrition among Children Under Five Years of Age in an Urban Setting in Indonesia

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ABSTRACT

Introduction: Undernutrition among children under five years of age remains a significant public health concern in Indonesia. Maternal and perinatal factors, particularly low birth weight and maternal characteristics during pregnancy, are suspected to play a critical role in early childhood nutritional outcomes; however, evidence from urban settings remains limited.
Objective: To identify dominant maternal and perinatal factors associated with undernutrition among children under five years of age in Pancoran Mas Subdistrict, Depok City.
Methods: An analytical observational study with a cross-sectional design was conducted in September 2024 in Pancoran Mas Subdistrict, Depok City. A total of 97 children under five years of age were selected using cluster random sampling. Child nutritional status was assessed using body mass index-for-age based on WHO Child Growth Standards. Data on maternal characteristics, perinatal history, infant feeding practices, and immunization coverage were collected from structured questionnaires and maternal–child health records. Associations were analyzed using chi-square tests, and multivariable logistic regression was performed to identify independent risk factors for undernutrition.
Results: The prevalence of undernutrition was 20.6%. Bivariate analysis revealed significant associations between undernutrition and a history of low birth weight, maternal age at pregnancy, maternal education level, and a history of preeclampsia. In the multivariable model, a history of low birth weight and maternal age at pregnancy (<20 years or >35 years) remained independently associated with undernutrition. Children with a history of low birth weight had a substantially higher risk of undernutrition compared with those born with normal birth weight (adjusted odds ratio = 17.40; 95% confidence interval: 2.43–12.44).
Conclusion: Undernutrition among children under five years of age in Pancoran Mas is strongly associated with maternal and perinatal factors, particularly low birth weight and maternal age at pregnancy. Strengthening maternal health interventions, improving antenatal care, and preventing low birth weight may contribute to reducing undernutrition in urban populations.

KEYWORD

Undernutrition
Children
Low birth weight
Maternal

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INTRODUCTION

Undernutrition among children under five years of age remains an unresolved public health problem in Indonesia and continues to contribute to suboptimal human capital development (Annisa Nuradhiani, 2023). Child undernutrition refers to a condition in which children experience insufficient intake of essential nutrients required for optimal growth and development, resulting in body weight that is not appropriate for age (Paul et al., 2021). Early childhood represents a critical period of rapid growth and development during which nutritional deficits may have long-lasting and potentially irreversible consequences. Adequate and balanced dietary intake, provided in appropriate portions according to age-specific requirements, is therefore essential. Inadequate nutritional intake, both in quality and quantity, may lead to delayed physical growth and impaired development. Insufficient nutrient absorption also compromises immune function, increasing susceptibility to infectious diseases, as nutrition plays a central role in maintaining immune competence. Beyond physical health, nutritional status is closely linked to cognitive development and intellectual capacity (Wardani & Sarah Renyoet, 2022). Globally, nearly half of all deaths among children under five years of age are attributable to undernutrition, with the greatest burden occurring in low- and middle-income countries (WHO, 2025)

ow birth weight (LBW) has been consistently identified as an important factor associated with undernutrition in early childhood. A study conducted in Pandeglang District, Indonesia, reported that children with a history of LBW were at significantly higher risk of undernutrition during the toddler period (Trisiswati et al., 2021). Similarly, a case–control study by Antologo et al. (2020) demonstrated a significant association between LBW and the occurrence of undernutrition among young children, reinforcing the role of early-life growth restriction in shaping later nutritional outcomes.

Maternal characteristics have also been shown to influence child growth and nutritional status. A literature review by Fitriani (2024) highlighted that maternal education level, knowledge, employment status, household income, and maternal nutritional status are key determinants of child growth and development. Higher maternal education is associated with improved capacity to acquire, interpret, and apply health-related information, which in turn positively influences child care practices (Fitriani, Nurul, et al, 2024). Education plays a critical role in promoting health literacy and improving overall quality of life, particularly in relation to child nutrition and health-seeking behaviors (Afwani et al., 2022).

In addition to maternal and perinatal factors, preventive health interventions play a crucial role in determining nutritional outcomes. Analysis of national Riskesdas data by Sari demonstrated significant associations between complete basic immunization coverage and nutritional status among children under five. Exclusive breastfeeding was also significantly associated with better nutritional outcomes. Children who do not receive exclusive breastfeeding are at increased risk of infectious diseases, which may further compromise nutritional status. Breastfeeding for less than six months has been associated with a higher risk of infection, nutrient deficiencies, mineral loss, growth retardation, and subsequent undernutrition and stunting compared with infants who receive exclusive breastfeeding for the recommended duration (Dahlian Syah, 2022).

According to the 2024 Health Profile of Depok City, the prevalence of wasting among children under five was reported at 6.18% (Dinkes Depok, 2024), exceeding the World Health Organization threshold of 2.43% and indicating a persistent public health concern (WHO, 2025). Pancoran Mas Primary Health Center, located in the central area of Depok City, serves a densely populated urban community and represents a key setting for addressing child nutrition problems. This study aimed to identify the dominant factors associated with undernutrition among children under five years of age in Depok City, with the goal of providing evidence to support more effective and targeted interventions for the prevention and management of wasting.

METHODS

This study employed an analytical observational design with a cross-sectional approach and was conducted in September 2024. Primary data were collected to capture respondent characteristics, including maternal age at pregnancy, maternal occupation and education level, maternal height and weight, child age at the time of the study, child sex, and anthropometric measurements of both mothers and children. Additional secondary data were obtained for key study variables, including exclusive breastfeeding status, coverage of basic immunizations, and birth weight. Anthropometric measurements were performed by trained enumerators (undergraduate students) who had received formal instruction and practical training in adult and child anthropometry as part of their academic coursework.

The study population consisted of all children under five years of age residing in Pancoran Mas Subdistrict, Depok City. A cluster random sampling technique was applied, with data collection conducted at the neighborhood unit (RW) level. Of the 20 neighborhood units in Pancoran Mas, 9 were randomly selected as study clusters. According to official records from Depok City, the total population of children under five years of age in Pancoran Mas was 1,921. The sample size was calculated using the Slovin formula, as the population size was known, resulting in a final sample of 97 children under five years of age.

The study variables encompassed multiple domains to identify dominant factors associated with undernutrition among children under five years of age in Pancoran Mas. The dependent variable was child nutritional status, assessed using the body mass index-for-age (BMI-for-age) indicator based on WHO Child Growth Standards. Children with BMI-for-age Z-scores between −3 and −2 standard deviations were classified as undernourished. Body mass index was calculated by dividing body weight (kg) by height squared (m^2). Weight measurements were obtained using a digital baby scale for children unable to stand and a digital weighing scale for older children, while height was measured using a stadiometer.

Independent variables included maternal age at pregnancy, maternal education level, child sex, exclusive breastfeeding status, birth weight, and basic immunization coverage. Maternal age was categorized as high risk if the mother was younger than 20 years or older than 35 years at the time of pregnancy. Maternal education was classified as low risk or high risk, with education at the junior secondary school level or lower considered to be associated with an increased risk of undernutrition. Data on exclusive breastfeeding, maternal characteristics, and child sex were obtained through structured questionnaires completed by respondents. Information on birth weight and immunization coverage was retrieved from maternal and child health (KIA) handbooks and, where necessary, supplemented by records maintained by community health volunteers.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS). Univariate, bivariate, and multivariate analyses were conducted. Prior to analysis, the questionnaire was tested for validity and reliability. Validity testing was conducted using item–total correlation analysis, with an r-table value of 0.182 (degrees of freedom = N − 2, N = 95). All questionnaire items were considered valid, as the calculated correlation coefficients exceeded the critical value. Reliability testing was performed using Cronbach's alpha, yielding values greater than 0.722, indicating acceptable internal consistency.

Univariate analysis involved the calculation of frequency distributions and percentages to describe respondent characteristics, child nutritional status, birth weight, exclusive breastfeeding practices, and basic immunization coverage. Bivariate analysis was conducted using Pearson's chi-square test with a significance level set at $p < 0.05$ to examine associations between independent variables and child nutritional status. Multivariate analysis was performed using binary logistic regression to identify

dominant risk factors associated with undernutrition among children under five years of age in Pancoran Mas, Depok City.

RESULTS

Univariate Analysis

Univariate analysis was conducted to describe the distribution of each study variable among the participants. Proportions were calculated to summarize the characteristics of children under five years of age and their mothers. As shown in Table 1, among the 97 children included in the study, 20.6% were classified as undernourished. A history of low birth weight (LBW) was reported in 17.5% of children. With regard to maternal characteristics, 19.6% of mothers had not completed senior high school, and 12.4% were employed. A history of preeclampsia during pregnancy was reported by 9.3% of mothers, while 39.2% had poor nutritional status during pregnancy.

Table 1. Distribution of child nutritional status, perinatal history, maternal characteristics, infant feeding practices, and immunization coverage

Variable	Frequency (n=97)	Percentage (%)
Child nutritional status		
Undernourished	20	20.6
Normal	77	79.4
Low birth weight history		
<2500 g	17	17.5
≥2500 g	80	82.5
Maternal education level		
Did not complete senior high school	19	19.6
Senior high school or higher	78	80.4
Maternal employment status		
Employed	12	12.4
Unemployed	84	86.6
History of preeclampsia		
Yes	9	9.3
No	88	90.7
Maternal nutritional status during pregnancy		
Undernourished	38	39.2
Normal	59	60.8
Maternal age at pregnancy		
<20 years	10	10.3
≥20 years	87	89.7
Exclusive breastfeeding		
No	85	87.6
Ye	12	12.4
Basic immunization coverage		
Incomplete	70	72.2
Complete	27	27.8

Regarding maternal age, 10.3% of mothers were younger than 20 years at the time of pregnancy. In terms of infant feeding practices, the majority of children (87.6%) did not receive exclusive breastfeeding. In addition, 72.2% of children had incomplete basic immunization coverage. These

findings indicate that several maternal, perinatal, and postnatal risk factors associated with undernutrition were prevalent among the study population.

Bivariate Analysis

Bivariate analysis was performed to examine the associations between potential risk factors and nutritional status among children under five years of age in Pancoran Mas Subdistrict, Depok City. The variables assessed included a history of low birth weight (LBW), maternal education level, maternal employment status, history of preeclampsia during pregnancy, maternal age at pregnancy, maternal nutritional status during pregnancy, and exclusive breastfeeding practices. Associations between independent variables and child nutritional status were evaluated using the chi-square (χ^2) test with a 95% confidence level ($\alpha = 0.05$). Odds ratios (ORs) were calculated to estimate the magnitude of risk associated with each factor.

As presented in Table 2, several maternal and perinatal factors showed significant associations with undernutrition among children under five years of age. Variables with p-values less than 0.05 were considered statistically significant and were subsequently included in multivariable analysis to identify dominant risk factors for undernutrition**.**

Table 2. Bivariate analysis of risk factors associated with nutritional status among children under five years of age

Variable	Undernourished n (%)	Normal n (%)	Total n (%)	OR	*p*-value
Low birth weight history					
<2500 g	10 (58.8)	7 (41.2)	17 (17.5)	10.00	<0.001*
≥2500 g	10 (12.5)	70 (87.5)	80 (82.5)	Ref	
Maternal education level					
Did not complete senior high school	7 (36.8)	12 (63.2)	19 (19.6)	2.92	0.051
Senior high school or higher	13 (16.7)	65 (83.3)	78 (80.4)	Ref	
Maternal employment status					
Employed	3 (25.0)	9 (75.0)	12 (12.4)	0.93	0.815
Unemployed	17 (20.2)	67 (79.8)	84 (86.6)	Ref	
History of preeclampsia					
Yes	6 (66.7)	3 (33.3)	9 (9.3)	10.57	0.002*
No	14 (15.9)	74 (84.1)	88 (90.7)	Ref	
Maternal nutritional status during pregnancy					
Undernourished	7 (18.4)	31 (81.6)	38 (39.2)	0.80	0.799
Normal	13 (22.0)	46 (78.0)	59 (60.8)	Ref	
Maternal age at pregnancy					
<20 or >35 years	6 (60.0)	4 (40.0)	10 (10.3)	7.82	0.005*
20–35 years	14 (16.1)	73 (83.9)	87 (89.7)	Ref	
Exclusive breastfeeding					
No	19 (22.4)	66 (77.6)	85 (87.6)	3.17	0.261
Yes	1 (8.3)	11 (91.7)	12 (12.4)	Ref	
Basic immunization coverage					
Incomplete	16 (22.9)	54 (77.1)	70 (72.2)	1.70	0.576
Complete	4 (14.8)	23 (85.2)	27 (27.8)	Ref	

As shown in Table 2, children with a history of low birth weight (LBW) exhibited a substantially higher prevalence of undernutrition, with 58.8% of children born weighing less than 2500 g classified as undernourished. Undernutrition was also more common among children born to mothers with lower educational attainment, with 36.8% of children whose mothers had not completed senior high school experiencing undernutrition. In addition, 25.0% of children born to employed mothers were classified as undernourished.

Maternal health factors during pregnancy were also associated with child nutritional status. Among mothers with poor nutritional status during pregnancy, 18.4% of their children were undernourished, while a markedly higher proportion of undernutrition was observed among children born to mothers who experienced preeclampsia during pregnancy (66.7%). Furthermore, maternal age at pregnancy showed a significant association with child nutritional status, with 60.0% of children born to mothers younger than 20 years or older than 35 years classified as undernourished.

Statistical analysis using Fisher's exact test demonstrated significant associations between undernutrition and a history of low birth weight, maternal education level, history of preeclampsia, and maternal age at pregnancy ($p < 0.005$). In contrast, chi-square analysis indicated no statistically significant associations between child undernutrition and maternal employment status, maternal nutritional status during pregnancy, exclusive breastfeeding practices, or basic immunization coverage ($p > 0.05$).

Multivariable Analysis

Table 3. Final multivariable analysis model identifying dominant factors

Variable	B	*p*-value	OR (95% CI)
Maternal age at pregnancy	6.615	0.028	6.615 (1.221–35.828)
History of low birth weight	—	0.004	17.404 (2.434–124.443)
Maternal education*	1.665	0.460	1.665 (0.431–6.432)
Low birth weight history × maternal nutritional status*	0.292	0.190	0.292 (0.046–1.839)
History of preeclampsia*	4.008	0.119	4.008 (0.699–22.961)

** Variables not statistically significant in the final multivariable model.*

Table 3 presents the results of the multivariable logistic regression analysis identifying dominant predictive factors for undernutrition among children under five years of age in Pancoran Mas Subdistrict, Depok City. Two variables were independently associated with undernutrition, namely maternal age at pregnancy and a history of low birth weight. Maternal education level, the interaction between low birth weight history and maternal nutritional status, and a history of preeclampsia during pregnancy were identified as confounding variables in this study. The analysis showed that the odds ratio for a history of low birth weight was 17.404, indicating that children with a history of low birth weight had a 17-fold higher risk of undernutrition compared with children born with normal birth weight, after adjustment for maternal education level, the interaction between low birth weight history and maternal nutritional status, and maternal history of preeclampsia.

DISCUSSION

Association between maternal characteristics and child nutritional status

Pregnancy at a maternal age younger than 20 years is associated with a substantially increased risk of adverse outcomes. This elevated risk is partly attributable to the fact that linear growth in females typically completes between the ages of 16 and 18 years, followed by pelvic maturation several years later, usually around the age of 20. Consequently, pregnancy occurring before full somatic and pelvic maturation may result in biological competition for nutrients between the mother and the fetus.

Conversely, pregnancy at an advanced maternal age (>35 years) also carries increased risk due to age-related physiological changes, including reduced elasticity of the birth canal and declining reproductive organ function. Maternal age also influences psychological readiness for pregnancy and childcare, as well as maternal capacity and experience in providing adequate nutrition to infants (Desni Sagita & Kusuma Wardani, 2022).

The findings of this study indicate a significant association between maternal age at pregnancy and undernutrition among children under five years of age. This result is consistent with evidence from Ghana, where children born to adolescent mothers were reported to have an eightfold higher risk of undernutrition compared with those born to adult mothers (Wemakor et al., 2018). Similarly, previous studies have demonstrated that pregnancy at a young maternal age is associated with an increased risk of low birth weight (LBW), which subsequently contributes to poor nutritional outcomes in early childhood (Astuti et al., 2022; Tarigan et al., 2023).

Maternal education level was also identified as an important factor associated with child undernutrition. A study by Khaeriyah (2020) reported that mothers with lower educational attainment were three times more likely to have undernourished children compared with mothers with higher education levels. Mothers play a central role in determining household food choices and feeding practices. Limited maternal education, particularly in relation to nutrition, may reduce maternal knowledge and awareness of balanced diets, resulting in lower dietary diversity and suboptimal child feeding practices (Khaeriyah et al., 2020).

Maternal undernutrition during pregnancy has been shown to increase the risk of low birth weight and subsequent child undernutrition. In addition, poor maternal nutritional status is associated with an increased risk of hypertensive disorders during pregnancy. Undernourished pregnant women are more likely to experience metabolic disturbances, including insulin resistance, diabetes, and hypertension (Sandi et al., 2023). Reduced maternal nutritional status may lead to decreased body fluid volume, resulting in hemoconcentration and delayed blood circulation to peripheral tissues (Putra, 2020). This condition may impair oxygen and nutrient delivery to tissues, including the placenta, leading to placental dysfunction and an increased risk of pregnancy-related hypertension (Andriani and Wulandari, 2022).

Association of low birth weight, exclusive breastfeeding, and basic immunization coverage with child nutritional status

The dominant factor associated with undernutrition among children under five years of age in this study was low birth weight (LBW). Previous research by Khalifah (2021) demonstrated that children born with LBW had a 6.49-fold increased risk of undernutrition compared with children born with normal birth weight. This elevated risk is partly explained by the immature immune system of LBW infants, which increases susceptibility to infectious diseases.

In addition, infants born with LBW often have underdeveloped gastrointestinal function, resulting in impaired nutrient absorption. Consequently, growth and development among LBW infants are more likely to be delayed, increasing the risk of undernutrition and severe malnutrition compared with infants born with normal birth weight. Another factor associated with child nutritional status is immunization coverage. Immunization enhances immune protection and reduces susceptibility to infectious diseases. Children who do not receive complete basic immunization are more vulnerable to communicable diseases, which may indirectly contribute to undernutrition (Nesa et al., 2024; Suyami et al., 2023). Previous studies have reported that children with incomplete basic immunization histories are up to six times more likely to experience stunting compared with those who receive complete immunization. Immunization therefore plays a crucial role in supporting optimal nutritional status among children (Sari et al., 2021)

Exclusive breastfeeding was not found to be significantly associated with undernutrition in this study. Nevertheless, low coverage of exclusive breastfeeding remains a public health concern in Depok City, particularly in Pancoran Mas Subdistrict. Several factors may contribute to the failure to achieve exclusive breastfeeding, including insufficient breast milk production, infant illness, maternal employment, mother–infant separation, medical indications, absence of maternal caregivers, maternal mortality, and other contextual factors. The success of exclusive breastfeeding is influenced by both internal and external factors. Internal factors include maternal knowledge and understanding of the benefits of exclusive breastfeeding, while external factors include educational background and occupational demands. Some working mothers may perceive exclusive breastfeeding as a barrier to career advancement, which may negatively affect breastfeeding practices (Sari et al., 2021).

Low birth weight and maternal age at pregnancy as dominant factors for undernutrition among children under five years of age

Maternal age at pregnancy emerged as a dominant factor associated with undernutrition among children under five years of age. Pregnancy at a young age increases the likelihood of nutritional competition between the mother and fetus, as adolescent mothers require additional nutrients to support their own growth in addition to fetal development (Hildawati et al., 2022). Pregnant women older than 35 years may experience declining physiological function and age-related health conditions, such as hypertension and diabetes mellitus, which can impair nutrient transfer to the fetus through the placenta. Consequently, pregnancies at advanced maternal age require greater energy and nutritional support.

Maternal age also reflects accumulated experience and knowledge related to pregnancy and nutrition. Women aged 20–35 years are generally considered to have greater psychological and cognitive maturity compared with younger mothers, enabling them to better process nutritional information and adopt appropriate dietary practices during pregnancy (Kasim et al., 2023). In contrast, pregnancy at a very young age may occur before optimal development of the uterus and pelvis, potentially reducing uteroplacental blood flow and limiting fetal nutrient supply. Furthermore, adolescent mothers are still undergoing physiological growth, which may compromise the ability to meet the nutritional demands of both mother and fetus (Limbong, 2022) (Angga Arsesiana, 2021). Consistent with these findings, Liznindya (2023) reported that mothers who became pregnant at high-risk ages (<20 years or >35 years) had a 15.9-fold increased risk of delivering infants with low birth weight compared with mothers aged 20–35 years. Birth weight refers to the infant's weight measured within the first hour after delivery. Low birth weight is defined as a birth weight of less than 2500 g. Infants born with LBW are particularly vulnerable to growth impairment and have a higher risk of mortality if adequate care is not promptly provided (Tifanny A. et al., 2022).

LBW infants face an increased risk of mortality, delayed growth and development during childhood, and long-term nutritional deficits compared with infants born with normal birth weight. Even among LBW infants who survive, vulnerability to infectious diseases, cognitive impairment, and developmental delays remains elevated into adulthood (Wigati et al., 2025). Growth and developmental delays among LBW infants often persist, increasing the likelihood of undernutrition and severe malnutrition later in childhood (Kamilia, 2019). Children with a history of LBW have been reported to be 1.5 times more likely to experience wasting later in life compared with children born with normal birth weight (Yudhistirana et al., 2025).

CONCLUSION

This study demonstrates that undernutrition remains a public health concern among children under five years of age in Pancoran Mas Subdistrict, Depok City. Maternal and perinatal factors were significantly associated with child undernutrition, with a history of low birth weight and maternal age at

pregnancy emerging as the dominant independent risk factors. These findings highlight the critical role of maternal health before and during pregnancy in shaping early childhood nutritional outcomes.

Strengthening maternal health interventions, particularly those targeting high-risk pregnancies and the prevention of low birth weight, may contribute to reducing the burden of undernutrition among children. Early identification of maternal risk factors through comprehensive antenatal care is essential for effective prevention strategies.

Public health interventions should prioritize improving maternal health and nutritional status before and during pregnancy through enhanced antenatal education, prevention of early pregnancy, and routine antenatal care monitoring. Integrating these efforts into existing maternal and child health programs may help reduce the risk of low birth weight and subsequent undernutrition in children.

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