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Original Article

The low-birth-weight infants' nutritional status related factors based on maternal characteristics in agricultural areas

Ira Rahmawati[1*], Desta Cahya Amartha[1], Nuning Dwi Merina[1], José Luis Llopis[2], Qori Ila Saidah[3]

ABSTRACT

Introduction: Low birth weight (LBW) infants are vulnerable to health problems that impact growth and development. However, mothers as primary caregivers may not be able to provide care optimally. Factors associated with maternal characteristics need to be analyzed to determine pediatric nursing interventions to improve LBW infant care. This study aims to analyze factors associated with the nutritional status of Low-Birth-Weight Infants (1-12 months) based on maternal characteristics in agricultural areas of Jember Regency.

Methods: The cross-sectional design study was conducted among infant and mother pairs by measuring nutritional status (Weight-for-Age) and distributing questionnaires on maternal characteristics such as age, education, parity, occupation, and responsive caregiving. Total sampling was collected in one of the agricultural areas of Jember that had a high LBW birthrate, resulting in 89 infant-mother pairs with a history of low-birth-weight births. Data collection on nutritional status and maternal demographics was obtained from the Maternal and Child Health Book, while responsive caregiving data was collected from questionnaires to mothers. The Spearman's rank test analyzed the relationship between infant nutritional status and maternal characteristics.

Results: The majority of infants had a normal nutritional status (88%). The characteristics of mothers are mostly aged in early adulthood (95.6%), multiparous (62.9%), elementary school educated (37.1%), not working (87.6%), and responsive caregiving as low as almost as high (50.6%; 49.4%). The results of the study showed that mothers' age, education level, and occupation status were not related to LBW infant nutritional status. However, maternal parity and responsive caregiving were related to the nutritional status (*P*-value = < .001).

Conclusion: The pediatric nurse should play a crucial role as an infant care provider to enhance mothers' empowerment in caring for LBW infants. The Responsive caregiving practice education could be an alternative pediatric nursing intervention to reduce LBW infant morbidity and mortality.

Keywords: low birth weight; nutritional status; pediatric nursing

INTRODUCTION

The incidence of Low birth weight (LBW) babies in Indonesia was reported at 3.4% across 25 provinces (Directorate of Community Nutrition, 2019, in Ramadani et al., 2024). In East Java Province, the prevalence of LBW in 2022 reached 20,907 cases, accounting for 26% of the total 535,874 births. Jember ranks as one of the cities in East Java with the highest mortality rates, with 36% of these cases attributed to LBW, and the prevalences in 2023 has reached 2,104 cases (Dinas Kesehatan Provinsi Jawa Timur, 2023). Ajung and Sukowono Districts, as rural regions in Jember engaged in farming activities, significantly contribute to cases of LBW. According to the Jember Regency Health Office data, the number of LBW cases in Ajung District in 2023 was 140, and 75 cases in Sukowono District.

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***Correspondence**: Ira Rahmawati (irarhmwt@gmail.com)
[1]Departement of Maternity and Pediatric Nursing, Faculty of Nursing, Universitas Jember, Jember, Indonesia
[2] Department of Nursing, Faculty of Nursing, Complutense University of Madrid, Madrid, Spain
[3] Department of Maternity and Pediatric Nursing, Faculty of Nursing, Sekolah Tinggi Ilmu Kesehatan Hang Tuah, Surabaya, Indonesia

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LBW children are still a worldwide health issue, occurring in 15-20% of all births currently, and particularly in developing countries (Thapa et al., 2022). LBW can lead to various issues with health in newborns, including hyperthermia, hypoglycemia, asphyxia, hypocalcemia, and polycythemia, along with long-term issues such as growth and development abnormalities (Nashita & Khayati, 2023; Salsabila et al., 2021). LBW is usually linked with preterm birth and intrauterine constraint, which puts eightfold risk of stunting over babies with normal birth weight (Taha et al., 2020). Thus, the growth and development of low-birth-weight babies require a complete assessment and intervention for their health. The assessment and management of the nutritional health of LBW participants is significant as it affects different aspects in their lives.

The initial six months are important in terms of growth and development at fast pace, and therefore it is necessary that the nutritional requirements of an infant are properly fulfilled (Kerac et al., 2021). Failure to fulfill their food needs will have a serious effect on their survival and well-being in the long term (Aneja et al., 2020). Poor treatment of LBW has many negative consequences. Growth starts during infancy, a crucial stage that can influence the physical, psychological, and behavioral status of the child (Nashita & Khayati, 2023). In addition, preterm infants who are denied proper care and stimulation are prone to coordination disorders, abnormal reflexes, and motor

deficits compromising body function and bearing a high risk of chronic ailments and suboptimal cognitive functions (Rana et al., 2024). Vulnerability of LBW to health complications can be prevented through adequate care by the parents as guardians. However, parents tend to face difficulties in caring for LBW infants due to biological immaturity of the infants, ultimately leading to decreased activity and responsiveness, thereby deterring responsiveness of the mother (Amaliya et al., 2023; Bedwell et al., 2022; Wang et al., 2022).

The failure of parents, particularly mothers, who are the major caregivers of the child, to offer proper care can disrupt infants' adjustment during a sensitive transition time, exposing them to health issues that could slow their development and growth in the future (Astuti et al., 2022). Caregiver inactivity and insensitivity will increase the risk of delayed development in motor, cognitive, and social-emotional areas for infants (Silveira et al., 2024; Rana et al., 2024).

The mother as the primary caregiver is a factor that affects the health of the baby, especially the quality of responsive care (Nurdiantami et al., 2022). Her characteristics influence the parenting styles adopted with children. Factors such as age, education level, employment, and the number of births can affect a mother's caregiving responsiveness (Gaidhane et al., 2022). Mothers with higher educational attainment are often better equipped to comprehend their child's developmental requirements, resulting in more responsive caregiving (Scherer et al., 2019). Employment status is also crucial; full-time working mothers frequently encounter limited time and energy to engage with their infants compared to those who are unemployed or work part-time, who usually exhibit higher responsiveness (Neli et al., 2021). Parity significantly impacts caregiving, as first-time mothers are often in the process of learning caregiving roles, which may lead to lower responsiveness than that observed in mothers who have had more than one child, who possess prior caregiving experience (Islam & Khan, 2023).

Additionally, a child's age influences interaction patterns since the requirements for stimulation and response evolve alongside motor and cognitive advancements. Lastly, the history of a baby's birth weight is vital; infants born with LBW necessitate more careful and responsive attention due to their heightened susceptibility to health and developmental issues (Frontera et al., 2024; Scherer et al., 2019). Therefore, it is crucial to comprehensively understand these elements in creating effective parenting strategies that promote optimal infant growth. This study aims to analyze various factors associated with the nutritional status of Low-Birth-Weight Infants (0-12 months) based on maternal characteristics in the agricultural areas of Jember Regency.

METHODS

Study Design

This study used a cross-sectional design. The population in this study was infants and mothers who cared for LBW infants in the Agricultural Area of Ajung and Sukowono Districts of Jember Regency, conducted in January 2025.

Samples and Sampling

The sample in this study was mothers who had babies with LBW in the age range of 1-12 months in the Agricultural Area of Ajung and Sukowono Subdistricts. Based on the Jember District Health Office, Ajung and Sukowono Health Center, the number of samples in this study was 89 mother-infant pairs, with 43 in Ajung District and 46 in Sukowono District. The participants are infants with a history of low birth weight, aged 1-12 months, whose parents agreed to participate, and excluding those currently hospitalized.

Variables

This study examined infant nutritional status (weight-for-age) as the dependent variable, while the independent variables included maternal characteristics such as age, education level, occupation, parity, and responsive caregiving behaviors. These variables were selected to explore the relationship between maternal factors and infant nutritional outcomes, with responsive caregiving serving as a key behavioral variable that could influence how mothers interact with and care for their infant.

Instruments

The primary instrument used was the Maternal Infant Responsiveness Instrument (MIRI), developed by Linda Amankwaa, PhD, RN and Rita Pickler, PhD, RN, which identifies maternal behaviors related to responsiveness in caring for both full-term and premature infants. The MIRI consists of 22 items measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with total scores ranging from 22 to 110. The instrument covers three main areas: mothers' perceptions of their responsiveness, infants' responses to maternal actions and interaction attempts, and barriers to responsiveness. This questionnaire has been translated and validated, demonstrating good validity with calculated r values exceeding the table value of .339 (df = 33) and reliable internal consistency with a Cronbach's Alpha of .862. Additionally, Maternal and Child Health Books served as secondary instruments for collecting demographic and health-related data.

Data Collection

Data collection utilized a mixed approach combining primary and secondary sources to ensure comprehensive information gathering. Demographic and health information including nutritional status, maternal age, occupation, education level, and parity were obtained from existing Maternal and Child Health Books, providing reliable baseline data. Meanwhile, responsive caregiving data were collected through direct distribution of MIRI questionnaires to mothers during posyandu visits and door-to-door visits, ensuring accessibility and convenience for participants. The questionnaires were completed specifically by mothers who served as primary caregivers for their infants, with this criterion verified through structured interviews to ensure data accuracy and relevance to the study objectives.

Data Analysis

Assessment of the infant's nutritional status was carried out by comparing body weight with age, based on the anthropometric standard category of the Indonesian Ministry of Health 2020. Weight and age measurements are conducted during posyandu by appropriately skilled health workers. Weight measuring devices are calibrated and standardized, and documented in the Maternal and Child Health book. The correlation data of this study between infant nutritional status and maternal characteristics were analyzed by the Spearman Rank Test ($\alpha = .05$).

Table 1. Background Characteristics of Respondent (n=89)

Variables	n	%
Infant's Age		
Young Infant	24	27.0
Older Infant	65	73.0
Gestational Age at Birth		
Aterm	32	36.0
Preterm	57	64.0
Birth Weight		
Low Birth Weight	64	71.9
Very Low Birth Weight	25	28.1
Infant's Nutrition Status		
Normal	79	88.8
Underweight	10	11.2
Mother's Age		
Adolescent	2	2.2
Early Adulthood	85	95.6
Middle Adulthood	2	2.2
Parity		
Primiparous	33	37.1
Multiparous	56	62.9
Education		
Elementary School	33	37.1
Junior High School	18	20.2
Senior High School	28	31.5
Higher Education	10	11.2
Occupation		
Unemployed	78	87.6
Farmer	4	4.5
Private Employee	3	3.4
Self-employed	3	3.4
Others	1	1.1
Responsive Caregiving		
Low	45	50.6
High	44	49.4

Table 2. Spearman Rank Correlation Test Results Between Maternal Characteristics and Low Birth Weight Infants Nutritional Status

Maternal Variables	Correlation Coefficient	*P*-value	Description
Age	-.120	.323	Not Significant
Parity	.250	< .001	Significant, positive correlation
Education	.020	.18	Not Significant
Occupation	.124	.12	Not Significant
Responsive caregiving	.780	< .001	Significant, positive correlation

Ethical Clearance

This study has received ethical approval from the Health Research Ethics Committee of the Faculty of Nursing, University of Jember No.426/UN25.1.14/KEPK/DL/2024.

RESULTS

Data is displayed using a characteristic distribution and Spearman Rank Test result. The results of this study show that most infants have a normal nutritional status. The characteristics of mothers are mostly aged in early adulthood, multiparous, elementary school educated, and not working (Table 1). The results showed that responsive caregiving carried out by mothers in the care of LBW babies was categorized as low almost as much as high (Table 1). The results of this study showed that there was no correlation (*P*-value > .05) between maternal age, education, and occupation to LBW infant nutritional status (Table 2). The results of this study indicate that there is a relationship (*P*-value = < .001) between maternal parity and responsive caregiving to infant nutritional status (Table 2). The responsive caregiving indicated a strong correlation, while maternal parity showed a weak correlation.

DISCUSSION

The Relationship Between Mother's Age and Infant's Nutritional Status

The results of this study show that the majority of the respondents are in early adulthood. This is in line with the Indonesian Ministry of Health (2023), which states that the ideal age for childbirth is between 20 and 35 years, so the respondents' ages are considered appropriate. However, the youngest respondent in this study was 18 years old. According to Putra (2021) in Wulansari et al. (2023), psychological maturity may be affected by age, i.e., individuals who are older tend to be emotionally mature. Young mothers are less stable in their emotions and less capable of caring for babies. Previous research also shows that young mothers are less responsive in interactions with babies and are still in the process of needing training (Anindawati, 2020; Arnita et al., 2020).

The results of the present study indicated that maternal age was not related to the nutritional status of LBW infants. In Labada et al. (2016), it was found that there was no relationship between mothers' age and nutrition status among toddlers. This finding was in agreement with the outcome of research by Yunus (2019), and the outcomes in the bivariate analysis indicated there was no correlation between maternal age and toddlers' nutritional status. Mothers aged at risk on age (<20 years and >35 years) in this analysis indicated they had lower malnutrition than mothers who had an optimal nutritional status. The advanced mother's age doesn't assure that the complete nutrition of a child is appropriately addressed. The applied nutrition knowledge and can offer healthy food to children are much greater than the biological age of the mother (Setiawati et al., 2023). Mother's nutrition knowledge, gained through formal and informal education, contributes even more than age. Overall, while maternal age does offer certain benefits in terms of experience and emotional stability that may aid in providing proper nutrition for children, knowledge, education, and social support are far more influential in meeting children's nutritional needs (Workicho et al., 2020).

The Relationship Between Parity and Infants' Nutritional Status

The results of this study showed that the majority of respondents are multiparous mothers, totaling 56 mothers (62.9%). This is consistent with the study by Khasanah & Rutina (2017), which found that 50% of respondents were multiparous. LBW births can occur in primiparous or multiparous mothers. In addition, the results of this study show that there is a correlation between parity status and the nutritional status of LBW infants. However, the relationship is weak: the more birth experiences, the better the nutritional status of LBW infants.

Primiparous mothers lack understanding of how to interact with their babies, which can hinder the mother's responsiveness (Arnita et al., 2020). This aligns with the findings of Larasati (2019), which revealed a statistical test result of *P*-value = .014, indicating a correlation between maternal parity and the nutritional status of toddlers assessed by their weight and height at a specific age. On the other hand, multiparous mothers have previous experience in caring for babies, which supports better interactions between the mother and baby. Ravn (2013), in Khasanah & Rutina (2017), found a relationship between previous childbirth experience and the mother-baby interaction score in preterm babies. The results of this study show that the majority of mothers have given birth before (multipara), although some are primipara. Multiparous mothers are likely to understand the needs of their baby because they have previous experience in caring for a baby, making them more prepared to respond to the baby's cues compared to primiparous mothers, who may still be adapting to their new role. This aligns with the study by Ravn (2013) in Khasanah & Rutina (2017), which explains that there is a relationship between previous birth experience and the mother-baby interaction score for premature babies.

However, other studies Abdullah & Salfitri (2018), noted that among respondents, 71.8% of multiparous mothers exhibited poor nutritional status, significantly higher than the 31% of primiparous mothers, with a *P*-value of .002 (*P*-value < α = .05), suggesting a connection between parity and toddlers' nutritional status. Toddlers of multiparous mothers face a 3.5 times increased risk of poor or abnormal nutritional status compared to those of primiparous mothers. Families with many children often struggle to meet their balanced dietary needs, leading to insufficient nutritional conditions for the child. As maternal parity rises, mothers are tasked with fulfilling the nutritional requirements of their children (Abdullah & Salfitri, 2018; Harahap et al., 2019; Simelane et al., 2020; Soleha & Tri Zelharsandy, 2023). The results of the research explanation can be a scientific rationale for the correlation of parity status and nutritional status of LBW infants.

The Relationship Between Education and Infants' Nutritional Status

In this study, the majority of mothers had an education level of elementary school or equivalent, accounting for 37.1%, which falls into the category of low education. This study found that higher education is positively associated with higher maternal nutrition knowledge, in line with Egg et al. (2020) stated that higher education will bring better nutrition knowledge, which is crucial in promoting good

nutrition and preventing malnutrition, especially in children. Enhancing the nutrition knowledge of caregivers/mothers is one of the primary keys to nutrition improvement intervention programs. The higher a person's level of education, the easier it is to receive information (Saragih, 2010 in Sarinengsih, 2020). However, the study found that some mothers with basic education had infants with normal nutritional status (body weight/age), and no relationship between maternal education and infant nutritional status. This is because current technological developments make it easier for mothers to access health information from various media, enabling them to increase their knowledge. In addition, baby posyandu activities help mothers increase knowledge related to the growth and development of the child, leading to better nutritional outcomes.

The Relationship Between Occupation and Infants Nutritional Status

The relationship between employment and infant nutritional status was found not to affect. The results of the study indicate that the majority of mothers are not employed or are homemakers, totaling 78 individuals (87.6%). Mothers who do not work tend to have more time to care for, interact with, and play with their babies, which can lead to higher responsiveness and sensitivity, ultimately fostering a stronger bond between the mother and child (Gauthier & DeGusti, 2012 in Indriana, 2022). On the other hand, according to Rahayu et al. (2024) research, working mothers impact their children's nutritional status, as they tend to have less time for childcare compared to stay-at-home mothers. Working mothers often struggle to provide breast milk consistently, and they may not regularly offer breast milk substitutes or additional foods, leading to an unbalanced nutritional intake (Jakaria et al., 2022).

The relationship between working mothers and the nutritional needs of infants and children is intricate, influenced by the trade-off between increased family income and reduced time for direct caregiving. Non-working mothers generally have more free time to focus on their children's necessities, such as providing exclusive breastfeeding, consistently offering complementary foods, and closely monitoring their children's eating habits and growth (Kyanjo et al., 2025; Permatasari & Waluyanti, 2019; Rashad & Sharaf, 2019). Kyanjo et al. (2025) noted that children of non-working mothers tend to receive better care, which enhances their chances of achieving good nutritional status, particularly during the early stages of life. Conversely, while working mothers can contribute to higher household income that helps secure nutritious food and other essentials, they frequently encounter difficulties due to limited caregiving time (Jakaria et al., 2022). Nonetheless, the status of working mothers is not a definitive factor affecting children's nutrition; there are other crucial elements to consider, such as family support and workplace provisions like lactation facilities and maternity leave, which enable mothers to meet their children's nutritional needs effectively. In reality, educated working mothers may find it easier to adjust breastfeeding schedules, pump breast milk, and select healthy complementary foods for their children. Similarly, mothers who do not work but lack nutritional knowledge or face economic constraints could struggle to fulfill their children's nutritional requirements. Therefore, it can be concluded that the status of working mothers relates to nutrition through both income and available caregiving time (Ketema et al., 2022; Oddo et al., 2018; Kyanjo et al., 2025).

While non-working mothers generally have more time for direct childcare, their children's nutritional status isn't guaranteed to be optimal if they lack adequate nutritional knowledge or face economic constraints. Pediatric nurses can play a vital role in providing comprehensive education, facilitating access to resources, and strengthening family support systems. Pediatric Nurses can help connect these families with community resources that offer affordable, nutritious food, nutritional counseling, and support groups, addressing potential economic barriers to optimal nutrition.

Although our study did not find a direct effect, the existing literature acknowledges the complex interplay between maternal employment, income, and caregiving time. For pediatric nurses working with families where mothers are employed, it's essential to advocate for supportive workplace policies, offer practical strategies for time management, and emphasize quality over quantity of time. Pediatric nurses can provide guidance on efficient meal preparation, healthy convenience food options, and effective time management strategies to ensure consistent feeding and care. Educated working mothers may find it easier to adapt to breastfeeding schedules and make healthy food choices. Nurses can emphasize the importance of high-quality, responsive interactions during available caregiving time, regardless of its duration.

The Relationship Between Maternal Responsive Caregiving and Infants Nutritional Status

The results showed that responsive parenting carried out by mothers in the care of LBW babies was categorized as low almost as much as high. Babies with LBW may exhibit weaker signals, making it more difficult for mothers to understand and interpret them (Khasanah & Rutina, 2017). Responsive caregiving is a crucial element in child development, particularly when it comes to nutrition. For the context of feeding, responsive caregiving refers to a parenting style with a caregiver who is sensitively and promptly aware of and reacts to the signals of hunger and fullness in the child, taking into account their developmental needs (Azwar et al., 2023). Infants who are fed with a responsive approach have healthier food consumption, which is related to less obesity and malnutrition. The responsiveness of feeding behaviors, as in the case of feeding, is associated with the nutritional status of the child, whereby both the quantity and quality of food matter in establishing good eating habits and food choices (Mugode et al., 2018; Nendyo et al., 2023). The research evidence indicates that responsive care has something to do with infant nutritional status.

It is affirmed by the report of WHO that responsive caregiving not only contributes to nutritional health but also enhances the child's cognitive and psychosocial development (WHO, 2022). Responsive care-givers also create avenues for children to try out healthy food, become independent, and develop awareness of positive liking of food (Septamarini et al., 2019). Thus, integration of responsivity, nutrition education, and a nurturing family setting is essential to provide optimal nutritional status to the children at times of development and growth (Abebe et al., 2017). The findings in this study indicated that most of the age of infants were 3-6 months, i.e., 36 infants (40.4%), then infants' age between 7-9 months, as many as 34 infants (38.2%).

The social development of infants at 3-6 months is a social stage where infants react to humans and non-humans (Hiddayaturrahmi et al., 2024). That stage is thus the stage

where infants are able to show their responsiveness to the mother. Therefore, providing education to mothers on how to read and respond to the cues of LBW babies and responsive caregiving training or consultation with medical professionals can help mothers communicate better and build a higher quality of interaction, which will ultimately encourage best development for BBLR babies. The responsive caregiving is important in influencing the development and growth of LBW infants, who are at higher risk of illness.

Responsive care involves appropriate interactive feedback between the caregiver and the infant, such as verbal and nonverbal responses, touch, and emotional expressions (Fuertes et al., 2022; Wang et al., 2022). Practice of responsive parenting, such as appropriate nutrition, growth and development stimulation, and a healthy setting, is likely to avoid growth and development issues (Ministry of Health of the Republic of Indonesia, 2023). Studies have established that responsive caregiving is linked with various domains of development in infants, including their physical growth, motor development, communication, problem-solving, and social-emotional development, particularly in the case of LBW infants (Patronick et al., 2023). Childhood nurses are well placed to change parental feeding behaviors by optimal responsive feeding recommendations in both healthcare facilities and community settings. This includes training parents to identify and respond to baby hunger and fullness signals, establishing a supportive feeding context, and facilitating developmentally relevant feeding behavior. Furthermore, pediatric nurses, in collaboration with community health nurses, play a crucial role in empowering families to optimize the care provided to children with a history of LBW. This collaborative approach facilitates sustained family support, enhances parental self-efficacy, and ultimately contributes to improved nutritional outcomes and overall well-being for this vulnerable population.

Research Limitations

Total sampling was used to reach a large number of infants with a history of low birth weight, because more specific criteria would have required extensive resources, including workforce and budget. As a result, the findings, although accurate for the population studied, often cannot be generalized to a broader or similar population because the conclusions may not apply to groups with slightly different characteristics. In our sample of infants with LBW, total sampling inherently cannot control for current age distribution, gestational age, birth weight, and current weight. This is evident in the proportion of older infants who have reached normal weight due to catch-up growth. Therefore, future research is expected to control for these variables, for example, through better sampling techniques, a wider location, and a larger sample size.

CONCLUSION

Nutritional status (weight-for-age) of LBW infants was influenced by various aspects such as the mother's parity and responsive caregiving. The results of the study showed that a mother's age, education level, and occupation status are not related to LBW infant nutritional status. Responsive caregiving is crucial in influencing the nutritional outcomes of LBW infants who are at a higher risk for health issues. Responsive caregiving is a factor that can be modified so that it can be used as an alternative nursing intervention. The research implications for pediatric nursing are that nurses must improve mothers' practices in responsive caregiving, such as ensuring proper nutrition, stimulating growth and development, and providing a healthy environment, to help prevent issues related to growth and development.

Declaration of Interest

There are no conflicts of interest.

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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