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A RETROSPECTIVE STUDY: RE-EXAMINING THE ESTABLISHED NARRATIVE ON THE ASSOCIATION BETWEEN MATERNAL CHRONIC ENERGY DEFICIENCY AND LOW BIRTH WEIGHT IN THE WORK AREA OF AIR NANINGAN PUBLIC HEALTH CENTER

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ABSTRACT

Background: Chronic Energy Deficiency (CED) in pregnant women remains a major nutritional concern and is widely recognized as a determinant of adverse perinatal outcomes, including Low Birth Weight (LBW). In the work area of Air Naningan Public Health Center, both CED and LBW remain prevalent, prompting the need for further evaluation of their association. This retrospective study aimed to analyze the relationship between maternal CED and LBW and to explore the observed mismatch in which many CED mothers still delivered normal-weight infants. **Methods**: This study used a retrospective analytic design involving 265 pregnant women who delivered in 2024. Data were extracted from electronic maternal cohort records (e-Kohort). Bivariate analysis using Chi-Square demonstrated a significant association between CED and LBW ($x^2 = 17.768$; $p < 0.001$). The odds ratio (OR = 5.586; 95% CI: 2.337–13.354) indicated that pregnant women with CED had a 5.6-fold higher risk of delivering LBW infants. **Result:** The prevalence of CED was 34.0%, while LBW occurred in 10.2% of births. Interestingly, 78.9% of CED mothers still delivered normal-weight infants, highlighting the multifactorial nature of LBW. **Conclusion:** These findings confirm CED as a strong predictor of LBW while emphasizing the importance of comprehensive maternal health interventions.

Keywords: Chronic Energy Deficiency; Low Birth Weight; Pregnancy; Retrospective Study

Introduction

Maternal nutrition during pregnancy plays a pivotal role in determining fetal growth, pregnancy progression, and neonatal survival. Adequate maternal energy and protein reserves are essential to support placental development, fetal organogenesis, and metabolic adaptation throughout gestation. Consequently, undernutrition during pregnancy—particularly Chronic Energy Deficiency (CED), defined by a Mid-Upper Arm Circumference (MUAC) measurement of <23.5 cm—has long been recognized as a major risk factor for adverse pregnancy outcomes (7). Maternal CED reflects long-standing insufficient caloric intake and micronutrient deficits, which can impair uteroplacental blood flow and restrict the availability of oxygen and nutrients essential for fetal growth (2). Low Birth Weight (LBW), defined as a birth weight below 2500 grams, remains one of the most important indicators of newborn health. LBW is associated with increased risks of neonatal mortality,

stunting, impaired cognitive development, and long-term metabolic disorders such as type 2 diabetes and cardiovascular disease (3). Globally, approximately 15–20% of infants are born with LBW, with the burden being highest in low- and middle-income countries where maternal malnutrition and limited access to quality antenatal care remain prevalent (6). Indonesia continues to face challenges related to LBW, with the 2018 Basic Health Research (Riskesdas) reporting a national prevalence of 6.2%, though subnational data often show disparities and significantly higher rates.

In the province of Lampung, LBW prevalence reached 13% in 2023, indicating substantial regional variation and the need for targeted maternal health interventions. Within the work area of Air Naningan Public Health Center, maternal nutrition problems and suboptimal pregnancy outcomes have become recurring issues of concern. Local data from 2024 indicate that 11% of pregnant women were classified as experiencing CED, while LBW occurred in approximately 25% of births—figures that exceed both provincial and national averages. These statistics highlight the urgency of understanding the interplay between maternal nutritional status and infant birth outcomes in this specific population. Although maternal CED is consistently identified as a strong predictor of LBW, recent evidence suggests that the relationship is not absolute, with LBW being shaped by a constellation of biological, socioeconomic, and environmental determinants. For example, maternal anemia, hypertensive disorders of pregnancy, infections, short interpregnancy intervals, poor dietary diversity, inadequate antenatal care (ANC) visits, and low household income have all been linked to impaired fetal growth independent of maternal MUAC (4). This multifactorial etiology may explain the observed mismatch in some settings, where a substantial proportion of CED mothers still deliver normal-weight infants, while some women with adequate nutritional status give birth to LBW infants. Research exploring this mismatch phenomenon is crucial, as it may reveal contextual modifiers such as dietary supplementation, family support systems, genetic factors, or variations in placental efficiency. Furthermore, the quality, frequency, and comprehensiveness of ANC visits—including nutritional counseling, micronutrient supplementation, and screening for maternal morbidities—may significantly influence birth outcomes even among nutritionally at-risk mothers (1). Given the persistent burden of CED and LBW in the Air Naningan region, and the inconsistencies observed between maternal nutritional status and neonatal outcomes, there is a need for a more in-depth analysis to clarify the extent and strength of the association between these variables in the local context. Understanding this relationship and its modifying factors is essential for developing targeted interventions to improve maternal nutrition, reduce LBW incidence, and achieve regional maternal and child health goals. (9) Therefore, this study aims to analyze the association between maternal Chronic Energy Deficiency and Low Birth Weight among women who delivered in the Air Naningan Public Health Center area in 2024, and to examine the mismatch phenomenon that has been reported in field observations.

Method

This retrospective quantitative study utilized secondary data from the electronic maternal cohort (e-Kohort) at Air Naningan Public Health Center covering all pregnancies in 2024. A total sampling approach was applied, in which all 302 recorded pregnancies were screened; 37 cases were excluded due to incomplete records or severe chronic maternal disease, leaving 265 eligible mother–infant pairs for analysis, as shown in Figure 1. Data were extracted using a structured checklist that included maternal demographics, MUAC measurements, antenatal care information, and infant birth weight. Maternal Chronic Energy Deficiency was defined as MUAC < 23.5 cm, and Low Birth Weight as < 2500 g. All data were cleaned and analyzed using IBM SPSS Statistics version 26. Univariate analysis described the distribution of variables, while the association between CED and LBW was examined using the Pearson Chi-Square test with a significance level of $p < 0.05$. The Odds Ratio and 95% confidence interval were calculated through the SPSS "Risk Estimate" function. Ethical approval and permission to access anonymized maternal data were obtained from Air Naningan Public Health Center.

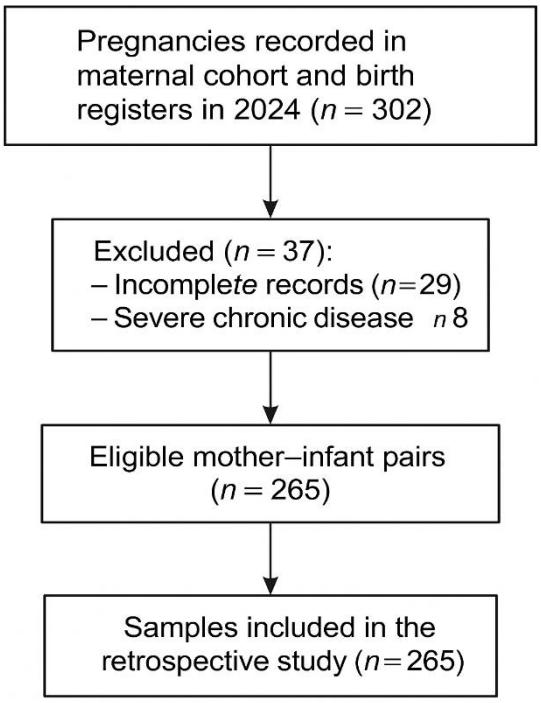

Figure 1. Flow Diagram of Sample Selection Process

Results and Discussion

The study analyzed 265 eligible mother–infant pairs to evaluate the association between maternal Chronic Energy Deficiency (CED) and Low Birth Weight (LBW). The characteristics of the study population and the statistical findings are summarized in the following tables

Tabel 1. Maternal Age Distribution (n = 265)

Maternal Age	**n**	**(%)**
<20 years	5	1,9
20–35 years	243	91,7
>35 years	17	6,4
Total	**265**	**100**

Most respondents (91.7%) were in the 20–35-year age group, representing the reproductive age range associated with lower obstetric risk. Only 6.4% were

above 35 years, a demographic known to carry increased risks of preeclampsia, gestational complications, and fetal growth restriction. These age patterns indicate that LBW in this setting may be influenced more by nutritional and environmental factors rather than maternal age alone.

Table 2. Maternal Nutritional Status Based on MUAC (n = 265)

Nutritional Status	**n**	**(%)**
Non-CED (≥ 23.5 cm)	175	66
CED (< 23.5 cm)	90	34
Total	**265**	**100**

Approximately one-third of pregnant women experienced CED, reflecting persistent maternal undernutrition in the region. This proportion aligns with national surveys showing high maternal undernutrition in low-income communities. The high CED prevalence underscores the need for strengthened antenatal nutritional surveillance and supplementation.

Table 3. Birth Weight Distribution (n = 265)

Birth Weight	**n**	**(%)**
Normal (≥ 2500 g)	238	89
LBW (< 2500 g)	27	10
Total	**265**	**100**

LBW prevalence reached 10.2%, slightly above the national target (<10%). While the majority of infants were born with normal birth weight, the proportion of LBW remains clinically relevant, given its association with neonatal morbidity, long-term developmental challenges, and increased risk of chronic disease in adulthood.

Table 4. Association Between CED and LBW (Chi-Square Test)

Birth Weight	**Non-CED n(%)**	**Non-CED n(%)**
Normal (≥ 2500 g)	167 (95.4%)	89
LBW (< 2500 g)	8 (4.6%)	10
Total	175 (100%)	**100**

*Chi-Square = 17.768; p = 0.000
*Odds Ratio (95% CI) = 5.586 (2.337–13.354)

There was a statistically significant association between maternal CED and LBW. Pregnant women with CED had a **5.6-fold higher risk** of delivering LBW infants compared with non-CED mothers. The findings indicate that maternal nutritional status, as measured by MUAC, is strongly associated with infant birth outcomes. The prevalence of CED in this study (34.0%) reflects persistent maternal undernutrition and supports global evidence showing that inadequate maternal energy and micronutrient reserves impair placental function and fetal growth, increasing the risk of intrauterine growth restriction (2&7). The LBW rate of 10.2% also aligns with provincial trends and signals ongoing challenges in improving neonatal health. Statistical analysis confirmed a significant association between CED and LBW, with CED mothers showing a markedly higher proportion of LBW infants (21.1% vs. 4.6%) and a fivefold increased risk of delivering LBW infants (OR 5.586), consistent with studies highlighting MUAC as a robust

predictor of fetal growth in resource-limited settings (10,11). However, the observation that most CED mothers (78.9%) still delivered normal-weight infants underscores the multifactorial nature of LBW. Factors such as maternal anemia, micronutrient deficiencies, infections, hypertensive disorders, socioeconomic constraints, and variability in ANC quality may modify fetal outcomes despite nutritional risk (1, 12). Genetic influences and placental adaptation may further explain why some fetuses maintain adequate growth even under suboptimal maternal conditions. Overall, these results reinforce the importance of addressing both nutritional and non-nutritional determinants in reducing LBW, emphasizing that while improving maternal nutrition is essential, comprehensive strengthening of antenatal care—including supplementation, early risk detection, and behavioral counseling—remains critical for optimizing birth outcomes.

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