



## ANALYSIS OF DETERMINANT FACTORS OF CHRONIC ENERGY DEFICIENCY (CED) IN PREGNANT WOMEN WITH MODIFICATION OF LAWRENCE GREEN AND SNEHANDU B. KAR'S THEORIES

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### ABSTRACT

Throughout the world, almost every day, 800 mothers die due to complications of pregnancy and childbirth, and more than 5 million babies die every year. One factor that can increase the risk of maternal and infant death is Chronic Energy Deficiency (CED) during pregnancy. This research aimed to analyse the determinants of CED factors in pregnant women with modifications to Lawrence Green's and Snehandu B. Kar's theories. This research used an analytical survey with a cross-sectional approach. In August–September 2023, there were 97 cases and 97 controls. The sampling technique was purposive sampling—bivariate analysis used chi-square and multivariate with a logistic regression test. The statistical analysis showed that education, gravida, parity, pregnancy interval, and husband's support have a significant relationship with CED ( $p < 0.05$ ). Meanwhile, age, knowledge, occupation, Antenatal care (ANC) examination, intention to become pregnant, independence in making health decisions, the role of health workers, family and health cadre support, transportation facilities, and ease of obtaining health information were not significant relationships to CED ( $p > 0.05$ ). Multivariate statistical analysis showed primigravida was the most dominant factor ( $p < 0.05$ ). The factors of education, gravida, parity, pregnancy interval, and husband's support were significant relationships with CED in pregnant women. The most dominant factor causing CED is primigravida. We recommend providing optimal FE tablets and educating adolescents about the importance of adolescent nutrition and integrated services in the school environment.

**Keywords:** chronic energy deficiency, nutritional status, pregnancy

## Introduction

Globally, over 800 mothers perish daily due to issues arising from pregnancy and delivery. Moreover, the annual infant mortality rate exceeds 5 million.<sup>1,2</sup> In 2021, Indonesia recorded 7,386 incidents of maternal fatalities and 27,566 cases of newborn deaths. Chronic energy deficit (CED) during pregnancy is a contributing factor to the increased risk of maternal and infant mortality.<sup>3</sup> The Southeast Asia region (SEA) is accountable for around 3.5 million fatalities among mothers and children.<sup>4,5</sup>

According to the Basic Health Research (Riskesdas) findings conducted in 2018, the occurrence rate of CED among pregnant women in Indonesia was 17.3%.<sup>6</sup> The prevalence of pregnant women with CED at 25 community health centers in the Lumajang district remained reasonably high (>10%) from 2020 to 2022, according to the Lumajang District Health Office (2023).<sup>7</sup> The significant frequency of CED underscores the continued urgency for timely intervention addressing dietary issues during pregnancy.

CED is a medical condition characterized by persistent energy, protein, and iron deficiency in the mother, leading to adverse health effects for both the mother and the infant.<sup>8</sup> CED during pregnancy can give rise to various risks and complications, including but not limited to anemia, hemorrhage, impaired weight gain, infection-related illnesses, and maternal mortality.<sup>9-11</sup> If a newborn has CED during the first trimester of pregnancy, problems with the fetus' nervous system, metabolism, and breathing, as well as poor organ development, are likely to happen.<sup>12,13</sup> Babies can be born early, have intrauterine growth restriction (IUGR), be taken with low body weight (LBW), have birth defects or die during the second and third trimesters.<sup>14-16</sup>

Both direct and indirect variables can impact the occurrence of CED in pregnant women. The primary determinants are the consumption of energy and protein sources and the presence of infectious illnesses. Indirect factors that influence the situation include age, gravida, parity, education level, knowledge, occupation, family income, food expenditure, food availability, and antenatal care (ANC).<sup>17-24</sup>

This study employs a modified version of two health theories, specifically Lawrence Green's and Snehandu B. Kar's theories. The indicators in Snehandu B. Kar's Theory that align with and enhance Lawrence Green's Theory include behavior intention and personal autonomy, which are unique to these health theories.<sup>25-27</sup> Personal autonomy is associated with the occurrence of CED in pregnant women, while a lack of decision-making independence is strongly linked to CED.<sup>24</sup>

Research on CED in pregnant women using Lawrence Green's Theory and Snehandu B. Kar's theory has yet to be found. Most studies are limited to examining CED in pregnancy only. Therefore, this study aimed to examine the factors influencing CED in pregnant women using Lawrence Green's and Snehandu B. Kar's modification theories. Hopefully, this study can help pregnant women and health professionals overcome CED.

## Methods

This quantitative research employed a cross-sectional design and analytic survey methodology. This research was carried out at four health centers in the Lumajang district between August and September 2023: Gucialit Health Center, Kedungjajang Health Center, Klakah Health Center, and Ranuyoso Health Center. The study's demographic comprised 128 pregnant women who underwent CED at the four health centers under investigation.<sup>28</sup>

The proportion estimation formula was employed to determine the sample size for this research, resulting in 97 cases of pregnant women with CED and 97 non-CED cases comprising the sample. The sampling procedure employed was purposive sampling. The sampling in this study was of pregnant women who came to the pregnancy examination and met the inclusion and exclusion criteria in the 4 health centers studied. There are inclusion and exclusion criteria in this study. The inclusion criteria consisted of pregnant women with CED, which consisted of two criteria: pregnant women with LILA <23.5 cm and pregnant women who lived for at least 1 year in the working area of 4 health centers. The second was pregnant women without CED, which consisted of 2 criteria: pregnant women with LILA  $\geq$ 23.5 cm and pregnant women who lived for at least 1 year in the working area of the 4 health centers studied. The exclusion criteria in this study were pregnant women who experienced serious illness (shortness of breath, seizures, undergoing hospitalization) during the data collection process. There are two variables in this study, were independent variables consisting of predisposing factors (age, education, knowledge, occupation, parity, gravida, pregnancy distance, compliance behavior of pregnant women in ANC examinations according to standards, intention to become pregnant, independence in making health decisions), reinforcing factors (the role of health workers, husband support, family support, health cadre support), and enabling factors (transportation facilities, ease of obtaining health information). The dependent variable in this study is the incidence of CED in pregnant women.

Documentation, questionnaires, and LILA tape measurements were employed to acquire the data. The principal investigator and two data collectors conducted the data collection process for this investigation. The data collectors received pre-training regarding the appropriate protocols for completing the questionnaire. Daily, throughout data collection, the questionnaires underwent a comprehensive review by the data collectors. To maintain the integrity of the data, the principal investigator also verified the completed questionnaires twice. Data collectors were required to have a minimum of a D3 health education, effective communication skills, and teamwork abilities.

Validity and reliability assessments were conducted at the Pasrujambe Health Center, which shares geographical areas and characteristics similar to the four health centers that serve as research sites, particularly for pregnant women. The research questionnaire's validity was assessed using a correlation value of  $R_{count} > R_{table} > 0.3494$ . The questionnaire's reliability was also verified using an Alpha Cronbach value  $> 0.6$ . Data analysis was conducted utilizing SPSS version 16.0.

Univariate and bivariate analyses were performed employing the chi-square test, and the logistic regression test was used for multivariate analysis. The Health Research Ethics Commission of the Faculty of Dentistry, Universitas Jember, granted ethical authorization for this investigation on July 6, 2023, under reference No. 2173/UN25.8/KEPK/DL/2023.

**Results**

In this study, the bivariate analysis revealed that certain factors, including education, gravida, parity, and pregnancy distance, have a significant relationship ( $P < 0.05$ ) with the incidence of CED in pregnant women. On the other hand, variables such as age, knowledge, occupation, compliance behavior of pregnant women in ANC examinations according to standards, intention to become pregnant, and independence in making health decisions have no relationship with the incidence of CED in pregnant women ( $P > 0.05$ ) (Table 1).

**Table 1. Results of Bivariate Analysis on Predisposing Factors**

| Variable                                       |                | Incidence of CED               |    |                                   |    | P-value | OR    | 95% CI for EXP(B) |        |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|--|----------------|--------------------------------|----|-----------------------------------|----|---------|-------|-------------------|--------|--|----------------|----|----|----|----|--------|-------|-------|--------|----------------|----|----|----|----|--|----------------|----|----|----|----|--------|-------|-------|--------|----------------|----|----|----|----|--|----------------|----|----|----|----|--------|-------|-------|--------|----------------|----|----|----|----|--|----------------|----|----|----|----|--------|-------|-------|--------|----------------|----|----|----|----|--|----------------|----|----|----|----|--------|-------|-------|--------|----------------|----|----|----|----|--|----------------|----|----|----|----|--------|-------|-------|-------|----------------|----|----|----|----|--|----------------|----|----|----|----|-------|-------|-------|-------|----------------|----|----|----|----|--|----------------|----|----|----|----|-------|-------|-------|-------|----------------|----|----|----|----|--|----------------|----|----|----|----|-------|-------|-------|-------|
|  |                | Pregnant women with CED (N=97) |    | Pregnant women without CED (N=97) |    |         |       | Lower             | Upper  |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  |                | n                              | %  | n                                 | %  |         |       |                   |        |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
| <b>Age</b>                                     | CED risk       | 18                             | 19 | 29                                | 30 | 0.065   | 0.534 | 0.273             | 1.046  |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | No CED risk    | 79                             | 81 | 68                                | 70 |         |       |                   |        | <b>Education</b>                               | Low            | 46 | 47 | 60 | 62 | 0.043* | 0.556 | 0.314 | 0.985  | High           | 51 | 53 | 37 | 38 | <b>Knowledge</b>                               | Moderately     | 7  | 7  | 12 | 12 | 0.227  | 0.551 | 0.207 | 1.465  | Knowledgeable  | 90 | 93 | 85 | 88 | <b>Occupation</b>                              | Unemployed     | 86 | 89 | 93 | 96 | 0.06   | 0.336 | 0.103 | 1.096  | Employed       | 11 | 11 | 4  | 4  | <b>Gravida</b>                                 | Primigravida   | 67 | 69 | 25 | 26 | 0.000* | 6.432 | 3.438 | 12.034 | Multigravida   | 30 | 31 | 72 | 74 | <b>Parity</b>                                  | Primipara      | 67 | 69 | 25 | 26 | 0.000* | 6.432 | 3.438 | 12.034 | Multipara      | 30 | 31 | 72 | 74 | <b>Pregnancy Interval</b>                      | CED risk       | 77 | 79 | 50 | 51 | 0.000* | 3.619 | 1.922 | 6.815 | No CED risk    | 20 | 21 | 47 | 49 | <b>ANC examination</b>                         | Non-standard   | 57 | 59 | 47 | 49 | 0.15  | 1.516 | 0.860 | 2.674 | Standard       | 40 | 41 | 50 | 51 | <b>Intention to become pregnant</b>            | No-intention   | 4  | 4  | 3  | 3  | 1.000 | 1.348 | 0.294 | 6.187 | With Intention | 93 | 96 | 94 | 97 | <b>Independence in making health decisions</b> | No-independent | 27 | 28 | 35 | 36 | 0.218 | 0.683 | 0.372 | 1.254 |
| <b>Education</b>                               | Low            | 46                             | 47 | 60                                | 62 | 0.043*  | 0.556 | 0.314             | 0.985  |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | High           | 51                             | 53 | 37                                | 38 |         |       |                   |        | <b>Knowledge</b>                               | Moderately     | 7  | 7  | 12 | 12 | 0.227  | 0.551 | 0.207 | 1.465  | Knowledgeable  | 90 | 93 | 85 | 88 | <b>Occupation</b>                              | Unemployed     | 86 | 89 | 93 | 96 | 0.06   | 0.336 | 0.103 | 1.096  | Employed       | 11 | 11 | 4  | 4  | <b>Gravida</b>                                 | Primigravida   | 67 | 69 | 25 | 26 | 0.000* | 6.432 | 3.438 | 12.034 | Multigravida   | 30 | 31 | 72 | 74 | <b>Parity</b>                                  | Primipara      | 67 | 69 | 25 | 26 | 0.000* | 6.432 | 3.438 | 12.034 | Multipara      | 30 | 31 | 72 | 74 | <b>Pregnancy Interval</b>                      | CED risk       | 77 | 79 | 50 | 51 | 0.000* | 3.619 | 1.922 | 6.815  | No CED risk    | 20 | 21 | 47 | 49 | <b>ANC examination</b>                         | Non-standard   | 57 | 59 | 47 | 49 | 0.15   | 1.516 | 0.860 | 2.674 | Standard       | 40 | 41 | 50 | 51 | <b>Intention to become pregnant</b>            | No-intention   | 4  | 4  | 3  | 3  | 1.000 | 1.348 | 0.294 | 6.187 | With Intention | 93 | 96 | 94 | 97 | <b>Independence in making health decisions</b> | No-independent | 27 | 28 | 35 | 36 | 0.218 | 0.683 | 0.372 | 1.254 | Independent    | 70 | 72 | 62 | 64 |  |                |    |    |    |    |       |       |       |       |
| <b>Knowledge</b>                               | Moderately     | 7                              | 7  | 12                                | 12 | 0.227   | 0.551 | 0.207             | 1.465  |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | Knowledgeable  | 90                             | 93 | 85                                | 88 |         |       |                   |        | <b>Occupation</b>                              | Unemployed     | 86 | 89 | 93 | 96 | 0.06   | 0.336 | 0.103 | 1.096  | Employed       | 11 | 11 | 4  | 4  | <b>Gravida</b>                                 | Primigravida   | 67 | 69 | 25 | 26 | 0.000* | 6.432 | 3.438 | 12.034 | Multigravida   | 30 | 31 | 72 | 74 | <b>Parity</b>                                  | Primipara      | 67 | 69 | 25 | 26 | 0.000* | 6.432 | 3.438 | 12.034 | Multipara      | 30 | 31 | 72 | 74 | <b>Pregnancy Interval</b>                      | CED risk       | 77 | 79 | 50 | 51 | 0.000* | 3.619 | 1.922 | 6.815  | No CED risk    | 20 | 21 | 47 | 49 | <b>ANC examination</b>                         | Non-standard   | 57 | 59 | 47 | 49 | 0.15   | 1.516 | 0.860 | 2.674  | Standard       | 40 | 41 | 50 | 51 | <b>Intention to become pregnant</b>            | No-intention   | 4  | 4  | 3  | 3  | 1.000  | 1.348 | 0.294 | 6.187 | With Intention | 93 | 96 | 94 | 97 | <b>Independence in making health decisions</b> | No-independent | 27 | 28 | 35 | 36 | 0.218 | 0.683 | 0.372 | 1.254 | Independent    | 70 | 72 | 62 | 64 |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
| <b>Occupation</b>                              | Unemployed     | 86                             | 89 | 93                                | 96 | 0.06    | 0.336 | 0.103             | 1.096  |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | Employed       | 11                             | 11 | 4                                 | 4  |         |       |                   |        | <b>Gravida</b>                                 | Primigravida   | 67 | 69 | 25 | 26 | 0.000* | 6.432 | 3.438 | 12.034 | Multigravida   | 30 | 31 | 72 | 74 | <b>Parity</b>                                  | Primipara      | 67 | 69 | 25 | 26 | 0.000* | 6.432 | 3.438 | 12.034 | Multipara      | 30 | 31 | 72 | 74 | <b>Pregnancy Interval</b>                      | CED risk       | 77 | 79 | 50 | 51 | 0.000* | 3.619 | 1.922 | 6.815  | No CED risk    | 20 | 21 | 47 | 49 | <b>ANC examination</b>                         | Non-standard   | 57 | 59 | 47 | 49 | 0.15   | 1.516 | 0.860 | 2.674  | Standard       | 40 | 41 | 50 | 51 | <b>Intention to become pregnant</b>            | No-intention   | 4  | 4  | 3  | 3  | 1.000  | 1.348 | 0.294 | 6.187  | With Intention | 93 | 96 | 94 | 97 | <b>Independence in making health decisions</b> | No-independent | 27 | 28 | 35 | 36 | 0.218  | 0.683 | 0.372 | 1.254 | Independent    | 70 | 72 | 62 | 64 |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
| <b>Gravida</b>                                 | Primigravida   | 67                             | 69 | 25                                | 26 | 0.000*  | 6.432 | 3.438             | 12.034 |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | Multigravida   | 30                             | 31 | 72                                | 74 |         |       |                   |        | <b>Parity</b>                                  | Primipara      | 67 | 69 | 25 | 26 | 0.000* | 6.432 | 3.438 | 12.034 | Multipara      | 30 | 31 | 72 | 74 | <b>Pregnancy Interval</b>                      | CED risk       | 77 | 79 | 50 | 51 | 0.000* | 3.619 | 1.922 | 6.815  | No CED risk    | 20 | 21 | 47 | 49 | <b>ANC examination</b>                         | Non-standard   | 57 | 59 | 47 | 49 | 0.15   | 1.516 | 0.860 | 2.674  | Standard       | 40 | 41 | 50 | 51 | <b>Intention to become pregnant</b>            | No-intention   | 4  | 4  | 3  | 3  | 1.000  | 1.348 | 0.294 | 6.187  | With Intention | 93 | 96 | 94 | 97 | <b>Independence in making health decisions</b> | No-independent | 27 | 28 | 35 | 36 | 0.218  | 0.683 | 0.372 | 1.254  | Independent    | 70 | 72 | 62 | 64 |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
| <b>Parity</b>                                  | Primipara      | 67                             | 69 | 25                                | 26 | 0.000*  | 6.432 | 3.438             | 12.034 |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | Multipara      | 30                             | 31 | 72                                | 74 |         |       |                   |        | <b>Pregnancy Interval</b>                      | CED risk       | 77 | 79 | 50 | 51 | 0.000* | 3.619 | 1.922 | 6.815  | No CED risk    | 20 | 21 | 47 | 49 | <b>ANC examination</b>                         | Non-standard   | 57 | 59 | 47 | 49 | 0.15   | 1.516 | 0.860 | 2.674  | Standard       | 40 | 41 | 50 | 51 | <b>Intention to become pregnant</b>            | No-intention   | 4  | 4  | 3  | 3  | 1.000  | 1.348 | 0.294 | 6.187  | With Intention | 93 | 96 | 94 | 97 | <b>Independence in making health decisions</b> | No-independent | 27 | 28 | 35 | 36 | 0.218  | 0.683 | 0.372 | 1.254  | Independent    | 70 | 72 | 62 | 64 |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
| <b>Pregnancy Interval</b>                      | CED risk       | 77                             | 79 | 50                                | 51 | 0.000*  | 3.619 | 1.922             | 6.815  |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | No CED risk    | 20                             | 21 | 47                                | 49 |         |       |                   |        | <b>ANC examination</b>                         | Non-standard   | 57 | 59 | 47 | 49 | 0.15   | 1.516 | 0.860 | 2.674  | Standard       | 40 | 41 | 50 | 51 | <b>Intention to become pregnant</b>            | No-intention   | 4  | 4  | 3  | 3  | 1.000  | 1.348 | 0.294 | 6.187  | With Intention | 93 | 96 | 94 | 97 | <b>Independence in making health decisions</b> | No-independent | 27 | 28 | 35 | 36 | 0.218  | 0.683 | 0.372 | 1.254  | Independent    | 70 | 72 | 62 | 64 |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
| <b>ANC examination</b>                         | Non-standard   | 57                             | 59 | 47                                | 49 | 0.15    | 1.516 | 0.860             | 2.674  |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | Standard       | 40                             | 41 | 50                                | 51 |         |       |                   |        | <b>Intention to become pregnant</b>            | No-intention   | 4  | 4  | 3  | 3  | 1.000  | 1.348 | 0.294 | 6.187  | With Intention | 93 | 96 | 94 | 97 | <b>Independence in making health decisions</b> | No-independent | 27 | 28 | 35 | 36 | 0.218  | 0.683 | 0.372 | 1.254  | Independent    | 70 | 72 | 62 | 64 |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
| <b>Intention to become pregnant</b>            | No-intention   | 4                              | 4  | 3                                 | 3  | 1.000   | 1.348 | 0.294             | 6.187  |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | With Intention | 93                             | 96 | 94                                | 97 |         |       |                   |        | <b>Independence in making health decisions</b> | No-independent | 27 | 28 | 35 | 36 | 0.218  | 0.683 | 0.372 | 1.254  | Independent    | 70 | 72 | 62 | 64 |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
| <b>Independence in making health decisions</b> | No-independent | 27                             | 28 | 35                                | 36 | 0.218   | 0.683 | 0.372             | 1.254  |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |
|  | Independent    | 70                             | 72 | 62                                | 64 |         |       |                   |        |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |        |                |    |    |    |    |  |                |    |    |    |    |        |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |                |    |    |    |    |  |                |    |    |    |    |       |       |       |       |

\*significant p-value < 0,05

**Table 2. Results of Bivariate Analysis on Reinforcing Factors**

| Variable                      |         | Incidence of CED               |    |                                   |    | P-value | OR    | 95% CI for EXP(B) |        |
|-------------------------------|---------|--------------------------------|----|-----------------------------------|----|---------|-------|-------------------|--------|
|                               |         | Pregnant women with CED (N=97) |    | Pregnant women without CED (N=97) |    |         |       | Lower             | Upper  |
|                               |         | n                              | %  | n                                 | %  |         |       |                   |        |
| <b>Role of health workers</b> | Less    | 7                              | 7  | 3                                 | 3  | 0.194   | 2.437 | 0.611             | 9.717  |
|                               | Support | 90                             | 93 | 94                                | 97 |         |       |                   |        |
| <b>Husband's support</b>      | Less    | 14                             | 14 | 3                                 | 3  | 0.005*  | 5.285 | 1.467             | 19.036 |
|                               | Support | 83                             | 86 | 94                                | 97 |         |       |                   |        |
| <b>Family support</b>         | Less    | 20                             | 21 | 24                                | 25 | 0.493   | 0.79  | 0.403             | 1.551  |
|                               | Support | 77                             | 79 | 73                                | 75 |         |       |                   |        |
| <b>Health cadres support</b>  | Less    | 10                             | 10 | 10                                | 10 | 1.000   | 1.000 | 0.396             | 2.523  |
|                               | Support | 87                             | 90 | 87                                | 90 |         |       |                   |        |

\* significant- value < 0,05

Enabling factors, variables of transportation facilities, and ease of obtaining health information did not have a significant relationship with the incidence of CED in pregnant women (P>0.05) (Table 3).

**Table 3. Results of Bivariate Analysis on Enabling Factors**

| Variable                                 |      | Incidence of CED               |    |                                   |    | P-value | OR    | 95% CI for EXP(B) |       |
|--|------|--------------------------------|----|-----------------------------------|----|---------|-------|-------------------|-------|
|  |      | Pregnant women with CED (N=97) |    | Pregnant women without CED (N=97) |    |         |       | Lower             | Upper |
|  |      | n                              | %  | n                                 | %  |         |       |                   |       |
| <b>Transportation facilities</b>         | Less | 39                             | 40 | 28                                | 29 | 0.097   | 1.657 | 0.911             | 3.013 |
|  | Easy | 58                             | 60 | 69                                | 71 |         |       |                   |       |
| <b>Easy access to health information</b> | Less | 12                             | 12 | 21                                | 22 | 0.085   | 0.511 | 0.236             | 1.108 |
|  | Easy | 85                             | 88 | 76                                | 78 |         |       |                   |       |

The multivariate analysis in this study showed that factors that made women more likely to develop CED in the gravida variable and factors that made women more likely to support their husbands had a P<0.05. This means that both the gravida variable and husband support have a significant effect on the incidence of CED in pregnant women (Table 4). Primigravida is the variable that has the most dominant influence on the incidence of CED in pregnancy, with an Exp. B value of 6.314. This means primigravida has a 6.314 times higher chance of experiencing CED than multigravida.

**Table 4. Results of multivariate analysis with logistic regression test**

| Variable                  | P-value | Exp(B) | 95% CI for EXP(B) |        |
|---------------------------|---------|--------|-------------------|--------|
|                           |         |        | Lower             | Upper  |
| <b>Gravida</b>            | 0.000*  | 6.314  | 2.519             | 15.822 |
| <b>Pregnancy interval</b> | 0.751   | 0.861  | 0.342             | 2.171  |
| <b>Husband's support</b>  | 0.031*  | 4.61   | 1.147             | 18.532 |
| <b>Education</b>          | 0.567   | 0.82   | 0.416             | 1.617  |

\*significant p-value < 0,05

## Discussion

The majority of participants in this study were in the non-risk age range of 20–35 years old, and there was a nearly equal number of those with low and high education levels. Most respondents have moderate knowledge and are unemployed. The majority of respondents with CED were first-time pregnant women and had unsafe pregnancy intervals, either less than or equal to 2 years or greater than or equal to 10 years. The ANC assessment yielded nearly identical percentages when compared to the norm. Most respondents got support from their husbands, families, and health cadres in their position as health professionals. Most participants desired to conceive and possess autonomy in healthcare choices throughout their pregnancy. Regarding transportation facilities and access to health information, most respondents reported convenience.

This study showed no correlation between age and CED in pregnant women. Some studies found that most respondents were 20–35 years old when a woman's reproductive organs and body were ready for pregnancy and had a lower risk of pregnancy complications.<sup>10,19,20</sup> Young (<20 years) and elderly (>35 years) mothers need more nutrition during pregnancy. Early pregnancy puts the fetus and mother in competition for nutrients. This happens because the mother is young. Adolescence involves rapid growth and development. Organ function declines in pregnant women over 35. Age-related hypertension and diabetes mellitus might block the placenta from feeding the baby. This explains the high CED rate at this age.<sup>22</sup>

This study showed a significant relationship between education and CED in pregnant women. Maternal education is substantially associated with CED in pregnant women. Higher education makes learning simpler; therefore, a person has more knowledge. Students in higher education should know more about nutrition to meet their nutritional needs.<sup>19,20,23,29</sup>

Lack of nutritional information might hinder pregnant women's eating choices. Knowledge makes pregnant women more selective about their eating habits. Health workers, print media, and electronic media provide knowledge in addition to formal education.<sup>30,31</sup> This study showed no correlation between knowledge and CED in pregnant women. Family finances might affect this. With minimal financial resources and a good understanding of CED, pregnant women are unable to satisfy their nutritional needs in quality and quantity, resulting in CED. Some studies have matched this and found that most mothers had good nutrition and CED knowledge.<sup>32,33</sup>

This study showed no correlation between occupation and CED in pregnant women. This study correlates with some studies<sup>20,21</sup> showing that a majority of mothers were homemakers or unemployed. Working pregnant women had 6.338 times the risk of CED than non-working pregnant women because more energy was used due to their workload. Pregnant women can work lightly.<sup>19</sup>

This study found a substantial correlation between gravida and CED in pregnant women. This study matches Banyuwangi's East Java research.<sup>32</sup> Most respondents in this research were

primigravida, which had a 6.432-fold higher risk of CED than multigravida. Young mothers are more likely to have CED because their bodies aren't ready to supply energy for fetal development. In addition, throughout adolescence and pregnancy, the nutritional demands of the mother and fetus compete since both are growing and developing. Because pregnant women have expertise in fulfilling dietary demands, multigravida has a lower risk of CED than primigravida.<sup>5,34</sup>

Grandemultipara is a high-risk pregnancy parity. For recovery after childbirth, mothers with multiple parities need a lot of nourishment.<sup>5,34,35</sup> Physically, several factors limit the uterus' ability to support foetal development.<sup>5,36</sup> This study showed a significant relationship between parity and CED in pregnant women. This study was supported by other study at Gondar Hospital, Ethiopia. In this study, most respondents were multiparous.<sup>20</sup> Multipara has 6.432 times the CED risk of primipara. Less parity among pregnant women means a reduced chance of CED.

This study found a strong correlation between pregnancy interval and CED in pregnant women. A risky pregnancy interval increases CED risk by 3.619 times. Too many pregnancies can deplete nutrients and weaken reproductive organs, causing CED malnutrition. The ideal pregnancy interval (3–9 years) allows the mother's body to heal for the following pregnancy.<sup>33</sup>

This study showed no significant correlation between ANC examination behavior and CED incidence in pregnant women. Another study found a strong relationship between ANC examination behavior following standards and CED in pregnant women.<sup>35,37</sup> In this study, ANC examination conduct follows standards approximately equally to non-standards. This makes ANC examination behavior unimportant for CED incidence. Although most pregnant women had ANC and ultrasounds, the ultrasounds were not performed according to the guidelines for the 1st and 3rd trimesters. Standardised ANC exams for pregnant women help identify and manage pregnancy problems like CED.

This study showed no correlation between intention to procreate and CED in pregnant women. This study found that most pregnant women want to get pregnant so they can prepare for their pregnancy. These pregnant women will arrange their food intake, pregnancy check routine, and birthing location from the start. Because it helps prevent and diagnose pregnancy issues early, planning throughout pregnancy can lower the chance of CED.

According to Arero research, there is a correlation between personal autonomy and CED in pregnant women.<sup>24</sup> In contrast to Arero's findings, this study showed no significant correlation between decision-making independence and CED in pregnant women. This study shows that most pregnant women have autonomy in making health decisions, so they can appropriately do health exams. Independent pregnant women can instantly take action if health concerns arise. These pregnant women will also be more receptive to dietary demands to avoid CED.

Reinforcing factors variable husband support has a significant relationship with the incidence of CED in pregnant women ( $P < 0.05$ ). In contrast, the variable role of health workers, family support,

and health cadre support has no significant relationship with the incidence of CED in pregnant women ( $P > 0.05$ ).

Healthcare workers help pregnant women stay healthy. Doctors, dentists, midwives, dietitians, health analysts, and pharmacists play a vital role in the integrated ANC process by educating and detecting pregnancy problems like CED. This study found no correlation between medical professionals and pregnancy CED. In this survey, most health personnel supported pregnant women. Most respondents reported that health workers provided nutrition counseling, CED prevention, FE tablet encouragement, laboratory tests, midwife ANC exams, and GP/OB ultrasounds.

Pregnant women require physical and psychological consolation, especially from their husbands. Husband support affects maternal health. Husband support can affect a mother's health behavior, such as maintaining her health and getting pregnancy checkups.<sup>38,39</sup> This study found a substantial correlation between spouse support and CED in pregnant women. Husbands who do not help their wives during pregnancy have 5.285 times the risk of CED.

This study was conducted in four health centers that had never researched CED before. This is one of the advantages of this study. In addition, this study modified two health theories, Lawrence Green's theory and Snehandu B. Kar's theory, to analyze the determinants of CED in pregnant women. Lawrence Green's theory used predisposing factors (the compliance behavior of pregnant women in ANC examinations according to the standards in this study is the mother's compliance in conducting pregnancy examinations six times during pregnancy), reinforcing factors (role of health workers), and enabling factors (transportation facilities) that were still not found in previous studies. Likewise, Snehandu B. Kar's theory used behavior intention (intention to become pregnant), social support (husband's and health cadres support), and accessibility of informants (easy access to health information), which were still not found in previous studies.

In addition to the advantages, this study also has limitations. In the variable reinforcing factors, data were collected by pregnant women filling out questionnaires, so the results obtained were based on the perceptions of pregnant women towards reinforcing factors. Therefore, it is necessary to conduct further research on CED in pregnant women using respondents who are directly concerned with reinforcing factors (health workers, husbands, families, and health cadres) so that more comprehensive determinants of CED factors can be known. In addition, further research can use adolescent respondents, prospective brides, pregnant women, and postpartum women. This is because this study only used pregnant women as respondents. Pregnant women are dynamic respondents because the pregnancy period lasts 9 months and 10 days, so respondents can change quickly.



## Conclusion

The bivariate analysis of this study concludes that education, gravida, parity, pregnancy distance, and support from the husband are significantly associated with the occurrence of CED in pregnant women. On the other hand, factors such as age, knowledge, occupation, adherence to ANC examination standards, intention to become pregnant, independence in making health decisions, support from health workers, family support, support from health cadres, transportation facilities, and ease of obtaining health information do not show a significant relationship with the incidence of CED in pregnant women. The multivariate analysis revealed primigravida is the variable with the greatest influence on the incidence of CED in pregnant women. Therefore, the researcher provides suggestions for optimizing the provision of Fe tablets to adolescent girls, conducting education related to the importance of fulfilling nutrition and counseling about the negative side of early marriage in adolescents, optimizing bride-to-be courses by providing education and understanding related to nutrition during pregnancy and delaying pregnancy until a woman has entered the ideal period for pregnancy, and empowering health cadres in counseling, prevention, and assistance of pregnant women in Posyandu for early detection and intervention of pregnant women at risk of CED.

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## Conflict of Interest

The author declares there is no conflict of interest.

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