

# Impact of nutrition mentoring by dietetic students on knowledge, dietary intake, and nutritional status in pregnant women with chronic energy deficiency in South Sulawesi

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## Abstract

Chronic Energy Deficiency (CED) in pregnant women raises the risk of premature birth and Low Birth Weight (LBW). CED pada ibu hamil menyebabkan gangguan pertumbuhan janin dan

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Key word: nutrition care, knowledge, intake, nutritional status, pregnant women.

Contributions: ND, conceptualization, data curation, formal analysis, methodology, validation, visualization, writing – original draft, review & editing; HA conceptualization, investigation, methodology, validation, and writing – original draft, review & editing.

Conflict of interest: the authors declare no conflict of interest.

Ethics approval and consent to participate: the research has received ethical approval from the Health Research Ethics Commission, Department of Nutrition, Health Polytechnic, Ministry of Health Makassar, Indonesia, based on ethical certificate 0625/KEPK-PTKMS/X/2022. During the research, the researcher pays attention to the ethical principles of information to consent, respect for human rights, beneficence and non-maleficence.

Informed consent: all participants in this study signed a written.

Patient consent for publication: written informed consent was obtained for anonymized patient information to be published in this article.

Funding: this research did not receive external funding.

Availability of data and materials: all data generated or analyzed during this study are included in this published article.

Acknowledgement: we would like to thank the Head of the Makassar City and Maros District Health Offices for granting permission for this research, the head of the health center, and the dietetic students who were educated at the location. Our gratitude also goes to the pregnant women who became the subjects of this study.

Received: 23 August 2024.  
Accepted: 27 October 2024.  
Early access: 28 November 2024.

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Healthcare in Low-resource Settings 2025; 13:12958  
doi:10.4081/hls.2024.12958

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meningkatkan risiko kelahiran bayi BBLR. This study evaluates the effectiveness of nutrition mentoring by dietetic students on the knowledge, intake, and nutritional status of pregnant women in Makassar and Maros, South Sulawesi. Conducted as part of the 2023 Dietitian Professional Education Program at Makassar Health Polytechnic, the study used a pretest-posttest design without a control group. Nutrition mentoring was provided through home visits three times a week for two weeks, involving 122 pregnant women with CED. Data were collected via structured interviews and 24-hour recalls, then analyzed using SPSS. The results showed significant improvements: nutrition knowledge increased from 49.9 to 88.6, and energy, protein, fat, and carbohydrate intake rose significantly ( $p < 0.05$ ). Upper arm circumference improved from 21.79 cm to 22.22 cm, with an average weight gain of 1.0 kg ( $p < 0.001$ ). 32.8% of participants transitioned from CED to normal nutritional status post-intervention. Nutrition mentoring by dietetic students effectively enhanced knowledge, nutrient intake, and nutritional status in this population.

## Introduction

Chronic Energy Deficiency (CED) in pregnant women has become an urgent public health issue in Indonesia<sup>1-3</sup> with a prevalence of 17.3% according to the 2018 Basic Health Research (Riskesdas).<sup>4</sup> This figure is higher compared to the prevalence in non-pregnant women, which is recorded at 14.5%, indicating that pregnancy exacerbates the risk of energy deficiency. In South Sulawesi Province, the prevalence of CED in pregnant women reaches 16.9%, while non-pregnant women have a higher prevalence of 17.7%.<sup>4</sup> Although the CED rate in non-pregnant women is higher, its impact on pregnant women is more critical, as this condition increases the risk of serious complications such as Low Birth Weight (LBW) and preterm birth. Babies born to mothers with CED are also at greater risk of experiencing stunting and growth disturbances in the future.<sup>5,6</sup>

LBW and preterm birth have short-term impacts such as respiratory problems, thermoregulation disorders, feeding difficulties, and nutritional problems in infants. In the long term, babies with LBW and prematurity are at higher risk of growth disturbances, delayed cognitive development, and an increased risk of chronic diseases such as diabetes and hypertension in adulthood. Moreover, both conditions also increase the likelihood of stunting, which affects overall quality of life.<sup>7</sup> Nutrition education plays an important role in increasing public knowledge and awareness about healthy eating patterns, especially for vulnerable groups such as pregnant women. Good nutritional knowledge enables individuals to make the right decisions regarding food intake, which directly impacts health. For pregnant women, adequate nutritional knowledge contributes to the selection of foods that support both maternal health and fetal growth. A lack of under-

standing of nutrition often leads to malnutrition, resulting in various complications such as CED, LBW, and preterm birth. Improving nutritional knowledge has been proven effective in enhancing dietary patterns, reducing the risk of pregnancy complications, and improving long-term health outcomes for both mother and child.<sup>8-10</sup> Nutrition education in the community must involve all elements of society, including dietitian students.

The involvement of dietitian students in nutrition mentoring offers dual benefits. First, they can apply academic knowledge in real-world contexts, enhancing their practical skills as nutrition professionals. Second, mentoring by dietitian students provides pregnant women with the opportunity to receive more intensive and personalized nutrition education. During the mentoring process, students can provide guidance on appropriate food intake, health monitoring, and necessary nutritional interventions. This mentoring also helps students understand the challenges faced by the community in applying nutrition principles, strengthening collaboration between academic education and health services. Thus, the involvement of dietitian students in nutrition mentoring programs can positively contribute to improving the nutritional status of pregnant women and the quality of education for the students themselves.<sup>11,12</sup>

Nutritional care for pregnant women is a mandatory part of the Professional Dietitian Education program, implemented in primary health care centers through the Nutrition Care Process (NCP), which includes assessment, diagnosis, intervention, monitoring, and evaluation.<sup>13</sup> Dietitian students are expected to develop comprehensive academic abilities to serve as nutrition educators, public health practitioners, community workers, and researchers in community nutrition programs.<sup>14</sup>

The care of pregnant women is a mandatory part of the Professional Dietitian Education program, implemented in primary health care centers through the NCP, which includes assessment, diagnosis, intervention, monitoring, and evaluation. Dietitian students are expected to develop comprehensive academic abilities to serve as nutrition educators, public health practitioners, community workers, and researchers in community nutrition programs.<sup>15</sup>

Traditionally, nutritional mentoring has been provided by healthcare professionals, community health workers, or volunteers.<sup>16</sup> However, there is a lack of research on the role of dietitian students in providing nutritional mentoring to pregnant women. Therefore, evidence is needed to evaluate the effectiveness of dietitian students in nutritional mentoring to develop appropriate interventions for this vulnerable population. A program places dietitian students annually in primary health care centers to provide nutritional care to pregnant women, but there has been no assessment of the impact of this mentoring on the nutritional knowledge, intake, and weight of pregnant women. This study aims to assess Impact of Nutrition Mentoring by Dietetic Students on Knowledge, Dietary Intake, and Nutritional Status in Pregnant Women with Chronic Energy Deficiency in South Sulawesi.

## Materials and Methods

### Research design

This study was part of the 2023 Dietitian Education Professional Activity Program at Makassar Health Polytechnic, aimed at assessing its impact on the nutritional status of pregnant women. According to the curriculum, each student is expected to have the competence to carry out nutrition care for pregnant

women using the NCP approach. Given this curricular goal, it was not possible to introduce variations in the intervention groups. We designed this study as an intervention using a pretest-posttest study design without a control group.

### Intervention process

The nutrition mentoring intervention was conducted by 23 dietitian students from Makassar Health Polytechnic. Each student was required to mentor five pregnant women. Before starting the nutrition mentoring, the students received a three-day briefing on the NCP for the community, focusing on pregnant women with CED. This briefing included nutrition assessment, diagnosis, intervention, monitoring, and evaluation. The briefing was provided by the lecturer responsible for the Pregnant Women Nutrition Care course. The program began with the screening of pregnant women experiencing CED, identified through the measurement of Mid-Upper Arm Circumference (MUAC) less than 23.5 cm. After the screening, the intervention started with home visits to conduct a nutrition assessment through the collection of anthropometric data (weight and MUAC), nutrient intake, and personal history and health condition of the mother. Based on the nutrition assessment results, a nutrition diagnosis was made, and an intervention plan was developed.

During each home visit, students provided individualized nutrition counseling, which included education on healthy eating patterns according to pregnancy conditions, as well as emotional support. Additionally, supplementary feeding was provided, adjusted to the nutritional needs of the pregnant women. Home visits were conducted three times a week for two weeks to ensure consistent monitoring and improvement in nutritional status.

Pretest assessments were conducted before the intervention to measure nutritional knowledge, nutrient intake, and the weight of the pregnant women. After two weeks of mentoring, a posttest was conducted to evaluate changes in these variables.

### Research location

This study was conducted at 20 community health centers (Puskesmas) in Makassar City and Maros Regency, South Sulawesi Province, Indonesia. The locations were selected based on the availability of instructors with at least a bachelor's degree in nutrition or applied nutrition, a minimum of five years of work experience, and a cooperation contract with Makassar Health Polytechnic.

### Study participants

The study sample was determined using a purposive sampling method, targeting pregnant women with CED (MUAC < 23.5 cm) who were willing to participate in the mentoring program. Exclusive sample criteria included pregnant women with chronic infectious diseases such as tuberculosis (TB) or HIV/AIDS, or those who did not complete the mentoring. The number of samples in each Puskesmas was adjusted to the number of mentors, with each student mentoring five pregnant women. A total of 122 participants met the criteria and agreed to participate. The sample size was determined based on the number of CED pregnant women in Makassar City in 2022, totaling 2,495 (an average of five per Puskesmas)<sup>17</sup>. With 23 students, a sample size of 125 was obtained; however, three participants were excluded as they did not meet the requirements and dropped out.

### Variables, instruments, and data collection

Demographic data, pregnancy history, and nutrition knowledge were collected through face-to-face interviews using a structured,

valid, and reliable questionnaire. Validity and reliability tests were conducted through a questionnaire trial using 10 normal pregnant women. The trial results showed a validity value of  $p < 0.05$ , and the reliability test with Cronbach's Alpha analysis showed a value of 0.688, greater than the  $r$  table value of 0.632. Nutrient intake was assessed using the 24-hour recall method with household measures and portion size estimates following the Nutrition Consumption Survey book.<sup>18</sup> Pregnant women's weight was measured using a digital scale with a precision of 0.1 kg, and each measurement was taken twice. Data collection was carried out by each mentor. MUAC was measured using a maternal MUAC tape produced by the Indonesian Ministry of Health with a scale of 0.1 cm.

### Data analysis

Nutrient intake data were processed using the Indonesian version of the NutriSurvey application and then entered into the SPSS program (version 26) along with nutrition knowledge and body weight data. Data entry followed a numerical system, with all data categories named and numbered according to SPSS guidelines. A paired  $t$ -test was used to assess changes in nutrition knowledge, nutrient intake, and body weight before and after nutrition counseling, preceded by a normality test using the Kolmogorov-Smirnov test, which showed  $p > 0.05$  for all variables. Statistical significance was determined at an alpha level of 5%.

### Ethics clearance

This study received approval from the Makassar Health Polytechnic Research Ethics Commission number: 0625/KEPK-PTKMS/X/2022. All data collection procedures adhered to the Helsinki Declaration. Each participant signed an informed consent form approved by the ethics commission, following a detailed explanation provided by the enumerator.

## Results

As shown in Table 1, most of the pregnant women had educational backgrounds of high school or junior high school and worked as housewives. Their husbands were mostly self-employed or worked as laborers or drivers. Many of the women were experiencing their first or second pregnancies and had typically undergone their second or third antenatal check-ups, as well as taking daily iron supplements.

Table 2 shows the nutrient intake of the mothers was below the Recommended Dietary Allowance (RDA) for energy, protein, fat, and carbohydrates. Similarly, their intake of vitamins and minerals was also below the RDA.

Table 3 shows the nutritional knowledge of pregnant women with CED improved by 38.7 points after receiving nutrition assistance from dietitian students. Statistical analysis showed a significant increase in knowledge ( $p=0.000$ ) across all educational backgrounds. Significant increases were observed at every education level, including primary school ( $p=0.000$ ), junior high school ( $p=0.000$ ), high school ( $p=0.000$ ), and college ( $p=0.000$ ). Although there was a tendency for knowledge score improvements to be inversely proportional to education level, this was not statistically significant ( $p=0.388$ ).

## Discussion

This study evaluated the outcomes of a nutrition mentoring

**Table 1.** Characteristic of pregnant women.

| Characteristic                      | n   | %    |
|-------------------------------------|-----|------|
| <b>Educational stage</b>            |     |      |
| Elementary school                   | 12  | 9.8  |
| Junior high school                  | 25  | 20.5 |
| Senior high school                  | 58  | 55.7 |
| University/Higher education         | 17  | 13.9 |
| <b>Occupation of pregnant women</b> |     |      |
| Civil servant                       | 5   | 4.1  |
| Private employer                    | 109 | 89.3 |
| Entrepreneur                        | 6   | 4.9  |
| Student (university level)          | 2   | 1.6  |
| <b>Occupation of husband</b>        |     |      |
| Civil servant                       | 10  | 8.2  |
| Private employer                    | 19  | 15.6 |
| Entrepreneur                        | 46  | 37.7 |
| Farmer/Fisherman                    | 11  | 9.0  |
| Laborer/Driver                      | 36  | 29.5 |
| <b>Nth pregnancy</b>                |     |      |
| First pregnancy                     | 58  | 47.5 |
| Second pregnancy                    | 39  | 32.0 |
| Fourth pregnancy                    | 8   | 6.6  |
| Fifth pregnancy                     | 15  | 12.3 |
| Sixth pregnancy                     | 2   | 1.6  |
| <b>Nth antenatal care visit</b>     |     |      |
| First antenatal care visit          | 23  | 18.9 |
| Second antenatal care visit         | 30  | 24.6 |
| Third antenatal care visit          | 27  | 22.1 |
| Fourth antenatal care visit         | 18  | 14.8 |
| Fifth antenatal care visit          | 24  | 19.7 |
| <b>Iron tablet consumption</b>      |     |      |
| Never                               | 10  | 8.2  |
| Sometimes                           | 38  | 31.1 |
| Every day                           | 74  | 60.7 |
| The number of samples               | 122 | 100  |

**Table 2.** Nutrient intake of pregnant women.

| Nutrients        | Intake amount | RDA*  | %RDA |
|------------------|---------------|-------|------|
| Energy (kcal)    | 1227          | 2427  | 50.1 |
| Protein (g)      | 50            | 77    | 64.9 |
| Fat (g)          | 38            | 68    | 55.9 |
| Carbohydrate (g) | 201           | 368   | 54.6 |
| Vitamin A (RE)   | 357           | 900   | 36.7 |
| Vitamin C (mg)   | 34            | 85    | 40.0 |
| Calcium (mg)     | 608           | 1067  | 57.0 |
| Phosphorus (mg)  | 544           | 883.3 | 61.6 |
| Iron (mg)        | 8             | 23    | 34.8 |
| Zinc (mg)        | 4             | 14.3  | 28.0 |

\*RDA based on the Decree of the Indonesian Ministry of Health, 2019.

program conducted by dietitian students at the Professional Work Practice site of the Dietitian Professional Education Program at Makassar Health Polytechnic, Indonesia. The results demonstrated a significant improvement in mothers' nutrition knowledge following the mentoring program. This improvement was attributed to the professional skills of the mentors and the effectiveness of the approach used. Prospective dietitian students have shown the competence to independently provide nutrition services, including education and counseling.<sup>19</sup> The nutrition education and counseling approach used in this study was based on standardized, systematic, and comprehensive nutrition assessments and diagnoses, tailored to the nutritional problems and etiologies experienced by each client.<sup>20</sup>

This study aims to evaluate the effectiveness of the nutrition mentoring program conducted by dietitian students in improving the nutritional knowledge, dietary intake, and nutritional status of pregnant women with CED. Overall, the study results showed that the program significantly improved maternal nutrition knowledge, with a 77.6% increase in knowledge scores, from 44.9 to 88.6. This indicates that the intervention had a significant positive impact on providing evidence-based nutrition education and counseling, which was delivered systematically and comprehensively by dietitian students.<sup>21,22</sup>

The increase in knowledge scores was more pronounced among pregnant women with lower education levels, as they had lower average pretest scores. Conversely, those with higher education levels had higher pretest scores, although the difference in improvement was not significant. Previous studies also showed consistent results, as recorded in studies in Addis Ababa and

Southwest Ethiopia, which reported significant increases in maternal nutrition knowledge after similar interventions.<sup>23</sup> This knowledge improvement was particularly evident in mothers with lower education levels, who initially had lower pretest scores, confirming that this intervention is highly beneficial for groups less exposed to nutritional information. This highlights the importance of comprehensive and standardized education programs, especially in Antenatal Care (ANC) services, where the quality of nutrition education is often suboptimal due to limited resources and healthcare workers' skills.<sup>24-26</sup> The results of this study underscore the importance of a comprehensive and standardized nutrition education approach, which can improve the quality of ANC services and have a broader impact on improving the nutritional status of pregnant women.<sup>27</sup>

In addition to knowledge, the dietary intake of pregnant women with CED also significantly increased after the intervention, particularly in terms of energy, protein, and fat intake. This improvement was reflected in the increase in MUAC, where 32.8% of women improved their nutritional status to normal after the mentoring program. Although this increase in intake did not fully meet the Recommended Dietary Allowance (RDA), the changes made directly helped to address the chronic energy deficiency in pregnant women.<sup>27</sup>

Furthermore, although this study did not measure micronutrient intake in detail, there are indications that nutrition mentoring by dietitian students also has the potential to improve maternal micronutrient intake. This is in line with findings from a study in Bengkulu, Indonesia, which showed an increase in carbohydrate,

**Table 3.** Changes in knowledge, nutrient intake, and pregnancy weight of pregnant women.

| Variable                      | n   | Before<br>(mean ± SD) | After<br>(mean ± SD) | Change<br>(mean ± SD) | Sig*      |
|-------------------------------|-----|-----------------------|----------------------|-----------------------|-----------|
| Nutritional knowledge         | 122 | 49.9±19.4             | 88.6±12.1            | 38.7±17.6             | <0.001*   |
| <b>Educational level</b>      |     |                       |                      |                       |           |
| Elementary school             | 12  | 48.3±22.9             | 83.3±13.7            | 35.0±4.8              | <0.001*   |
| Junior high school            | 25  | 43.9±20.7             | 85.3±13.5            | 41.4±4.4              | <0.001*   |
| Senior high school            | 68  | 48.6±17.5             | 88.4±11.4            | 39.8±1.9              | <0.001*   |
| University                    | 17  | 65.0±16.4             | 98.2±05.3            | 33.2±4.2              | <0.001*   |
| Sig**                         |     |                       |                      | 0.388**               |           |
| <b>Nutrition intake</b>       |     |                       |                      |                       |           |
| Energy (kcal)                 | 122 | 1227.2±411.8          | 1390.6±482.9         | 163.4±33.3            | <0.001*   |
| Protein (g)                   | 122 | 50.3±16.5             | 58.2±19.3            | 8.0±16.8              | <0.001*   |
| Fat (g)                       | 122 | 37.6±22.7             | 45.8±26.7            | 8.2±20.7              | 0.002*    |
| Carbohydrate (g)              | 122 | 201.4±196.5           | 212.0±87.5           | 10.6±141.3            | 0.407*    |
| MUAC (cm)                     | 122 | 21.8±1.2              | 22.2±1.1             | 0.8±0.8               | <0.001*   |
| <b>Nutritional status (%)</b> |     |                       |                      |                       |           |
| Normal                        |     | 0                     | 40 (32.8%)           |                       | <0.001*** |
| CED                           |     | 122 (100%)            | 82 (67.2%)           |                       |           |
| Body weight (kg)              | 122 | 46.8±5.4              | 47.8±5.6             | 1.0±1.5               | <0.001*   |
| <b>Gestational age</b>        |     |                       |                      |                       |           |
| 1-3 months                    | 28  | 43.4±5.0              | 44.0±5.4             | 0.6±0.9               | 0.002*    |
| 4-6 months                    | 45  | 46.1±5.4              | 47.1±5.1             | 1.0±1.9               | 0.001*    |
| 7-9 months                    | 49  | 49.4±4.5              | 50.6±4.7             | 1.2±1.3               | <0.001*   |
| Sig**                         |     |                       |                      | 0.296**               |           |

\*Paired t-test; \*\* Independent t-test; \*\*\*Mc Nemar test.

protein, fat, iron, and calcium intake after a nutrition intervention in pregnant women with malnutrition and anemia. This improvement is closely related to improved nutrition knowledge and perception.<sup>28,29</sup>

This study also showed an increase in maternal weight during the nutrition mentoring program, particularly in the third trimester of pregnancy. Although there was a statistically significant weight gain, the average maternal weight gain did not meet the WHO recommendations, indicating a need for further improvements in intervention strategies. Factors such as pre-pregnancy Body Mass Index (BMI), parity, socioeconomic status, and diet during pregnancy can affect weight gain.<sup>30,31</sup>

These findings are consistent with research in Makati, Philippines, and East Shoa Zone, Ethiopia, which reported improvements in the nutritional status of pregnant women after receiving nutrition education and counseling interventions. One of the main benefits of nutrition education programs is increasing pregnant women's awareness of healthy eating during pregnancy, which can ultimately improve their nutritional practices.<sup>32,33</sup>

One significant benefit of nutrition education is that it enhances pregnant women's knowledge about the ideal diet during pregnancy, fostering positive attitudes and practices toward good nutritional status.<sup>34</sup> Additionally, nutrition counseling and education increase awareness of the importance of adequate nutrient intake and the adverse effects of food aversions during pregnancy. To improve the nutritional status and overall health of pregnant women, nutrition education and counseling, along with mobile health services during antenatal check-ups, should be prioritized.

Although this intervention did not significantly impact overall pregnancy weight gain, the average weight gain for the women was only 5 kg, which is much lower than the recommended 10-12 kg. Several factors contribute to pregnancy weight gain, including pre-pregnancy BMI, parity, socioeconomic status, ANC care, diet during pregnancy, and comorbid medical conditions.<sup>35</sup>

The practical implications of this research for healthcare provision, particularly in Community Health Centers (Puskesmas), highlight the need to integrate nutrition mentoring programs involving dietitian students into routine antenatal services. Nutrition mentoring has proven effective in improving the knowledge and dietary intake of pregnant women with CED, and it can be used as a strategy to improve nutritional status. Puskesmas can collaborate with educational institutions to provide intensive training to students so that they can deliver structured nutrition education. Additionally, routine monitoring, home visits, and improved access to nutritious food sources should be strengthened, particularly for low-income families.

This study has several limitations, including a pretest-posttest design without a control group, which may affect the validity of the results. The limited sample size from selected health centers may influence the generalizability of the findings. Data collection relied solely on interviews and 24-hour recalls, introducing potential recall bias. Additionally, there was no long-term evaluation of the intervention's impact, which may limit understanding of the sustainability of the nutritional guidance's effects on pregnant women's nutritional status. Future studies should include a control group design to improve the validity of results and allow for stronger comparisons. Additionally, a larger sample size and more diverse health centers should be involved so that the findings can be generalized to a broader population. Relying solely on interviews and 24-hour recall methods poses a risk of recall bias; thus, more objective nutritional intake measurement methods, such as food diaries or repeated surveys, should be considered. Long-term evaluation is also essential to understand the sustained impact of

nutrition mentoring, providing a clearer picture of the program's effectiveness in improving maternal nutritional status. This evaluation will help determine whether the positive effects of the intervention persist over time.

## Conclusions

Nutrition mentoring by dietitian students significantly improves the nutritional knowledge, dietary intake, and nutritional status of pregnant women with CED. This intervention effectively reduces the prevalence of CED, with improvements in MUAC and maternal weight after the intervention. A total of 32.8% of the samples shifted from CED status to normal nutritional status, highlighting the importance of dietitian students' roles in nutrition education programs.

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