

INFORMASI ARTIKEL

Received: February, 05 2026

Revised: February, 15, 2026

Available online: February, 21, 2026

at : <https://e-jurnal.iphorr.com/index.php/mchc>

The relationship between health services and food intake with the incidence of chronic energy deficiency in pregnant women

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Abstract

Background: Malnutrition in pregnant women is a global health problem that accounts for about 7% of the world's disease burden and contributes to more than 20% of maternal deaths. The WHO estimates that 35–40% of pregnant women in developing countries are at risk of mild to moderate KEK, which leads to an increase in MMR and newborn deaths.

Purpose: To analyze the relationship between health services and food intake with chronic energy deficiency (CED) in pregnant women.

Method: This study used an analytical observational design with a case-control approach. The sample consisted of 44 people, comprising 11 case samples and 33 control samples. Data were collected through interviews using questionnaires and analyzed using path analysis.

Result: There is a significant relationship between health services ($p = 0.000$) and food intake ($p = 0.001$) with chronic energy deficiency in pregnant women.

Conclusion: This study concluded that there is a relationship between health services and food intake with chronic energy deficiency in pregnant women in the Kenali Besar Community Health Center area of Jambi City in 2025.

Suggestion: Pregnant women are expected to pay more attention to fulfilling their nutritional intake during pregnancy and make optimal use of health services such as regular antenatal care (ANC) visits.

Keywords: Chronic Energy Deficiency; Malnutrition; Pregnancy.

INTRODUCTION

Malnutrition is a global health problem that remains a serious concern, especially among vulnerable groups such as pregnant women and children. Malnutrition in pregnant women is a global health challenge, contributing 7% to the global disease burden and being the main cause of more than 20% of maternal deaths (Figa, Temesgen, Mahamed, & Bekele, 2024). Based on data from the Central Statistics Agency (2020), the Maternal Mortality Rate (MMR) in Indonesia is still relatively high at 189 per 100.000 live births, which is far from the 2030 Sustainable Development Goals (SDGs) target of ≤ 70 per 100.000 live births (Central Statistics Agency, 2023). The main causes of maternal mortality are hemorrhage (1.330 cases),

hypertension in pregnancy (1.110 cases), and circulatory system disorders (230 cases) (Heryunanto, Putri, Izzah, Ariyani, & Herbawani, 2022). These hemorrhagic conditions are related to the nutritional status of pregnant women. Pregnant women with KEK have insufficient energy reserves, which increases the risk of various pregnancy complications, including a high likelihood of hemorrhage and maternal mortality.

Chronic Energy Deficiency (CED) is a condition of long-term malnutrition, mainly due to insufficient energy and protein consumption (Lorenza, 2025). Chronic Energy Deficiency (CED) in pregnant women can be identified based on upper arm circumference (UAC) measurements of < 23.5 cm (Lestari,

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Mulyaningsih, Yunus, & Rauf, 2025). The WHO (2021) states that pregnant women with CED are more likely to have poor pregnancy outcomes (Rahayu & Purnomo, 2024). Pregnant women at risk of Chronic Energy Deficiency (CED) are prone to various pregnancy complications, including anemia, low birth weight (LBW), bleeding, and increased susceptibility to infectious diseases, which can even lead to maternal mortality (Rosita & Rusmimpong, 2022).

According to the Global Nutrition Report (2021), CER is one of the contributing factors to increased maternal mortality, as it triggers obstetric complications such as hemorrhage and infection (Global Nutrition Report, 2021). This condition not only affects the health of mothers during pregnancy but also contributes significantly to high maternal mortality rates, with approximately 40% of maternal deaths in developing countries caused by KEK. The country with the highest prevalence of KEK in pregnant women is Bangladesh at 47%, while Indonesia ranks fourth with a prevalence of 35.5%, and Thailand has the lowest prevalence, between 15% and 25% (WHO, 2015) (Sari, Rahmawati, & Suriani, 2021). This situation indicates that CEM remains a major challenge in efforts to reduce maternal and neonatal mortality rates worldwide.

At the national level, the prevalence of chronic energy deficiency (CED) in pregnant women has shown a downward trend in the last five years. Based on Ministry of Health (2018) data, the prevalence of CEM among pregnant women in Indonesia reached 17.3% (Ministry of Health of the Republic of Indonesia, 2018). Meanwhile, according to SKI (2023) data, the prevalence of CEM among pregnant women has decreased to 16.9% (Ministry of Health of the Republic of Indonesia, 2024). However, this figure is still far from the target of the Indonesian Ministry of Health's Strategic Plan (Renstra) 2022-2024, which is to reduce the prevalence of CME in pregnant women to 10% (Rahayu & Purnomo, 2024). This condition confirms that efforts to improve the nutrition of pregnant women are still a national priority. However, at the regional level, particularly in Jambi Province, the prevalence of KEK shows a different trend.

In Jambi Province, the prevalence of Chronic Energy Deficiency (CED) in pregnant women is also still considered a public health issue that requires

attention. The 2023 Jambi Province Health Profile Summary notes a sharp increase in CEM cases, from 202 cases in 2022 (0.3% of 67,728 pregnant women) to 5,784 cases in 2023 (8.3% of 69,322 pregnant women) (Jambi Province Health Office, 2022). The surge in KEK cases is thought to reflect not only an actual increase in incidence but also a number of systemic factors, such as improvements in the reporting system and increased detection coverage in health facilities.

The city of Jambi is the area with the highest number of KEK cases in Jambi Province, with 1,165 cases in 2023, followed by Bungo district (843 cases) and Merangin district (663 cases) (Jambi Provincial Health Office, 2023). Based on data from the Jambi City Health Office in 2024, the number of KEK cases was recorded at 403 cases. This shows that the Kenali Besar Community Health Center recorded 70 cases of KEK (6.64% of 1,054 pregnant women). This condition indicates that although the national prevalence tends to decline, in Jambi City itself, KEK cases have actually increased, so further research is needed to identify the determinants.

Based on the conceptual framework from UNICEF 2020, malnutrition is influenced by three groups of determinants, namely direct determinants, basic determinants, and determining determinants. Direct determinants include food intake and infectious diseases. Meanwhile, basic determinants include food security, maternal care, and health services. Determinants include resources, norms, and governance (UNICEF, 2020). Inadequate food intake causes protein and energy to be used as the main source of energy, so that both functions cannot run optimally, putting them at risk of suffering from KEK (Dictara, Angraini, Mayasari, & Karyus, 2020). Infectious diseases can be an initial factor in malnutrition due to a decrease in appetite, disruption of the absorption of nutrients in the digestive tract, and an increase in nutritional requirements during the course of the disease (Kartini, 2020).

RESEARCH METHOD

This study is a quantitative study using an analytical observational approach and a case-control design. The case-control research method compares two groups of respondents, namely those who have suffered from the disease (cases) and those who

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have not suffered from the disease (controls). This study was conducted in the city of Jambi, specifically in the Kenali Besar Community Health Center Working Area, starting in November 2025. The population used in this study was pregnant women residing in the Kenali Besar Community Health Center Working Area in 2025. The sample in this study used a 1:3 ratio, namely 11:33, resulting in a total sample of 44 people.

Sampling in this study used the non-probability sampling method with the proportionate stratified random sampling technique, because the population of pregnant women in the Kenali Besar Community Health Center working area is not homogeneous and is stratified based on sub-districts. For the case group, samples were obtained from the register of pregnant women with KEK status recorded at the Nutrition Clinic. As for the control group, samples were determined through matching efforts based on selected case samples, for example, by taking pregnant women without KEK from the same or nearest neighborhood association or sub-district as the cases, so that the environmental conditions were relatively comparable.

In this study, the instrument used was a questionnaire. A questionnaire is a data collection method that presents a series of questions that have been systematically arranged, where respondents only need to provide answers. Data collection for this study used two types of data, namely primary data and secondary data. Primary data collection was carried out through direct interviews with respondents using a prepared questionnaire to obtain information related to the variables being studied. The questionnaire covered identity, characteristics, food intake, and health services. Meanwhile, secondary data was information obtained from official sources, including the Jambi City Health Office and data on

visits by pregnant women to the KIA clinic, which was collected by researchers from the Kenali Besar Community Health Center in Jambi City. This data was used for preliminary study purposes.

Next, the collected data will be analyzed using path analysis with SmartPLS 4 software that applies the Partial Least Square (PLS) method. Path analysis is a statistical technique used to evaluate and examine causal relationships between variables in a research model. Path analysis with Smart PLS is used to understand the structure of the relationship between variables, test hypotheses, and identify the main determinants that contribute to the emergence of dependent variables in a research phenomenon. The measurement model (outer model) explains the relationship between latent variables and the indicators that represent them. The measurement model is evaluated through confirmatory analysis using the Multi-Trait Multi-Method (MTMM) approach, which aims to assess convergent validity and discriminant validity. Convergent validity can be seen from the strength of the correlation between each indicator and the latent variable it measures. An indicator is considered valid if the Average Variance Extracted (AVE) value is greater than 0.50 or if all outer loading values of the indicator on the variable show a value of ≥ 0.50 . Discriminant validity is evaluated on reflective indicators by assessing the cross loading value, where each indicator should have the highest loading value on the construct it measures, with a minimum value of ≥ 0.70 . Furthermore, structural testing (inner model) describes the relationship and accuracy of estimates between latent variables (constructs) in a structural model. This model is used to measure the extent of direct and indirect influences that occur between variables in the study.

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RESEARCH RESULTS**Table 1. Respondent Characteristics (N=44)**

Variable	Case (n=11)	Control (n=33)
Mother's Age (n/%)		
19-23 years	5/45.6	15/45.4
24-28 years old	2/18.1	6/18.2
29-33 years old	2/18.1	6/18.2
34-38 years old	1/9.1	3/9.1
39-43 years old	1/9.1	3/9.1
Address (n/%)		
Kenali Besar Village	3/27.2	9/27.3
Bagan Pete Village	7/64.6	21/63.6
Simpang Rimbo Village	1/9.2	3/9.1
Parity (n/%)		
First child	6/54.5	18/54.4
Second child	3/27.3	9/27.3
Third child	2/18.2	6/18.2
Occupation (n/%)		
Not Working/Housewife	7/63.3	20/60.6
Self-employed	1/18.2	5/15.5
Private employee	1/9.1	4/12.1
Civil/Military/Police/ state-owned enterprises	1/9.1	4/12.1

The table above shows that the characteristics of the research respondents based on the age of the pregnant women were mostly aged 19-23 years, namely 5 (45.6%) respondents in the case group and 15 (45.4%) respondents in the control group. Based on the address of the pregnant women, most of them were in the Bagan Pete sub-district, with 7 (63.6%) respondents in the case group and 21 (63.6%) respondents in the control group. Based on parity, most had a first parity, namely 6 (54.5%) respondents in the case group and 18 (54.5%) in the control group. Meanwhile, based on the occupation of pregnant women, most were unemployed/housewives, namely 7 (63.6%) in the case group and 20 (60.6%) in the control group.

Outer Model Testing

Outer model testing or measurement model testing aims to assess the level of validity and reliability of indicators in measuring constructs in a research model.

Convergent Validity

Convergent validity in the measurement model with reflective indicators was assessed through the relationship between the scores of each item, which was analyzed using SmartPLS 4.0 software. An indicator was considered to have a good relationship if its loading value was above 0.70.

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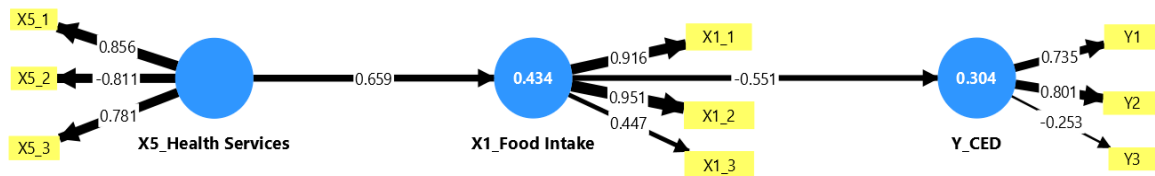


Figure 1. Outer Model of Food Intake and Health Services Variables

Table 2. First Stage Outer Loading Values

Variable	X1 Food intake	X5 Health Services	Y CED
X1.1	0.911		
X1.2	0.946		
X1.3	0.466		
X5.1		0.865	
X5.2		-0.797	
X5.3		0.781	
Y1			0.732
Y2			0.775
Y3			-0.299

Based on the results of data processing using SmartPLS presented in Table 2, most indicators in each research variable have an outer loading value above 0.5, so they are declared valid. Meanwhile, there are 3 indicators that show outer loading values below 0.5, namely in the variables of TTD consumption compliance, access to health services, and total weight gain of mothers, so they must be eliminated to produce a new model image as follows:

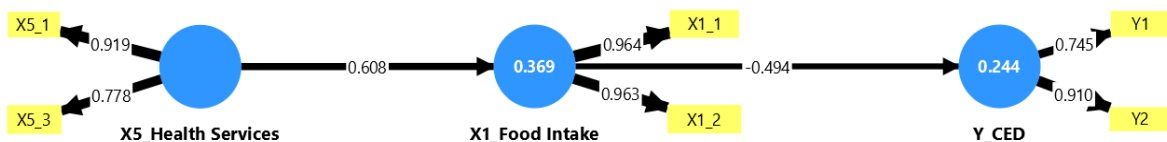


Figure 2. Outer Model Convergent Validity 2

Tabel 3. Outer Loading Values in the Second Stage

Variable	X1 Food intake	X5 Health Services	Y CED
X1.1	0.966		
X1.2	0.961		
X2.1			
X5.1		0.916	
X5.3		0.781	
Y1			0.741
Y2			0.913

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Based on the data in Table 3, it can be observed that there was an increase in the outer loading value for the previous indicators after elimination. Recalculation was performed so that the outer loading was more than 0.5 and declared valid.

Discriminant Validity

Discriminant validity is used to ensure that each construct in the latent variable has different characteristics and does not overlap with other constructs.

Tabel 4. Cross Loading Results

Variable	X1	X5	Y
X1_1	0.966	0.584	-0.485
X1_2	0.961	0.586	-0.468
X5_1	0.614	0.916	-0.284
X5_3	0.384	0.781	-0.197
Y1	-0.304	-0.083	0.741
Y2	-0.490	-0.344	0.913

Based on the cross-loading values in Table 4, it can be seen that each indicator has a higher cross-loading value on its own variable compared to other variables. This finding shows that all indicators used in the study have met the criteria for good discriminant validity, because each indicator is able to represent its variable more strongly than other variables.

Reliability

Reliability testing is conducted to ensure that the instruments used are capable of measuring variables consistently and accurately. The level of reliability can be evaluated using Cronbach's Alpha and Average Variance Extracted (AVE). A variable is considered reliable if it has a Composite Reliability value of more than 0.7 and an AVE value of > 0.5 . In addition, a Cronbach's Alpha value above 0.6 also indicates that the variable is trustworthy or reliable.

Tabel 5. Analisis Reliability

Variable	Cronbach's alpha	Average variance extracted (AVE)
X1	0.923	0.928
X2	0.684	0.759
X3	0.699	0.768
X4	0.841	0.862
X5	0.636	0.725
Y	0.575	0.691

Based on Table 5, the Food Intake variable (X1) shows good reliability because it has a Cronbach's Alpha value above 0.70. Meanwhile, Health Services (X5) has a Cronbach's Alpha value above 0.60, so it can still be categorized as quite reliable, even though its consistency level is not as strong as variable X1. The variable Y has a Cronbach's Alpha value below 0.60, so its reliability is considered inadequate. However, all variables have met the convergent validity criteria because each has an AVE value exceeding 0.50, thus being able to describe the convergent validity of the existing indicators.

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Inner Model Testing

Inner model or structural model testing aims to assess the strength and direction of relationships between constructs in a research model.

Hypothesis Testing

At the hypothesis testing stage, an analysis is conducted to determine whether the independent variables have a significant effect on the dependent variables.

Tabel 6. Path Coefficient Hypothesis Test

Variable	Original Mampl (O)	Sample Mean	Standard Deviation	T statistic (O/STDEV)	P- Value
X1 -> Y	-0.563	-0.573	0.164	3.429	0.000
X5 -> X1	0.644	0.630	0.172	3.746	0.000
X5 -> X2	0.578	0.571	0.163	3.545	0.000

Based on Table 6, the hypothesis testing results show that all relationships between variables in the research model are statistically significant.

Research Findings

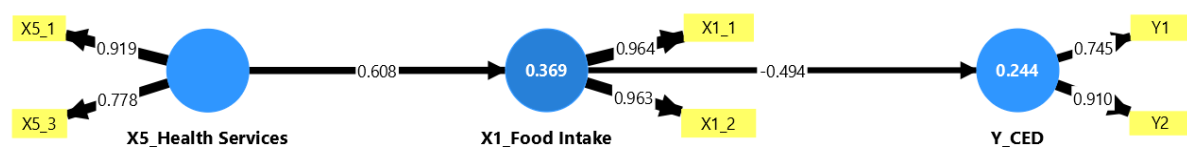


Figure 3. Research Findings

Based on statistical analysis, there is a significant relationship between health services and food intake on chronic energy deficiency in pregnant women.

DISCUSSION

Based on the results of statistical analysis, there is a significant relationship between health services and food intake in pregnant women. Analysis using SmartPLS produced a path coefficient of 0.644, indicating that health services are positively related to food intake, meaning that the better the quality and access to health services, the more likely pregnant women are to have their food intake needs met. The statistical analysis results show a p-value of 0.000 ($p < 0.05$) with a T-statistic value of 3.746 (> 1.96), so that the relationship is statistically significant and the research hypothesis is accepted. In accordance with the UNICEF (2020) conceptual framework, health services, including ANC visits and the PKH program,

play an important role in ensuring adequate food intake for pregnant women (UNICEF, 2020).

Mothers who regularly attend ANC check-ups and receive guidance through the PKH program tend to better understand their energy and protein needs during pregnancy (Sawitri, Meliyanti, Nurlatifah, Deliani, & Trisiani, 2023). These findings support the results of a study conducted by Nadimin et al., which stated that three weeks of nutrition counseling can increase knowledge and intake in pregnant women with CED. This shows that the quality of health services, particularly through structured nutrition counseling, plays an important role in encouraging increased food intake in pregnant women (Nadimin,

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Ipa, Hartono, & Aisy, 2024). This is also in line with the research by Lidia et al., which states that health education plays a significant role in the food intake of pregnant women. This study confirms that nutritional messages conveyed to pregnant women by competent health workers through a comprehensive and continuous approach play a very important role in increasing mothers' knowledge and encouraging the formation of better eating habits. Therefore, antenatal care (ANC) services in health facilities need to be the driving force in coordinating various efforts to improve understanding of nutrition during pregnancy (Teweldemedhin, Amanuel, Berhe, Gebreyohans, Tsige, & Habte, 2021). The results of the study found that health services play an important role in improving the quality of food intake for pregnant women. A positive correlation indicates that the better the access to and quality of health services received by mothers, the better their energy and protein intake. Pregnant women who regularly utilize antenatal care (ANC) services tend to receive nutrition education, nutritional status monitoring, and counseling related to nutritional needs during pregnancy, thereby gaining a better understanding of how to manage their daily diet.

Furthermore, the results of the analysis indicate that food intake is significantly related to CED occurrence in pregnant women. Analysis using SmartPLS produced a path coefficient value of -0.563 , indicating that food intake, particularly energy and protein intake, has a negative relationship with CED occurrence. These findings indicate that the more adequate the energy and protein intake during pregnancy, the lower the risk of CED in pregnant women, while inadequate food intake tends to increase the risk of CED. The statistical analysis results showed a p-value of 0.000 ($p < 0.05$) with a T-statistic value of 3.429 (> 1.96), so that the relationship was declared statistically significant and the research hypothesis was accepted. In accordance with the UNICEF (2020) conceptual framework, food intake is one of the important factors contributing to the increased risk of chronic energy deficiency (CED) in pregnant women (UNICEF, 2020). Adequate energy intake is important to meet the increased metabolic needs during pregnancy, while protein plays a role in the formation and maintenance of the mother's body tissues and fetal growth. This condition

can deplete the mother's nutritional reserves and increase the risk of CEE (Dictara et al., 2020). These findings are in line with the research conducted which showed that the chi-square test resulted in a p-value of 0.003 (< 0.05) with an OR value of 0.367 , indicating that there is a significant relationship between protein intake in pregnant women and the incidence of CED in pregnant women at the Tegalrejo Community Health Center in Yogyakarta in 2024 (Adnani & Nurhidayah, 2024). Additionally, this study is supported who showed that the chi-square test yielded a p-value of 0.002 (< 0.05), indicating a significant association with the occurrence of CED in pregnant women. Multivariate analysis showed that low protein intake (OR: 6.80 ; 95% CI: $1.62-28.59$) was associated with the incidence of CED (Wati, Murwani, Kartasurya, & Sulistiyani, 2024). The relationship between food intake and the incidence of Chronic Energy Deficiency (CED) in pregnant women in the working area of the Kenali Besar Community Health Center shows that adequate energy and protein intake during pregnancy remains an important concern. Some pregnant women still have energy and protein intake below average, reflecting suboptimal nutritional fulfillment. This condition has the potential to increase the risk of CEE, so adequate energy and protein intake needs to be a major focus in efforts to prevent CEE in pregnant women.

MMR in this study was measured using two anthropometric indicators, namely upper arm circumference (UAC) and body mass index (BMI) before pregnancy. Both reflect energy reserves and chronic nutritional status in pregnant women. Increased energy and protein intake influenced by the quality of health services will contribute to improving LISA and BMI values to the normal range, thereby removing mothers from the CED category. Conversely, mothers with low energy and protein intake tend to have an MUAC < 23.5 cm and BMI < 18.5 , indicating limited body energy reserves and reinforcing the picture of ME. Thus, changes in energy and protein intake are directly reflected in changes in MUAC and BMI.

Overall, these findings indicate that quality health services play an important role in reducing the incidence of MEI through improved food intake. Health services not only serve to detect and manage pregnancy complications, but also provide a main

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entry point for nutritional interventions through education, counseling, nutritional status monitoring, and strengthening of socioeconomic support. When health services function optimally and are able to increase energy and protein intake adequacy, mothers' LILA and BMI become more ideal, and

ultimately the risk of chronic energy deficiency during pregnancy can be reduced. These findings are in line with the UNICEF framework, which places health services and food intake as direct and fundamental factors in the nutritional status of pregnant women.

CONCLUSION

There is a positive correlation between health services, consisting of ANC visits and PKH recipients, and food intake, consisting of energy and protein intake, with a P-value of 0.000. This indicates that the better the quality of health services received by pregnant women, for example through regular antenatal care (ANC) visits, nutrition counseling, pregnancy status monitoring, supplementation, and social program support such as PKH, the better the quality of food intake and the better the quality of food consumed. Furthermore, there is a negative relationship between food intake consisting of energy and protein intake and chronic energy deficiency consisting of LILA and BMI before pregnancy, with a P-value of 0.001. This means that the better the food intake of pregnant women in terms of adequate energy and protein intake, the lower the risk of CEF in pregnant women.

SUGGESTION

Pregnant women are expected to pay more attention to fulfilling their nutritional intake during pregnancy by consuming a variety of balanced foods according to their energy and protein needs, as well as maintaining personal hygiene to prevent infectious diseases. In addition, health workers are expected to collaborate with posyandu cadres in monitoring nutritional status and providing information on the importance of balanced nutrition and the prevention of infectious diseases, as well as making optimal use of health services through regular antenatal care (ANC) visits and complying with the recommendations of health workers and providing information on the importance of balanced nutrition and the prevention of CED.

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DOI: 10.56922/mchc.v4i11.2426