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Determinants of Chronic Energy Deficiency (CED) in Pregnant Women at Banjarejo Health Center

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Abstract

Chronic Energy Deficiency (CED) in pregnant women remains a major contributor to low birth weight (LBW) cases in Indonesia. The Indonesian Ministry of Health, in line with the 2015–2030 Sustainable Development Goals (SDGs), has targeted a reduction in CED prevalence among pregnant women to 5%. However, the 2024 report from the Madiun City Health Office recorded the highest prevalence of CED among pregnant women at the Banjarejo Community Health Center, reaching 8.5%. This study aimed to analyze factors associated with the incidence of CED among pregnant women at the Banjarejo Health Center in Madiun City. An observational analytic method with a case-control design was employed. The study involved 78 respondents, consisting of 39 cases and 39 controls, with inclusion criteria of pregnant women in their first and second trimesters. Data were collected using a structured questionnaire and analyzed through univariate and bivariate approaches. The findings showed that maternal knowledge level (p = 0.040) and compliance with iron (Fe) tablet consumption (p = 0.008) were significantly associated with CED. It is recommended that pregnant women at risk of CED improve their knowledge of pregnancy nutrition and adhere to proper Fe tablet intake, including correct timing, dosage, and management of side effects.

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Introduction

Chronic Energy Deficiency (CED) in pregnant women remains a significant public health problem in Indonesia due to It's close link to the incidence of Low Birth Weight (LBW). According to the Ministry of Health of the Republic of Indonesia (Kementerian Kesehatan RI, 2023), the target of the 2015–2030 SDGs is to reduce the national prevalence of CED in pregnant women to 5%. However, a 2024 report from the Madiun City Health Office showed that the highest prevalence of CED in pregnant women occurred in the Banjarejo Community Health Center (Puskesmas) working area, at 8.5%, which is above the national target. This indicates a continued increase in the incidence of CED in pregnant women in the Banjarejo Community Health Center working area in Madiun City.

CED is a condition in which the body experiences a chronic energy imbalance between energy intake and energy expenditure, which is generally measured by the mid-upper arm circumference (MUAC). In pregnant women, a MUAC measurement of less than 23.5 cm is considered an indicator of CED (Dirjen kemenkes, 2022). Chronic Energy Deficiency Syndrome (CED) negatively impacts not only maternal health, such as muscle weakness and complications during delivery, but also the fetus, including the risk of miscarriage, premature birth, congenital defects, and low birth weight (LBW) (Noviriyanti et al., 2023).

Many factors may be associated with the incidence of CED during pregnancy. These factors include maternal knowledge and adherence to iron (Fe) tablet consumption. Previous research has shown that nutritional knowledge is crucial in shaping dietary practices during pregnancy (Safirah Alim et al., 2024) while adherence to iron tablet consumption is crucial for preventing anemia and supporting fetal growth (Harmawati Rustan & Kartini S, 2024).

Despite numerous previous studies, there is a lack of studies integrating behavioral and health service determinants of CED incidence, particularly in high-prevalence areas such as the Banjarejo Community Health Center. Many existing studies fail to consider the local context or focus on only one variable. Therefore, this study aims to fill this gap by examining various factors contributing to maternal knowledge and adherence to iron tablet consumption in the first and second trimesters of pregnancy.

What distinguishes this study is its more focused and local approach, targeting healthcare centers with consistently high rates of CED. This research is expected to provide evidence-based recommendations for local health interventions and support the achievement of national health goals.

Methods

This study used an observational analytical design with a case-control approach. The aim of this design was to identify factors associated with the incidence of Chronic Energy Deficiency (CED) in pregnant women in the Banjarejo Community Health Center, Madiun City.

The study population was all pregnant women in their first and second trimesters who underwent pregnancy check-ups at the Banjarejo Community Health Center. A total of 78 respondents were selected using a purposive sampling technique. The sample was divided into two groups: 39 respondents in the case group (pregnant women with CED) and 39 respondents in the control group (pregnant women without CED).

Inclusion criteria included pregnant women in their first or second trimester, having complete prenatal checkup records, and being willing to participate. Exclusion criteria included pregnant women with chronic illnesses unrelated to nutritional status (such as Protein Energy Deficiency (PED), autoimmune disease).

Data were collected through a questionnaire and secondary data from maternal medical records at the Banjarejo Community Health Center. The questionnaire included sections on nutritional knowledge and adherence to iron (Fe) tablet consumption. Nutritional knowledge was assessed using a questionnaire adapted from previous research. Chronic Energy Deficiency (CED) status was determined based on mid-upper arm circumference (MUAC). Pregnant women with a MUAC <23.5 cm were classified as having CED, in accordance with guidelines from the Ministry of Health of the Republic of Indonesia (Kemenkes RI, 2021).

Data were analyzed using data processing software. Univariate analysis was used to describe the characteristics of the respondents. Bivariate analysis (Chi-square test) was used to identify the relationship between independent variables and the incidence of CED. A p-value <0.05 was considered statistically significant. The independent variables in this study were maternal knowledge and adherence to iron tablet consumption, while the dependent variable was the incidence of CED in pregnant women. This study has obtained ethical approval from the authorized Health Research Ethics Committee and all respondents have provided informed consent before data collection was carried out.

Results

The results of the study were conducted on pregnant and non-pregnant women with CED who met the inclusion and exclusion criteria. The sample selection used a purposive sampling technique. This study was conducted on 78 respondents.

Table 1. Characteristics of respondent subjects based on demographics.

Varabel	Case		Control		Total	
	f	%	f	%	f	%
Age						
≤ 20 years	5	12,9	2	5,2	7	8,9
21 – 34 years	22	56,4	33	84,6	55	70,5
≥ 35 years	12	30,7	4	10,2	16	20,5
Education						
SMP	2	2,5	2	2,5	4	5,1
SMA/SMK	21	26,9	20	25,6	41	52,5
University	15	19,2	18	23,0	33	42,3
Gestational Age						
Trimester 1	13	33,3	9	23,1	22	28,2
Trimester 2	26	66,7	30	76,9	56	71,7
Employment						
Unemployed	20	25,6	28	35,8	48	61,5
Employed	15	19,2	10	12,8	25	32,0
Self-employed	4	5,1	1	1,2	5	6,4

Table 1. Based on the table above, the majority of respondents were in the age group of 21–34 years, with 22 respondents (56.4%) in the case group and 33 respondents (84.6%) in the control group. In terms of maternal education, most respondents had completed senior high school/vocational high school, with 21 respondents (26.9%) in the case group and 20 respondents (25.6%) in the control group. The lowest level of education was junior high school, represented by 2 respondents (2.5%) in both the case and control groups. Regarding gestational age, most respondents were in the second trimester, with 26 respondents (66.7%) in the case group and 30 respondents (76.9%) in the control group. Meanwhile, respondents in the first trimester were fewer, with 13 respondents (33.3%) in the case group and 9 respondents (23.1%) in the control group. In terms of occupation, the majority of respondents were unemployed, with 20 respondents (25.6%) in the case group and 28 respondents (35.5%) in the control group. The smallest proportion of respondents were self-employed, with 4 respondents (5.1%) in the case group and 1 respondent (1.2%) in the control group.

Table 2. Bivariate Analysis Between Variables Using Chi Square Test

Variable	Category	Chronic Energy Deficiency in Pregnant Women				*OR*	*95%CI*	P value
		Cases		Control				
		f	%	f	%			
Mother's level of knowledge	Enough	27	69,2	17	43,6	2,912	1,150 – 7,372	0,040
	Good	12	30,8	22	56,4			
Total		39	100	29	100			

Based on the table above, it can be seen that respondents who have a low level of knowledge in the case group were 27 respondents with a percentage of 69.2%, greater than the control group, which was 17 respondents with a percentage of 43.6%. Meanwhile, respondents who have a good level of knowledge in the case group were 12 respondents with a percentage of 30.8%, smaller than the control group, which was 22 respondents with a percentage of 56.4%. So the proportion of respondents who have a low level of knowledge in the case group was greater than in the control group.

The results of data processing using the Chi-Square test showed a p-value of 0.040 <α = 0.05. So it can be concluded statistically that there is a relationship between the level of maternal knowledge and the incidence of KEK in pregnant women in the Banjarejo Community Health Center Working Area, by showing an OR value of 2.912 and a value (95% CI = 1.150-7.372), so that respondents with a low level of knowledge have a risk 2.912 times greater of suffering from KEK in pregnant women compared to respondents who have a good level of knowledge.

Table 3. Bivariate Analysis Between Variables Using Chi Square Test

Variable	Category	Chronic Energy Deficiency in Pregnant Women				*OR*	*95%CI*	P value
		Cases		Control				
		f	%	f	%			
Fe tablet consumption rate	Not obey	15	38,5	4	10,3	5,469	1,616 – 18,508	0,008
	Obedient	24	61,5	35	89,7			
Total		39	100	39	100			

Based on the table above, it can be seen that respondents who had a level of compliance with consuming Fe tablets with non-compliance in the case group were 15 respondents with a percentage of 38.5% greater than the control group, namely 4 respondents with a percentage of 10.3%. Meanwhile, respondents who had a level of compliance with consuming Fe tablets in the case group were 24 respondents with a percentage of 61.5%, which was smaller than the control group, namely 35 respondents with a percentage of 89.7%. So the proportion of respondents who had a higher level of compliance with consuming Fe tablets and were non-compliant in the case group was greater than in the control group.

The results of data processing using the Chi-Square test showed a p-value of 0.008 <α = 0.05. So it can be concluded statistically that there is a relationship between compliance with Fe tablet consumption and the incidence of KEK in pregnant women in the Banjarejo Health Center Working Area, by showing an OR value of 5.469 and a value (95% CI = 1.616-18.508), so that respondents with a non-compliant level of compliance with Fe tablet consumption have a 5.469 times greater risk of suffering from KEK in pregnant women compared to respondents who have a compliant level of compliance with Fe tablet consumption.

Discussion

This study aims to analyze the relationship between the level of maternal knowledge and the level of compliance with consuming Fe tablets with the incidence of Chronic Energy Deficiency in pregnant women.

The results of the chi square test analysis show that the significance value is p value of 0.040 <α = 0.05. So it can be concluded that statistically there is a relationship between the level of maternal knowledge and the incidence of KEK in pregnant women in the Banjarejo Health Center Working Area and the OR value of 2.912 so that respondents with a low level of knowledge have a 2.912 times greater risk of suffering from KEK in pregnant women compared to respondents who have a good level of knowledge.

In this study, maternal knowledge is taken from the basic decisions a mother makes in making decisions and taking action. Knowledge of pregnancy nutrition is necessary for pregnant women to plan their menus. Meal planning is especially important to address pregnancy complaints in each trimester. In the first trimester, nausea and vomiting are common, so pregnant women need to be more mindful of their diet and consider their future health. Maternal knowledge of pregnancy nutrition is an indirect factor in the development of CED. Knowledge of pregnancy nutrition is crucial for meeting nutritional needs during pregnancy. For pregnant women, nutritional intake is necessary not only for themselves but also for the fetus they are carrying (LISKA et al., 2022).

This research is in line with the research conducted by Nadila Safirah Alim, et al., (2024) from the results of the research conducted obtained results with the Chi Square test. The p-value of 0.018 indicates that the p value <0.05, OR = 182, which means there is a significant relationship between the knowledge of pregnant women and the incidence of chronic energy deficiency at the Antang Perumnas Health Center. Pregnant women who have less knowledge are 182 times more likely to experience KEK. So in this study it can be concluded that there is a significant relationship between the knowledge of pregnant women and the incidence of chronic energy deficiency at the Antang Perumnas Health Center (Safirah Alim et al., 2024).

At the level of maternal knowledge caused by the lack of maternal literacy factors so that many mothers rush to answer questions without considering the answers afterward, especially on dietary questions, many mothers answer according to what is seen in the initial answer without considering a more appropriate answer, while in mothers with a good level of knowledge but experiencing KEK, it can be seen in the level of education and maternal diet where some mothers who have good knowledge are still less precise in choosing a good diet for pregnant women's nutrition and also at the level of education also hinders the mother's knowledge regarding the fulfillment of maternal nutrition needed during pregnancy, this can make the level of maternal knowledge regarding pregnancy nutrition one of the indirect factors related to the occurrence of KEK in pregnant women in the Banjarejo Community Health Center Working Area.

The results of the chi square test analysis on the variable level of compliance with Fe tablet consumption showed that the significance value was p value of 0.004 <α = 0.05. So it can be concluded that statistically there is a relationship between the level of compliance with Fe tablet consumption and the incidence of KEK in pregnant women in the Banjarejo Health Center Working Area and the OR value of 5.469 so that respondents with a non-compliant level of compliance with Fe tablet consumption have a 5.469 times greater risk of suffering from KEK in pregnant women compared to respondents who have a compliant level of compliance with Fe tablets.

Compliance with prenatal supplements refers to the pregnant woman's adherence to the recommendations of health workers to take iron tablets. Iron tablet consumption patterns are measured by the mother's behavior in taking the iron tablets and continuing to take the medication despite experiencing side effects such as constipation, nausea, and other normal drug effects. Therefore, if the mother regularly consumes iron tablets, it can prevent the occurrence of CED. The purpose of administering iron tablets in the context of CED is to increase hemoglobin levels in the blood and prevent or treat anemia caused by iron deficiency. By increasing iron intake through iron tablets, it is hoped that iron status can be optimized and the risk of CED and anemia-related health problems can be prevented (Harmawati Rustan & Kartini S, 2024).

This research is in line with the research conducted by Harmawati, et al. 2024. The results of the study obtained that from the analysis test by looking at the chi square test value obtained a p value of 0.000 smaller than the value of 0.05 which means that H0 is rejected and Ha is accepted or there is a relationship between chronic energy deficiency (CED) and the consumption pattern of Fe tablets at the Kurra Health Center, Tana Toraja Regency. This is due to unbalanced food consumption and absorption patterns during pregnancy, based on the dominant causative factor causing the occurrence of CED in pregnant women is the occurrence of anemia and can be caused by the inadequacy of iron in the body which can be obtained from consuming Fe tablets.

At the level of consumption of Fe tablets caused by side effects of the drug where mothers who experience side effects in consuming Fe tablets tend to stop consuming them and are reluctant to consume them again, this is also seen from many mothers who are wrong in the time of consuming Fe tablets where the advice from health workers is at night but many mothers consume them after eating, this often causes side effects of nausea after consuming them. Meanwhile, in mothers who have a level of consumption of Fe tablets who are already compliant can also be affected by CED can also be caused by a lack of total energy that is not met such as mothers who consume regularly but are not balanced with the consumption of other intakes needed by pregnant women so that there is a large possibility that the mother can experience CED even though routinely in compliance with the level of consumption of Fe tablets. So the provision of Fe tablets in the context of CED does not work well which functions to increase hemoglobin levels in the blood and prevent or overcome anemia caused by iron deficiency. By increasing iron intake through Fe tablets, it is hoped that it can optimize iron status and prevent the risk of CED. So this makes the indirect variable of compliance with Fe tablet consumption related to the occurrence of KEK in pregnant women in the Banjarejo Community Health Center Work Area.

Conclussion

The conclusion of this study is that a correlation was found between maternal knowledge and adherence to iron tablet consumption and the incidence of Chronic Energy Deficiency in pregnant women. The level of maternal knowledge has a risk of 2.912 times, while the level of compliance with consuming Fe tablets has a risk of 5.469 times.

Recommendations for readers, especially pregnant women experiencing chronic energy deficiency syndrome (CED), include improving maternal knowledge regarding nutritional health during pregnancy and increasing adherence to iron tablet consumption, ensuring proper timing and dosage, to minimize side effects. Furthermore, efforts should be made to manage diets and ensure adequate overall nutrition for both mother and baby during pregnancy.

Author Contributions

For research articles with several authors, a short paragraph Conceptualization, Khusnul Khotimah Al Isthikhomah; methodology, Khusnul Khotimah Al Isthikhomah; software, Khusnul Khotimah Al Isthikhomah; validation, Khusnul Khotimah Al Isthikhomah, Zainal Abidin, S.K.M., M.Kes (Epid), and Avicena Sakufa Marsanti, S.K.M., M.Kes.; formal analysis, Khusnul Khotimah Al Isthikhomah; investigation, Khusnul Khotimah Al Isthikhomah; resources, Khusnul Khotimah Al Isthikhomah; data curation, Khusnul Khotimah Al Isthikhomah; writing—original draft preparation, Khusnul Khotimah Al Isthikhomah; writing—review and editing, Khusnul Khotimah Al Isthikhomah, Zainal Abidin, S.K.M., M.Kes (Epid), and Avicena Sakufa Marsanti, S.K.M., M.Kes.; visualization, Khusnul Khotimah Al Isthikhomah; supervision, Zainal Abidin, S.K.M., M.Kes (Epid), and Avicena Sakufa Marsanti, S.K.M., M.Kes.; project administration, Khusnul Khotimah Al Isthikhomah; funding acquisition, Khusnul Khotimah Al Isthikhomah.

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (Ethics Committee) of STIKes Bhakti Husada Mulia Madiun (protocol code 017/E-KEPK/STIKES/BHM/V/2025; date of approval: May 2025).

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Conflicts of Interest:

This study is likely to experience information bias, particularly in the variables of maternal knowledge and compliance with iron tablet consumption. Information bias can occur due to differences between the information provided by respondents and the actual situation, either due to a lack of understanding or a desire to provide answers that are considered socially correct. To minimize this, researchers have attempted to balance this by conducting in-depth interviews with some respondents. During the interview process, researchers used good delivery techniques, such as re-explaining the meaning of the questions in simple, easy-to-understand language, and creating a comfortable atmosphere so that respondents feel safe and open in providing answers.

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