

DETERMINANTS OF CALCIUM INTAKE AMONG PREGNANT WOMEN IN RURAL AREAS OF EAST KUTAI REGENCY

Lia Agustin^{1*}, Rismayanti M², Dian Rahmawati³

Universitas STRADA Indonesia

*Corresponding author: liaagustin77.la@gmail.com

ABSTRACT

Inadequate calcium intake during pregnancy remains a major nutritional problem in rural areas and may increase the risk of adverse maternal and fetal outcomes. This study aimed to analyze the determinants of calcium intake among pregnant women in Sangkulirang, East Kutai Regency, Indonesia. A cross-sectional study was conducted among 52 pregnant women selected using purposive sampling. Calcium intake was assessed using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) and categorized based on Recommended Dietary Allowance (RDA). Data were analyzed using chi-square and logistic regression tests. Most respondents (61.5%) had inadequate calcium intake. Maternal knowledge ($p=0.001$), antenatal care utilization ($p=0.003$), occupation ($p=0.041$), education ($p=0.045$), and maternal age ($p=0.041$) were significantly associated with calcium intake. Maternal knowledge was identified as the dominant determinant (OR=5.21; 95% CI=1.89–14.32). Maternal knowledge and antenatal care utilization are important determinants of calcium intake among pregnant women in rural areas.

Keywords: Antenatal Care, Calcium Intake, Determinants, Pregnant Women, Rural Area

INTRODUCTION

Calcium is an essential micronutrient required during pregnancy due to its critical role in fetal bone development, maternal bone metabolism, and the prevention of pregnancy-related complications. Adequate calcium intake has been shown to reduce the risk of hypertensive disorders, including preeclampsia, which remains a leading cause of maternal and perinatal morbidity and mortality worldwide (Gerede et al., 2025). The demand for calcium increases significantly during pregnancy, particularly in the second and third trimesters, making adequate intake crucial for optimal maternal and fetal outcomes (Kumar & Kaur, 2017).

Despite global recommendations, inadequate calcium intake among pregnant women remains a significant public health issue, particularly in low- and middle-income countries. Studies have reported that a large proportion of pregnant women fail to meet the recommended daily intake of calcium, with prevalence rates exceeding 60% in several developing regions (Agustina et al., 2023); (Mithal & Gernand, 2022). In Southeast Asia, dietary patterns characterized by low consumption of dairy products and calcium-rich foods contribute to this deficiency (Lassi et al., 2020). This condition increases the risk of adverse pregnancy outcomes, including low birth weight and impaired fetal growth (Black et al., 2021).

In Indonesia, inadequate calcium intake among pregnant women remains a persistent concern. National data indicate that dietary diversity among pregnant women is still limited, affecting the adequacy of micronutrient intake, including calcium (Kementrian Kesehatan RI, 2022). Previous studies have also highlighted that socioeconomic status, education level, and knowledge significantly influence maternal nutritional intake (Fitri et al., 2026). However, disparities are more pronounced in rural areas, where access to nutritious foods, health services, and nutrition-related information is often limited (UNICEF, 2021).

Kutai Timur Regency, particularly the Sangkulirang subdistrict, represents a rural area with potential challenges in maternal nutrition. Although maternal health services such as antenatal care are available, the adequacy of nutrient intake, especially calcium, has not been well documented. Rural populations often face geographical barriers, economic constraints, and cultural practices that may influence dietary behavior during pregnancy (Cavia et al., 2024). These factors may contribute to suboptimal calcium intake among pregnant women.

Previous studies have identified several determinants of calcium intake, including maternal age, education, occupation, income, knowledge, dietary patterns, and utilization of antenatal care services (J. E. Christian et al., 2021) (Gerede et al., 2025). Among these factors, knowledge and health service utilization play a crucial role in shaping dietary behavior, as women who receive adequate health education are more likely to adopt appropriate nutritional practices. (Mangwane et al., 2024)

However, studies specifically examining the determinants of calcium intake among pregnant women in rural areas of Indonesia remain limited, particularly in Kutai Timur. Understanding these determinants is essential to design effective and targeted nutrition interventions. Therefore, this study aims to analyze the determinants of calcium intake among pregnant women in a rural area using a cross-sectional approach.

METHODS

This study employed an analytic observational design using a cross-sectional approach to analyze the determinants of calcium intake among pregnant women in a rural area. The study was conducted in November 2025 at the Sangkulirang Primary Health Center, East Kutai Regency, East Kalimantan, Indonesia.

The study population consisted of all pregnant women residing in the Sangkulirang area during the study period. A total of 52 respondents were selected using purposive sampling. Purposive sampling was applied due to the limited number of pregnant women who met the inclusion criteria during the data collection period. The inclusion criteria were pregnant women who were willing to participate, able to communicate effectively, and residing in the study area. Pregnant women with severe illness or incomplete questionnaire data were excluded from the study.

The dependent variable in this study was calcium intake adequacy among pregnant women. The independent variables included maternal age, education level, occupation, level of knowledge, and utilization of antenatal care (ANC) services. Calcium intake was assessed using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). The intake was then compared with the Recommended Dietary Allowance (RDA) for pregnant women. Calcium intake was categorized as adequate if respondents consumed ≥ 1200 mg/day and inadequate if intake was < 1200 mg/day.

Maternal knowledge regarding calcium nutrition during pregnancy was measured using a structured questionnaire consisting of multiple-choice questions. Knowledge scores were categorized as good if respondents answered $\geq 75\%$ of the questions correctly. The questionnaire had been tested for validity and reliability prior to data collection and demonstrated acceptable reliability with a Cronbach's alpha value of > 0.70 .

Data collection was conducted through face-to-face interviews by trained enumerators using structured questionnaires. Prior to the interviews, respondents were informed about the study objectives and provided written informed consent.

Data were analyzed using statistical software. Univariate analysis was performed to describe respondent characteristics. Bivariate analysis using the Chi-square test was conducted to examine the association between independent variables and calcium intake adequacy. Variables with p-values < 0.25 in the bivariate analysis were included in multivariate logistic

regression analysis to identify the dominant determinants of calcium intake. Statistical significance was established at $p < 0.05$. The results were presented as odds ratios (OR) with 95% confidence intervals (CI).

This study received ethical approval from the Health Research Ethics Committee of Universitas STRADA Indonesia with ethical clearance number 1223423/EC/KEPK/I/II/2025. All procedures were conducted in accordance with research ethics principles, and respondents' confidentiality was strictly maintained.

Table 1. Characteristics of Respondents

Variable	Category	n	%
Age	20–25 years	8	15.4
	26–30 years	30	57.7
	31–35 years	14	26.9
Education	Primary–Junior High	6	11.5
	Senior High School	28	53.8
	Higher Education	18	34.6
Occupation	Employed	25	48.1
	Housewife	27	51.9
Gestational Age	1–3 months	9	17.3
	4–6 months	30	57.7
	7–9 months	13	25.0
Parity	First pregnancy	27	51.9
	≥ 2 pregnancies	25	48.1

The majority of respondents were aged 26–30 years (57.7%), had a senior high school education (53.8%), and were housewives (51.9%).

Table 2. Distribution of Calcium Intake

Calcium Intake	n	%
Adequate	20	38.5
Inadequate	32	61.5
Total	52	100

More than half of the respondents had inadequate calcium intake (61.5%).

Table 3. Bivariate Analysis of Determinants of Calcium Intake Among Pregnant Women

Variable	Adequate (%)	n	Inadequate n (%)	Total	p-value
Knowledge					
Good	15 (68.2)	7 (31.8)	22	0.001	
Poor	5 (16.7)	25 (83.3)	30		
ANC Utilization					
Regular	16 (61.5)	10 (38.5)	26	0.003	
Irregular	4 (15.4)	22 (84.6)	26		
Irregular	4 (15.4)	22 (84.6)	26		
Occupation					
Employed	14 (56.0)	11 (44.0)	25	0.041	
Housewife	6 (22.2)	21 (77.8)	27		
Education					

Higher Education	11 (61.1)	7 (38.9)	18	0.045
Primary–Senior High	9 (26.5)	25 (73.5)	34	
Age				
20–30 years	18 (47.4)	20 (52.6)	38	0.041
31–35 years	2 (14.3)	12 (85.7)	14	

Bivariate analysis showed that maternal knowledge, antenatal care utilization, occupation, education level, and maternal age were significantly associated with calcium intake among pregnant women ($p < 0.05$). Pregnant women with good knowledge and regular antenatal care utilization tended to have more adequate calcium intake compared to those with poor knowledge and irregular antenatal care visits.

Table 4. Multivariate Analysis of Determinants of Calcium Intake

Variable	OR	95% CI	p-value
Knowledge	5.21	1.89–14.32	0.001
ANC utilization	4.76	1.67–13.58	0.003
Occupation	2.85	1.03–7.89	0.041
Education	2.12	0.93–4.85	0.072

Bivariate analysis showed that knowledge, antenatal care utilization, education, occupation, and age were significantly associated with calcium intake ($p < 0.05$). Multivariate analysis identified knowledge as the most dominant factor (OR=5.21; $p = 0.001$), indicating that pregnant women with good knowledge were more likely to have adequate calcium intake.

DISCUSSION

The findings of this study indicate that the majority of pregnant women in Sangkulirang had inadequate calcium intake (61.5%), highlighting that calcium deficiency remains a significant nutritional concern in rural settings. This result is consistent with previous studies conducted in low- and middle-income countries, where insufficient calcium intake among pregnant women is highly prevalent due to limited dietary diversity and low consumption of calcium-rich foods (Agustina et al., 2023)(Mithal & Gernand, 2022)(Lassi et al., 2020). In Indonesia, similar findings have been reported, indicating that maternal diets are often insufficient in meeting micronutrient requirements, particularly calcium (Kementrian Kesehatan RI, 2022).

Calcium plays a crucial role during pregnancy, particularly in fetal bone development and maternal physiological regulation. Inadequate intake has been associated with an increased risk of hypertensive disorders, including preeclampsia, which remains a major contributor to maternal morbidity and mortality (World Health Organization, 2021)(Hofmeyr et al., 2019) (Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., & Ezzati, 2013). The high prevalence of inadequate calcium intake found in this study suggests the need for targeted nutritional interventions, especially in rural populations.

This study found that maternal knowledge was the most dominant determinant of calcium intake (OR=5.21; $p = 0.001$). This finding supports behavioral theories suggesting that knowledge is a key factor influencing health-related behaviors, including dietary practices. Women with better knowledge are more likely to understand the importance of calcium and make appropriate food choices (P. Christian et al., 2021)(Ekayanti et al., 2025). Previous studies have also demonstrated that nutrition education significantly improves dietary intake during pregnancy (Masthalina et al., 2026) (Roggero et al., 2021). Therefore, strengthening maternal knowledge through structured health education programs is essential.

Utilization of antenatal care (ANC) services was also significantly associated with calcium intake. Pregnant women who regularly attended ANC visits were more likely to have adequate calcium intake. This may be explained by the role of ANC as a platform for delivering nutrition education, counseling, and supplementation (Lassi et al., 2020)(UNICEF, 2021). WHO guidelines emphasize the importance of integrating nutrition interventions, including calcium supplementation, into routine antenatal care (World Health Organization, 2021). However, the effectiveness of ANC in improving nutritional outcomes depends on the quality of counseling and accessibility of services.

Education level was found to be associated with calcium intake, although it was not a dominant factor in multivariate analysis. Women with higher education levels tend to have better access to health information and are more capable of adopting healthy behaviors (Kramer et al., 2020) (Victora et al., 2021). Education influences not only knowledge but also attitudes and decision-making processes related to nutrition. However, in rural settings, the effect of education may be moderated by other factors such as income and food availability.

Occupation was also significantly associated with calcium intake. Working women were more likely to have adequate calcium intake compared to housewives. This may be related to better economic status and purchasing power, allowing access to more diverse and nutritious foods (Mithal & Gernand, 2022)(Bhutta, Z. A., Salam, R. A., & Das, 2021). Socioeconomic status has been widely recognized as a determinant of nutritional adequacy, particularly in resource-limited settings.

Maternal age was another factor associated with calcium intake. Women within the optimal reproductive age range may have better health awareness and experience in managing pregnancy-related nutritional needs (Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., & Ezzati, 2013). However, age is often interrelated with other factors such as education, parity, and knowledge, making its independent effect less pronounced in multivariate analysis.

The findings of this study highlight that calcium intake among pregnant women is influenced by multiple interrelated factors, including individual, socioeconomic, and health service-related determinants. In rural areas such as Sangkulirang, these factors are further compounded by limited access to nutrition information, geographical barriers, and cultural dietary practices (UNICEF, 2013) (FAO, 2022). Therefore, interventions to improve calcium intake should adopt a comprehensive approach, combining nutrition education, strengthening antenatal care services, and improving access to calcium-rich foods.

This study has several strengths, including the use of an analytic approach to identify multiple determinants of calcium intake in a rural population. However, some limitations should be acknowledged. The cross-sectional design limits the ability to establish causal relationships. In addition, the use of SQ-FFQ relies on respondents' recall, which may introduce recall bias. Despite these limitations, the study provides important insights into maternal nutrition in rural settings and can serve as a basis for future interventions and research.

CONCLUSION

Most pregnant women in the Sangkulirang area of East Kutai Regency have calcium intake that does not meet the recommended requirements. Research results indicate that there is a significant relationship between age, education level, occupation, knowledge level, and utilization of antenatal care services with calcium intake in pregnant women. Based on multivariate analysis, knowledge level is the most dominant factor in determining the adequacy of calcium intake.

These findings indicate that increasing pregnant women's knowledge through nutrition education as well as optimizing antenatal care services are important strategies for improving

calcium intake adequacy. Therefore, comprehensive interventions are needed that not only focus on providing supplementation but also on improving health literacy and access to nutritional information for pregnant women, especially in rural areas.

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