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Associations Between ANC History, Anemia, Exclusive Breastfeeding, and Maternal Diet with Nutritional Status of Children Aged 2–5 in Rural Indonesia

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ABSTRACT

The first thousand days of life, beginning with pregnancy, are crucial for a child's development, influenced by factors like maternal nutrition, health, antenatal care (ANC), exclusive breastfeeding, birth weight, immunization, and complementary feeding. Regular ANC visits are vital for monitoring the health of both mother and fetus. This cross-sectional study examined the association between ANC history, anemia during pregnancy, exclusive breastfeeding, and maternal dietary practices with child nutritional status in Ciranggem Village, Sumedang Regency (2021–2023). Data from 30 mothers of children aged 2–5 years were analyzed using Chi-square tests. Significant associations ($p < 0.05$) were found between all four maternal factors and child nutritional outcomes, highlighting their collective impact on growth. The study used an analytical observational design with total sampling. Results showed 73.3% of mothers received ANC, practiced exclusive breastfeeding, and maintained a healthy diet, while 26.7% had a history of anemia. Children's nutritional status was as follows: Normal (66.7%, 20 children), Stunting (20%, 6 children), Underweight (10%, 3 children), and Overweight (3.3%, 1 child). Statistical analysis yielded a p-value < 0.05, indicating a significant link between maternal factors and child nutrition.

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Introduction

The first thousand days of life, or the "window of opportunity," is a golden period for the growth and development of children, starting from conception until the age of two years. This period is closely related to pregnant women, beginning with the adequacy of their nutritional intake, health status, and antenatal care (ANC), while for children aged 0–24 months, it includes exclusive breastfeeding, birth weight, immunization, and the provision of complementary foods [1]. According to the World Health Organization (WHO) in 2018, around 86% of women worldwide accessed ANC at least once during their pregnancy. In 2020, WHO reported that 89% of pregnant women accessed ANC services with healthcare workers at least once [1]. However, this percentage varies by region. In developing countries, the percentage drops to around 68%. Compared to other developing regions, Southeast Asia has the lowest ANC attendance rate, with only 54% of women attending at least one ANC visit [2].

Globally, WHO underscores the first 1,000 days of life, including pregnancy through the first two years after birth, as a vital period for establishing a child's lifelong health trajectory. Inadequate maternal nutrition and poor access to quality antenatal care can compromise fetal growth and increase the risk of stunting and other forms of malnutrition in early childhood. WHO recommends a minimum of eight ANC visits during pregnancy to ensure timely screening, health education, and nutritional interventions. Yet, ANC attendance rate, especially in low- and middle-income countries (LMICs) such as Indonesia remains low. According to the Indonesian Ministry of Health, many women in Indonesia fail to meet this standard, particularly in rural and underserved communities.

The number of ANC visits in Indonesia over the past three years (2019–2021), however, has shown an increase. In 2019, ANC coverage reached 92.7%, and by 2021, it increased to 95.2%. There was also an increase in coverage for the first ANC visit in the first trimester (2019: 72.3%; 2021: 81.3%) and for the fourth visit (2019: 61.4%; 2021: 70.0%). In 2020, the coverage of ANC visits showed high figures, with the first visit reaching 96.84% and the fourth visit 90.18%. However, in 2021, although the figures remained high, there was a slight decline, with the first visit reaching 94.71% and the fourth visit 86.85%.

ANC visits, as recommended by the national government, are important to monitor the health of the mother and fetus as early as possible. In addition, these visits help prepare for optimal labor, the postpartum period, and lactation for the mother [3]. The minimum standard ANC frequency in Indonesia is as follows: two visits in the first trimester, one visit in the second trimester, and three visits in the third trimester (ANC 2-1-3) [4].

Poor ANC services can lead to low birth weight (LBW); a baby's weight and body length at birth reflect the mother's health condition during pregnancy, including her nutritional status

[5]. Parameters for assessing the nutritional status of pregnant women include anthropometry, mid-upper arm circumference (LILA), hemoglobin (Hb) levels, and dietary intake. An Hb level of <10 mg/dL in pregnant women is classified as anemia [6]. Anemia during pregnancy can lead to problems in babies such as LBW, stunting, and even infant death. For pregnant women, anemia increases the risk of bleeding before and during childbirth, as well as maternal mortality. Thus, it contributes to higher maternal and infant mortality rates. Anemia in pregnant women hampers the transport of nutrients and oxygen (O_2) to the fetus through the placenta, impairing fetal growth and development [6].

Nutrition during childhood significantly influences growth and development, even during pregnancy. If a pregnant mother receives adequate nutrition, the baby is more likely to be born with a normal birth weight. On the other hand, malnourished mothers are more likely to give birth to babies with low birth weight [7]. The most important source of nutrition for a newborn is breast milk. Breast milk is the most ideal food both physiologically and biologically and should be given during early life. It not only contains high nutritional value but also immune components that protect against various diseases that can hinder a baby's growth [8].

Breastfeeding should begin immediately after birth and continue exclusively for the first six months, without adding or substituting other foods or drinks [9]. However, exclusive breastfeeding coverage in Indonesia is still below expectations. Nationally, in 2017, the percentage of babies receiving exclusive breastfeeding was 61.33%. This figure has not yet reached the government's target of 80% (Indonesian Ministry of Health) [10].

Therefore, this study aims to examine whether there is an association between maternal ANC history and exclusive breastfeeding with the nutritional status of children, particularly in Ciranggem Village, Sumedang Regency, West Java. Sumedang was selected as the study location because of its high utilization of ANC services, as indicated by the 19,929 pregnant women who visited the Sumedang Health Center for ANC services in November 2023. This makes it a relevant setting to explore the link between maternal care practices and child nutrition outcomes.

Despite the well-established importance of maternal health factors(such as ANC, anemia, exclusive breastfeeding, and diet) in influencing child nutritional outcomes, there remains a lack of localized, community-based data from rural areas in LMICs such as Indonesia. This study contributes to the existing body of knowledge by examining these associations in Ciranggem Village, a rural area in Sumedang Regency, Indonesia. The setting offers relevant insights into maternal and child health dynamics in under-resourced environments, where health system access and dietary diversity are often limited.

However, it is important to acknowledge that this study is inherently limited by its small sample size (n = 30), cross-sectional design, and absence of multivariable analysis to

adjust for potential confounders. These limitations restrict the generalizability and depth of inference from the findings. While the study does not offer novel methodological approaches or causal conclusions, it provides a useful snapshot of maternal-child health interactions at the community level and may serve as a preliminary reference for future, larger-scale research and policy development.

Literature Review

A. Antenatal Care

ANC refers to healthcare services provided by professionals to pregnant women, following established ANC standards. Pregnant women are recommended to attend ANC visits twice in the first trimester, once in the second trimester, and three times in the third trimester. The purpose of ANC is to ensure that pregnant women receive comprehensive care, including check-ups, education, and detection of high-risk conditions, so that preventive or curative actions can be taken promptly if needed [10].

B. Anemia in pregnant women

Anemia is a condition in which the number of erythrocytes or their ability to transport oxygen is insufficient to meet the body's physiological needs. This can result from decreased production of erythrocytes and/or hemoglobin. Anemia during pregnancy is defined by Hb levels below 11 g/dL in the first and third trimesters, and below 10.5 g/dL in the second trimester, or by a hematocrit level below 33% [11]. According to WHO, the severity of anemia is categorized based on hemoglobin levels: mild anemia (10–10.9 g/dL), moderate anemia (7–9.9 g/dL), and severe anemia (less than 7 g/dL). Severe anemia requires immediate medical attention, and an Hb level below 4 g/dL is considered an emergency, potentially leading to congestive heart failure, sepsis, or even death.

C. Pregnant women's diet

A dietary pattern refers to the regulation of the type and quantity of food consumed, aimed at maintaining health, supporting nutritional status, and preventing or aiding in the treatment of disease [12]. It reflects repeated eating behaviors of individuals to meet their nutritional needs [13]. In general, dietary patterns consist of three components: the type, amount, and frequency of food consumed.

The type of food includes staple foods consumed daily such as rice, corn, sago, tubers, and flour, along with animal and vegetable side dishes, vegetables, and fruits. The number of meals refers to the total amount of food consumed by an individual. Eating frequency refers to how often food is consumed each day, typically including breakfast, lunch, dinner, and snacks [14].

D. Child nutritional status

Nutritional status measures how well a child's nutritional needs are met, typically assessed through indicators such as weight and height. It reflects the balance between nutrient intake and the body's metabolic needs. When food intake meets these needs, the result is good nutritional status. However, prolonged deficiencies or excesses in essential nutrients can lead to malnutrition, which may present as either undernutrition or overnutrition [15]. Nutritional status is also defined as the health condition that results from the balance between nutrient intake and physiological requirements [16].

This study adapts the United Nations Children's Fund (UNICEF) framework to focus on maternal factors such as ANC history, maternal anemia, exclusive breastfeeding, and dietary patterns, which influence the nutritional status of children aged 2 to 5 years. At the basic level, contributing factors include socio-economic status, maternal education, and access to healthcare services. At the household and maternal level, maternal dietary patterns reflect the quality and diversity of food intake during and after pregnancy, influencing maternal reserves, breastfeeding quality, and overall family nutrition. Maternal anemia, often caused by iron deficiency, lowers the oxygen-carrying capacity of the blood, impairing fetal development, reducing birth weight, and affecting breastfeeding effectiveness. The frequency and quality of ANC visits determine the early detection and management of nutritional risks, impacting both maternal and fetal health. Exclusive breastfeeding during the first six months provides essential nutrients and immune protection, supporting proper growth and development.

At the immediate level, child nutrition is influenced by inadequate dietary intake and illness during the post-weaning period (ages 6–59 months), often resulting from suboptimal maternal feeding practices, low food diversity in the household, and repeated infections or illnesses associated with early nutritional deficiencies. The final outcome is reflected in the child's nutritional status, assessed through weight-for-age, height-for-age (stunting), and weight-for-height (wasting), which together indicate the cumulative effect of these risk factors over time.

Material And Methods

Based on the research objective, which is to describe and analyze the association between maternal antenatal care history, anemia during pregnancy, maternal diet, and exclusive breastfeeding with children's nutritional status in 2021 to 2023 in Ciranggem Village, Sumedang Regency, this study used an observational analytical design with a cross-sectional approach. A minimum of 30 participants was determined based on conventional

recommendations for correlational studies, though this may limit statistical power [17]. Given the small sample size and absence of multivariable analysis, the results should be interpreted cautiously.

The study was conducted at the Posyandu in Ciranggem Village, Sumedang Regency, West Java, from November 2023 to December 8, 2023. The population included all mothers who had children aged 2 to 5 years and were registered and actively participating in control activities at the Posyandu during their pregnancies between 2021 and 2023. The sample was selected using a total sampling technique, involving 30 participants who met the inclusion and exclusion criteria.

Data were processed using IBM SPSS Statistics Version 27 software. The Chi-square (χ^2) test was used to analyze the association between the independent variables and the dependent variable. The confidence interval (CI) was set at 95 percent, and a p-value less than 0.05 was considered statistically significant.

Results and Discussions

A. Univariate analysis results

Table 1 presents the results of a univariate analysis involving 30 respondents. It includes data on the distribution of ANC history, anemia history in pregnant women, exclusive breastfeeding, and mothers' dietary patterns. The results show that most respondents, namely 22 mothers (73.3%), had fulfilled ANC history, with ≥ 6 visits during pregnancy. Meanwhile, 8 mothers (26.7%) did not meet the recommended ANC frequency.

Regarding anemia, 9 out of 30 respondents (26.7%) had Hb levels < 12 g/dL, while the remaining 21 mothers (73.3%) had Hb levels ≥ 12 g/dL. As for exclusive breastfeeding, 22 out of 30 mothers (73.3%) reported providing exclusive breastfeeding. In terms of dietary patterns, 22 mothers (73.3%) had a diet that met nutritional standards.

Table 1. Univariate analysis results (n = 30).

Description	Frequency	Percentage
Antenatal Care History		
Fulfilled	22	73.3
Not Fulfilled	8	26.7
Hb Level		
< 12	9	30.0
≥ 12	21	70.0
Exclusive Breastfeeding		
Yes	22	73.3
No	8	26.7

Description	Frequency	Percentage
Nutritional Needs		
Fulfilled	22	73.3
Not Fulfilled	8	26.7

Table 2. Children's nutritional needs (n = 30).

Nutrition Needs	Frequency	Percentage
Normal	20	66.7
Overweight	1	3.3
Underweight	3	10
Stunting	6	20

Table 2 provides an overview of the nutritional status of children in Ciranggem Village from 2021–2023. Of the 30 children, 20 (66.7%) had normal nutritional status, 1 child (3.3%) was overweight, 3 children (10%) were underweight, and 6 children (20%) were stunted.

B. Bivariate analysis results

Table 3 shows the association between ANC history in pregnant women and children's nutritional status. Based on Chi-square analysis, a significant association was found between ANC history and children's nutritional status ($p < 0.05$). Of the 21 mothers with ≥ 6 ANC visits, 19 had children with normal or overweight status, and 2 had children who were underweight or stunted. Among the 9 mothers with < 6 ANC visits, 1 child was normal, 6 were stunted, and 2 had both underweight and stunted status. These results show a significant association between ANC history and children's nutritional status.

Table 3. Association between maternal ANC history and child nutritional status (n = 30).

Child Nutritional Status	Maternal ANC History		Total	P-Value
	< 6	≥ 6		
Normal and Overweight	1	19	20	0.001
Underweight dan Stunting	8	2	10	
Total	**9**	**21**	**30**	

ANC visits play a preventive role in identifying high-risk pregnancies and supporting maternal and fetal health. Our findings support previous research indicating better child nutrition outcomes among mothers with complete ANC attendance. It prepares mothers for childbirth, postpartum recovery, breastfeeding, and reproductive health restoration [18]. ANC services are preventive services aimed at monitoring the mother's health and preventing complications for both mother and fetus. Efforts must be made to ensure that pregnant women remain healthy until delivery. If there are physical or psychological abnormalities, they can be identified immediately so that pregnant women can give birth without complications [19]. The frequency of ANC examinations is at least six times during

pregnancy. The examination includes anamnesis, monitoring of the mother and fetus, recognition of high-risk pregnancies, immunization, advice and counseling, and accurate data recording at each visit [20].

Based on previous studies, pregnancy check-ups are influenced by various factors. Attitude and knowledge have a significant association with the completeness of pregnancy checks (ANC 2-1-3), with attitude being a particularly influential factor [21]. The awareness and willingness of pregnant women to undergo regular pregnancy checks is a manifestation of healthy behavior. Healthy behavior is influenced by an individual's knowledge, attitude, and motivation to take action. If someone has knowledge about what needs to be done, they are more likely to develop a positive attitude and motivation to do it [22].

The reluctance of pregnant women to attend regular check-ups is caused by low public awareness of their importance and by economic factors [23]. Common reasons for not attending check-ups include lack of time due to work or childcare responsibilities, absence of pregnancy-related complaints, lack of knowledge about how to access check-ups, and general apathy. Economic factors are complex and significantly influence various aspects of life, affecting individual behavior [24].

Nutritional intake greatly determines the health of pregnant women and the fetus they are carrying. Nutritional needs during pregnancy increase by 15 percent compared to those of non-pregnant women. This nutritional increase is needed for the growth of the uterus, breasts, blood volume, placenta, fluid requirements, and fetal development, which accounts for 40 percent, while the remaining 60 percent supports maternal growth [25]. Through education and knowledge, pregnant women can develop their critical thinking skills, making it easier to solve problems they face. The results of this study also align with the theory that anemia is influenced by poor nutritional status. A woman who has poor nutritional status, such as a LILA measurement of less than 23.5 cm, is likely to experience iron loss and anemia [26].

Table 4 shows the association between the history of anemia in pregnant women and the nutritional status of children. The association between anemia in pregnant women and child nutritional status was analyzed using Chi-square, and the results showed a significant association ($p = 0.001$, $p < 0.05$). According to [5], the Hb level required for pregnant women during pregnancy is between 12 and 15 g/dL. The study results showed that 10 pregnant women with Hb levels ≤ 12 had children with good nutritional status. However, among pregnant women with Hb levels ≤ 12, two had children with underweight conditions, six had children with stunting, and one had a child who was both underweight and stunted [27].

Table 4. Association between history of anemia in pregnant women and child nutritional status (n = 30).

Child Nutritional Status	Mother's Hb History		Total	P-Value
	≤ 12	> 12		
Normal and Overweight	2	18	20	0.001
Underweight dan Stunting	8	2	10	
Total	**10**	**20**	**30**	

The increase in blood volume begins in the first trimester by 15 percent compared to the pre-pregnancy condition. This is followed by a very rapid increase in the second trimester. During pregnancy, 1000 mg of iron is needed, with approximately 300 mg actively transferred to the fetus and placenta [25]. In general, there are three causes of iron deficiency anemia in pregnant women: low iron (Fe) reserves due to menstruation and previous childbirth, insufficient iron intake from food, and disrupted eating patterns caused by nausea during pregnancy [28]. Physiological needs during pregnancy increase with gestational age. If this condition is not balanced with adequate iron intake, it can lead to anemia in pregnant women. Anemia during pregnancy reduces the flow of iron and oxygen to the fetus. Iron is a micronutrient that plays a role in the formation of hemoglobin, which functions as an oxygen carrier throughout the body. Limited iron flow hinders the metabolic processes of the fetal body. These metabolic processes are essential for achieving bone mineral density during fetal growth, which begins between weeks 1 and 13 of pregnancy, or the first trimester [29]. Iron deficiency during this period increases the risk of prematurity, LBW, and short birth length [30].

Table 5 shows that the observed variable is exclusive breastfeeding, while the independent variable is the child's nutritional status. The results of the analysis indicate a p-value of 0.001 ($p < 0.05$), which statistically means there is a significant association between the history of exclusive breastfeeding and the child's nutritional status.

Table 5. Association between exclusive breastfeeding history and child nutritional status (n = 30).

Child Nutritional Status	Exclusive Breastfeeding		Total	P-Value
	≤ 12	**> 12**		
Normal and Overweight	20	2	22	0.001
Underweight dan Stunting	2	6	8	
Total	**22**	**8**	**30**	

Exclusive breastfeeding was the independent variable observed, while the dependent variable was the child's nutritional status. The results of the analysis show a p-value of 0.001, which statistically indicates an association between the history of exclusive breastfeeding and the child's nutritional status. This is consistent with [31], which also found a p-value of

0.001, indicating a significant association between exclusive breastfeeding and nutritional status. Stunting is caused by multidimensional factors and is not solely due to poor nutrition experienced by pregnant women or toddlers. Several contributing factors to stunting include the condition of the mother or prospective mother, the child's condition, socio-economic factors, sanitation, and access to clean drinking water [31].

Breast milk produced by the mother contains all the nutrients required for a child's growth and development [32]. Exclusive breastfeeding means the child is given only breast milk, without any additional fluids such as formula milk, fruit juices, honey, tea, or water, and without any solid foods such as bananas, papaya, porridge, biscuits, or rice-based foods, for the first six months. Children who are exclusively breastfed receive no fluids or solids other than breast milk, except for oral rehydration solutions, vitamin drops or syrups, minerals, or prescribed medications. UNICEF and WHO recommend exclusive breastfeeding for at least six months. Solid foods should be introduced after the child reaches six months of age, and breastfeeding should be continued until the child is two years old [33].

The results of the study also showed that one toddler (3.3 percent of respondents) who was exclusively breastfed still experienced stunting. This reinforces that stunting is influenced by multiple factors, not only poor nutrition during pregnancy or infancy. These factors include the mother's condition, the child's condition, socio-economic status, sanitation, and access to drinking water [34]. One contributing factor in the child's condition is LBW, defined as a birth weight of less than 2500 grams. LBW is closely linked to increased fetal mortality and morbidity, and it can hinder growth and cognitive development while increasing the risk of chronic diseases later in life [35].

Table 6 shows that 22 mothers had their nutritional needs met, while 8 did not. Chi-square analysis revealed a significant association (p = 0.001), indicating that the association between maternal nutritional needs and child nutritional status is statistically significant. These findings demonstrate a clear link between maternal nutrition and the nutritional status of their children.

Table 6. Association between maternal dietary history and child nutritional status (n = 30).

Child Nutritional Status	Nutritional Needs		Total	P-Value
	Fulfilled	Not Fulfilled		
Normal and Overweight	21	1	22	0.001
Underweight dan Stunting	1	7	8	
Total	**22**	**8**	**30**	

The measurement of children's nutritional status aims to assess their current condition and predict long-term health outcomes [36]. Body weight and height are among the predictors used to determine whether a child is classified as normal, underweight, overweight, or stunted [37]. As an indicator of nutritional status, body weight reflects the current state, which can fluctuate daily. It is easily influenced by sudden factors such as food and drink consumption, excretion of metabolic substances, and illness [38].

Many factors influence a baby's birth weight, one of which is the nutritional status of the mother during pregnancy, as it determines the intake available to the baby in the womb. Adequate nutritional status before pregnancy can be assessed using the Body Mass Index (BMI). Nutritional status both before and during pregnancy has a significant impact on fetal intake and growth. The fetus's nutritional needs increase rapidly during the third trimester, when cellular hypertrophy begins. If the mother's nutritional intake is insufficient during this period, it can negatively affect the baby's birth weight. Women who have inadequate nutritional status or are classified as underweight during pregnancy are at greater risk of giving birth to babies with low birth weight [39].

Conclusion

This study highlights the multifactorial association between maternal health factors, such as ANC history, maternal anemia, exclusive breastfeeding practices, and maternal dietary patterns, and the nutritional status of children aged 2 to 5 years. In line with the adapted UNICEF conceptual framework, the findings affirm that child nutrition is not the result of isolated variables but rather a product of intersecting biological, behavioral, and social determinants rooted in maternal conditions and caregiving practices. This study underscores the importance of comprehensive maternal care, including adequate ANC, nutritional support, and exclusive breastfeeding, in promoting optimal child nutrition. However, due to the small sample size and cross-sectional design, further research with broader populations and adjusted models is recommended. Poor ANC attendance, maternal anemia, suboptimal breastfeeding, and inadequate maternal diets were all found to significantly contribute to the risk of undernutrition in early childhood. These findings are consistent with WHO and Indonesian government priorities that advocate for a life-course approach to maternal and child health, particularly within the first 1,000 days and continuing beyond.

Study Limitations and Recommendations

This study has several limitations that must be acknowledged. First, the small sample size (n=30) limits the generalizability of the findings to broader populations. The use of a cross-sectional design also restricts the ability to infer causal associations between maternal health factors and child nutritional outcomes. Additionally, the study employed only bivariate (Chi-square) analysis without adjusting for potential confounders such as maternal education, socio-economic status, parity, or environmental factors, which could influence both exposure and outcome variables.

Given these limitations, the observed associations should be interpreted with caution. While the findings support the importance of maternal ANC attendance, exclusive breastfeeding, nutritional adequacy, and anemia prevention, they do not establish direct causality.

Future research should involve larger, more diverse samples and adopt longitudinal or cohort designs to better assess causal pathways. Multivariate analysis should also be used to control for confounding variables and improve the robustness of the findings. Exploring qualitative insights into maternal practices and barriers to accessing care may also enrich understanding and inform targeted interventions.

Informed Consent and Ethical Statement

This study was conducted in accordance with ethical standards and was reviewed and approved by the Ethics Review Committee of the Faculty of Medicine, Universitas Kristen Indonesia (*Approval No. 7A/Etik Penelitian/FKUKI/2023*). All participants were informed about the objectives, procedures, risks, and confidentiality of the study. Participation was entirely voluntary, and written informed consent was obtained from all respondents before data collection. Participants had the right to withdraw at any stage without any consequences. The anonymity and privacy of all participants were strictly maintained throughout the research process.

Conflict of Interest

The authors declare that there is no conflict of interest.

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