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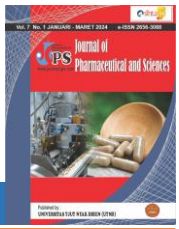

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Risk Factors for Stunting in Toddlers in the Mogang Community Health Center Work Area, Palipi District, Samosir Regency in 2024

Faktor Risiko Kejadian Stunting Pada Anak Usia Balita di Wilayah Kerja Puskesmas Mogang Kecamatan Palipi Kabupaten Samosir Tahun 2024

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Abstract

Background: Based on the 2023 Indonesian Health Survey (SKI) in Samosir Regency, the prevalence of stunting was 22.4%, with Palipi District recording the highest rate. As of August 2024, the incidence of stunting in Palipi District reached 14.34% (182 toddlers). Although there has been a decline, stunting remains a priority program in Samosir Regency. Objective: This study aims to analyze the risk factors associated with the incidence of stunting among toddlers in the working area of Mogang Public Health Center, Palipi District. Method: This research employed a quantitative design with a cross-sectional approach conducted in the working area of Mogang Public Health Center in 2024. The study sample consisted of 93 mothers with toddlers, selected using accidental sampling techniques. Data were analyzed using univariate, bivariate (Chi-Square test), and multivariate (logistic regression) analyses. Results: The bivariate analysis revealed significant relationships between maternal nutritional status (p=0.000), parenting pattern (p=0.000), maternal education level (p=0.000), family income level (p=0.002), and household sanitation conditions (p=0.000) with the incidence of stunting. However, multivariate analysis identified only three dominant and independent variables: maternal education level (p=0.014; Exp(B)=26.410), parenting pattern (p=0.001), and household sanitation condition (p=0.023). Conclusion: Maternal education level, parenting pattern, and household sanitation are proven to be the dominant factors influencing stunting. Mothers with low education levels are 26 times more likely to have stunted children. Preventive efforts should prioritize interventions targeting these three factors through focused health education programs.

Keywords: Stunting, Nutritional Status, Parenting Patterns, Home Sanitation Conditions.

Abstrak

Latar Belakang: Berdasarkan hasil Survey Kesehatan Indonesia (SKI) Kabupaten Samosir, angka kejadian stunting sebesar 22,4% pada tahun 2023, dengan Kecamatan Palipi sebagai wilayah tertinggi. Hingga Agustus 2024, kejadian stunting di Kecamatan Palipi mencapai 14,34% (182 balita). Meskipun mengalami penurunan, stunting tetap menjadi program prioritas di Kabupaten Samosir. **Tujuan:** Penelitian ini bertujuan untuk menganalisis faktor-faktor risiko yang berhubungan dengan kejadian stunting pada balita di Wilayah Kerja Puskesmas Mogang, Kecamatan Palipi. **Metode:** Jenis penelitian yang digunakan adalah kuantitatif dengan rancangan *cross-sectional* yang dilakukan di Wilayah Kerja Puskesmas Mogang pada tahun 2024. Sampel penelitian berjumlah 93 orang ibu yang memiliki balita, yang diambil dengan teknik *accidental sampling*. Data dianalisis secara univariat, bivariat (uji Chi-Square), dan multivariat (regresi logistik). **Hasil:** Hasil analisis bivariat menunjukkan adanya hubungan yang signifikan antara status gizi ibu (p=0,000), pola asuh anak (p=0,000), tingkat pendidikan ibu (p=0,000), tingkat pendapatan keluarga (p=0,002), dan kondisi sanitasi rumah (p=0,000) dengan kejadian stunting. Namun, analisis multivariat mengungkap bahwa hanya tiga variabel yang merupakan faktor dominan dan independen, yaitu tingkat pendidikan ibu (p=0,014;

Exp(B)=26,410), pola asuh anak (p=0,001), dan kondisi sanitasi rumah (p=0,023). **Kesimpulan:** Tingkat pendidikan ibu, pola asuh, dan sanitasi rumah terbukti sebagai faktor dominan stunting. Ibu berpendidikan rendah berisiko 26 kali lebih besar memiliki anak stunting. Upaya pencegahan perlu memprioritaskan intervensi pada ketiga faktor ini melalui pendidikan kesehatan yang terfokus.

Kata Kunci: *Stunting, Status Gizi, Pola Asuh, Kondisi Sanitasi Rumah.*

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Introduction

Stunting, a condition of impaired growth and development in children caused by chronic malnutrition and recurrent infections, remains a serious global public health problem, particularly in low- and middle-income countries [1]. This condition—difficult to reverse after the first 1,000 days of life—affects not only physical stature but also cognitive development, educational achievement, and economic productivity in adulthood, thereby reinforcing cycles of poverty and inequality [2]. In 2020, the WHO estimated that 149.2 million children under five were affected by stunting, with the highest burden found in Africa and Asia.

Indonesia bears a significant share of this challenge. Although the national stunting prevalence declined from 27.7% in 2019 to 21.5% in 2023 [3], the figure still exceeds the WHO public health threshold of 20% and the government's target of 14% by 2024 (Ministry of Health of the Republic of Indonesia, 2024). The government has launched various strategic programs, including the National Nutrition Awareness Movement (Gerakan Nasional Sadar Gizi), which focuses on interventions during the first 1,000 days of life to break the intergenerational cycle of malnutrition [4].

In North Sumatra, the prevalence of stunting also declined, from 21.1% in 2022 to 18.9% in 2023 (Department of Communication and Information, 2024). However, Samosir Regency continues to exhibit high rates, ranging from 36.7% in 2021 to 22.4% in 2023 [5]. Within the regency, the Palipi District, particularly the service area of the Mogang Community Health Center (Puskesmas), recorded a prevalence of 14.34% in August 2024, affecting 182 children under the age of five. These figures highlight the need for targeted local interventions.

The causes of stunting are multifactorial, involving direct, underlying, and fundamental factors. Previous studies have highlighted key risk factors, including maternal nutritional status, childcare practices, parental education, household income, and environmental conditions such as access to clean water and sanitation [6–9]. Maternal education is often cited as a dominant factor influencing a mother's ability to access health information, adopt appropriate feeding practices, and utilize health services effectively [10]. Nevertheless, specific studies examining local dynamics in geographically challenging areas such as Samosir—which includes both island and mainland territories with potential access disparities—remain limited.

This study aims to identify the risk factors associated with stunting among children under five in the Mogang Community Health Center service area of Palipi District, Samosir Regency. By analyzing the relationships between maternal nutritional status, childcare practices, maternal education, household income, and household water and sanitation conditions, this research aims to provide evidence-based recommendations to strengthen local stunting prevention programs and support accelerated stunting reduction in this priority area.

Experimental Section

Research Design

This study used a quantitative research method with a cross-sectional research design where the measurement of independent variables (maternal nutritional status, childcare patterns, maternal education level, family income level, access to clean water and home sanitation conditions) with dependent variables (stunting incidence) in the working area of the Mogang Health Center, Palipi District, Samosir Regency in 2024 was carried out at relatively the same time.

Location, Time, Population, Sample, and Research Variables

This research will be conducted in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency, with an implementation schedule spanning from June 2024 to February 2025. The population in this study consists of all mothers with toddlers in the working area of the Mogang Community Health Center, totaling 1,269 individuals. Samples were taken from this population using the technique of accidental sampling, where the research sample consisted of mothers of toddlers who visited the integrated health post (posyandu) in the area in 2024. Based on the formula calculation with an error rate (d) of 0.1, the sample size was 93 mothers.

This research involves one dependent variable, namely stunting incidents in toddlers, which is measured based on the z-score of height according to age (TB/U). The independent variables studied include maternal nutritional status (measured by BMI), parenting patterns, mother's education level, family income level (referring to the UMK of Samosir Regency), access to clean water, and home sanitation conditions. All independent variables were measured using questionnaires and interviews, except for maternal nutritional status, which was directly measured, and home sanitation conditions, which were observed and recorded on an ordinal scale.

Data Collection.

Data were collected through primary and secondary data. Primary data were obtained directly from respondents via questionnaires, measurements, and observations for variables such as maternal nutritional status, parenting patterns, education, income, access to clean water, and sanitation. Secondary data were sourced from official records at the Mogang Community Health Center, including information on the number of toddlers and medical records related to stunted growth.

Validity and Reliability Test

Validity testing is used to measure the validity of a questionnaire. A questionnaire is considered valid if the questions accurately measure what they are intended to measure. Reliability testing is used to determine the extent to which measurement results are relatively consistent when measurements are taken twice or more. In this study, the significance level of the validity test was set at 0.05, and the reliability test achieved a Cronbach's Alpha value greater than 0.6. Therefore, the questionnaire used in this study was valid and *reliable.* The questionnaire used in this study was modified from the research of Nurul Anggraeni and Oktia Woro Kasmini Handayani on Parenting Patterns and Health Services during the Pandemic on the Incidence of Toddler Stunting in Bantul Regency and Veramita Nanda Pradana, Suparmi, and Ratnawati on Personal Hygiene, Water Availability, and Environmental Sanitation with the Incidence of Stunting in Toddlers Aged 6-59 Months in the Working Area of Singorojo I Health Center, Kendal Regency [11,12].

Data Management and Measurement Aspects

Data management in this study was carried out through several systematic stages. The first stage was editing, which involved checking the completeness of the questionnaire. Next, coding was performed by assigning a numeric code to each answer to facilitate the analysis process. The coded data was then entered into a computer program through a data entry process. After input, the data was presented in analytical tables through a tabulation stage. The final stage involved data cleaning, which entailed double-checking all processed data to identify and correct potential errors before proceeding with further analysis.

Measurement Aspects

Measurement of research variables was conducted using specific methods and criteria for each variable. Maternal nutritional status was measured by calculating the Body Mass Index (BMI) based on weight and

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height measurements, then categorized into good nutrition (BMI 18.5–24.9 kg/m²) and poor nutrition (BMI outside the range). Parenting patterns were assessed using a 20-question questionnaire, with a score of 11–20 categorized as good and a score of 0–10 as poor. Maternal education level was categorized as low (maximum junior high school) and high (high school or college), while family income was compared with the Samosir Regency UMK (Rp 2,583,697). Access to clean water was measured with seven questions and categorized as good if it achieved a perfect score. Home sanitation conditions were assessed using 10 questions, with a score of 6–10 indicating good conditions. The incidence of stunting was determined based on the measurement of the Height/Age z-score in the Child Health Card (KMS), where a z-score <-2 SD was categorized as stunting.

Data Analysis.

Data analysis in this study was conducted in three stages. The first stage is a univariate analysis that aims to describe the characteristics of each research variable, including independent variables (maternal nutritional status, childcare patterns, education level, family income, access to clean water, and home sanitation) and the dependent variable (stunting incidence), which are presented in the form of a frequency distribution. The second stage is a bivariate analysis using the Chi-Square test to examine the relationship between each independent variable and the incidence of stunting, with a significance criterion of p-value <0.05. The third stage is a multivariate analysis using logistic regression to analyze the joint influence of all independent variables on the incidence of stunting. Before conducting the multivariate analysis, a bivariate test was first performed on each variable to filter out those that were not significant at the 95% confidence level, which would then be included in a more complex logistic regression model.

Results and Discussion

Description of Research Location

This research was conducted in the working area of the Mogang Community Health Center, Palipi District. Administratively, Palipi District is within the Samosir Regency government area, North Sumatra Province. In 2003, Toba Samosir Regency was divided into two regencies, namely Toba Samosir Regency and Samosir Regency, through Law No. 36 of 2003. Samosir Regency encompasses sub-districts on Samosir Island and a portion of the mainland of Sumatra Island. Palipi District is located at 20°28′ – 20°36′ North Latitude and 980°45′ – 980°53′ East Longitude. Geographically, this region borders several areas, including: to the north, the Simanindo and Ronggur Nihuta Districts; to the south, Lake Toba; to the west, the Pangururan District; and to the east, the Nainggolan District. The area is 129.55 square kilometers.

Stunting remains a major child health issue in Palipi District. As of August 2024, the stunting rate had reached 14.34%. Despite the decline, stunting remains a priority in Samosir Regency, in line with national guidelines. The Mogang Community Health Center (Puskesmas) in Palipi District, Samosir Regency, has implemented various strategies and programs to address stunting in the region. These efforts include improving maternal and child health (MCH) services, providing complete basic immunizations (BCG, DPT, OPV, and measles), providing vitamin A, which is essential for supporting child growth and development and preventing stunting, monitoring the nutritional status of toddlers, and enhancing the quality of health services. Through these programs and efforts, the Mogang Community Health Center plays an active role in addressing stunting in Palipi District, Samosir Regency.

Univariate Analysis Results

Univariate analysis presents the results of the research variables in a descriptive manner. The variables in this study are the independent variables (maternal nutritional status, child-rearing patterns, maternal education level, family income level, access to clean water, and home sanitation conditions) and the dependent variable (stunting incidence).

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Frequency Distribution of Maternal Nutritional Status

Table 1. Frequency Distribution of Nutritional Status of Mothers with Toddlers in the Working Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

No	Maternal Nutritional Status	n	%
1	Good	70	75,3
2	Not good	23	24,7
	Amount	**93**	**100,0**

Maternal nutritional status is obtained based on BMI, which is the result of calculating Maternal Weight (Kg) divided by the square of Maternal Height (M). Maternal nutritional status will be categorized into Poor Nutrition (BMI < 18.5 kg/m²) or > 25.0–29.9 kg/m²) and Good Nutrition (BMI 18.5–24.9 kg/m²). The frequency distribution of the nutritional status of mothers with toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is presented in Table 1 below.

Based on Table 1 above, it can be seen that the frequency distribution of nutritional status of mothers who have toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is highest in the good category, namely 70 mothers (75.3%) and lowest in the poor category, namely 23 mothers (24.7%).

Distribution of Parenting Patterns

The distribution of child-rearing patterns among mothers with toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is presented in Table 2 below.

Table 2. Distribution of the Frequency of Parenting Patterns for Children with Toddlers in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

No	Parenting Patterns	n	%
1	Good	76	81,7
2	Less Good	17	18,3
	Amount	93	100,0

Based on table 2 above, it can be seen that the distribution of the frequency of childcare patterns carried out by mothers who have toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is highest in the good category, namely 76 mothers (81.7%) and lowest in the bad category, namely 17 mothers (18.3%).

Frequency Distribution of Education Level

The frequency distribution of the education level of mothers with toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is presented in Table 3 below.

Table 3. Distribution of the Frequency of Education Level of Mothers with Toddlers in the Working Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

No	Level of education	n	%
1	Higher Education (High School, University)	79	84,9
2	Low (Did not finish elementary school, primary school, junior high school)	14	15,1
	Amount	93	100,0

Based on Table 3 above, it can be seen that the frequency distribution of the education level of mothers who have toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency is highest in the high category, namely 79 mothers (84.9%) and lowest in the low category, namely 17 mothers (15.1%).

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Frequency Distribution of Income Levels

The frequency distribution of income levels among families with toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, will be presented in the table 4.

Table 4. Frequency Distribution Table of Income Levels of Families with Toddlers in the Working Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

No	Family Income Level	n	%
1	> Minimum Wage	77	82,8
2	≤ UMK	16	17,2
	Amount	**93**	**100,0**

Based on Table 4 above, it can be seen that the frequency distribution of income levels of families with toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is highest in the > UMK category, namely 77 mothers (82.8%) and lowest in the ≤ UMK category, namely 16 mothers (17.2%).

Distribution of Frequency of Access to Clean Water

The distribution of the frequency of access to clean water for mothers with toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is presented in Table 5 below.

Table 5. Distribution of Frequency of Access to Clean Water for Mothers with Toddlers in the Working Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

No	Access to Clean Water	n	%
1	Good	51	54,8
2	Less Good	42	45,2
	Amount	93	100,0

Based on table 5 above, it can be seen that the distribution of the frequency of access to clean water for mothers who have toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is highest in the good category, namely 51 mothers (54.8%) and lowest in the less good category, namely 42 mothers (45.2%).

Frequency Distribution of Home Sanitation Conditions

The frequency distribution of sanitation conditions in the homes of mothers with toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is presented in Table 6 below.

Table 6. Frequency Distribution of Sanitation Conditions of Homes of Mothers with Toddlers in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency, 2024

No	Home Sanitation	n	%
1	Good	71	76,3
2	Less Good	22	23,7
	Amount	**93**	**100,0**

Based on table 6 above, it can be seen that the frequency distribution of sanitation conditions in the homes of mothers who have toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is highest in the good category, namely 71 mothers (76.3%) and lowest in the less good category, namely 22 mothers (23.7%).

Distribution of Stunting Incident Frequency

The distribution of stunting incidents in children of mothers with toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is presented in Table 7 below.

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Table 6. Distribution of the Frequency of Stunting Incidents in Children of Mothers with Toddlers in the Working Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

No	Stunting Incident	n	%
1	Clumsy	14	15,1
2	No Stunting	79	84,9
	Amount	93	100,0

Based on table 6 above, it can be seen that the distribution of the frequency of stunting incidents in children of mothers who have toddlers in the working area of the Mogang Health Center, Palipi District, Samosir Regency, is highest in the non-stunting category, namely 79 mothers (84.9%) and lowest in the stunting category, namely 14 mothers (15.1%).

Bivariate Analysis

Bivariate analysis presents the results of statistical analysis of the relationship between independent variables (maternal nutritional status, childcare patterns, maternal education level, family income level, access to clean water, and home sanitation conditions) and the dependent variable (stunting incidence) in the working area of the Mogang Health Center, Palipi District, Samosir Regency.

The Relationship between Maternal Nutritional Status and the Incidence of Stunting in the Working Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the study on the relationship between maternal nutritional status and the incidence of stunting in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency, are presented in Table 7 below.

Table 7. Relationship between Maternal Nutritional Status and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

Maternal Nutritional Status	Stunting Incident				Total		Sig.
	Stunting	%	No Stunting	%	n	%	
Good	4	5,7	66	94,3	70	100,0	0,000
Not good	10	43,5	13	56,5	23	100,0	
Total	14		79		93		

Based on Table 7 above, it can be seen that of the 70 mothers with good nutritional status, four mothers (5.7%) have children who experience stunting, while 66 mothers (94.3%) do not. Of the 23 mothers with poor nutritional status, 10 (43.5%) have children who experience stunting, and 13 (53.5%) do not. The results of statistical tests using the chi-square test show a significance value (sig.) of 0.000. This value is smaller than the degree of error ($\alpha = 0.05$), indicating a statistically significant relationship between maternal nutritional status and the incidence of stunting in the Working Area of the Mogang Health Center, Palipi District, Samosir Regency.

The Relationship between Parenting Patterns and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the study on the relationship between parenting patterns and the incidence of stunting in the working area of the Mogang Health Center, Palipi District, Samosir Regency, are presented in Table 8 below.

Based on Table 8 above, it can be seen that of the 76 mothers with good parenting patterns, two mothers (2.6%) have children who experience stunting, while 74 mothers (97.4%) do not. Of the 17 mothers who have poor parenting patterns, 12 (70.6%) mothers have children who experience stunting, and 5 (29.4%) do not experience stunting. The results of statistical tests using the chi-square test show a significance value (sig.) of 0.000. This value is smaller than the degree of error ($\alpha = 0.05$), indicating a statistically significant relationship between mothers' parenting patterns and the incidence of stunting in the Mogang Health Center Working Area, Palipi District, Samosir Regency.

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Table 8. Relationship between Parenting Patterns and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

Parenting Patterns	Stunting Incident				Total		Sig..
	Stunting	%	No Stunting	%	n	%	
Good	2	2,6	74	97,4	76	100,0	0,000
Not good	12	70,6	5	29,4	17	100,0	
Total	14		79		93		

The Relationship Between Education Level and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the study on the relationship between maternal education level and the incidence of stunting in the working area of the Mogang Health Center, Palipi District, Samosir Regency, are presented in Table 9.

Based on Table 9 above, it can be seen that of the 79 mothers with a high level of education, four mothers (5.1%) have children who experience stunting, while 75 mothers (94.9%) do not. Of the 14 mothers with a low level of education, 10 (71.4%) have children who experience stunting, and 5 (28.6%) do not. The results of statistical tests using the chi-square test show a significance value (sig.) of 0.000. This value is smaller than the degree of error (α = 0.05), indicating that there is a statistically significant relationship between maternal education level and the incidence of stunting in the Working Area of the Mogang Health Center, Palipi District, Samosir Regency.

Table 9. Relationship between Maternal Education Level and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

Level of education	Stunting Incident				Total		Sig.
	Stunting	%	No Stunting	%	n	%	
High	4	5,1	75	94,9	79	100,0	0,000
Low	10	71,4	5	28,6	14	100,0	
Total	14		79		93		

The Relationship Between Family Income Level and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the study on the relationship between family income levels and the incidence of stunting in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency, are presented in Table 10.

Table 10. Relationship between Family Income Level and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

Income level	Stunting Incident				Total		Sig.
	Stunting	%	No Stunting	%	n	%	
> Minimum Wage	7	9,1	70	90,9	77	100,0	0,002
≤ UMK	7	43,8	9	56,2	16	100,0	
Total	14		79		93		

Based on Table 10 above, it can be seen that of the 77 mothers whose family income exceeds the UMK, seven mothers (9.1%) have children who experience stunting, while 70 mothers (90.9%) do not. Of the 16 mothers whose family income is ≤ UMK, 7 (43.8%) have children who experience stunting, and 9 (56.2%) do not. The results of statistical tests using the chi-square test show a significance value (sig.) of 0.002. This value is smaller than the degree of error (α = 0.05), so it can be concluded that there is a relationship between family income levels and the incidence of stunting in the Working Area of the Mogang Health Center, Palipi District, Samosir Regency.

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The Relationship Between Access to Clean Water and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of research on the relationship between access to clean water and the incidence of stunting in the working area of the Mogang Health Center, Palipi District, Samosir Regency, are presented in Table 11 below.

Table 11. Relationship between Access to Clean Water and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

Access to Clean Water	Stunting Incident				Total		Sig.
	Stunting	%	No Stunting	%	n	%	
Good	6	11,8	45	88,2	51	100,0	0,493
Less Good	8	19,0	34	81,0	42	100,0	
Total	14		79		93		

Based on Table 11 above, it can be seen that of the 51 mothers who have access to good, clean water, six mothers (11.8%) have children who experience stunting, while 45 mothers (88.2%) do not. Of the 42 mothers with poor access to clean water, 8 (19.0%) have children who experience stunting, while 34 (81.0%) do not. The results of statistical tests using the chi-square test show a significance value (sig.) of 0.493. This value is greater than the degree of error (α = 0.05), so it can be concluded that there is no relationship between access to clean water and the incidence of stunting in the Working Area of the Mogang Health Center, Palipi District, Samosir Regency.

The Relationship between Home Sanitation Conditions and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the study on the relationship between home sanitation conditions and the incidence of stunting in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency, are presented in Table 12 below.

Table 12. Relationship between Home Sanitation Conditions and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency in 2024

Home Sanitation Conditions	Stunting Incident				Total		Sig.
	Stunting	%	No Stunting	%	n	%	
Good	3	4,2	68	95,8	71	100,0	0,000
Not good	11	50,0	11	50,0	22	100,0	
Total	14		79		93		

Based on Table 12 above, it can be seen that of the 71 mothers with good home sanitation conditions, three mothers (4.2%) have children who experience stunting, while 68 mothers (95.8%) do not. Of the 22 mothers with poor home sanitation conditions, 11 (50.0%) have children who experience stunting, and 11 (50.0%) do not. The results of statistical tests using the chi-square test show a significance value (sig.) of 0.000. This value is smaller than the degree of error (α = 0.05), so it can be concluded that there is a relationship between the sanitation conditions of mothers' homes and the incidence of stunting in the Working Area of the Mogang Health Center, Palipi District, Samosir Regency.

Multivariate Analysis

Bivariate Selection

After bivariate analysis is conducted, a multivariate analysis is then conducted to determine the most dominant relationship between the independent variables and the dependent variable. The initial stage of multivariate analysis is determining the potential independent variables (multivariate candidate variables) that will be included in the multivariate analysis, namely, variables from the bivariate analysis results that have a p-value <0.25 (Lemeshow, 1990). The multivariate analysis used in this study is the t-test. *Logistic Regression is simple.*

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Table 13. Candidate Variables for Multivariate (*Logistic Regression* Simple)

No	Variables	*p-value* (<0,25)	Information
1.	Maternal nutritional status	0,000	Candidate
2.	Parenting patterns	0,000	Candidate
3.	Mother's education level	0,000	Candidate
4.	Family income level	0,002	Candidate
5	Access to clean water	0,493	No Candidate
6	Sanitary conditions of the house	0,000	Candidate*

From Table 13 above, the results of the analysis of the independent variables in relation to the dependent variable are presented. The variables with a P value <0.25 are maternal nutritional status, childcare patterns, maternal education level, family income level, and home sanitation conditions.

Final Modeling

The second stage in multivariate analysis involves constructing a comprehensive model by including all candidate variables for analysis. Multivariate analysis seeks to identify the optimal model that determines the factors contributing to stunting in children. In this case, all candidate variables are tested simultaneously. For more details, see Table 14.

Table 14 Final Model of Multivariate Logistic Regression Analysis: Double Effect of Variables on Maternal Nutritional Status, Childcare Patterns, Maternal Education Level, Family Income Level, Home Sanitation Conditions on the Incidence of Stunting

Variables		B	Sig.	Exp	95% C. I for EXP (B)	
					Lower	*Upper*
Final Stage	Parenting patterns	-4.421	0.001	0.012	0.001	0.177
	Level of education	3.274	0.014	26.410	1.954	356.968
	Sanitary conditions of the house	-2.934	0.023	0.053	0.004	0.673

From table 14 it is known that the final results of modeling using multiple logistic regression tests (*logistic regression*) shows that all final variables have a significant value of p<0.005, so it can be concluded that the results of the variable analysis with the binary regression test (logistic regression) show that the most dominant variable is the mother's education level with a significant value of 0.014 with an Exp B value = 26,410, it is concluded that a mother with a low level of education will have a 26 times greater chance of having a stunted child compared to a mother with a high level of education.

Discussion

The Relationship between Maternal Nutritional Status and the Incidence of Stunting in the Working Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the statistical test examining the relationship between maternal nutritional status and the incidence of stunting, using the chi-square test, showed a significance value (p-value) of 0.000. This value is smaller than the degree of error (α = 0.05), indicating a statistically significant relationship between maternal nutritional status and the incidence of stunting in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency.

Maternal nutritional status has a significant influence on the incidence of stunting, as it can impact the growth and development of the fetus and infant during the first 1,000 days of life, both during pregnancy and after delivery. Inadequate nutrition during pregnancy can lead to fetal malnutrition, which hinders the development of vital organs and tissues, including the brain and the immune system. Maternal nutritional deficiencies, including those of protein, calories, iron, and folic acid, can lead to low birth weight and increase the risk of stunted growth.

Research by Alfarisi et al. (2019) suggests that maternal nutritional status during pregnancy may contribute to stunting in toddlers. Bivariate analysis using the Chi-square test showed a significant relationship between maternal nutritional status during pregnancy and stunting in toddlers aged 6-59 months

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(p-value 0.005). Research by Baiq Reni Pratiwi (2024) also found a strong and significant relationship between maternal nutritional status during pregnancy and stunting in toddlers aged 24 months in Kuta Village, Pujut District, Central Lombok Regency. The Chi-Square test value showed a significance value of 0.000 and an Odds Ratio (OR) of 51.6, indicating a significant relationship between maternal nutritional status during pregnancy and stunting.

Another study conducted by Widya Pradani and Indarti (2023) showed a relationship between maternal nutritional status during pregnancy and the incidence of stunting in toddlers aged 2-3 years at the Teritip Community Health Center in Balikpapan. The chi-square analysis showed a p-value of 0.042, indicating a significant relationship between maternal nutritional status during pregnancy and stunting in toddlers.

Research by Azzahro (2023), which aims to determine the relationship between maternal nutritional status during pregnancy and the incidence of stunting in infants aged 0-12 months in the Pegandon Community Health Center work area, Kendal Regency, shows that there is a significant relationship between maternal nutritional status during pregnancy and the incidence of stunting in infants aged 0-12 months.

Various research results indicate that maternal nutritional status during pregnancy has a significant influence on the incidence of stunting in toddlers. Mothers with poor or suboptimal nutritional status during pregnancy are at higher risk of giving birth to children with stunting. Maternal nutritional status is not only important during pregnancy, but also after delivery, especially during breastfeeding. Undernourished mothers can have insufficient milk production or low-quality breast milk. Breast milk is the primary source of nutrition for infants, particularly during the first six months of life. Infants who do not receive sufficient and quality breast milk are at higher risk of stunting. Therefore, monitoring and improving the nutritional status of pregnant women is crucial to preventing stunting in children.

The Relationship between Parenting Patterns and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the statistical test examining the relationship between parenting patterns and stunting incidence, using the chi-square test, showed a significance value (p-value) of 0.000. This value is smaller than the error rate ($\alpha = 0.05$), indicating a significant relationship between parenting patterns and stunting incidence in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency. Parenting patterns include how parents care for, feed, and provide stimulation to their children. Good parenting patterns can create an environment that supports a child's physical and mental development, while poor parenting patterns can increase the risk of stunted growth.

This is supported by the research findings of Said, M.A., & Hasan, M.S. (2022), which found that parenting patterns involving active parental attention to providing nutritious food and health care are strongly associated with a reduced risk of stunting in children in rural Indonesia. Parents who take their children to integrated health posts (Posyandu) more frequently and provide highly nutritious food tend to have children with better height.

Another study, conducted by Prasetyani, D., & Lestari, R. (2021), revealed that poor parenting practices, such as late or insufficiently nutritious complementary feeding, are directly linked to an increased incidence of stunting. This study also showed that families with parenting practices that pay little attention to their children's nutritional needs are more likely to have children with stunting. Similarly, research by Aji, S. M., & Hidayat, T. (2020) showed that parenting practices that support healthy eating habits in children aged 6-24 months are associated with a reduced prevalence of stunting. This study also emphasized the importance of parental involvement in providing nutritious food and educating children about good eating habits.

Kurniasari, N., & Sari, M. F. (2019) found that inappropriate parenting patterns, such as the use of unhealthy processed foods and inadequate child development stimulation, are associated with high stunting rates. Yuliana, R., & Saputra, W. (2023) found that positive parental interactions, including providing appropriate portions of food and emotional support, can reduce the risk of stunting [13]. Families with parenting patterns that are more responsive to children's nutritional and health needs show lower stunting rates.

Widyaningrum (2020) demonstrated that exclusive breastfeeding and parenting patterns involving the provision of nutrient-rich foods are directly related to improved growth in children [14]. Parenting patterns that include regular check-ups at health facilities also show a link to stunting prevention. This study revealed that parenting patterns involving active attention to children's nutrition, such as choosing nutritious foods and monitoring children's intake, can reduce the incidence of stunting. This study also reveals that parental ignorance about the importance of a nutritious diet significantly contributes to the occurrence of stunting.

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Based on the above research, it can be concluded that parenting patterns that prioritize attention to nutritious food, exclusive breastfeeding, and adequate cognitive and emotional stimulation are highly influential in preventing stunting. Good parenting helps create optimal conditions for child growth, while poor parenting patterns, such as indifference to a child's nutritional needs or lack of healthcare, can increase the risk of stunting.

The Relationship Between Maternal Education Level and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the statistical test examining the relationship between maternal education level and the incidence of stunting, using the chi-square test, showed a significance value (p-value) of 0.000. This value is smaller than the degree of error ($\alpha = 0.05$), so it can be concluded that there is a relationship between maternal education level and the incidence of stunting in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency.

The relationship between maternal education and the incidence of stunting in children is a crucial issue in public health studies, particularly because maternal education plays a significant role in determining parenting patterns, food choices, and understanding of children's health. Research shows that higher maternal education is often associated with a reduced incidence of stunting in children, as more educated mothers tend to have better knowledge about nutrition and child health care.

Research conducted by Soejono, H., & Astuti, D. (2021) shows that mothers with low levels of education are more likely to have children with stunting. Higher education is associated with mothers' ability to seek information about nutrition and child care, which in turn reduces the risk of stunting. Similarly, research by Ningsih, S., & Hidayati, N. (2020) found that mothers who did not complete elementary school were more likely to have children with stunting. Lower maternal education levels were associated with a lack of knowledge about the importance of child nutrition and access to health services.

Another study by Yulianti, D., & Prasetyo, A. (2022) revealed that a higher level of maternal education is associated with a reduced risk of stunting in children. Mothers with higher education are more likely to breastfeed and choose nutritious foods for their children exclusively. Kurniawati, A., & Setiawati, L. (2019) also stated that maternal education has a significant influence on a child's nutritional status. Mothers with higher education are better equipped to understand the importance of monitoring their child's growth and development, and they are more likely to take their children to integrated health posts (Posyandu), which in turn reduces the incidence of stunting.

Zahra, S., & Rahmawati, E. (2020) demonstrated that mothers with low educational backgrounds may neglect child health checks and provide less nutritious food. Higher education helps mothers understand the importance of balanced nutrition and optimal child health. Similarly, Fitriani, M., & Susanto, H. (2021) proved that mothers with lower education have difficulty accessing correct nutritional information, which is associated with a high prevalence of stunting in their children. This study also emphasizes the importance of education to increase parental knowledge about child nutrition. Herlina, D., & Prabowo, D. (2022) study shows that maternal education influences stunting rates in Indonesia, with highly educated mothers more often providing healthy food and taking their children to health services for growth monitoring.

Based on these studies, it can be concluded that maternal education significantly influences the incidence of stunting in children. Mothers with higher education tend to have better knowledge about nutrition, good parenting practices, and improved access to health services. This contributes to a reduced risk of stunting in their children. Conversely, mothers with less education tend to have a limited understanding of nutrition and child health care, which can increase the risk of stunting.

The Relationship Between Family Income Level and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the statistical test examining the relationship between family income levels and stunting incidence, using the chi-square test, showed a significance value (p-value) of 0.002. This value is smaller than the degree of error ($\alpha = 0.05$), indicating that there is a statistically significant relationship between family income levels and stunting incidence in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency.

Family income also plays a significant role in the incidence of stunting in children. Low family income is often associated with limited access to nutritious food, adequate healthcare, and a supportive environment

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for child development. Research indicates that families with lower incomes often face greater challenges in meeting their children's nutritional needs, which in turn increases the risk of stunting.

Soejono, H., & Astuti, D. (2021) found that low-income families are more likely to have stunted children due to difficulties in purchasing nutritious food and transporting their children to health facilities [15]. Similarly, research by Prasetyani, D., & Lestari, R. (2020) showed that children from low-income families are at a higher risk of stunting due to limited access to nutritious food and healthcare [16].

Zahra, S., & Rahmawati, E. (2020) revealed that low-income families face difficulties more often in providing nutritious food, which increases the risk of stunting in children. Similar research results were conducted by Kurniawati, A., & Setiawati, L. (2019). This study showed that children from low-income families have less access to health services, which is directly related to higher stunting rates.

Another study, conducted by Fitriani, M., & Susanto, H. (2021), showed that families with lower incomes have children at higher risk of stunting due to lack of access to nutritious food and adequate healthcare. Yulianti, D., & Prasetyo, A. (2022) revealed that children from lower-income families have less nutritious diets, which increases the risk of stunting. This study also emphasizes the critical role of family income in preventing stunting.

Based on these studies, it can be concluded that family income level has a significant influence on the incidence of stunting. Low-income families often struggle to provide nutritious food, access adequate healthcare, and create an environment conducive to child growth and development. All of these factors contribute to the high prevalence of stunting in children in low-income families. Therefore, efforts to reduce stunting must involve increasing family income, improving access to healthcare, and providing education on proper nutrition for parents.

The Relationship Between Access to Clean Water and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the statistical test examining the relationship between access to clean water and the incidence of stunting using the chi-square test showed a significance value (sig.) of 0.493. This value is greater than the degree of error ($\alpha = 0.05$), so it can be concluded that there is no relationship between access to clean water and the incidence of stunting in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency.

While access to clean water is crucial for preventing infectious diseases and supporting child health, the link between clean water access and stunting is not always straightforward. There are several reasons why, even when access to clean water is available, it does not always correlate with a reduction in stunting.

The people of Palipi District, Samosir Regency, generally obtain clean water through various sources, including protected springs, drilled wells, and piped water networks. However, data from the Samosir Regency Central Statistics Agency shows that in 2016, most households still relied on river or lake water (27.39%) and protected springs (20.74%) as their primary source of drinking water. To improve access to clean water, the government has constructed Drinking Water Supply Systems (DWSS) in several villages, including Hatoguan Village and Pardomuan Nauli Village. Construction began in July 2023 with a budget of IDR 2.2 billion and was completed on schedule in December 2023. Overall, despite government efforts to provide clean water through the construction of SPAMs, the people of Palipi District still face challenges in water distribution and quality. Further attention is needed to ensure that clean water infrastructure functions optimally and is evenly distributed throughout the region (BPS Samosir Regency, 2023).

Research by Soejono, H., & Astuti, D. (2021) indicates that, despite improved access to clean water, poor sanitation and a lack of awareness about personal hygiene remain significant obstacles hindering efforts to prevent stunting. Other factors, such as poor nutrition and inadequate health management, continue to contribute to the high prevalence of stunting despite the availability of clean water.

The results of another study, as stated by Zahra, S., & Rahmawati, E. (2020), found that even though families have access to clean water, poor sanitation and environmental hygiene remain factors that cause infectious diseases and diarrhea, which have an impact on decreasing children's nutritional status and increasing the risk of stunting.

Kurniawati, A., & Setiawati, L. (2019). This study shows that although clean water is available in some areas, lack of knowledge about air hygiene and unhealthy eating behaviors increases the risk of stunting. Access to clean water alone is insufficient if it is not complemented by education about sanitation and nutrition. Similar research results were presented by Widyaningrum, R. (2020). This study revealed that although access to clean water is crucial in preventing infectious diseases, other factors, such as the availability

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of nutritious food and inadequate monitoring of child growth and development, have a greater impact on the incidence of stunting [14].

Access to clean water is indeed a crucial factor in preventing stunting; however, other factors, such as poor sanitation, unhealthy diets, parental education levels, and the availability of health services, play a larger role in determining whether children will experience stunting. Therefore, while clean water is crucial, it is not the sole factor influencing the prevalence of stunting. A combination of many other social, economic, and health factors must be considered to address stunting effectively.

The Relationship between Home Sanitation Conditions and the Incidence of Stunting in the Work Area of the Mogang Community Health Center, Palipi District, Samosir Regency

The results of the statistical test examining the relationship between home sanitation conditions and stunting incidence, using the chi-square test, showed a significance value (sig.) of 0.000. This value is smaller than the degree of error ($\alpha = 0.05$), indicating a statistically significant relationship between home sanitation conditions and stunting incidence in the working area of the Mogang Community Health Center, Palipi District, Samosir Regency.

Home sanitation is a crucial factor influencing stunting in children. Poor sanitation can lead to various health problems, including diarrhea and gastrointestinal infections, which interfere with nutrient absorption and hinder a child's physical growth. Poor sanitation can also be linked to an unhealthy environment, directly increasing the risk of malnutrition and stunting.

Poor sanitation, including limited access to clean water, inadequate toilet facilities, and poorly managed waste disposal, can have a significant impact on children's health in numerous ways. Unhygienic environments can lead to gastrointestinal infections, such as diarrhea, which can interfere with a child's ability to absorb nutrients. Frequent diarrhea can lead to dehydration, malnutrition, and significant weight loss. Limited access to clean water increases a child's risk of exposure to pathogens that can cause disease. Lack of clean water for handwashing or cleaning eating utensils also increases the risk of infection. Poor sanitation is associated with environments filled with dirt and waste, which create conditions that support the spread of infectious diseases and reduce living conditions that support healthy child growth. Limited access to good sanitation is also associated with poor nutritional status, as infections caused by poor sanitation interfere with nutrient absorption.

Soejono, H., & Astuti, D. (2021) found in their research that poor sanitation, including limited access to clean water and inadequate toilet facilities, is associated with an increased incidence of stunting. Children in areas with poor sanitation are more susceptible to infections that interfere with nutrient absorption. Another finding is that Kurniasari, N., & Sari, M.F. (2019) revealed that poor household sanitation, particularly related to inadequate waste disposal management, increases the prevalence of stunting. Poor sanitation can lead to recurrent infections that reduce the efficiency of nutrient absorption in children.

Widyaningrum, R. (2020) also demonstrated that poor sanitation can lead to children experiencing more frequent illnesses caused by poor hygiene, which in turn increases the risk of stunting. An unhygienic environment also impacts a child's immune system, weakening it. Similarly, Fitriani, M., & Susanto, H. (2021) demonstrated that poor home sanitation increases the incidence of stunting in children, as children living in environments with poor sanitation are more susceptible to infectious diseases that can disrupt growth and nutrient absorption [14].

Yuliana, R., & Saputra, W. (2022) demonstrated that poor sanitation is associated with a higher frequency of gastrointestinal infections in children, leading to growth disorders and an increased prevalence of stunting. Children in environments with poor sanitation show poorer growth indicators [13].

Based on these studies, it can be concluded that poor household sanitation conditions are closely related to increased stunting rates. Poor sanitation creates an environment conducive to the spread of infectious diseases, particularly diarrhea and other gastrointestinal infections, which interfere with nutrient absorption and stunt child growth. Improved sanitation, including access to clean water and adequate sanitation facilities, can help reduce the risk of infection and support healthy child development.

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Conclusion

Based on the results of the statistical analysis, this study concludes that maternal nutritional status, childcare patterns, maternal education level, family income, and household sanitation are significantly associated with the incidence of stunting among toddlers in the working area of the Mogang Community Health Center. However, access to clean water showed no significant association with stunting incidence. Among all the variables examined, maternal education level emerged as the most dominant factor, with an Exp(B) value of 26.410, indicating that mothers with low educational attainment have a 26 times higher risk of having stunted children compared to those with higher education level.

Conflict of Interest

The author states there are no conflicts of interest. The independent nature of this research protected the impartiality and validity of its results.

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Supplementary Materials

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