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Stunting Countermeasures Model (A Case Study of a Specific Nutrition Intervention Program)

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ABSTRACT

Introduction: The prevalence of stunting in Indonesia (24.4%). The data from Southeast Sulawesi Province (2021), showed that the prevalence of stunting included 35.2% in Buton Regency, 30.9% in South Buton, 22.8% in Central Buton, 21,3% Bombana, 20% North Buton, 19,8% East Kolaka, 19.5% Konawe South, 19.3% in Konawe, 17.3% in Muna Regency, 16.4% North Konawe, 14.9% Wakatobi, 13.7% in West Muna, 12.2% Kolaka, 11.1% in Bau-Bau City, 9% in Konawe Island, 9% in North Kolaka, and 5.6% in Kendari City. Kolaka Regency in 2022 showed that the number of stunting toddlers was 620, consisting of 481 toddlers in the short category and 139 toddlers in the very short category. In this study, we aim to see a reduction in the incidence of stunting through specific nutritional interventions.
Methods: This research used quantitative methods with a cross-sectional design. The sample in this research was 244 respondents, using a purposive sampling technique.
Results: There is a relationship between: socio-economic and the incidence of stunting (X2count = 41.164 > X2Table = 3.841); Exclusive Breastfeeding and the incidence of Stunting (X2count= 18.511 > X2Table = 3.841); breast milk complementary food and the incidence of Stunting (X2count= 5.678 > X2Table= 3.841); immunization and the incidence of Stunting (X2count value = 69.750 > X2Table value = 3.841); the vitamin A capsules and the incidence of Stunting (X2count= 8.001 > X2Table= 3.841); protein intake and the incidence of Stunting (X2count= 3.927 > X2Table= 3.841); energy adequacy figures and Stunting criteria (X2count= 11.759 > X2Table= 3.841); The stunting control model through a combined scenario experienced a decline rate with an optimistic strategy of 1.82%.
Conclusion: In conclusion, there was a significant relationship between household socio-economic factors, exclusive breastfeeding, complementary breastfeeding, immunization, vitamin A capsules, protein intake, and energy intake and the incidence of stunting.

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INTRODUCTION

The prenatal period is the beginning of a child's growth and development period, which is marked by an increase in size, development of the number of cells, tissues, physical size and body structure (1). Stunting is a failure to achieve child growth caused by chronically inadequate nutritional intake of the body during the first 1000 days of life and recurrent illnesses during childhood, which, if suffered permanently will result in stunted growth, and limited physical and cognitive capacity of the child. It is estimated that the incidence of stunted toddlers worldwide will be 22% or 149.2 million in 2020 (2). Children growing up in low- and middle-income countries will facing double challenges in nutritional status, namely undernutrition and overnutrition (3).

The case of stunting discovered in Indonesia is 24.4%. Data from Southeast Sulawesi Province in 2021, the distribution of stunting by district shows the prevalence of stunting as follows: Buton Regency at 35.2%, South Buton 30.9%, Central Buton 22.8%, Bombana 21.3%, North Buton 20%, Kolaka East 19.8%, South Konawe 19.5%, Konawe 19.3%, Muna Regency 17.3%, North Konawe 16.4%, Wakatobi 14.9%, West Muna 13.7%, Kolaka 12.2 %, Bau-bau city 11.1%, Konawe Islands 9%, North Kolaka 9%, and Kendari city 5.6% (4).

The occurrence of stunting will cause problems in the form of decreased body productivity, which will ultimately reduce the quality of human resources (5). Many risk factors cause stunting, both in the short and long term (6). The short-term impact of stunting is non-optimal physical body size and metabolic disorders, while the long-term impact is a decrease in intellectual capacity, and structural and nerve function that occurs in short toddlers is permanent, which can result in decreased cognitive abilities in children at school and productivity in adulthood, to increasing the risk of non-communicable diseases such as DM and cardiovascular disease. In addition, (7) Decreased educational achievement and loss of productivity are long-term impacts of stunting.

Kolaka Regency is one of the administrative areas in Southeast Sulawesi Province that has been included in the stunting locus since 2019. The stunting rate in Kolaka Regency in 2018 was the highest in Southeast Sulawesi, reaching 29%. Intervention was given by health services to reduce the stunting rate to 14.8% in 2020 and 12.2% in 2021. Thirteen stunting special location sub-districts in Kolaka Regency received the intervention program, including Kolaka sub-district with one stunted toddler, Latambaga: 29 toddlers, Wundulako: 155 toddlers, Baula: 40 toddlers, Pomalaa: 45 toddlers, Polinggona: 50 toddlers, Watubangga: 49 toddlers, Toari: 4 toddlers, Tosiba: 189 toddlers, Wolo: 21 toddlers, Iwoimendaa: 40 toddlers. The intervention program in Kolaka Regency itself was carried out as a form of stunting mitigation to prevent and control stunting and address direct and indirect causes. One of the direct causes of stunting is the food consumption patterns of toddlers, where protein and energy intake is less than the daily nutritional adequacy rate, then exclusive breast milk is not provided, the mother's nutrition and comorbidities suffer, while the indirect causes are the level of people's knowledge, age, education level, socio-economic level, poor parenting patterns, especially feeding behavior and practices, culture, food availability, health services, and environmental factors (8).

According to (5) the cause of stunting is due to economic status, including income, employment, and purchasing power, meeting the family's nutritional needs, mother's knowledge, and parenting styles also play an important role in the occurrence of stunting. Apart from that, (10) the problem of stunting in children occurs due to family economic problems, non-exclusive breastfeeding, poor complementary feeding, and incomplete immunization.

The government and local health organizations have implemented programs to reduce the incidence of stunting, including through the provision of additional food and micronutrient supplementation in several districts. This program is an integral part of efforts to reduce stunting rates by involving various sectors, such as health, education, and community empowerment, to provide a more holistic approach. A literature study, based on a review of 16 articles conducted (11), looked at the role of Specific Nutrition Intervention through the First 1000 Days of Life Program in Stunting Prevention. The study concluded that overall, the specific nutrition intervention program has been proven to reduce stunting rates by preventing and addressing the causes of stunting through government assistance. In line with a study conducted (12) in assessing the effectiveness of nutritional supplementation during the first 1000 days to reduce the prevalence of stunting in children aged 24 months through the provision of wheat soya blend plus (WSB) + and lipid-based nutrient supplement - medium-quantity (LNS-MQ) during the first 1000 days of life was proven to increase children's linear growth and reduce stunting in children aged 24 months. This is different from the findings of a study conducted (13) in Pakistan looking at the effectiveness of nutritional supplementation through the provision of additional micronutrients (wheat, soy, and lipid-based supplements) in

reducing stunting among children under the age of five. Absorption of nutrients through short-term interventions is considered ineffective in reducing stunting, but continuous nutritional supplementation is needed for mothers during pregnancy until the first six months of breastfeeding, and nutritional supplementation for children up to the age of 6–59 months.

Based on the description presented above, the intervention program in efforts to prevent and reduce stunting that has been carried out by the Kolaka Regency government can reduce the prevalence of stunting (14). Compared to several other districts in Southeast Sulawesi Province, Kolaka Regency is one of the areas that has succeeded in suppressing and reducing the incidence of stunting with various programs implemented. The program is implemented by looking at the factors that influence the incidence of stunting, where the factors that have been identified are taken into consideration in planning and budgeting for Health Service activity programs in collaboration with other district offices, especially in efforts to overcome and reduce the prevalence of stunting in Kolaka Regency. The nutritional intervention program in this research was studied from the aspects of household economics, mother's parenting patterns, and toddler food consumption patterns. This research will be carried out in 4 sub-districts, some of which are the locus of the stunting prevention program in Kolaka Regency.

METHOD

Research Type

This research uses a quantitative approach. The variables measured using the quantitative method consist of the dependent variable, namely the incidence of stunting, and the independent variables consisting of socioeconomic status, exclusive breastfeeding, complementary feeding, complete basic immunization, administration of vitamin A capsules, protein intake, and energy intake.

Population and Sample/Informants

The population of this study was all mothers of stunted toddlers with a total of 620 respondents spread across 5 sub-districts, namely Kolaka sub-district, Wundulako sub-district, Baula sub-district, Pomalaa sub-district and Latambaga sub-district. Based on the Slovin formula, the number of samples in the study was 244 respondents. In addition, the results of calculations using the ISAAC and MICHAEL sample size determination tables from a population of 650 with a significance level of 5% were 227 respondents, so researchers preferred this result based on the formula with a larger population. From a total sample of 244 respondents, based on the number of stunted toddlers in each research location, 184 toddlers were taken randomly using the criteria for being short and 60 very short. The sampling technique uses a purposive sampling technique, which is a sampling technique where the researcher determines sampling by determining special characteristics.

Research Location

The study was conducted in 5 sub-districts, some of which are the locus of the stunting prevention program in Kolaka Regency. The 5 sub-districts were selected based on the consideration that several of these areas are the locus region of the Kolaka Regency Government in efforts to prevent and overcome stunting, which are generally located in coastal areas and the district capital. In addition, Kolaka Regency has decreased stunting prevalence from 14.8% to 12.2%, on average the sub-districts are located in coastal areas and close to the district capital which has diverse characteristics. The decrease in this figure can be used as an example by other districts to reduce stunting prevalence through programs that the Kolaka Regency government has implemented.

Instrumentation or Tools

The quantitative component of the study used a validated questionnaire, and weight scales to measure of body weight and food recall. Body weight was measured using SECA and height was measured using Microtoice, each of which has been standardized. Household economic variables containing education, employment, income, and food expenditure were not tested for validity because they were already included in the demographic data. Then for the provision of immunization and the provision of vitamin A capsules, the data were obtained from the Toddler KMS. The adequacy of protein and energy was measured by a 24-hour food recall for toddler energy and protein intake. The validity test was carried out on the provision of exclusive breastfeeding and the provision of complementary foods based on the test results obtained a Cronbach alpha value of 0.837 and the provision of

complementary foods obtained a Cronbach alpha value of 0.793. So it can be concluded that this instrument is valid and reliable.

Data Collection Procedures

This research was carried out through several stages of activities, both in the form of library research, data collection and processing, and model analysis activities using the Stella 9.0.2 application.

Data Analysis

All data was analysed in 3 stages, namely: Stage I: Univariate analysis to determine the frequency distribution, which aims to explain or describe the characteristics of each variable studied. The variables tested in this analysis are household socio-economics, exclusive breastfeeding, giving complementary foods (CF), immunization, and giving vitamin A capsules, protein intake, and energy intake. Stage II: Bivariate analysis using the chi-square test to analysed the relationship between household socio-economics, exclusive breastfeeding, giving complementary foods to breast milk, immunization, and giving vitamin A capsules, protein intake, and energy intake with the incidence of stunting. Bivariate analysis used a chi-square test to analysed the relationship between household economy, maternal parenting patterns, and toddler food consumption patterns with stunting incidence. Bivariate analysis aims to determine the relationship between independent variables and dependent variables analysed using the Chi-Square statistical test at a 95% confidence level ($\alpha = 0.05$). All cells are eligible for modelling analysis using the dynamic system modelling approach because all cells have an expected count of less than 5.

Stage 3 is modeling: Concept analysis using a dynamic systems approach, namely observing data from the past to the present, inputting it into the model, and then simulating. Data was obtained from secondary data and also primary data. The dynamic system model that represents the structure of a feedback diagram is a cause-and-effect diagram or what is commonly known as a causal loop diagram. This diagram is an indication of the direction of the flow of changes in variables and their polarity. Dynamic modeling in this study begins with a study theory regarding the relationship between household socio-economic variables, exclusive breastfeeding, complementary feeding, immunization, vitamin A capsules, protein intake, and energy intake with stunting events. After that, a causative loop diagram was created to determine the direction of the relationship in the system circle and also added toddler population variables to determine the rate of increase or decrease in the number of toddlers. The analysis was carried out using a Causal Loop Diagram and Stock Flow Diagram simulation, where data grouping and data input were carried out in a structural model. Based on the results of the prediction simulation, scenarios are then created to improve the prediction results that are not by the objectives by improving the model inputs so that the results of the scenario simulation meet the research objectives. The selection of scenario strategies is carried out to strengthen the projections that have been produced in the previous stage. The strategy scenario is conditioned under standard conditions (business as usual), moderate, and optimistic, and the simulation needs are by the implementation capabilities. The simulation is carried out through 4 stages, namely the first stage, compiling concepts, symptoms, or processes that will be imitated by determining the elements that participate in the symptoms or the process, the second stage is making and formulating the model, the third stage is carrying out simulations using the model that has been created. Where in the quantitative model, simulations are carried out by entering data into the model, and calculations are carried out to determine the symptoms or behavioral processes the fourth stage is validating to determine the suitability between the simulation results and the symptoms or processes that are imitated. The simulation results are then used to understand the symptoms or behavioral processes and to determine their tendencies in the future. To test the validation of the model, a simple validation test is carried out through a causal loop diagram related to the problem, and consistency with cause and effect, dimensions in a valid model, a reasonable behavioral model, and a balanced model mass, meaning that the total quantity entering and leaving the system process remains explained.

Ethical Approval

This study was approved by the Health Research Ethics Committee of Mandala Waluya University (Approval Number: 35.b/KEP/UMW/2023). The confidentiality of all participants was strictly maintained throughout the research process. In this study, there were no ethical problems associated with it because there was no element of

coercion toward respondents before being interviewed, respondents were given an informed consent sheet stating their willingness to be respondents, with a guarantee of the confidentiality of the information provided.

RESULTS

The results of this research in Table 1 show that the percentage of stunting in Kolaka Regency in 5 sub-districts is 244 toddlers, there are 184 toddlers (75.4%) with short criteria and 60 toddlers (24.6%) with very short criteria. The socio-economic status of the respondents' households in this study was 57.8% poor, and 42.2% of the household socio-economic conditions were adequate. The results of this study mean that, on average, toddlers are given exclusive breast milk (69.7%) and appropriate complementary foods (57.4%). The research results showed that almost all toddlers received complete basic immunization (91%). Meanwhile, for giving vitamin A capsules, almost all toddlers routinely receive vitamin A capsules (91.4%). The results showed an adequate protein adequacy rate (51.2%) and an adequate energy adequacy rate (67.2%). The average protein adequacy figure in this study was 18.34 grams of protein, and the average energy adequacy figure was 1066 kcal per day.

The results of the bivariate test analysis in Table 2 show that of the 141 respondents with poor household economics, there were 68 toddlers (48.2%) had a less toddler food consumption pattern, and 73 toddlers (51.8%) had adequate food consumption patterns. Although economic conditions play an important role in access to food, some households with limited financial conditions can still provide adequate nutritional intake to their children, in addition, some households also receive social assistance or participate in food programs that help provide food for their children. The results of the analysis of exclusive breastfeeding show that of the 74 toddlers who were not given exclusive breastfeeding, there were 32 toddlers (43.2%) with very short stunting criteria and 42 toddlers (56.8%) with short stunting criteria. Meanwhile, of the 170 toddlers who were given exclusive breastfeeding, there were 28 toddlers (16.5%) with very short stunting criteria and 142 toddlers (83.5%) with short stunting criteria. Stunting is caused by many factors and is not only caused by poor nutrition experienced by pregnant women and toddlers but also the condition of the mother and toddler during pregnancy, economic conditions are related to this. Several indications need to be studied further, namely regarding the mother's consumption patterns, from pregnancy to breastfeeding. The quality of breast milk is also influenced by the nutritional intake consumed by the mother, if when breastfeeding the mother does not optimize the consumption of nutritious food, then the nutrition obtained by the child through the breast milk given cannot be maximized. The results of the analysis of complementary breastfeeding (CF) showed that of the 104 toddlers who were given inappropriate CF, there were 34 toddlers (32.7%) with very short stunting criteria and 70 toddlers (67.3%) with short stunting criteria. Meanwhile, of the 140 toddlers who were given appropriate CF, there were 26 toddlers (18.6%) with very short stunting criteria and 114 toddlers (81.4%) with short stunting criteria. The results of this study indicate that several toddlers who were given appropriate complementary foods suffered from stunting. This is because stunting is not only caused by multidimensional factors where air quality and sanitation in the surrounding environment can also affect children's health.

The results of the analysis of complete basic immunization show that of the 22 toddlers with incomplete immunization achievements, all toddlers (100%) with stunting criteria are very short. Meanwhile, of the 222 toddlers who achieved complete immunization, there were 38 toddlers (17.1%) with very short stunting criteria and 184 toddlers (82.9%) with short stunting criteria. Although toddler immunization is complete, it does not mean that they are free from stunting because several other factors can cause stunting according to findings at the location, including knowledge, exclusive breastfeeding, poor sanitation due to the absence of toilets, stagnant water channels, open garbage, and an unclean environment, parental education, parental employment, parental income are all related to this. The results of the analysis test on giving vitamin A capsules showed that of the 21 toddlers who were not regularly given vitamin A capsules, there were 11 toddlers (52.4%) with very short stunting criteria and 10 toddlers (47.6%) with short stunting criteria. Meanwhile, of the 223 toddlers who were regularly given vitamin A capsules, there were 49 toddlers (22%) with very short stunting criteria, and 174 toddlers (78%) with short stunting criteria. This is caused by the irregular administration of vitamin A capsules every 6 months.

Based on the results of the protein intake analysis test showed that of the 119 toddlers with inadequate protein levels, there were 33 toddlers (27.7%) with very short stunting criteria and 86 toddlers (72.3%) with short stunting criteria. Meanwhile, of the 125 toddlers with adequate protein intake, there were 27 toddlers (21.6%) with very short stunting criteria and 98 toddlers (78.4%) with short stunting criteria. This could be due to the quality of protein consumed. Although the average toddler is in a coastal area, based on research results, their animal protein intake is

less diverse. The results of the energy intake analysis test showed that of the 80 toddlers with inadequate energy levels, there were 31 toddlers (38.8%) with very short stunting criteria and 49 toddlers (61.2%) with short stunting criteria. Meanwhile, of the 164 toddlers with adequate energy levels, there were 29 toddlers (17.7%) with very short stunting criteria and 135 toddlers (82.3%) with short stunting criteria. This is due to low energy intake in stunted toddlers caused by several factors, including the frequency and amount of feeding, reduced appetite, low energy density, and accompanying infectious diseases.

Model specification is carried out by developing a theoretical model. This research uses a research conceptual framework built based on the conceptual framework of the causes of the stunting problem in Indonesia as a model for constructing a cause-and-effect diagram. A cause-and-effect diagram (causal loop) is a chain that identifies a picture of a problem in a systems approach where the variables are interconnected. This is the beginning of modelling with Powersim based on the theoretical framework of stunting events. The stages in a dynamic system begin with understanding the system and end with the problem, thus forming a closed circle.

In the model simulation in this study, the number of stunted toddlers is influenced by the toddler population. The variables in this study consist of factors that influence the prevalence of stunting, including household socio-economics, exclusive breastfeeding, complementary feeding, complete basic immunization, vitamin A capsules, energy intake, and protein intake. Next, a simulation was carried out to predict the number of stunting incidents in 2045.

Dynamic modelling begins with a theoretical study regarding the relationship between household socio-economic variables, exclusive breastfeeding, complementary feeding for breast milk, complete basic immunization, vitamin A capsules, energy intake, and protein intake with stunting incidence variables after that a causal loop diagram is created To determine the direction of the relationship in the system circle, a variable for the development of the toddler population is also added to determine the increase or decrease in toddlers. After the image is formed and there are no longer any question marks (which means it is fit), a simulation is then carried out to predict the decline in stunting prevalence in 2045. The resulting model is in the form of a table containing the estimated results of the decline in stunting prevalence every year until 2045; the results are then converted into a graph. downward trend in prevalence. Strategy scenarios are conditioned on standard conditions (business as usual), moderate and optimistic, and simulation requirements are adjusted to implementation capabilities. The simulation results consist of a combination of all variables. In Table 3, it can be seen that there is a decrease in the prevalence of stunting when compared to simulations without scenarios that do not carry out programs for stunting incidents. The results show that in the modelling scenario, there is a decrease in the prevalence of stunting in 2045 by 1.15% to 8.23%, when compared to without the scenario in 2045, the prevalence of stunted toddlers was 9.38%. The rate of decline with an average annual rate is 1.82, meaning that by combining the scenario that all variables are increased by 100%, the prevalence of stunting can be reduced by 1.82% each year.

Table 1. Frequency Distribution of Respondents Based on The Prevalence of Stunting Incidence, Household Socio-economy, Exclusive Breastfeeding, Complementary feeding, Complete Basic Immunization, Vitamin A Capsules, Protein Intake, and Energy Intake

Characteristics	**n= 244**	**%**
Education		
Low	96	39,4
High	148	60,6
Income		
Low	145	59,4
High	99	40,6
Spending on Food		
Low	140	57,4
High	104	42,6
Household Socioeconomics		
Not enough	141	57.8
Enough	103	

Characteristics	n= 244	%
Exclusive breastfeeding		42.2
Not given	74	
Given	170	30.3
Providing CF		69.7
It is not by	104	
In accordance	140	42.6
Complete basic immunization		57.4
Incomplete	22	
Complete	222	9.0
Vitamin A		91.0
Not routine	21	
Routine	223	8.6
Protein adequacy rate		91.4
Not enough		
Enough	119	
Energy adequacy figure	125	48.8
Not enough		51.2
Enough	80	
	164	32.8
		67.2

Source: Primary Data

Table 2. Factors Associated with The Incidence of Stunting

Variable	Stunting events				Total		Statistical Analysis
	Very Short		Short				
	n	%	n	%	n	%	
Household Socioeconomics							
Not enough	68	48.2	73	51.8	141	100	X^2count= 18,511
Enough	9	8.7	94	91.3	103	100	*Phi*= 0.286
Exclusive breastfeeding							X^2count= 41.164
Not given	32	43.2	42	56.8	74	100	*Phi* = 0.387
Given	28	16.5	142	83.5	170	100	
Providing CF							X^2count= 5.678
It is not by	34	32.7	70	67.3	104	100	*Phi* = 0.162
In accordance	26	18.6	114	81.4	140	100	
Immunization							X^2count= 69,750
Incomplete	22	100	0	0	22	100	*Phi* = 0.551
Complete	38	17.1	184	82.9	222	100	
Vit.A Capsules							X^2 calculate = 8.001
Not routine	11	52.4	10	47.6	21	100100	*Phi* = 0.198
Routine	49	22.0	174	78.0	223		
Protein intake							X^2count= 3.927
Not enough	33	27.7	86	72.3	119	100	*Phi* = 0.244
Enough	27	21.6	98	78.4	125	100	
Energy Intake							
Not enough	31	38.8	49	61.2	80	100	X^2count= 11,759
Enough	29	17.7	135	82.3	164	100	*Phi* = 0.230
Total	60	24.6	184	75.4	244	100	

Source: Primary Data

Table 3. Estimated Stunting Prevalence in 2023-2045 with Combined Scenario

Year	Number of Toddlers Stunting	Rate of decline Combined	Combined Scenario		
			SMELL	Moderate	Optimistic
2023	3,804.91	0.46	18.71	18.5	18.25
2024	4,823.47	1.07	23.03	22.53	21.96
2025	5,415.99	1.61	25.11	24.34	23.5
2026	5,731.90	2.03	25.81	24.83	23.78
2027	5,868.97	2,3	25.66	24.54	23.36
2028	5,891.16	2.46	25.01	23.8	22.55
2029	5,840.28	2.53	24.08	22.83	21.55
2030	5,743.64	2.52	22.99	21.74	20.47
2031	5,619.05	2.47	21.84	20.61	19.37
2032	5,478.12	2,4	20.68	19.48	18.28
2033	5,328.38	2.31	19.53	18.38	17.22
2034	5,174.72	2.19	18.41	17.31	16.22
2035	5020.25	2.09	17.35	16.3	15.26
2036	4,866.99	1.98	16.33	15.34	14.35
2037	4,716.17	1.87	15.37	14.43	13.5
2038	4,568.57	1.76	14.45	13.57	12.69
2039	4,424.63	1.66	13.59	12.76	11.93
2040	4,284.60	1.56	12.78	11.99	11.22
2041	4,148.60	1.48	12.02	11.27	10.54
2042	4,016.64	1.39	11.3	10.6	9.91
2043	3,888.71	1.3	10.62	9.96	9.32
2044	3,764.73	1.22	9.98	9.37	8.76
2045	3,644.64	1.15	9.38	8.8	8.23
Average annual rate of decline				0.90	1.82

Source: Primary data, 2022.

DISCUSSION

Overcoming the factors that influence the incidence of stunting always begins with efforts to understand the behavior of variables/factors related to stunting so that it makes it easier to create causal loops stock-flow diagrams can then be processed in the powers program. Socioeconomic factors are consistently associated with the incidence of stunting, such as household economic status (15). The results of this study showed that of the 141 respondents with poor household economics, there were 68 toddlers (48.2%) who had very short toddlers, while 73 toddlers (51.8%) had short toddlers. This is because even though economic conditions play an important role in access to food, some households with limited financial conditions are still able to provide adequate nutritional intake to their children, this could be because some households may receive social assistance or participate in food programs that help provide food for their children. children. Programs like this can help ensure that children receive adequate food intake even if their household economic conditions are not good. The local government provides non-cash food assistance and provides additional food to toddlers so that toddlers' nutritional intake is adequate. The theory (16) states that one of the indirect causes of the stunting problem is household economic income which is influenced by the level of parental education. If parental education is high, then the greater the opportunity to earn sufficient income to be able to live in a good and healthy environment.

This proves that socioeconomic levels influence the family's ability to meet the nutritional needs of toddlers. In addition, socio-economic conditions also influence the choice of types of additional food and the timing of feeding as well as healthy living habits (17). This has a significant impact on the incidence of stunting in toddlers, meaning that toddlers from low-income families are at greater risk than those from families with sufficient income. The results of this research are also by research conducted (9) in Korea, the results showed that intake of protein, calcium, phosphorus, potassium, and vitamin C was related to household economy. Families with a low household economy will have a higher risk of getting low intakes of protein, calcium, phosphorus, potassium, and vitamin C.

In overcoming stunting in Kolaka Regency, the government can implement an action strategy that involves aspects of household economy, maternal parenting patterns, and toddler food consumption patterns, through several recommended strategies including household economic empowerment, increasing maternal knowledge and parenting patterns, promoting healthy toddler food consumption patterns and, integration of policies between sectors, and monitoring and systematically evaluating programs. As a contribution, several things that need attention and at the same time carrying out practices/materials in efforts to achieve toddlers, stunting prevention programs through education and the community, to the relevant regional heads/OPDs to determine the most appropriate strategy that can be used, the use of health services needs to be improved again, and increasing the role of cadres in Integrated Service Post (Posyandu) to stimulate and monitor toddler development using the *KIA Book.*

The results of the analysis of exclusive breastfeeding show that of the 170 toddlers who were given exclusive breastfeeding, there were 28 toddlers (16.5%) with very short stunting criteria and 142 toddlers (83.5%) with short stunting criteria. This is because stunting is caused by multiple factors and is not only caused by poor nutrition experienced by pregnant women and toddlers. Several factors that cause stunting can be described, namely the situation of mothers/future mothers, the situation of toddlers, the socio-economic situation, and the situation of sanitation and access to drinking water (10). One of the factors in the situation of toddlers is LBW. Data by (20) as many as 52.5% or only half of the 2.3 million babies aged less than 6 months who receive exclusive breast milk in Indonesia. According to (21) The reason for the low coverage of exclusive breastfeeding is due to mothers' lack of knowledge about the importance of exclusive breastfeeding at the age of 0-6 months, which makes many mothers still reluctant to give exclusive breastfeeding to their babies. The negative impacts caused by stunting in the short term are disruption of brain development, intelligence, physical growth disorders, and metabolic disorders in the body. Meanwhile, the impact of stunting in the long term is a decrease in cognitive abilities and learning achievement, decreased immunity so that people get sick easily, and a high risk of developing diabetes, obesity, heart and blood vessel disease, cancer, stroke, and disability in old age (22).

Based on the results of the analysis of complementary breastfeeding, showed that of the 140 toddlers who were given appropriate CF, there were 26 toddlers (18.6%) with very short stunting criteria and 114 toddlers (81.4%) with short stunting criteria. Entering the age of six months, babies need other nutritional intake besides breast milk to support their growth and development. The results of this research show that several toddlers who were given appropriate complementary foods (CF) suffered from stunting, this is because stunting is not only caused by multi-dimensional factors where the quality of water and sanitation in the surrounding environment can also affect children's health. Water contamination and poor sanitation can increase the risk of diseases that inhibit growth, in addition, children who have certain food intolerance disorders may have difficulty absorbing nutrients properly from the food they consume. In addition, the provision of varied and nutritious food will support the nutritional status of children, but with low family income conditions, it is not possible to meet nutritional needs continuously. So that the provision of CF is not optimal to support the fulfilment of children's nutritional needs according to their age. The requirements for good CF are that it is given on time, contains complete and balanced nutrition, and is given correctly (23). This research is to previous research (15), that toddlers who receive inappropriate CF have a 7.4 times risk of stunting compared to toddlers who receive appropriate CF. Apart from providing complementary foods and exclusive breastfeeding, providing complete basic immunization is also one of the causes of stunting in toddlers.

In this study, the immunization studied was a complete basic immunization program from the government which is intended for children aged 9 months. For complete basic immunization, babies are given Hepatitis B (HB-0) immunization when they are less than 24 hours old, (BCG and Polio 1) when they are 1 month old, (DPT-HB-Hib 1 and Polio 2) when they are 2 months old, (DPT-HB-Hib 2 and Polio 3) at the age of 3 months, (DPT-HB-Hib 3, Polio 4 and IPV or Polio injection) at the age of 4 months, and measles immunization when the baby is 9 months old. Based on the results of the data collected, it was found that previously, 22 children under five did not receive incomplete immunization, and 222 children under five received complete immunization. Basic immunization is very important for toddler immunity, which to the national target that complete basic immunization must reach the target of up to 100%. Toddlers who are not fully immunized will experience impaired immunity against infectious diseases because antibody production decreases, making it easier for disease germs to enter, this can interfere with the production of various types of enzymes for the digestion of food. Based on the results of the chi-square statistical test, the value of X^2count = 69.750, with the value of X^2Table = 3.841, then X^2count > This shows that there is a relationship between toddler immunization and the incidence of stunting. From the results of the correlation test, phi

value = 0.551 was obtained, which means that there is a strong relationship between toddler immunization and the incidence of stunting. These results indicate that immunization is a risk factor for stunting. This is in line with research (16) that states that there is a relationship between providing complete basic immunization and the incidence of stunting, with the statistical test results obtaining a value of p = 0.001, it can be concluded that there is a significant relationship between providing immunization and the incidence of stunting.

In addition, to complete basic immunization, administering vitamin A capsules is essential to help combat childhood infections, and vitamin A supplements have been clinically proven to reduce the severity of respiratory infections and mortality in children with measles (2). The findings of the study conducted by Damanik (2014)(26) demonstrated a connection between toddlers' full immunization and stunting. Toddlers with incomplete vaccinations have weakened immunity, which leaves them vulnerable to infection. If untreated, illnesses put children at risk for stunting. Apart from that, vitamin A supplementation can reduce the number of infectious diseases in children, especially Diarrhea and ARI, which often occur in children. Providing complete basic immunization can also reduce the frequency of illness in children. Based on the results of the chi-square statistical test, the value of X^2count = 8.001, with a value of X^2Table = 3.841, then X^2count > This shows that there is a relationship between giving vitamin A capsules and the incidence of stunting. The results of this study are in line with (17) which show a significant relationship between vitamin A and stunting, and based on Fisher's test results, show that there is a relationship between the completeness of vitamin A administration and the incidence of stunting (p=0.024). So that vitamin A intake is adequate, it can be replaced with adequate levels of vitamin A, the main thing is through food intake, namely through fruit and vegetables, which are full of vitamins. Usually, orange and red fruits and vegetables contain lots of vitamin A. Apart from that, you can also eat protein such as fish, eggs, and shrimp. Children who receive incomplete vitamin A supplementation are 0.020 times more likely to experience stunting than children who receive complete vitamin A supplementation, according to research findings by Putri et al. (2021) (28), which demonstrated a significant correlation between vitamin A and stunting. A lack of vitamin A in toddlers can result in osteoblasts producing less bone matrix, which inhibits the remodelling process and interferes with bone development. When bone production is disrupted, growth is initially impeded, and stunting ensues(29).

The results of the analysis of protein intake and the incidence of stunting in this study showed that of the 119 toddlers with inadequate protein levels, there were 33 toddlers (27.7%) with very short stunting criteria and 86 toddlers (72.3%) with short stunting criteria. This could be due to the quality of the protein consumed. Protein from diverse food sources such as meat, fish, eggs, and dairy products has a better amino acid profile than plant protein. Even though the average toddler is found in coastal areas, based on research results, their animal protein intake is less diverse. Most toddlers only consume food made from vegetable protein. This is by research (18) which states that stunted children have lower protein intake compared to normal children. Insufficient protein intake is associated with a risk of stunting 5,160 times compared to adequate protein intake in children under five.

Meanwhile, of the 80 toddlers with inadequate energy levels, there were 31 toddlers (38.8%) with very short stunting criteria and 49 toddlers (61.2%) with short stunting criteria. This is due to low energy intake in stunted toddlers which is caused by several factors including the frequency and amount of feeding, reduced toddler appetite, low energy density, and comorbid infectious diseases. The results of the chi-square statistical test obtained a value of X^2count = 11.759, with a value of X^2Table = 3.841, then X^2count > This shows that there is a relationship between the energy adequacy rate and the incidence of stunting. From the results of the relationship strength test, phi value = 0.230 was obtained, which means that there is a weak relationship between the energy adequacy figure and the incidence of stunting. This is in line with research (19), that low energy intake poses 6,111 times the risk of toddler stunting in the Karanganyar sub-district.

The results of modelling in this combined scenario, namely by combining scenarios of improving household socio-economics, giving exclusive breastfeeding, giving complementary foods to breast milk, immunization, giving vitamin A capsules, protein intake, and energy intake, show that there is a fairly good rate of reduction in stunting management. It can be seen that there is a decrease in the prevalence of stunting when compared to simulations without scenarios that do not carry out programs for stunting incidents. The results show that in the combined scenario there will be a decrease in 2045 by 1.15% to 8.23%, when compared with the no scenario in 2045, the prevalence of stunting in children under five is 9.38%. The rate of decline has an average annual rate of 1.82, meaning that by combining household socio-economic scenarios, exclusive breastfeeding, complementary breastfeeding, immunization, giving vitamin A capsules, increasing protein intake and energy intake by 100%, the incidence of

stunting can be reduced. amounting to 1.82% annually. This is in line with studies that state that stunting can be prevented by increasing access to health services for underprivileged communities, paying attention to nutritional intake, improving the economic status of families with toddlers (32), increasing child immunization coverage, deworming and maternal iron supplementation often coincide with reductions in stunting (33).

Interpretation of Key Findings

Based on the results of the chi-square statistical test, the value of X^2count = 69.750, with the value of X^2Table = 3.841, then X^2count > This shows that there is a relationship between toddler immunization and the incidence of stunting. From the results of the correlation test, *phi* value = 0.551 was obtained, which means that there is a strong relationship between toddler immunization and the incidence of stunting. These results indicate that immunization is a risk factor for stunting. Apart from that, vitamin A supplementation can reduce the number of infectious diseases in children, especially diarrhea and ARI which often occur in children. Providing complete basic immunization can also reduce the frequency of illness in children. Based on the results of the chi-square statistical test, the value of X^2count = 8.001, with a value of X^2Table = 3.841, then X^2count > This shows that there is a relationship between giving vitamin A capsules and the incidence of stunting. This is due to low energy intake in stunted toddlers which is caused by several factors including the frequency and amount of feeding, reduced toddler appetite, low energy density, and comorbid infectious diseases. The results of the chi-square statistical test obtained a value of X^2count = 11.759, with a value of X^2Table = 3.841, then X^2count > This shows that there is a relationship between the energy adequacy rate and the incidence of stunting. From the results of the relationship strength test, phi value = 0.230 was obtained, which means that there is a weak relationship between the energy adequacy figure and the incidence of stunting.

Several efforts to prevent and reduce the prevalence of stunting carried out by the government include integrated nutritional interventions as stated in Regent Regulation No. 29 of 2019 concerning Efforts to prevent and accelerate the reduction of stunting rates and Regent Regulation No. 30 concerning the role of village governments in reducing stunting rates. Kolaka Regency itself is currently designing stimulants for the community such as: providing nutritional intake, socialization of the impact of stunting in schools, healthy lifestyles, and the availability of clean water facilities and infrastructure. Several things related to the implementation of the stunting prevention program in Kolaka Regency that is integrated with stunting prevention action activities include referral of toddlers to the laboratory for worm examination, acceleration of eating eggs and drinking milk, education of mothers of toddlers, coordination with the Social Service regarding the facilitation of JKN management, socialization of Ettawa goat milk products as a source of animal protein (Livestock Service), socialization of the love of eating fish and vegetables (Fisheries & Food Security Service), socialization of fortified rice (Food Crops & Horticulture Service). Various stunting prevention action programs have proven to be able to reduce the prevalence of stunting in Kolaka Regency in 2022 to 10.8%.

Comparison with Previous Studies

This is in line with research Nusantri et al. (2023) that states that there is a relationship between providing complete basic immunization and the incidence of stunting, with the statistical test results obtaining a value of p = 0.001, it can be concluded that there is a significant relationship between providing immunization and the incidence of stunting. Consuming vitamin A can affect the nutritional status of toddlers. According to (17) the founding relationship between vitamin A and stunting, and based on Fisher's test results, show that there is a relationship between the completeness of vitamin A administration and the incidence of stunting (p=0.024). So that vitamin A intake is adequate, it can be replaced with adequate levels of vitamin A, the main thing is through food intake, namely through fruit and vegetables which are full of vitamins. Apart from that, low energy intake poses 6,111 times the risk of toddler stunting in the Karanganyar sub-district. This is in line with research by (19).

Limitations and Cautions

This study did not measure sensitive program interventions, but only specific programs, where specific programs only reduced prevalence by 30%. The limitations of this study only show the causal relationship between variables and do not use longitudinal or experimental designs due to time and cost constraints. Given the limitations of this analysis, one of which is the limitation of the variables used. For this reason, further analysis is needed by adding or replacing these variables with other variables that are relevant to stunting, of course with a longer period.

Another limitation is related to the availability of secondary data/information, missing data, and the quality of secondary data. The availability of data published at the district level is still limited, making it difficult to obtain more comprehensive information at the district level. Data related to toddler food consumption patterns and household economics are not available, even though these variables are very important for predicting stunting. The results of data processing show that for certain variables the data varies greatly and some tend to be homogeneous.

Recommendations for Future Research

Proposes a stunting prevention program policy through health education and community empowerment through regular house-to-house visits. Apart from that, the use of health services needs to be increased further and the role of cadres at village-level service (Integrated service post/Posyandu) to stimulate and monitor the development of toddlers needs to be increased. Further researchers need to conduct longitudinal studies if they want to understand how changes occur over time or use experimental studies with a wider population coverage so that results can be obtained that can be generalized.

CONCLUSION

From the research results, it can be concluded that there is a significant relationship between household socio-economic factors, exclusive breastfeeding, complementary breastfeeding, immunization, vitamin A capsules, protein intake, and energy intake and the incidence of stunting. The stunting prevention model through household socio-economics, exclusive breastfeeding, complementary breastfeeding, immunization, vitamin A capsules, protein intake, and energy intake with the incidence of stunting with an estimated average prevalence in 2023-2045 experiencing a rate of decline with an optimistic strategy (1.82%). The community can prevent stunting by starting from improving the household economy, implementing good parenting patterns by providing food, including providing special breastfeeding and providing nutritious and timely complementary foods, and utilizing health services. The findings can also be used as input for policymakers or health practitioners related to the prevention and handling of stunting, including improving the household economy, maternal parenting patterns, toddler food consumption patterns, and coordinating time and work according to their respective roles.

AUTHOR'S CONTRIBUTION STATEMENT

AN, IS, and HD contribute equally to this study.

CONFLICTS OF INTEREST

The authors declare that no significant competing financial, professional, or personal interests might have affected the performance or presentation of the work described in this manuscript.

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