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Original Article

Dynamic System Model Using the Combi (Communication for Behavioral Impact) Method Approach to Early Detection of Stunting Neonates in Pregnant Women North Sumatra

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ABSTRACT

This study addresses the persistent nutritional challenge of stunting in Indonesia, often misconceived as solely hereditary. Research indicates that genetic factors contribute only 15%, emphasizing the significance of nutritional intake, growth hormones, and maternal and toddler health in stunting. The research aims to identify and prevent early stunting in neonates, aligning with the government's goal to combat stunting by 2025. Using an observational research design and dynamic system modeling through Stella software, the study develops an effective strategy model for reducing stunted neonates in the future. Simulation experiments provide reliable insights into dynamic systems, predicting various scenarios based on input data. Results highlight the importance of enhancing Antenatal Care (ANC) standards, iron supplementation, additional nutrition, and effective case management for pregnant women. Implementation of these factors at low to medium levels could potentially reduce stunted neonates by 25%, reaching 44% at a high level compared to current conditions. The study further recommends an empowerment model for pregnant women, involving family assistance in managing highly nutritious food based on local wisdom. This holistic approach addresses the root causes of stunting, contributing to the success of stunting prevention programs in Indonesia. The research emphasizes the multifactorial nature of stunting and provides valuable insights for policymakers and healthcare practitioners to develop comprehensive strategies for effective intervention and prevention.

Keywords: *Stunting, Dynamics, Early Detection, Combi.*

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INTRODUCTION

Stunting is a disturbance of growth physique, which has already passed, forming a decrease in the speed of growth in human development, which is impacted by nutrition [1]. Food needs more results from no balance factors growth (internal and external factors) [2]. Nutrition can occur during some periods of development, such as pregnancy, period perinatal, breastfeeding, infancy, and growth (childhood). This, too, can be caused by deficiencies in various nutrients, for example, micronutrients, proteins, or energy [3].

The country develops, and Asia is known that one in three children experiences stunting, with an incidence reaching 46%, followed by the African region at 38%. The incidence rate of checking in the country developed, and people experiencing poverty reached 32%. Indonesia is the fifth country with a high prevalence of child stunting, 7.8 million, after India, China, Nigeria and Pakistan [4].

Stunting data based on Basic Health Research (Riskesdas) results in 2021, namely 37.2%, decreasing to 30.8% in 2020. In 2021, the prevalence of concise growth in toddlers was 18.0%, a decline from 11.5% in 2020. However, the prevalence of short-on toddlers increased from 19.2% in 2020 to 19.3% in 2021. Overall Nationally, the highest majority of very short and short (first order) is occupied by East Nusa Tenggara (NTT) at 42.6%, West Sulawesi at 39.8% and the Province North Sumatra is as big as 37.3% [5].

According to the Indonesian Ministry of Health in 2021, the Status Monitoring Survey Nutrition data shows that stunting for the 2018-2021 period is that in 2018 it was 28.9%, in 2019 it was 29%, in 2020 it was 27.5% and in 2021 it was 29.6%. Means from 2019 happen increase compared to 2018, decrease on year 2020 And go on Again on year 2021 [6].

The North Sumatra Health Profile in 2019 still found problems related to toddler nutrition, namely Malnutrition at 0.13%, Malnutrition at 1.98%, Short Toddlers at 2.61% and Underweight Toddlers at 2.13%. The prevalence of malnutrition in 2018 and 2019 has the same figure, namely 0.13%, the prevalence of malnutrition compared to 2018 was 1.66% and in 2019 it was 1.98%, there was an increase of 0.32%, for short-term toddlers. In 2018 it was 1.51% and in 2019 it was 2.61%, there was a significant increase of 1.1%, while for underweight toddlers in 2018 it was 2.33% and in 2019 it was 2.13%, there was a decrease of 0.2 % (7). In Medan City Based on the data obtained for malnourished toddlers, as much data was obtained 0.11%, toddlers with wasting as much as 0.46%, and toddlers with stunting 0.3% [7].

Energy and substance intake nutrition No adequate, as well as disease infection is a factor that plays a major role in the problem of stunting. Quantity and the quality of protein intake has an effect on plasma insulin growth levels factor I (IGF-I) and also bone matrix proteins and growth factors which plays an important role in bone formation. Apart from that, in the Lancet Series explains several micronutrients that are very important for preventing the occurrence of stunting, namely vitamin A, zinc, iron and iodine. However, some substances Other micronutrients such as calcium and phosphorus also play a very important role growth linear child [8]. Status nutrition Mother pregnant very influence circumstances health and development fetus. Disturbance growth in content can causes weight low birth. Research in Nepal shows that babies with heavy born low have risk Which more tall For become stunting [9]. Long born baby Also relate with incident stunting. Research in Kendal shows that babies with short birth lengths risky tall to incident stunting on toddler [10]. Factor other Which relates with stunting is intake breast milk Exclusive on toddler. Research in Ethiopia South prove that toddler Which No get breast milk exclusive for 6 month risky tall experience stunting [11]. Indonesia has set targets in accordance with the SDGs Program in 2030 in the health sector, namely through efforts to improve nutrition and health quality in combating the prevalence of stunting. Achieving the SDGs goals must be prepared from now by coordinating across sectors. Over the last 20 years, handling of the stunting problem has been very slow, globally, the percentage of children whose growth is stunted has decreased by only 0.6% per year since 1999. It is predicted that if this continues, then 15 years later it is estimated that 450 million children will suffer from it. Delayed growth or stunting affects children's level of intelligence and quality of life and will have an impact on the economy of a country because it is influenced by unproductive human resources. The causal factor is thought to be a lack of cross-sectoral roles in preventing stunting, so there is a need to strengthen the role through convergent actions to accelerate stunting reduction in each region. There are two provinces where the prevalence of stunting is very high, namely >40%, namely North Sumatra and South Sumatra. Based on these prevalence figures, it is known that the incidence of stunting in Sumatra is high.

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is high. The prevalence of stunting (very short and short) in North Sumatra Province in 2018 was 32.5 percent. The prevalence rate for shortness in Labuhan Batu Regency in 2018 was 16.31% short and 21.06% very short. To achieve the SDGs target of reducing infant, under-five and maternal mortality and overcoming disease, it is necessary to have the managerial capacity of public health service institutions both at the central and regional levels which is very limited so that various basic health service programs do not run effectively. Public health development requires professional staff who are able to manage various health service programs including maternal and child health priorities which are the focus of resolution in the next five year period including increasingly complex and widespread public health problems, such as high infant, child and maternal mortality and the incidence of stunting and wasting in children which has an impact on children's productivity which will decrease due to impaired growth and development as well as various disease complications occurring in children.

METHOD

In this research, researchers used an observational research design with a dynamic system modeling approach, namely collecting data to design a model using software Stella , which aims to describe and predict the future incidence of neonatal stunting in pregnant women. Model Analysis carried out with simulation experiments. A series of logic related to simulations can provide sufficient results, reliable (although not exact) information about the properties of models that describe and analyze important concepts of dynamic systems in order to predict various cases or situations through input research data or literature data.

RESULTS

Table 1. Distribution of respondents based on characteristics in the treatment group and control group of pregnant women

Characteristics	Group				Amount	
	Treatment		Control			
	N	%	N	%	N	%
Age						
< 20 Years	1	3.7	3	11.1	4	7.4
20 – 40 Years	7	25.9	11	40.8	18	33.3
>40 Years	19	70.4	13	48.1	32	59.3
Parity						
<4 times	13	48.1	14	51.9	27	50
>4 times	14	51.9	13	48.1	27	50
Education						
elementary school	1	3.7	5	18.5	6	11.1
Junior High School	8	29.6	7	25.9	15	27.8
Senior High School	18	66.7	14	51.9	32	59.3
PT	-	-	1	3.7	1	1.8
Work						
Doesn't work	5	18.5	8	29.7	13	24.1
Private	16	59.3	10	37	26	48.1
Civil servants	6	22.2	9	33.3	15	27.8
ANC frequency						
<4 Times	18	66.7	11	40.7	29	53.7
>4 Times	9	33.3	16	59.3	25	46.3

Based on the table above, the results of the univariate analysis show that according to age characteristics in the treatment group, 19 respondents (70.4%) were aged > 40 years in the treatment group, while 13 respondents (70.4%) were in the control group. Meanwhile, education in the treatment group had more than 18 (66.7%) high school education levels and 14 (51.9%) respondents in the control group. Based on the occupation of the respondents, 16 (66.7%) respondents had more private jobs. Meanwhile, the controls were 10 (37%) respondents. Based on ANC frequency of less than 4 times in the treatment group there were 18 (66.7%) respondents, while the controls were more than 4 times as many as 16 (59.3%).

Based on the 10 ANC Standards showing the results of statistical tests before and after the assistance that pregnant women must receive every time they visit health services, there are 4 (four) antenatal care standards that have not been consistently implemented as in the table below:

Table 2. Distribution based on ANC standards before and after the assistance intervention for pregnant women at high risk of stunting neonates.

ANC standard (score 0-1)	Treatment		Control	
	Pre-test	Post-test	Pre-test	Post-test
	Mean±	Mean±	Mean±	Mean±
Standard 1	0.98	1.00	1.00	1.00
Standard 2	0.98	1.00	1.00	1.00
Standard 3	0.98	1.00	1.00	1.00
Standard 4	0.90	1.00	0.98	1.00
Standard 5	0.86	1.00	0.81	1.00
Standard 6	0.67	1.00	0.74	0.91
Standard 7	0.90	1.00	0.91	0.98
Standard 8	0.42	1.00	0.56	0.74
Standard 9	0.58	0.95	0.49	0.77
Standard 10	0.42	0.93	0.44	0.67

From the table above, it can be seen that before the intervention, in both the treatment and control groups, the implementation of ANC standards that were not running well (below 80%) were standard 6 (administering blood supplement tablets), standard 8 (laboratory examination), standard 9 (counseling), and standard 10 (case management). For the administration of blood supplement tablets (TTD) after the intervention, both the treatment and control groups experienced an increase. However, the mean level of regularity of respondents taking blood supplement tablets (TTD) only reached 0.58 in the control group and 0.97 in the intervention group.

Table 3. Matrix between factors and scenarios simulated in a dynamic model

	Scenario1 (Pessimistic)	Scenario2 (Moderate	Scenario3 (Optimistic)
ANC check	Frequency of regular ANC checks every 4 months (2 times in pregnancy (according to existing conditions)	Frequency of ANC visits per 3 months (tri semester)	Regular ANC frequency every 2 months (6 times during pregnancy)
Administration of Fe Tablets	Regular Fe frequency every 4 months (3 times during pregnancy) according to existing conditions	Fe frequency per 3 months (4 times during pregnancy)	Regular Fe frequency per 2 months (6 times during pregnancy)
PMT (Implemen	PMT implementation is running low (30%) according to existing	Implementation of PMT is moderate (50%)	PMT implementation runs optimally (75%)

tation of Nutritional Status)	conditions according to existing conditions		
Case Management	Implementation of Case Management is still relatively low in terms of frequency, materials, methods, funding and institutions (according to existing conditions)	Implementation of Case Management activities at a medium level in all aspects (frequency, materials, methods, funding and institutions)	Implementation of Case Management at an optimal level in all aspects (frequency, materials, methods, funding and institutions)

These three scenarios are simulated over a time span of 3 years with intervals (time steps) every month so that the simulation results will be shown for 3 X 12 = 36 months.

Table 4. Dynamic simulation results of early detection. High risk of stunting in pregnant women

Month	Scenario 1	Scenario 2	Scenario 3
1	90.9787	92.2413	94.1900
2	89.2440	90.6747	92.5660
3	80.4760	82.1100	84.0333
4	75.5100	76.9353	79.7700
5	74.5113	76.0360	77.9800
6	79.7047	81.2500	83.4653
7	77.0867	78.5513	80.8593
8	75.7527	77.2607	79.3007
9	84.2420	85.6753	87.8540
10	89.5393	91.0840	92.7640
11	93.8947	95.2120	96.9500
12	87.1973	88.6573	91.0280

Based on the values in the table above, the difference between scenario 2 and scenario 1 is calculated, so the calculated increase in high-risk ranges from 1.26 to 1.63% with an average of 1.46%. The increase in high-risk cases from scenario 1 to scenario 3 ranges from 3.26 to 4.26% with an average of 3.55%. These results indicate that the simultaneous effect of the ANC implementation scenario, Fe administration and PMT will be able to increase by 1.46% the value of decreasing rest in pregnant women on the incidence of stunting neonates. from low level to medium level and increase by 3.55% from low level to high level.

The effects of implementing ANC, giving Fe and PMT directly affect the growth and development of the fetus in the womb. In a moderate scenario with increased ANC frequency activity, Fe administration from 4 times to 8 times during pregnancy and increased application of nutritious food management, it can increase fetal growth and development to reduce the occurrence of short retardation in neonates thereby reducing the chance of increasing stunting or short stature due to intake. nutrients, growth hormones and the occurrence of infectious diseases in mothers and neonates can be avoided in the following period so that the stunting-free rate can increase by 1.46%.

DISCUSSION

Stunting is a problem of chronic malnutrition caused by intake Lack of nutrition for a long time due to inadequate food intake according to nutritional needs. Stunting occurs

when the fetus is still in the womb and only appeared when the child was two years old. Malnutrition at an early age increases infant and child mortality rates, causing sufferers to suffer easily sick and having poor posture as an adult. Cognitive abilities sufferers also decrease, resulting in long-term economic losses long for Indonesia. Several efforts to prevent stunting early on toddlers in Indonesia, among others, through the First 1,000 Days of Life Movement and Project Health and Nutrition Based Public (PKGBM) [11,12,13].

In the process of child growth and development, UNICEF formulates three factor main Which affect growth and development in no way direct (underlying factors), that is food House ladder, parenting, And sanitation environment. Third factor the influence status nutrition And Also level health child Which Also join in determine quality growth as well as development child [14]. Determining good intake is very important to achieve body length which should. Birth weight, birth length, gestational age and pattern foster care is a number of factors that influence the incidence of stunting. Long body born is Wrong one factor risk incident stunting on toddler [15].

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Stunting related with status nutrition is circumstances body Which balance between nutritional intake and needs. Nutrient availability at levels mobile needed for growth, maintenance and operate function body. Poor nutritional status on basically caused by interaction between intake unbalanced nutrition and infectious diseases [17,18]. According to the United Nations Children's Fund (UNICEF), nutritional problems are caused by various factors, both direct (food unbalanced and infectious diseases) or indirectly include parenting patterns (eating parenting and health parenting). Eating parenting can be an attitude and behavior Mother or nanny other in give Eat. Pattern foster health and pattern foster self as attitude and action Mother to conditionchildren's environment, including: environmental cleanliness and sanitation, toddler care in circumstances Healthy nor Sick [19].

Behavior health at a time can strengthen theory incident stunting related to nutritional status, Laurence W. Green coined behavioral theory state behavior health influenced by 3 factor main namely: Factors predisposition (predisposing factors), that is: factor trigger behavior like: age, knowledge, experience, education, attitude, trust, confidence, parity, And other so on, supporting factors (enabling factors), namely: factors that support the emergence behavior like environment physique, fund And sources Which There is in society, Reinforcing factors, namely: factors that strengthen or push somebody For behave Which originate from person other for example: regulation And policy government, officer health, figuresociety/religion nor from party family [20,21].

In this study, the dynamics of the stunting population were more influenced by aspects of ANC implementation, Fe administration and through improving healthy living behavior and improving case management. The interesting thing about this research is the effect of the PMT scenario of increasing nutritional status in this model [22]. The effect of PMT will have a direct influence on the growth and development process of the fetus by improving the quality of nutritional intake in pregnant women. The simultaneous effect of implementing the PMT scenario can occur through a mechanism for improving food management in pregnant women's families with the nutritional content needed during pregnancy. This will lead to increased healthy living behavior and efforts to improve nutritional status.

CONCLUSION

Several strategy formulations and recommendations related to efforts to reduce stunting, especially in the stunting locus area at a particular time, are principally built from the results of model simulations associated with implementing ANC implementation scenarios, Fe Fulfillment, and provision of Supplementary

Food. In principle, these three scenarios boil down to efforts to reduce stunting in children. Another scenario that is no less important in this dynamic model research is managing highly nutritious local food to meet the nutritional needs of pregnant women and fetuses and prevent stung neonates. It is necessary to increase the role and commitment of all those responsible for the program by involving all parties. There is a need for a comprehensive policy in developing strategies to reduce stunting acceleration based on the needs of each region/district, especially stunting locus areas or regions.

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