

# TURNITIN RIVAI

*by Anita Rahmiwati*

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1 Original Research

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3 **Potential Economic Losses Due to Stunting in Toddlers In Ogan**  
4 **Komering Ilir Regency**

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10 22

11 **ABSTRACT**

12 Stunting is a chronic condition that arises due to nutritional deficiencies during pre- and postpartum  
13 periods. It is a significant public health issue in Indonesia, with a prevalence of approximately 29.6%  
14 nationwide and about 22.6% in Ogan Komering Ilir Regency. Therefore, this research aimed to  
15 identify the risk factors associated with stunting in toddlers aged 12-35 months and calculate the  
16 economic losses incurred by this condition. To achieve this, a cross-sectional design was employed,  
17 and a sample of 77 toddlers was selected through simple random sampling. Data was collected using  
18 questionnaires, and calculations based on the Konig 1995 and Horton 1999 formulas were used to  
19 analyze the Gross Regional Domestic Product (GRDP) per capita. The research found that stunting  
20 had a prevalence of 51.9% in toddlers. Additionally, the research identified that dietary diversity  
21 was significantly related to the occurrence of stunting with a p-value of 0.0001 and was identified as  
22 the most dominant factor, whereas economic status, toddler participation, and history of infectious  
23 diseases were not significantly related to stunting with a p-value >  $\alpha$ . The study also estimated the  
24 potential economic losses incurred by stunting, which amounted to IDR 170 billion and IDR 765  
25 billion, respectively, or 0.67%-3.03% of OKI's GRDP, resulting from a 2% and 9% decrease in  
26 productivity. Hence, this research suggests that food consumption diversity is the most dominant  
27 factor significantly related to stunting in toddlers in Ogan Komering Ilir Regency.

28 **Keywords:** Economic Losses, Nutritional Status, Risk Factors, Stunting, Toddlers

29 **INTRODUCTION**

30 Stunting is a long-term condition caused by poor healthcare and nutritional problems during the  
31 prenatal and postnatal periods (1). This accumulation effect can lead to increased mortality rates,  
32 motor development disorders, bodily function imbalances, and cognitive impairments in children (2).  
33 Children who experience stunting after the age of two have their body growth hindered, and their  
34 potential for growth is not maximized until they reach adolescence or adulthood. Even if growth  
35 occurs, it will not be in height, but rather in width. The impact of stunting goes beyond physical  
36 growth and can have detrimental effects on health resilience, development, and productivity due to  
37 linear growth disturbances (3).

38 According to estimates from the World Bank, cases of malnutrition in the community result in a  
39 2.5% loss in Gross Domestic Product (4). Furthermore, there is a negative correlation between the  
40 Gross Regional Domestic Product (GRDP) per capita and the prevalence of malnutrition in toddlers.  
41 This means that the higher the value of GRDP per capita in an area, the lower the prevalence of  
42 malnutrition (5). This is because a large GRDP value indicates a large economic resource capacity  
43 and vice versa (6).

44 According to the 2017 Nutritional Status Monitoring (NSM), the prevalence of stunting in toddlers  
45 decreased from 37.2% in 2013 to 29.6% but increased from 27.5% in 2016. The prevalence of  
46 stunting in toddlers in South Sumatra province is 22.8%. Furthermore, the NSM report shows that

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[http://dx.doi.org/10.21776/ub.ijhn.\\*\\*\\*\\*\\*](http://dx.doi.org/10.21776/ub.ijhn.*****)

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(decimal is written: 1.5; less than or more signs are written with spaces before numbers: < 2.3; numbers with a per cent sign written without space: 25%; units written with space after number: 70 g, 1.5 ml/mol; minus sign - or + between numbers written without space: 1.5-2.5 or 2+3; plus sign or less between numbers is written with a space: 12 ± 0.5; ratio is written: RR 1.5 CI 95% 2.5-2.8 or OR -0.79 CI 95% 0.01-0.10; significance value is written: p = 0.03 or p < 0.01).

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47 there are 12 Sub-district in South Sumatra province still in the acute-chronic category, with more  
 48 than 20% of toddlers experiencing stunting (7). Therefore, this research aims to identify the risk  
 49 factors associated with stunting in toddlers aged 12-35 months in Pedamaran Sub-district and the  
 50 economic losses incurred by the Ogan Komering Ilir (OKI) Regency.

## 51 METHOD

### 52 Research Design

53 This research was conducted using a cross-sectional design.

### 54 Research Subjects

55 The sample consisted of 77 mothers who had toddlers aged 12-35 months. Furthermore, the sampling  
 56 technique used was proportional stratified random sampling.

### 57 Data Collection/Materials and Tools

58 In this research, to calculate the economic losses secondary data was used including the Gross  
 59 Regional Domestic Product per capita of Ogan Komering Ilir Regency by field of work in 2017 (8),  
 60 the number of births and population by age group in 2017 OKI Regency (9), The benchmark  
 61 rate from Bank Indonesia, and the prevalence of stunting in Ogan Komering Ilir Regency. The data  
 62 collected was then analyzed using the Konig and Horton formula with the Microsoft Excel program.  
 63 The formula used for calculating the economic value of a child when they start to work is as follows:

$$64 \quad FV_{[r,t]} = P_0 (1 + r)^t$$

65 The large economic value until the child enters the retirement period was calculated using the  
 66 following formula:

$$67 \quad FVA_{[r,t]} = \frac{FV_{[r,t]} [(1 + r)^t - 1]}{r}$$

68 The potential economic value of a child at the age of 0 years was calculated using the following  
 69 formula:

$$70 \quad PV_{[0]} = \frac{FVA_{[r,t]}}{(1 + r)^t}$$

71 The magnitude of the lost productivity cost due to stunting was calculated using the following  
 72 formula:

$$73 \quad P_{PEM} = Prev \times \sum BL \times PV_{[0]}$$

74 Calculation of the magnitude of the economic loss due to stunting with the correction factor from  
 75 Horton, states that in actual conditions, the child can still recover and still has a productivity value  
 76 of less than 100%. Therefore, it will only experience a productivity loss of 2-9%. The following  
 77 formula is used:

$$78 \quad P_{PEM} = f_{(cor)} \times Prev \times \sum BL \times PV_{[0]}$$

### 79 Description:

- 80 a.  $FV_{[r,t]}$  = Income in productive age (15-64 years old).
- 81 b.  $FVA_{[r,t]}$  = Economic value until the child enters retirement age.
- 82 c.  $PV_{[0]}$  = Child's economic potential at 0 years old.
- 83 d.  $P_0$  = PDRB per capita.
- 84 e.  $r$  = Annual interest rate.
- 85 f.  $t$  = Years in productive age.

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- 86 g. PPEM = Potential economic loss due to stunting.  
87 h. Prev = Prevalence of stunting.  
88 i. TBL = Total births.  
89 j. f(cor) = Correction factor (2% and 9%).

#### 90 Data Analysis

91 The data analysis performed was univariate, bivariate, and multivariate. Bivariate analysis was  
92 performed using statistical tests and the Chi-Square test, while multivariate analysis was performed  
93 using the predictive logistic regression model test.

### 94 RESULT

#### 95 Family and Sample Characteristics

96 Family characteristics collected include descriptions of parents' education, occupation, and average  
97 age. Meanwhile, the characteristics of the sample include a distribution of the gender and the average  
98 age of the toddlers. The characteristics of the family indicate that the highest level of education for  
99 fathers was high school graduates, accounting for 33.8%, while 39% for mothers. Based on the  
100 parents' occupation, the majority of fathers work as self-employed/traders, accounting for 58%, while  
101 the majority of mothers are housewives/not working, accounting for 77.9%. The characteristics of  
102 the sample show that 50.6% of the boy and 49.4% are girl. The average age of the toddlers collected  
103 was 22 months.

#### 104 Characteristic Respondent

105 In this research, the data in the table 1 shows that more than 50% of the toddlers examine fall under  
106 the category of stunted toddlers. Subsequently, of the families that participated, almost 60%, belong  
107 to the category with low economic status. In this research, there are more families with limited dietary  
108 diversity, accounting for 61%, compared to those with diverse diets. Almost 80% of the toddlers in  
109 the families examine have good habits of attending integrated service post programs. The results  
110 show that 87% of toddlers have a history of infectious diseases.

#### 111 Economic Losses

112 Based on the analysis results, it was found that out of 46 toddlers from low-economic families, there  
113 was an equally balanced proportion of stunted and normal status. The statistical results of the  
114 bivariate analysis in the presented table above show that the economic status described by household  
115 food expenditure is not related to the occurrence of stunting in toddlers (p-value > 0.05).

116  
117 Table 3 shows that the group of families with limited dietary diversity has the largest proportion of  
118 stunting in toddlers, accounting for about 70.2%. Meanwhile, in families with diverse diets, the  
119 largest proportion was reported in the influence on the normal toddler height. The statistical results  
120 show that the dietary diversity variable is related to the occurrence of stunting in toddlers in the  
121 Pedamaran sub-district, with a p-value of 0.0001 (p-value <  $\alpha$ ). Subsequently, diversity in food is a  
122 risk factor: PR 7.745 CI 95% 2.706-22.175, which means if a family consumes a limited variety of  
123 foods, it can increase the risk of stunting in toddlers by 7.745 times greater than families with diverse  
124 food consumption.

125 Table 4 shows that there are still toddlers experiencing stunting with the highest proportion in the  
126 group whose attendance at integrated service posts is less than 8 times, accounting for 56.3%. The  
127 p-value in the statistical results is 0.916 (p-value >  $\alpha$ ), which means there is no relationship between  
128 toddler participation in integrated service posts and stunting.

129 Table 5 shows that 40 toddlers experienced stunting, of which 36 had a history of infectious diseases  
130 with a proportion of 53.75%. The p-value generated from statistical calculations is 0.637, which

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14 means there is no relationship between the history of infectious diseases in toddlers during the last month and stunting.

#### 133 *Final Modeling Results*

134 From the table 3, it is found that the variable that enters the final modeling is Dietary Diversity. The  
135 statistical results show that there is a relationship between the diversity of food consumed in the  
136 family and stunting in toddlers. Other statistical results show a PR value of 7.745, meaning  
137 consuming a monotonous diet in the family can affect the development of a toddler's height and can  
138 cause the toddler to be classified as stunting 7.745 times more than families who consume diverse  
139 foods.

#### 140 *Calculation of Losses*

141 The results of the calculations performed using the appropriate formula are presented in table 7. The  
142 amount of income during the productive age (FV) is 128 million rupiahs. The economic value until  
143 the child reaches retirement age (FVA) is 9,402 billion rupiahs. The potential economic value of the  
144 child at the age of 0 (PV) is 2,284 billion rupiahs. The amount of productivity loss due to stunting  
145 (PEM) is 8,498 billion rupiahs.

146 However, according to Horton (1999), individuals who experience malnutrition problems will  
147 experience a decrease in productivity of 2%-9%. Therefore, in table 8, the amount of losses caused  
148 by a 2% and 9% decrease in productivity due to stunting in the calculation using the last formula is  
149 Rp170 billion – Rp765 billion.

#### 150 **DISCUSSION**

##### 151 *Relationship between family economic status and stunting*

152 In this research, the economic status was measured using the household expenditure indicator for  
153 food for one month. Previous research has shown that in developing countries, people usually use  
154 their income to buy food. Subsequently, family economic status was divided into two categories,  
155 namely low and high economic status (10).

23 The results of the statistical test results showed that the economic status, as described by household  
156 food expenditure was not significantly associated with the occurrence of stunting in toddlers in the  
157 Pedamaran sub-district (p-value > 0.05). This result is different from previous research that also used  
158 household food expenditure as an indicator of economic status, the results of statistical tests showed  
159 economic status as described by household food expenditure had a significant relationship with  
160 the incidence of stunting in toddlers in Palembang City, to be precise at the 11th Public Health Center  
161 Ilir (p-value > 0.031) (11). Then research conducted by Indrastuty and Pujiyanto, which reported a  
162 significant relationship between family economic status and stunting in toddlers (12,13).

164 Between economic status and stunting is that the amount of money spent by households is not  
165 maximally used to buy high-quality food ingredients. Although families with higher food spending  
166 may have more money, that doesn't necessarily mean more money is being used to buy more diverse  
167 and higher-quality food for their children. The quality and quantity of food needed to meet nutritional  
168 requirements cannot be met. Therefore, diversity is necessary because each food provides different  
169 chemical elements needed by the body for growth and health (14).

##### 170 *Diversity of Toddler Consumption (Dietary Diversity) with Stunting Incidents*

171 Toddlers' food consumption quality can be assessed through the variety of menus and food  
172 ingredients they consume, which can be measured by the dietary diversity score (DDS).  
173 Subsequently, an individual's dietary diversity score aims to reflect their nutritional adequacy, and  
174 research across different age groups has shown that an increase in an individual's dietary diversity  
175 score is associated with an increase in the nutritional adequacy of the food consumed (15).

176 The chi-square test results show a significant relationship between dietary diversity and the incidence  
177 of stunting in toddlers ( $p \leq 0.05$ ). This result is consistent with a survey conducted by Ruel and  
178 Arimond in 11 countries, which showed a relationship between dietary diversity and nutritional status  
179 measured by weight-for-length/height (TB/U) in children aged 19 months. In addition to this  
180 research, other findings from Faiqoh, Suyatno, and Kartini indicate a significant relationship between  
181 dietary diversity and the incidence of stunting in toddlers aged 24-59 months (16).

182 Food consumption is a crucial factor in determining a person's nutritional status, as it involves the  
183 types and amounts of food an individual or a group consumes at a specific time (17,18). The quality  
184 of the diet can be determined by the diversity of consumption since various nutritional needs can be  
185 met through a variety of foods (19).

#### 186 ***The Relationship between Toddler Participation in Integrated Healthcare Center and Stunting***

187 Madanijah and Triana grouped the mothers of toddler's participation in integrated health posts into  
188 four categories, based on attendance, activity, use of the Towards Health Card (KMS), and efforts to  
189 develop the integrated health posts such as providing funding, facilities, personnel, and time, as well  
190 providing food or supplementary feeding (20).

191 The statistical test result showed that there was no relationship between toddler participation in  
192 integrated health posts and the incidence of stunting in the Pedamaran sub-district. This research is  
193 consistent with an investigation conducted by Wahyuningtyas, which found no relationship between  
194 maternal perception of Integrated Healthcare Center and toddler participation in Integrated  
195 Healthcare Center with the incidence of stunting in Giliw in Surakarta (17). Furthermore,  
196 research by Rarastiti found no relationship between frequency of toddler visits to the Integrated  
197 Healthcare Center and their nutritional status (19). This research is not in line with an investigation  
198 conducted by Anggraeni, which found a significant relationship between family activity in Integrated  
199 Healthcare Center activities and the nutritional status of toddlers (21).

200 The lack of correlation between toddlers' participation in the Integrated Healthcare Center and the  
201 occurrence of stunting may be due to suboptimal utilization of the Integrated Healthcare Center.  
202 Furthermore, Fitri stated that Integrated Healthcare Center is one of the good approaches to reducing  
203 morbidity or mortality in children and improving the nutritional status of toddlers (22).

#### 204 ***Correlation between History of Disease Infection and Incidence of Stunting***

205 Infectious disease is a direct cause of nutritional problems, and its presence in a child's body can have  
206 an impact on the nutritional status. The results of statistical tests conducted show no relationship  
207 between the history of infectious diseases and occurrence of stunting in children in the Pedamaran  
208 Sub-district. This research is different from the results of the previous investigation conducted by  
209 Soekirman, which showed that infectious diseases are one of the factors associated with stunting (5).  
210 Subsequently, diarrheal diseases among children also contribute to the incidence of stunting in some  
211 African countries, such as Libya (23).

212 These results showed a negative correlation, which could be because the infectious diseases surveyed  
213 only covered the past month, which may not necessarily represent the infectious diseases that the  
214 children in Pedamaran have experienced. Subsequently, Nirmalasari stated that stunting is the result  
215 of a combination of poor quality consumption, morbidity, infectious diseases, and environmental  
216 problems over a long or chronic period (24).

#### 217 ***Potential Economic Losses Due to Stunting***

218 The loss of economic potential due to stunting in toddlers in Ogan Komering Ilir Regency, when they  
219 are adults and experience a loss of productivity of 2% was IDR 170 billion, while a 9% productivity  
220 loss was IDR 765 billion. Looking at this as a percentage of GDP, the loss of economic potential due  
221 to a 2% and 9% drop in productivity was about 0.67%-3.03%.

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222 Renyoet stated that the economic losses caused by stunting in toddlers cannot be fully calculated yet  
 223 because the calculation does not include the cost of treatment due to infectious diseases that occur in  
 224 stunted toddlers, as well as the cost of premature death caused by non-communicable or other  
 225 diseases caused by stunting (5).

226 Every newborn baby is a potential human resource that has its economic productivity value.  
 227 Meanwhile, high birth rates and increasing numbers of stunted children can lead to high potential  
 228 economic losses as well. According to Freijer, the total additional cost for malnutrition-related adult  
 229 patients was estimated at 1.9 billion euros in 2011, which is equivalent to 2.1% of the total national  
 230 healthcare expenditure in the Netherlands and 4.9% of total healthcare sector costs (23). A meta-  
 231 analysis of 45 longitudinal studies in the United States shows that there is a significant relationship  
 232 between height and career success and salary in the work environment. A person who is six feet (1.82  
 233 m) on average earns a salary over a 30-year career of about \$166,000 more than someone who is five  
 234 feet five inches (1.55 m) tall. This shows that a person's height affects the type of work, income, and  
 235 work productivity (5,25).

### 236 CONCLUSION

237 In conclusion, the study found that stunting was a prevalent issue in the Pecairan Sub-district, with  
 238 a rate of 51.9% in toddlers aged 12-35 months. Meanwhile, the results showed that there was a  
 239 relationship between dietary diversity and the incidence of stunting (p-value = 0.0001; PR = 2.705-  
 240 22.175). There was no significant relationship between other factors such as economic status (p-  
 241 value = 0.854), participation of toddlers in integrated health packages (p-value = 0.916), and history of  
 242 infectious diseases (p-value = 0.637) and the relationship with the incidence of stunting. Therefore,  
 243 the most dominant factor related to stunting was dietary diversity. There were economic losses  
 244 caused by decreased productivity of 2% and 9% due to stunting, amounting to IDR 170 billion and  
 245 IDR 765 billion, respectively, or 0.67%-3.03% of the 2017 OKI GRDP.

### 246 Author Contributions:

247 ANR and AR in this study have a role in designing research and data analysis. Then ANR and AR  
 248 also has the role of writing manuscripts and revisions for important content.

### 249 Declaration of Conflict of Interest:

250 There are no conflicts of interest associated with this publication.

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### 258 Ethics clearance

259 This study was ethically approved by Health Research Ethics Committee Faculty of Public Health  
 260 Sriwijaya University, with number: 75/UN9.1.10/KKE/2019.

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**Table 1. Frequency Distribution of Univariate Results**

No	Variable	N	%
1	Stunting		
	Stunting	40	51.9
	Normal	37	48.1
2	Economic Status		
	Low ( < Rp 1.923.857,- )	46	59.7
	High ( ≥ Rp 1.923.857,- )	31	40.3
3	Dietary Diversity		
	Undifferentiated Consumption	47	61.0
	Diverse Consumption	30	39.0
4	Toddler Participation in Posyandu		
	Not Good (<8x)	16	20.8
	Good ( ≥ 8x )	61	79.2
5	History of infection		
	Yes	67	87.0
	No	10	13.0

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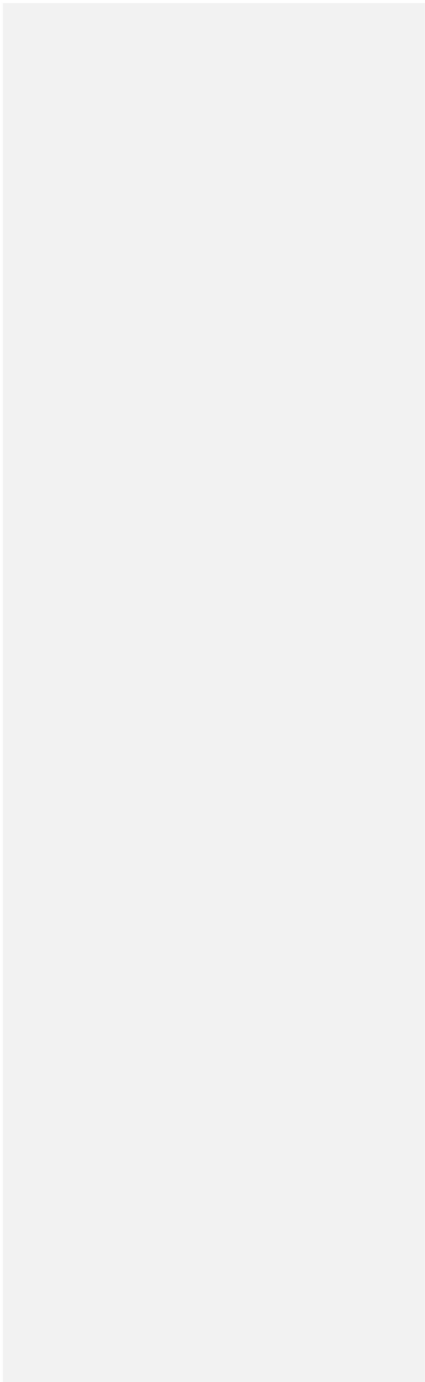
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**Table 2. Relationship between Economic Status  
(Household Food Expenditures) and Stunting**

Economic Status	TB/U Nutritional Status				N	p-value	PR 95% CI
	Stunting		Normal				
	n	%	n	%			
Low	23	50.0	23	50.0	46	0.854	0.824 (0.330 – 2.053)
High	17	54.8	14	45.2	31		

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**Table 3. Relationship between Dietary Diversity and Stunting**

<i>Dietary Diversity</i>	Status Gizi TB/U				N	p-value	PR 95% CI
	Stunting		Normal				
	n	%	n	%			
Consumption does not vary	33	70.2	14	29.8	47	0.000	7.745
Various consumption	7	23.3	23	76.7	30	1	(2.705 – 22.175)

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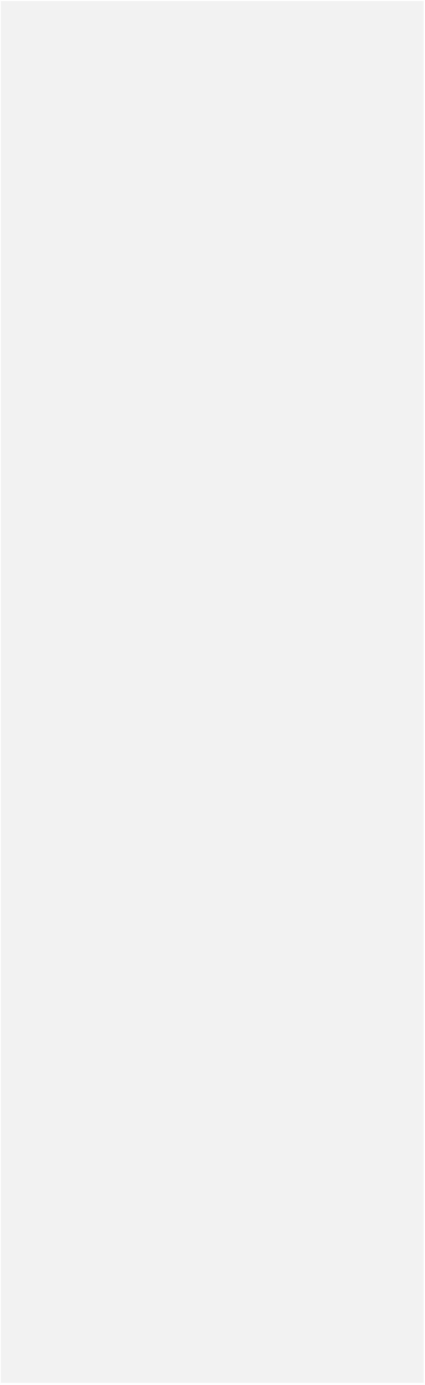
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440 **Table 4. Relationship between Toddler Participation in Integrated Service Post and**  
 441 **Stunting**

Toddler participation in integrated service post	TB/U Nutritional Status				N	p- value	PR 95% CI
	Stunting		Normal				
	n	%	n	%			
Not Good	9	56.3	7	43.7	16	0.916	1.244 (0.411 – 3.768)
Good	31	50.8	30	49.2	61		

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**Table 5. Relationship between History of Disease Infection and Stunting**

History of infection	TB/U Nutritional Status				N	p-value	PR 95% CI
	Stunting		Normal				
	n	%	n	%			
Ya	36	53.7	31	46.3	67	0.637	1.742
Tidak	4	40.0	6	60.0	10		(0.450 – 6.741)

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**Table 6. Final Multivariate Modeling Results (final model)**

Variable	p-value	PR	95% CI	
		Crude	Min	Max
<i>Dietary Diversity</i>	0.00001	7.745	2.705	22.175

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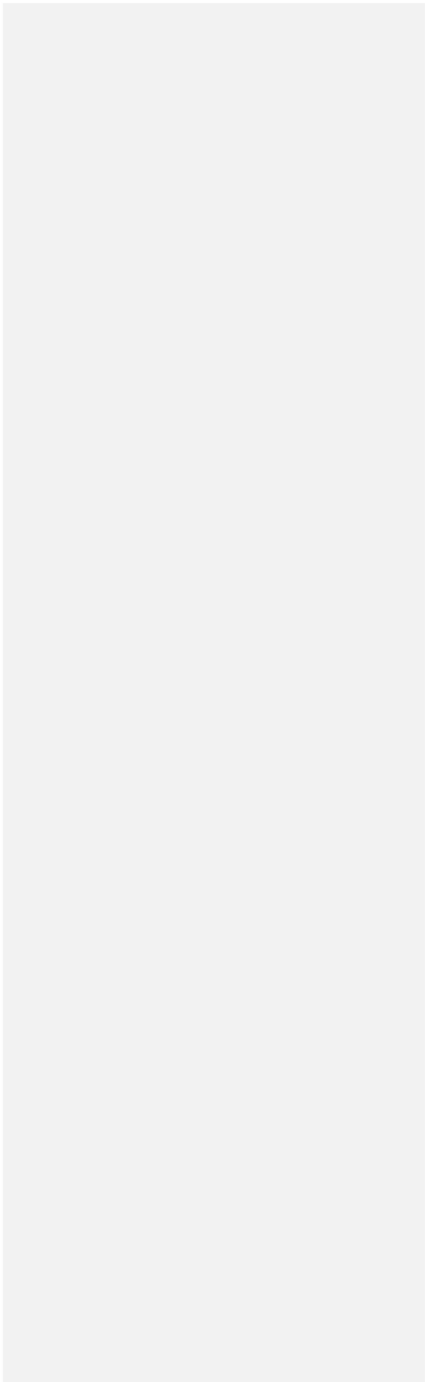
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**Table 7. Formula Calculation Results**

Formula Variables	Yield (Billion Rupiah)
FV	0.128
FVA	9.402
PV	2.284
PPem	8.498

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557 **Table 8. Potential Economic Losses due to Stunting in Ogan Komering Ilir Regency**

Regency	2%	9%	%PDRB	
	(Billion rupiah)	(Billion rupiah)	2%	9%
Ogan Komering Ilir	170	765	0.67	3.03

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