

## RESEARCH STUDY

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# The Relationship between Food Diversity and Development of Stunted Toddlers in Cisayong District, Tasikmalaya Regency, Indonesia

## Hubungan Keragaman Makanan dan Perkembangan Balita Stunting di Kecamatan Cisayong Kabupaten Tasikmalaya Indonesia

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**ABSTRACT**

**Background:** Stunting is chronic malnutrition causes impaired physical growth, cognitive functions, motor skills, decreased physical capacity, and nerve development. The prevalence of stunting in Tasikmalaya Regency was 24.4% in 2021 then increased to 27.2% in 2022. One of the stunting locus villages in Tasikmalaya Regency is Cisayong.

**Objectives:** The primary aim of the study was to analyze the relationship between food diversity and the development of stunted toddlers in Cisayong Village, Tasikmalaya Regency.

**Methods:** Case control study with a population of toddlers aged 24-59 months based on toddler weighing data in February 2023. The samples were calculated based on the Lemeshow formula involving 49 toddlers in the case group and 98 toddlers in the control group. The adopted research instruments were the food diversity score questionnaire and the Pre-Development Screening Questionnaire (KPSP).

**Results:** Most toddlers (57.14%) consumed a variety of foods, (62.59%) indicated developmental stages that did not match the KPSP. The results of the Mann Whitney test produced a p-value of 0.47 indicating that there was no significant difference in the variety of food consumed by toddlers. Toddlers whose developmental stages did not match were more often identified in stunted toddlers rather than well-grown toddlers. In particular, there was a significant difference in developmental level scores between the two groups of toddlers (p-value<0.001).

**Conclusions:** Well-grown toddlers indicated the same differences in terms of food diversity. There was a difference in developmental level scores between the two groups of toddlers.

**INTRODUCTION**

Stunting is chronic malnutrition occurring during the early years of life in toddlers. During the toddler years, stunting can lead to a number of problems, such as poor motor skills, impaired cognitive function, stunted physical growth, lower physical capacity, stunted neurological development, decreased productivity, and lost financial gains. Stunting prevents toddlers from reaching optimal physical and cognitive potentials. Studies conducted in India unveiled that persistent stunting in infancy was associated with a decrease in IQ of 4-5 points<sup>1</sup>.

A toddler's first 1000 days of life beginning at conception (270 days) and end at age 2 (730 days) remains crucial. This occurs there is a high need for nutritional intake needed for neurogenesis, neuron migration, axonal, dendritic growth, synaptogenesis and myelination. During this period, the brain grows to about

80% of its adult weight. During this time, malnutrition can cause in serious and irreversible harm<sup>2</sup>.

A more diverse diet also means good quality nutrition to enhance bone health and physical strengths resulting in better motor performance<sup>3</sup>. Dietary diversity is correlated with mental development, gross motor skills and fine motor skills functioning as significant mediators related to stunting. High nutritional needs and capabilities are necessary to sustain early life development and growth at high rates<sup>4</sup>. Long acknowledged as a crucial component of a high-quality diet, dietary variety is identified on the idea that no one meal can supply the proper quantity of nutrients to sustain optimum health. Food variety or Dietary Diversity Score (DDS) is the quantity of nutritional categories ate during a 24-hour time frame. The DDS marker is useful for assessing toddlers' nutritional status, wholesome sufficiency, and food quality<sup>3</sup>.

Toddlers undergo a rapid growth phase characterized by a twofold to fourfold increase in the need for essential amino acids. The best supply of necessary amino acids comes from animal protein containing a high digestion and bioavailability. Consuming staple foods, and at least one animal food and fruit or vegetables every day remains necessary to meet toddlers' micronutrient needs. The World Health Organization (WHO) uses dietary diversity as one of the key indicators for assessing toddlers' eating practices<sup>5</sup>. Fish/shrimp and poultry (animal sources) protein intake is positively associated with changes in cognitive Z-score. This study infers that increasing consumption of animal proteins can help prevent cognitive decline<sup>6</sup>.

The food varieties containing vitamin B12 are fundamentally creature meat, fish, eggs, and dairy. In toddlers with severe vitamin B12 deficiency, macrocytic anemia were common manifestations<sup>7</sup>. In general, animal proteins (meat, eggs, and milk; approximately 93%) are more digestible than vegetable proteins (nuts, seeds) in the original dietary matrix (about 80%)<sup>8</sup>. An essential fat-soluble micronutrient, vitamin A is required for healthy mucous membrane maintenance, appropriate growth and development, immunity, reproductive health, and eyesight, particularly for dark adaptation<sup>9</sup>. Inflammation, alterations in leptin, and elevated glucocorticoids due to early starvation can all lead to epigenetic modifications. Developmental delays may emerge from these alterations in neurogenesis, apoptosis, and synaptic dysfunction. All of which can impede neurodevelopment<sup>10</sup>. The brain regions responsible for cognition, memory, and motor abilities are affected by malnutrition. Empirically speaking, Ocansey's study also demonstrated the connection between stunting and cognitive performance<sup>11</sup>.

Comprehending how dietary diversity is related to the development of children under five is highly crucial to scrutinize because it can support the implementation of interventions against stunting in the future<sup>12</sup>. The results of the 2018 Basic Health Research (*Riskesdas*) reported that the percentage of toddlers experiencing fine motor development disorders was 9.8%. This number was higher than the 6.2% viewed from the 2013 *Riskesdas* data related to fine motor development issues. This demonstrates that toddlers with motor development disorders—particularly those involving fine motor skills—represent a significant public health issue in Indonesia<sup>13</sup>. The Indonesian Nutritional Status Survey (SSGI) performed by the Ministry of Health revealed that the countries' stunting prevalence dropped from 24.4% in 2021 to 21.6% in 2022. This amount, however, was still greater than the World Health Organization's (WHO) 20% upper tolerance for stunting<sup>2</sup>.

Tasikmalaya Regency reported a stunting prevalence of 24.4% in 2021, then increased to 27.2% in 2022 and was ranked fourth for the highest stunting prevalence in West Java Province in Indonesia<sup>14</sup>. In Tasikmalaya Regency, there are 8 sub-districts with a high prevalence of stunting. In response to this, special locations (locus) for stunting, namely Cisayong, Cigalontang, Bojongasih, Taraju, Salopa, Sukahening, Bojonggambir, and Sukarame sub-districts were selected. Cisayong District is included in the stunting locus. Data

from simultaneous weighings conducted in August 2022 at the Cisayong Community Health Center revealed that 643 toddlers between the ages of 0 and 59 months suffered from stunting. The toddlers were spread across 13 villages, namely Santanamekar, Sukajadi, Cisayong, Sukasukur, Jatihurip, Sukaharja, Mekarwangi, Nusawangi, Cikadu, Purwasari, Cileuleus and Sukamukti. Cisayong Village is the village with the highest cases of stunting, namely 476 toddlers<sup>15</sup>.

Toddlers aged 24-59 months are a crucial age where there is an increase in physical development, learning abilities, social and emotional<sup>16</sup>. The percentage of toddlers consuming a minimum dietary diversity (including at least four types of food) was unchanged from 53.1% in 2007 to 53.7% in 2017, and was lower in rural regions according to a combined study of the Indonesian Demographic and Health Survey from 2007 to 2017<sup>14</sup>. Likewise, Food and Agriculture Organization (FAO) guidelines note that there are nine categories of food, namely cereals, green vegetables, vitamin A-rich vegetables and fruits, other vegetables and fruits, organ meat (offal) meat and fish, eggs, nuts and seeds, and milk and its preparations<sup>17</sup>.

This study attempts to evaluate the impacts of toddlers' dietary diversity on stunted toddlers' growth since it is still under-researched. This study aimed at analyzing the relationship between food diversity and the development of stunted toddlers in Cisayong Village, Tasikmalaya Regency. Studies have never been conducted on food diversity and the development of stunted toddlers in Cisayong. Therefore, this study is urgent to undertake. Further, food diversity indicators are useful for assessing food quality, nutritional adequacy and nutritional status of children to be a basis for providing interventions to reduce the incidence of stunting in Indonesia in general and Cisayong Village in particular.

## METHODS

This study was conducted in the Cisayong Village. The consideration for selecting this investigative place was it was a locus village (special location) for stunting investigation. Besides, there had not been studies focusing on food diversity and the development of stunted toddlers in such a village. This study was crucial to identify the development of stunted toddlers at an early stage so that they could prevent disability and improve long-term health (e.g. physical and social well-being), prevent short-term and long-term health effects (e.g. disability and death) and minimize the impact on individual income and gross national product.

This study adopted an observational study with a cross-sectional study design to analyze the relationship between food diversity and the development of stunted toddlers. The investigative population was 1,123 toddlers in Cisayong Village, Cisayong District, Tasikmalaya Regency. Their ages ranged from 24-59 months in 2023. This study was undertaken to toddlers aged 24-59 months. These ages were selected because it was a crucial age where there was an increase in physical development, learning abilities, social and emotional. The participants of this study were mothers possessing toddlers. Besides, case inclusion (Stunting) criteria were

toddlers aged from 24 to 59 months in Cisayong District. Moreover, mothers possessing stunted toddlers based on particular criteria, such as the height/age index. This was undertaken because the anthropometric standard for assessing toddlers' nutritional status was applied. The measuring results were at the threshold (Z-Score) <-2 SD to -3 SD and lived permanently at the investigative location. Furthermore, participants were willing to be interviewed and they filled out an informed consent form. Case exclusion criteria were that the toddlers' mothers were absent for 3 consecutive times at the time of the study. Control inclusion (well-) criteria were toddlers with normal height/age index living permanently at the research location, with the same age range as the case group, same gender as the cases and willingness to be interviewed.

The sample was calculated by adopting the Lemeshow formula. The results in a total sample of 49 cases with a ratio of cases and controls of 1:2. It meant that the total sample was 147 people. The independent variable in this study was food diversity. Examination of toddlers' development applying the Pre-Screening Development Questionnaire (KPSP) aimed at determining whether the development of toddlers was normal or not (there were deviations). Interpreting the development of toddlers can be viewed from this illustration "if the number of Yes answers is 9 or 10, the development of toddlers reached the stage of development (S)". Additionally, "If the number of Yes answers was 7 or 8, or the Yes answers were 6 or less, the development toddlers was inappropriate to the developmental stage". The research instrument was implemented to measure food diversity through a dietary diversity questionnaire adapted from the Dietary Diversity Score Indicator Guide. It was carried out to obtain food diversity score data. The food diversity score was obtained by adding up the consumed food groups. Toddlers with a total score of ≥4 (4 types of food groups) were categorized as consuming a variety of food. Meanwhile, toddlers with a total score < 4 can be categorized as consuming less diverse foods. The Pre-Developmental Screening Questionnaire (KPSP) was the development examination test utilizing a questionnaire<sup>18</sup>. The Developmental Pre-Screening Questionnaire (KPSP) was one of the screening/detection tools required by the Ministry of Health to be used at the primary health care level. The Pre-Developmental Screening Questionnaire (KPSP) is an early detection instrument in the development of children aged 0 to 6 years.

The purpose of screening (examining) toddlers'

development with KPSP was to determine whether their development was normal or not (e.g. deviations). The KPSP form according to age contains 9-10 questions focusing on the attained developmental abilities. Answer Yes: If the mothers/caregivers of toddlers answers: the child can or has or often or sometimes does it. Answer No: If the child's mother/caregiver answers: the child has never done it or never or the child's mother/caregiver doesn't know. Number of answers Yes 9 or 10, the child's development is appropriate to the stage of development (S) 7 or 8, the child's development is doubtful (M) 6 or less, there may be deviations (P). The dependent variable in the research was child development which was measured using the Pre-Developmental Screening Form (KPSP) from the Indonesian Ministry of Health. The results of the Mann Whitney statistical test obtained a p-value<0.05 meaning that there was a difference in development level scores between stunted and well-grown toddlers. The Health Research Ethics Committee at Mataram Health Polytechnic had granted ethical permission for this research and officially proven with reference number LB.01.03/6/328/2023 dated July 21, 2023.

## RESULTS AND DISCUSSIONS

Cisayong District is one of the sub-districts in Tasikmalaya Regency, West Java Province. In general, Cisayong District is located in a stretch area with an average height of 450-800 meters above sea level. Cisayong District consists of 13 villages with a total of 87 Community Units (RW) and 341 Neighborhood Units (RT). The villages in Cisayong District cover Santanamekar, Cisayong, Sukajadi, Sukasukur, Jatihurip, Sukaharja, Mekarwangi, Nusawang, Cikadu, Purwasari, Cileuleus, Sukasetia and Sukamukti. The largest number of RTs and RWs are located in Cisayong Village with 39 RTs and 13 RWs. On the other hand, the village with the lowest number of RTs is situated in Sukamukti Village with 21 RTs. Cisayong District has an area of 35.43 km<sup>2</sup> with various territorial boundaries. In particular, in South and West, Cisayong Village borders Sukaratu District. In the North, it borders Sukahening District. In the East, it borders Tasikmalaya Municipality. The total population of Cisayong Village is 61,121 people consisting of 31,036 male residents and 30,085 female residents. The educational backgrounds of the Cisayong residents are elementary school (20.65%), junior high school (56.65%), senior high school (13.48%), associate degrees (D1, D2 and D3) (1.92%), undergraduate and post-graduate degrees (S1, S2 and S3) (1.63%).

**Table 1.** Frequency Distribution of Toddler Characteristics in Cisayong Village, Tasikmalaya Regency in 2023

Characteristics	Stunting	Well-Grown
<b>Mother's Age (Year)</b>		
Mean	31.63	31.59
Standard Deviation	6.55	6.46
Minimum	21	19
Maximum	49	46
<b>Toddler's Age (Month)</b>		
Mean	39.82	38.00
Std. Deviation	9.21	10.31
Minimum	24.00	24.00
Maximum	58.00	59.00

<b>Toddler's Gender (n (%))</b>		
Male	29 (59.2)	57 (58.2)
Female	20 (40.8)	41 (41.8)
<b>Toddler's Height (cm)</b>		
Mean	85.28	97.30
Std. Deviation	5.86	8.54
Minimum	74.00	83.00
Maximum	99.00	119.00

The average height of the stunted toddler group in Cisayong District, Tasikmalaya Regency was 85 cm, shorter than the height of well-grown toddler group, namely 97 cm. In the stunted toddler group, the shortest height was 74 cm compared to 83 cm for those without stunting. The highest height in the stunted toddler group was 99 cm. This means that the height of the tallest group of stunted toddlers was lower when compared to the group of well-grown toddlers (119 cm as the maximum height). Maternal level was a hereditary intermediary in foreseeing youngster level. Expanding a mother's level may decrease the gamble of hindering in her youngsters. Notwithstanding, it ought to be noticed that hereditary factors merely assumed 30% parts in a youngster's level.

On the other hand, 70% was brought about by external factors including the wholesome and wellbeing intake, such as natural variables, nurturing designs, and the toddlers' eating patterns affecting the dietary status of toddlers. Toddlers conceived <46 cm long were more limited in level than their companions when they arrived at two years old. There is a correlation between birth length and body length, body height, birth body length and growth and development<sup>19</sup>. Toddlers with a birth length under 48 cm (short) tended to have a 15.0 times higher gamble of encountering hindering contrasted with those possessing a body length ≥48 cm. The body length of the toddlers cannot be separated from the growth and development of fetus during the neonatal period <sup>20</sup>.

**Table 2.** Diversity of Toddler Food in Cisayong District in 2023

No.	Food Group	Food material	Stunting		Well-Grown	
			Yes n (%)	No n (%)	Yes n (%)	No n (%)
1.	Cereals	Rice, corn/maezena, cassava, potatoes, sweet potatoes, (white/purple), wheat/wheat or processed food ingredients	49 (100.0)	0 (0%)	98 (100.0)	0 (0%)
2.	Green vegetable	Beans, broccoli, kangkong, lettuce, cassava leaves, mustard greens, pumpkin leaves and spinach.	14 (28.6)	35 (71.4)	14 (14.3)	84 (85.7)
3.	Fruits and vegetables are sources of Vitamin A	Carrots, pumpkin, mango, papaya, tomatoes	19 (38.8)	30 (61.2)	33 (33.7)	65 (66.3)
4.	Other fruits and vegetables	Cucumbers, eggplants, mushrooms, long beans, apples, avocados, bananas, durian, grapes, pears, guava, longan, pineapple, rambutans, strawberries, watermelon and star fruit	21 (42.9)	28 (57.1)	35 (35.7)	63 (64.3)
5.	Innards	Tripe, heart, Gizzard, lungs and intestines	2 (4.1)	47 (95.9)	1 (1.0)	97 (99.0)
6.	Fish and meat	Tripe, heart. Gizzard, lungs and intestines	22 (44.9)	27 (55.1)	53 (54.1)	45 (45.9)
7.	Egg	Chicken eggs, duck eggs and quail eggs	30 (61.2)	19 (38.8)	70 (71.4)	28 (28.6)
8.	Pods, seeds and nuts	Green beans, peanuts, soybeans (tempeh, tofu, soy milk) nuts and seeds products (peanut butter)	17 (34.7)	32 (65.3)	24 (24.5)	74 (75.5)
9.	Dairy products and milk	Milk and dairy products	19 (38.8)	30 (61.2)	36 (36.7)	62 (63.3)

The average Dietary diversity score (DDS) in Cisayong District, Tasikmalaya Regency was 3.90. This signifies a low food diversity score compared to a Dietary

diversity score of four or higher. The averages identified in this study were very identical to those detected in earlier research on children under five in Ghana, Africa.

Such research was conducted in Ekumfi Narkwa, Ghana. The findings uncovered that the main food group consumed daily was the meat food group reaching 79.8% (e.g. consumption of meat and fish). Daily fish consumption was 78% (195 of 250) leading to high consumption of meat. One-tenth of children (27 out of 250) consumed food with rich vitamin A every day. Almost half (118 of 250) of children met minimum food requirements with a mean food diversity score of  $2.28 \pm 1.33$ . Food diversity in Ekumfi Narkwa was limited for children under five. Fruits and vegetables derived from plants with abundant vitamin A were underutilized despite high meat consumption.<sup>21</sup>

Bone-building nutrients can be obtained from food. Bones comprise of 35% minerals (basically Ca and P), 20% natural collagen materials, and 45% water. In the 1,000 HPK period, it is feasible for toddlers to be hindered from stunting through appropriate nurturing and eating designs. Factors related to the mother's healthy state during pregnancy are indirect reasons enhancing fetal growth. Intrauterine growth retardation (IUGR) is caused by poor nutrition during pregnancy. As a result, babies born may have poor nutrition and developmental and growing problems. Increased metabolic demand and decreased appetite are signs of malnutrition in toddlers experiencing growing problems due to inadequate food intake and frequent infections.<sup>20</sup>

**Table 3.** Food Diversity and Toddler Development Stages Categories of Stunted and Well-Grown Toddlers in Cisayong District in 2023

Research variable	Stunting n (%)	Well-Grown n (%)	Amount n (%)
<b>Food Diversity</b>			
Diverse	26 (53.1)	58 (59.2)	84 (57.14)
Non-Diverse	23 (46.9)	40 (40.8)	63 (42.86)
<b>Toddler Development Stages</b>			
Inappropriate	35 (71.4)	57 (58.2)	92 (62.59)
Appropriate	14 (28.6)	41 (41.8)	55 (37.41)

More toddlers consuming assorted food did not suffer from stunting than those who did not. Based on the results of *KPSP* measurements of toddlers in Cisayong District, toddlers inappropriate at stage of development may be identified in stunted toddlers.

Detailed information about toddler development can be viewed in the supplementary file. One of them is that more than half of the number of stunted toddlers aged 24 to 30 months in Cisayong District could not take off their clothes (shirts, skirts or trousers). Only 50% of the stunted toddlers were able to ascend stairs independently while standing or gripping a wall or banister. More than 75% of stunted toddlers aged 24 to 30 years could not eat their own rice without spilling a lot. More than half of stunted toddlers aged 30 months to 35 months could not eat their own rice without spilling a lot. Half of stunted toddlers aged 30-35 months could not help pick up their own toys or lift dishes if asked. Nearly half of stunted toddlers aged 36 months to 41 months (45%) were not be able to throw a ball. In addition, there were half stunted toddlers between the ages of 42 and 47 months were not able to peddle a tricycle for at least three meters compared to well-grown toddlers (16%) who were able to perform it. Moreover, only half of all stunted toddlers aged 48-53 months could stand on one leg without holding on so that they were able to maintain balance within 2 seconds or more. On the contrary, all stunted toddlers could stand on one leg without holding on so that they maintain balance within 2 seconds or more. Furthermore, a quarter of stunted toddlers aged 54 months to 59 months could not produce longer words. In this case, they did not recognize whether the line is longer or not. Conversely, all well-grown toddlers (100%) were able to identify it.

There were 71.4% of stunted toddlers in Cisayong District indicate inappropriate developmental stages. The growth of toddlers according to developmental stages is

more prevalent in well-grown toddlers than in stunted toddlers. Cognitive growth encompasses a wide range of intricate mental skills. This process can be observed in children's varied advancements in a number of domains, such as knowledge, learning, reasoning, memory, and problem solving. Reaching the highest possible levels of cognitive growth requires mastery of language, comprehension, and thinking processes. A deficit in ideal accomplishment is typically deployed to characterize abnormal development. According to the WHO, stunted children do not only have growth issues but also developmental disabilities. Three factors may be applied to evaluate a toddler's development, such as physical, cognitive, and psychosocial stages. Stunting has been correlated to the short term to higher rates of morbidity and mortality, subpar cognitive (intellectual), motor, language development and higher health care expenses. The long-term consequences of impeding include improper adult body posture, increased risk of obesity and other degenerative diseases, decreased regenerative health, inappropriate learning and performance limits in the classroom, and inappropriate productivity and job limits<sup>2</sup>.

In the Primary Paper for Area 5 of the Public Widyakarya Food and Sustenance, pay, and efficiency in adulthood, Toddlers with learning disabilities completed lesser levels of schooling than those without such disabilities. This occurred because learning disabilities were related to mental development manifested in word reading, spelling, number crunching, and overall reading skills. Malnourished toddlers indicated difficulties to focus, remember, learn, and acquire visual and auditory information. Hindering affects mental development at specific stages. However, at higher stages, it brings about long haul mental hindrance<sup>20</sup>. Likewise, hindering is related with sub-standard mental health which adversely affects mental turn of events, instructive



accomplishment and monetary effectiveness in later life. In toddlers, the course of development of synapses takes place when it is connected with mental turn of events, such as language, perusing and memory abilities. Toddlers are a period when the density of brain synapses grows fastest. Various food sources are associated with metabolic chemicals, synapses, DNA replication, and cell division (all important components of the composite structure of the cerebrum). Dealing with this, hunger is connected with deficiencies in memory, visuomotor coordination, and interactive abilities. Further, a decrease in IQ scores is also associated with the severity of malnutrition. Malnutrition in toddlers significantly contributes to their cognitive development <sup>22</sup>.

**Differences in Dietary Diversity Scores Between Stunted and Non-Stunting Toddlers**

The output of the Kolmogorof Smirov test revealed that food diversity score data for stunted and well-grown toddlers had an Asymp value. Sig. (2 tailed) 0.003 and 0.000 (p-value<0.05). It means that the food diversity score data are not normally distributed. In other words, the Mann Whitney statistical test was utilized to determine the difference in food diversity scores between stunted and well-grown toddlers. The results of the Mann Whitney test attained a p-value = 0.47. It proves that there is no difference in food diversity between stunted and well-grown toddlers.

**Table 4.** Differences in Food Diversity Scores Between Stunting and Well-Grown Toddlers in Cisayong District in 2023

Diversity	n	Mean	SD	Mean Range	Mann-Whitney U	p-value
Stunting	49	3.90	1.12	77.38	2235.50	0.47
Not Stunting	98	3.72	1.01	72.31		

In table 4, the Exact.Sig column illustrated (2-tailed)/significance for a two-sided test is 0.47, or a probability above 0.05. This means that the development of stunted toddlers is not significantly different from the development of well-grown toddlers in Cisayong District, Tasikmalaya Regency. This finding is harmonious with a study conducted in N'Djamena—Chad sub-Saharan Africa in 2022 on a total of 881 households selected for the survey. The results disclosed that the average food diversity score was 6.5 ± 1.6 but the relationship between the food diversity score and stunting was not significant<sup>23</sup>. Another study of the relationship between food diversity, eating patterns and food intake in stunted children demonstrated that inadequate energy intake was associated with 132 (44.9%) stunted children and 125 (45.6%) insufficient fat intake (p-value<0.050). There was a connection between dietary variety and hindering with a typical worth of dietary variety of 7.51 ± 0.87 (p-value<0.050). Regarding diet, there was a relationship between less consumption of nuts and stunting (p-value = 0.019) and foods containing sugar (p-value = 0.050), namely 135 (45.3%) and 103 (43.8%). Consequently, children stunting is related to the quality and quantity of food <sup>24</sup>.

Micronutrients consumption should also be taken into account in the growth of toddlers. Micronutrients encompassing Vitamin C are essential for the production of collagen, fiber and structural proteins necessary for bone growth. Calcium intake is considerably pivotal for bone formation. Calcium plays a role in the process of substrate formation and accumulation ability during bone tissue formation. The mechanisms of cell division, growth and tissue recovery can be hampered due to insufficient calcium. As a result, it potentially inhibits the weight and height of children <sup>25</sup>. Inadequate fat intake may affect fat synthesis in which this fat functions as a substance required for children's growth and development. Background Micronutrient deficiencies often occur in women in low- and middle-income

countries. Initiation of multiple micronutrient supplements before 20 weeks' gestation provides a greater reduction in preterm birth. Generally, the survival and birth effects resulting from multiple micronutrient supplementation are greater with high compliance (≥95%) to that supplementation. Dual micronutrient supplementation does not significantly increase the risk of stillbirth (6-month neonatal death) nor overall, nor in any of the 26 subgroups examined. Early initiation in pregnancy and high adherence to various micronutrient supplements also provide greater overall benefits <sup>26</sup>.

Further, studies conducted in Sub-Saharan Africa generate a strong correlation between stunting and toddler ages. The age range of children most affected by stunting was 12 to 23 months. Similarly, the examination reported that hindering in toddler was not fundamentally correlated with low dietary variety. Conversely, there was a strong correlation between food insecurity, child age, and household size and toddler stunting aged from 12 to 59 months. Therefore, in order to lower malnutrition and food insecurity, it is necessary to suggest for the implementation of multisectoral nutritional interventions, particularly in communities and to create mechanisms increasing family income. For the purpose of early malnutrition identification and treatment, toddlers should possess their regularly-assessed nutritional status <sup>26</sup>.

**Differences in Development of Stunted and Not Stunted Toddlers**

The results of the Kolmogorof Smirov test unveiled that toddler development scores were not normally distributed (p-value<0.05). In other words, the Mann Whitney statistical test was adopted to determine the difference in toddler development scores between stunted and well-grown toddlers. The Mann Whitney statistical test results signified a difference in development level scores between stunted and well-grown toddlers with a p-value of less than 0.001.

**Table 5.** Differences in the Development of Stunted and Well-Grown Toddlers in Cisayong District, Tasikmalaya Regency in 2023

Development	n	Mean	SD	Mean Rank	Mann Whitney	p-value
Stunting	49	7.00	2.18	55.31	1485.00	0.00*
Not Stunting	98	8.24	0.94	83.35		

\*Mann Whitney test (significant if p-value<0.05)

Mustakim performed a cross-sectional study in Surabaya from July 2020 to March 2021. The study involved three hundred children. In particular, 150 of them were stunted and the remaining 150 were well-grown. Compared to well-grown children, stunted children were more likely to experience growing delays. Growing delays are correlated to children stunting in between the ages of one and three<sup>10</sup>.

Another study conducted by Amelia utilizing Denver II in the Sentolo I Kulon Progo Community Health Center operating area. The findings reported a connection between stunted and well-grown toddlers occurring between the ages of 24-59 months (p-value = 0.003). This study revealed that growth and development issues affected 69.7% of stunted children. Because stunting has long-term implications on health performance, it detrimentally affects toddler development. The growth and development of stunted and well-grown toddlers were illustrated to be related, notably in cross-sectional research design equipped with the technique of purposive sampling. Anthropometric measures (SQ-FFQ) and interviews were employed to gather data. A toddler development questionnaire designed based on the Ministerial Regulations of Education Regulations, Culture (*Permendikbud*) No. 137 of 2014 was adopted. In particular, it deals with national criteria for toddlers to test cognitive function. Multiple logistic regression, Fisher's Exact, and Chi Square tests were employed to examine the data. The findings designated that toddlers should consume enough magnesium (83.3%), protein (73.8%), and zinc (76.2%). Poor toddler intake was iodine (97.6%). The prevalence of poor cognitive function was 57.1%. Stunting and protein consumption are related to toddlers' cognitive performances where protein intake becomes the most influential factor<sup>27</sup>.

A cross-sectional study of 91 stunted children sequentially recruited from elementary schools in the West Ungaran District of the Semarang Regency revealed that 84 (92.3%) of the children were moderately stunted and 7 (7.7%) were severely stunted. Moreover, children's gross motor development indicated below average at 46.1% with an average intelligence score of 91.92. In this case, low gross motor development scores in children are linked to stunting nutritional status. Given these facts, parents and schools should be able to enhance nutrition and offer stimulation to promote gross motor abilities<sup>28</sup>. The generalizability of this study is quite high since it applies a population from the general public (not just patients seeking treatment). The limitations of this study rest on the absence of describing the course of stunting and incidence or prognosis of stunting.

## CONCLUSIONS

There is no statistically significant correlation identified in Cisayong District, Tasikmalaya Regency among miscellaneous toddlers' feeding options and prevalence of stunting. On the other hand, there is a

significant difference in the developmental level scores of stunted and well-grown toddlers in Cisayong District. It is important to educate parents of stunted toddlers about the detrimental effects of malnutrition on cognitive development. This enables them to recognize such impairments at an early age. Additionally, parents are encouraged to take a corrective or remedial action to overcome stunting by promoting the general growth and development of children. Further, it is necessary to carry out other investigative efforts (e.g. adopting a cohort study) to be able to confirm the existence of a relationship between food diversity and the development of stunted toddlers in Cisayong Village, Cisayong District, Tasikmalaya Regency, West Java, Indonesia.

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## CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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## AUTHOR CONTRIBUTIONS

NL: conceptualization, investigation, methodology, supervision, writing–review and editing; SN: methodology, writing–original draft; RAG: methodology; formal analysis, writing–original draft; DR: formal analysis, resources, writing–original draft, writing–review and editing.

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