



## Immunization status lowers the incidence of stunting in children 1-5 years

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### Introduction

Stunting is a multifactorial condition where a toddler has less body length compared to their age. Based on the World Health Organization (WHO) child growth standard, stunted children were categorized as Z-score <-2SD. Stunting plays a major role in determining children's long-term growth and it can also affect social-economic problems. Based on the Indonesia Ministry of Health report in 2017 on the global prevalence of

### Abstract

Stunting is a multifactorial condition where a toddler has less body length compared to their age. One of the factors is the immunization status of children, which can lead to susceptibility to infection and caused growth disturbance. This study was conducted to determine whether immunization plays a role as one of the interventions to prevent stunting in children aged 1-5 years by using a cross-sectional observational study with a total of 110 children aged 1-5 years who visited the Public Health Center of Jatinegara District, East Jakarta between September-November 2019. Questionnaires, anthropometric assessment using body length board and microtoice, and Z-score assessment were obtained during the study. The Chi-square test was performed for data analysis. The result of this study showed that 47,3% of respondents had incomplete immunization status, and 84.6% of the child were stunted. Immunization plays a role as one of the factors preventing stunting in children aged 1-5 years ( $p < 0,001$ ). It can be concluded that immunization is one of the factors that contribute to lowering the incidence of stunting in children aged 1-5 years.

**Keywords:** stunting, immunization, children, age 1-5 years

stunting, 55% of stunted children are in Asia, and Indonesia is ranked third among the highest stunting prevalence (36,7%) in South-East Asia between 2005-2017.<sup>1</sup>

Many factors play a role in stunting such as gender, age, low birth weight, history of infection, exclusive breastfeeding, family income, nutritional intake, maternal conditions during pregnancy, environmental sanitation, and also immunization.<sup>2</sup> World Health Organization has recommended that immunization and nutritional intake are the basic needs for children's growth and one of a few major preventions against stunting.<sup>3</sup> Indonesia's government has implemented Universal Child Immunization (UCI) with the aim of 100% of children being completely immunized, however, up

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to 2014 UCI in Indonesia had only 80% of children coverage who were completely immunized.<sup>4</sup>

Infections can mediate the changes in the body's ability to absorb and are also responsible to decrease the nutrients in the body. Infections can cause malabsorption, intestinal damage, activation of the immune system, and also reduced nutrient intake which will cause nutrient loss.<sup>5,6</sup>

Immunization was given to increase the child's immunity to specific pathogens and prevent further infections. Children under five years have an immature immune system known as anti-inflammation which susceptible to infections. Exposure to pathogens will activate the immune system to produce specific antibodies and cytokines to fight the pathogens. If the infections are repeated or chronic they can cause high levels of cytokines in the blood and suppress a child's appetite by increasing the production of leptin and decreasing the production of ghrelin. Leptin plays a role to inhibit appetite, while ghrelin plays a role to increase appetite in individuals. Repeated and chronic infections also inhibit the production of growth hormones.<sup>7</sup>

Previous studies showed different results. Swathma et al.<sup>8</sup> stated that children with incomplete immunization status had a 6 times higher risk of stunting. Fajariyah et al.<sup>9</sup> stated there is a relationship between complete immunization status and the occurrence of stunting. Children with incomplete immunizations status tend to be easily infected by pathogens which leads to high cytokine levels and stimulates higher leptin resulting in decreased appetite for children that will cause faster energy loss and high level of cytokines will also inhibit the work of growth hormones causing growth disruption and leads to stunting.<sup>10,11</sup>

In contrast to previous studies, Setiawan et al.<sup>12</sup> stated both complete and incomplete immunization status had the same risk of stunting. Azriful et al.<sup>13</sup> stated that there is no relationship between immunization status and the incidence of stunting. This is because of the multifactorial nature of stunting, immunization is just one of the factors, there are still a lot of other factors that play a role in stunting such as low birth weight, history of infection, exclusive breastfeeding, family income, nutritional intake, maternal conditions during

pregnancy, environmental sanitation, and also immunization.<sup>2</sup> The possibility of herd immunity helps to prevent stunting even though the children's immunization status is incomplete.<sup>12</sup>

According to the Basic Health Research or Riset Kesehatan Dasar (RISKESDAS) in Indonesia in 2010, 2013, and 2017 the prevalence of stunting showed an insignificant decline. Central Java is also known as one of the large provinces in Indonesia and still had a high prevalence of stunting 20-30%. Immunization is one of the interventions to protect children from specific infections. Children who have incomplete basic immunizations are more vulnerable to infections which can cause a decrease in appetite and growth disruption. Complete basic immunizations are one of the preventions to control childhood infections and can also maintain optimal child's nutritional status.<sup>3</sup>

Based on differences in previous studies and the possibility of immunizations to prevent stunting and maintains children's nutritional status, this study's objective was to determine the relationship between immunization status and the incidence of stunting in children aged 1-5 years by separating the children's age into four groups with the distance within one year from each group.

## Methods

### Study Design

This study was an observational study using a cross-sectional design. This study was conducted in the Public Health Center of Jatinegara District, East Jakarta, Indonesia from September to November 2019.

### Population and sample

The study population was children aged 1-5 years who visited the Public Health Center. The sample consisted of 110 children aged 1-5 years fulfilling inclusion criteria and was selected by consecutive non-random sampling.

### Study variables

The dependent variable was stunting, and the independent variables were immunization status, gender, and age. Children were divided based on gender and age. Gender was divided into boys and girls, while age was divided into four groups that consisted of 12-23 months, 24-35 months, 36-47 months, and 48-60 months. The inclusion criteria in this study were children aged 1-5 years who visited the Public Health Center and had maternal & child health books. The exclusion criteria in this study were children aged 1-5 years who had a history of low birth weight and short stature due to genetic and/or congenital disorders. All parents of the subjects signed the informed consent form.

### Study instruments

The study instrument used for data collection was a questionnaire to determine age, gender, history of low birth weight, genetic disorder, and growth hormone deficiency. Another instrument used for this study was a Maternal and Child Health Book (*Buku Kesehatan Ibu dan Anak/ KIA*) to collect data on child's immunization records. The immunizations status was complete if the child was fully immunized that consisting of 1 dose of *Bacille Calmette-Guerin* (BCG), 3 doses of Diphtheria-Pertussis-Tetanus (DPT), 4 doses of Polio, 3 doses of Hepatitis B, and 1 dose of Measles and considered incomplete when the child missed one or more dose of the scheduled immunizations, or not fully immunized. After the immunization status was collected, the child's height/ length was measured by using a microtoice instrument for the height of children >24 months and a length board for the length of children < 24 months. A child's body length/ height and age were assessed in Z-scores using the WHO growth standard for boys and girls aged from birth up to 5 years.

### Data analysis

Data analysis using Chi-square test with SPSS 26.0 program in the Windows operating system. Univariate analysis was used to determine the frequency of each variable. Bivariate analysis was used to determine significant relationships between dependent and independent variables.

## Results and discussion

### Subject characteristic

The results in Table 1 showed that 66 (60%) of the subjects were girls, 43 (39.1%) aged between 12-23 months, 58 (52.7%) subjects have complete immunization status and 64 (58.2%) subjects were not stunted.

Table 1 showed that 66 (60%) of the subjects were girls, meanwhile in Jombang District, showed that the subjects were mostly boys (55.7%) than girls (44.3%).<sup>14</sup> Other studies conducted in Babakan Madang, West Java showed the subjects were mostly girls (51%) than boys (49%).<sup>15</sup>

This study categorized the subject's age into four groups and most subjects' age was 12-23 months (39.1%), followed by 24-35 months (25.5%). In the previous study, subjects' age was divided into two groups and the majority of subjects were < 24 months (82.2%) and in line with this study.<sup>14</sup> Study which was conducted in Rwanda categorized the subjects' age into three groups and the majority of subjects were between 24-59 months old (58%).<sup>16</sup>

**Table 1.** Subject Characteristics

Variable	Category	Frequency (n)	Percentage (%)
Gender	Girls	66	60.0
	Boys	44	40.0
Age	12-23 months	43	39.1
	24-35 months	28	25.5
	36-47 months	27	24.5
	48-60 months	12	10.9
Immunization status	Complete	58	52.7
	Incomplete	52	47.3
Stunting	Yes (<-2SD)	46	41.8
	No (>-2SD)	64	58.2

Most of the subjects in this study had complete immunization status (52.7%) and were not similar to previous studies. The study by Nurdin et al.<sup>2</sup> conducted in Palu, found the majority of subjects' immunization statuses were incomplete (55.6%), and not similar to the study by Azriful et al.<sup>13</sup> where most of the subjects' immunization status were

incomplete (79.1%). It has been reported that complete immunization status coverage in Jakarta in 2018 reached 68%, but was below the national target.<sup>17</sup> The low coverage of immunization in Indonesia, especially DKI Jakarta, classified as an urban area, could be caused by various factors, as stated in the study by Triana et al.<sup>18</sup> This could be due to low parental education, parental knowledge, and parental attitudes in responding to immunization. Parents of respondents in this study tend to have low knowledge about immunization, where on average they knew that complete basic immunization is only enough for one dose of each vaccination. However, complete basic immunization as stated by the Ministry of Health consisted of 1 dose of *Bacille Calmette-Guerine* (BCG), 3 doses of Diphtheria-Pertussis-Tetanus (DPT), 4 doses of polio, 3 doses of hepatitis B, and 1 dose of measles.<sup>18,19</sup>

The prevalence of stunting in this study was 41.8%. Based on RISKESDAS 2018, Indonesia has managed to decrease the prevalence of stunting since 2013 from 37.2% to 30,8%. Jakarta has a lower stunting prevalence compared to the National prevalence, the prevalence of stunting in Jakarta is around 17.7%.<sup>20</sup> The prevalence of stunting in this study was higher than both National and Jakarta's prevalence of stunting.

*Relationship between gender, age, immunization status, and stunting*

Table 2 showed from the total of 110 subjects based on gender 25 (27.5%) of girls were stunted, aged 12-

23 months 19 (17.3%) were stunted, and 44 (40%) of subjects who had incomplete immunization status were stunted. It has also been found that there was no relationship between gender ( $p=0,305$ ) and age ( $p=0,206$ ) compared to the incidence of stunting, however, there is a relation between immunization status with the incidence of stunting ( $p<0,001$ ).

The result of this study showed there was no relationship between gender and stunting, the majority of subjects are girls. Setyawati et al.<sup>21</sup> stated there was no relationship between gender and stunting. A study conducted by Kirsten et al.<sup>22</sup> also stated there was no relationship between gender and stunting. In the first year of life during infancy boys have less height status than girls, but boys' height increased following their age, also the difference in nutritional intake and parenting for each individual plays a role in child growth. Boys tend to have higher meal frequency after age 2-3 years, but in some low-to-middle income countries, girls have a higher risk of stunting due to the gender discrimination that will affect their nutritional intake which results in an under-nutrition that led to stunting. Overall gender does not play a significant role to determine stunting, with both genders having a high risk of stunting.<sup>22,23</sup>

In contrast with this study, research conducted by Alphonse et al.<sup>16</sup> showed there is a relationship between gender and stunting, and it appeared that stunting mostly occurred in boys at an early age of life. Garenne et al.<sup>24</sup> also stated that boys under 30 months of age had a higher risk of stunting. This is due to *Follicle Stimulating Hormone* (FSH) and *Luteinizing Hormone* (LH) in girls being higher from an early age and helping to fasten the growth.

**Tabel 2.** The relationship between gender, age, immunization status, and stunting

Variable	Category	Stunting				Total	p
		Yes		No			
		n	%	n	%		
Gender	Girls	25	27.5	41	37.3	66	0.305
	Boys	21	23.1	23	20.9	44	
Age	12-23 months	19	17.3	24	21.8	43	0.206
	24-35 months	8	7.3	20	18.2	28	
	36-47 months	15	13.6	10.9	27	27	
	48-60 months	4	3.6	8	7.3	12	
Immunization status	Complete	2	1.8	56	50.9	58	0.001*
	Incomplete	44	40	7.3	7.3	52	

\*The statistical result using Chi-square test with a significance value  $p<0.05$

However, boys tend to reach their hormonal peak point around puberty. Based on the way of parenting between boys and girls also plays a role in determining to stunt. It is stated that boys tend to be released to the outside world more quickly so that the possibility of being exposed to infection is higher than girls. Generally, boys are given complementary foods earlier before the age of 6 months which makes boys more susceptible to the exposure to diarrhea and recurrent infections that can interfere with their growth and development.<sup>23,24</sup>

This study showed no relationship between age and stunting, and the majority of subjects aged in this study were 12-23 months. Schrijner et al.<sup>26</sup> stated there is no significant relationship between age and stunting. The introduction of complementary food at an early age can affect child growth but tends to diminish over time because of other factors such as better nutritional intake and parenting during the golden period of life. In general, both studies stated there is no relationship between age and stunting in children under five years old.

In contrast, Alphonse et al.<sup>16</sup> found a relationship between age and stunting. Garenne et al.<sup>24</sup> also stated there is a relationship between age and stunting, especially in children under five years. Stunting also was a reversible condition in children >24 months due to the adequate intervention of nutritional intake during the golden period of life, known as catch-up growth. Children >24 months should be easier to follow their catch-up growth due to children in this age having a larger appetite than children aged < 24 months and also relying fully on the nutritional intake given by the parents. This condition also made catch-up growth a critical window due to the difference in parenting and nutritional intake given by the parents in each child individually.<sup>16,23</sup>

Stunting prevalence globally occurred in children aged 12-36 months. At the age of 24 months, breastfeeding stops being given and children will depend entirely on the food provided by the parents at this time the nutritional status of the child needs to be considered and there are frequent nutritional problems, in addition, children's motor skills increased rapidly at the age of 24

months and the possibility of infection also increases, due to this theory the prevalence of stunting at the age of 24 months increases. Furthermore, children's motor skills increased rapidly at this age and the desire to know the surrounding environment increases which leads to the possibility of infection also increases, so at the age of 24 months there is a high enough risk of nutritional problems and infection, and the prevalence of stunting at the age of 24 months increases.<sup>21,23</sup>

The result of this study showed a relationship between immunization status and stunting, the majority of this study had complete immunization status. A study conducted by Berendsen, et al.<sup>7</sup> stated there is a relationship between immunization status and stunting.<sup>7</sup> Another study conducted by Fajariyah et al.<sup>9</sup> also stated a relationship between immunization status and stunting. World Health Organization has recommended immunization as one of the interventions to prevent stunting in children, Public Health services are also campaigning for immunization as prevention of stunting. By having complete immunization, the child's body will produce memory cells against certain infections and prevents children from exposure to pathogens. However, children with incomplete immunization status tend to easily be infected by pathogens which leads to high cytokine levels and stimulates higher leptin that resulting in decreased appetite for children when this is activated for a long time, especially during repeated or chronic infections it will cause rapid energy loss and cytokines produced will also inhibit the work of growth hormones causing growth disruption and lead to stunting.<sup>7,10,11</sup>

Besides preventing stunting, complete basic immunization also helps promote catch-up growth in stunted children. If stunted children receive a complete dose of basic immunization, they will have the same IgG level as a non-stunted child with complete basic immunization.<sup>13,21</sup>

In contrast to this study, Arya et al.<sup>27</sup> stated there was no relationship between immunization status and stunting. Setiawan, et al.<sup>12</sup> also stated both complete and incomplete immunization status had the same risk on the incidence of stunting. Immunization is not the only factor to prevent

stunting, adequate nutritional intake, low birth weight, history of infection, exclusive breastfeeding, family income, maternal conditions during pregnancy, and environmental sanitation are all factors contributing to optimal growth.<sup>2</sup> Recent studies also stated that herd immunity played a role in preventing stunting in incomplete immunized children. Herd immunity can increase community immunity to a specific pathogen because the community is mostly immunized, and children who are not immunized will be protected by the community's immune system so they are protected against infection.<sup>12</sup>

The limitation of this study is the lack of laboratory evidence to exclude genetic disorders and growth hormone deficiency. Further research is suggested to include laboratory evidence to exclude genetic disorders and growth hormone deficiency, also other factors that also play role in stunting need to be excluded such as a history of maternal nutritional status during pregnancy and before pregnancy, child's nutritional intake, and the history of exclusive breastfeeding. Public Health Center can improve the IEC program (Information, Education, Communication) regarding the health of children aged 1-5 years, especially the importance of immunization in children.

## Conclusion

This study showed that there is a significant relationship between immunization status and the incidence of stunting among children aged 1-5 years. Complete immunization prevents children from exposure to pathogens by, producing memory cells against certain infections and also helps child's catch-up growth. This study also showed no significant relationship between age and gender in the incidence of stunting in children aged 1-5 years. Both the government, physicians, and health workers should continuously build social awareness to increase immunization targets.

## Conflict of Interest

Authors declared no conflict of interest regarding this article.

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