Path Analysis on the Life-Course Biopsychosocial Determinants of Stunting in Children Under Five Years of Age in Karawang, West Java

Rona Luthfi Fauziyyah[1], Yulia Lanti Retno Dewi[2], CSP Wekadigunawan[2], Rita Benya Adriani

[1]Masters Program in Public Health, Universitas Sebelas Maret
[2]Faculty of Medicine, Universitas Sebelas Maret
[3]School of Health Polytechnics Surakarta, Central Java

ABSTRACT

Background: Studies have shown that stunted children are more likely to start school later, perform more poorly on cognitive functioning tests, and are more likely to drop out of school. In future, adults who are stunted as children earn 20% less than comparable adults who were not stunted and are 30% more likely to live in poverty and less likely to work in skilled labor. This study aimed to examine the life-course biopsychosocial determinantsof stunting in children under five years of agein Karawang, West Java, using a path analysis model.
Subjects and Method: This was a case control study carried out inTunggakjati, Rengasdengklok, Kutawaluya, Pedes, and Medangasem community health centers, Karawang, West Java, from April to May 2018. A sample of 225 children under five was selected for this study by fixed disease sampling, consisting of 75 stunted children and 150 normal children. The dependent variable was stunting. The independent variables were maternal height, maternal middle upper arm circumference (MUAC), low birthweight (LBW), history of infection illness, maternal education, exclusive breastfeeding, complementary feeding, and family support. Child height was measured by infantometer or microtoice. The other variables were measured by questionnaire. The data were analyzed by path analysis run on Stata 13.
Results: Stunting increased with LBW (b=1.64; 95% CI=0.69 to 2.59; p=0.001) and history of infection illness (b=1.80; 95% CI=0.94 to 2.67; p<0.001). Stunting decreased with maternal height ≥150 cm (b=-1.57; 95% CI=-2.43 to -0.71; p<0.001) and appropriate complementary feeding (b=-1.80; 95% CI=-2.53 to -1.08; p<0.001). Stunting was indirectly affected by maternal MUAC, maternal education, exclusive breastfeeding, and family support.
Conclusion: Stunting increases with LBW and history of infection illness, but decreases with maternal height ≥150 cm and appropriate complementary feeding. Stunting is indirectly affected by maternal MUAC, maternal education, exclusive breastfeeding, and family support.

Keywords: stunting, life-course, biopsychosocial, children under five

Correspondence:
Rona Luthfi Fauziyyah. Masters Program in Public Health, Universitas Sebelas Maret. Jl. Ir. Sutami No. 36 A, Surakarta 57126, Central Java. Email: rona.luthfi@gmail.com.
Mobile: +6281316970696

BACKGROUND

Qualified resources have been determined since the first 1000 days of life. During this time, new individuals will experience a very optimal process of growth and development. If it is not supported with adequate nutrition, it is susceptible to stunting to effect irreversible on physical growth and also the cognitive development (Hardinsyah, 2016).

Stunting is one of three nutritional problems that occur globally. Stunting conditions illustrate the existence of chronic nutritional problems in the long term (UNICEF, 2013). According to data from the World Health Organization (WHO) in 2017, there were 22% of stunting toddlers worldwide. The results of nutritional status monitoring (PSG) in 2017 noted the prevalence of stunting toddlers in Indonesia which increased to 29.6 % consisting of 19.8% stunted and 9.8% severely stunted, it experienced an increase compared to the previous year. Karawang is one of the thirteen priority districts / cities with intervention of stunting children in West Java, with the prevalence of stunting under five according to the 2017 PSG results of 26.1%.

Stunting can be caused by multidimensional factors including biopsychosocial factors that occur throughout the life cycle (Kliegman et al., 2016; Murti, 2016). The purpose of this study was to analyze the lifelong biopsychosocial determinants of the incidence of stunting in children under five in Karawang, West Java.

SUBJECTS AND METHOD

1. Study Design

This was an analytic observational study with a case control design. The study was conducted in Karawang, West Java, from April to May 2018.

2. Population and Samples

The target population in this study was all children under five years of age. The source population was children aged 12-59 months in Tunggakjati, Rengasdengklok, Kutawaluya, Pedes, and Medangasem community health centers. A sample of 225 children was selected by fixed disease sampling, comprising 75 stunted children and 150 normal children.

3. Study Variables

The dependent variable was stunting. The independent variables were maternal height, maternal middle upper arm circumference (MUAC), low birth weight (LBW), history of infectious disease, family support, maternal education, exclusive breastfeeding, and complementary feeding.

4. Operational Definition of Variables

Stunting was defined as nutritional status in children aged 12-59 months based on the results of height for age measurement. It was categorized according to anthropometric standard based on the Decree of the Minister of Health of the Republic of Indonesia in 2010. Data on body length (children at aged under 2 years) was measured by infantometer. Body height was measured by microtoise. The measurement scale was continous, but for the purpose if data analysis, it was transformed into dichotomous, coded 0 for normal children and 1 for stunted children.

Maternal height was defined as the result of the measurement of the mother's height during pregnancy. The data were collected by maternal and child health monitoring book. The measurement scale was continous, but for the purpose if data analysis, it was transformed into dichotomous, coded 0 for <150 cm and 1 for ≥150 cm.

Maternal MUAC was defined as the result of measuring the upper arm circumference of the mother during pregnancy as measured by circling the MUAC tape in the middle of the acromion (shoulder tip) and oligonone (elbow) in units of centimeters (cm). The data were collected by maternal and child health monitoring book. The measurement scale was continous, but for the purpose if data analysis, it was transformed into dichotomous, coded 0 for ≥23.5 cm and 1 for <23.5.

LBW was defined as infant birth weight which was weighed immediately after birth using infant weight scale. The data were collected by maternal and child health monitoring book. The measurement scale was continous, but for the purpose if data analysis, it was transformed into dichotomous, coded 0 for ≥2,500 g and 1 for <2,500 g.

History of infectious diseases was defined as an infectious disease that has been or is being suffered by children, including diarrhea or respiratory infection in the past six months. The data were collected by questionnaire. The measurement scale was categorical, coded 0 for no and 1 for yes.

Family support was defined as the interaction of family members (spouse/ husband, biological mother, mother-in-law) which gives rise to caring, compassion, giving attention, appreciation and assistance in the form of information, assessment, instrumental, and emotional which aims to facilitate the mother in carrying out her role caring for children, measured using a questionnaire. The data were collected by questionnaire. The measurement scale was continous, but for the purpose if data analysis, it was transformed into dichotomous, coded 0 for weak and 1 for strong.

Maternal education was defined as the highest level of formal education completed by mother. The data were collected by questionnaire. The measurement scale was categorical, coded 0 for <senior high school and 1 for ≥senior high school.

Exclusive breastfeeding was defined as a condition where children only get breast milk in the first 6 months of life without additional food or other drinks (including water, honey, formula milk, and fruit) except drugs. The data were collected by questionnaire. The measurement scale was categorical, coded 0 for no and 1 for yes.

Complementary feeding was defined as a condition where children eat food or other drinks as a companion or nutritional supplement rather than a substitute for breast milk for the first time. The data were collected by questionnaire. The measurement scale was continuous, but for the purpose if data analysis, it was transformed into dichotomous, coded 0 for inappropriate and 1 for appropriate.

5. Data Analysis

The data were analyzed by path analysis run on Stata 13 program to determine the relationship of independent variables to the dependent variable and find out the magnitude of the relationship on these variables.

6. Research Ethics

The research ethics includes informed consent, anonymity, confidentiality and ethical clearance. The ethical clearance of this study was carried out by Research Ethics Commission of Dr. Moewardi hospital, Surakarta. It has been declared ethically eligible based on a decree number: 483 / IV / HREC / 2018.

RESULTS

1. Characteristics of Subjects

Table 1 shows that the characteristics of children under five are >24 months old, namely 179 subjects or 79.6%. As many as 125 study subjects (55.6%) were female.

The characteristics of maternal age are mostly less than 35 years, which are 178 subjects or 79.1%. Most of the study subjects (50.2%) had family income <Rp 2,100,000 per month.

Table 1. Study Subject Characteristics

Variable	N	(%)
Children Age		
<24 months	46	20.4
≥24 months	179	79.6
Gender		
Male	100	44.4
Female	125	55.6
Maternal Age		
< 35 years old	178	79.1
≥35 years old	47	20.9
Family Income		
< Rp 2,100,000	113	50.2
≥ Rp 2,100,000	112	49.8

2. Univariate Analysis

Description of univariate analysis explains the general description of the data from each variable, including maternal height, maternal MUAC, LBW, history of infectious diseases, family support, education, exclusive breastfeeding, complementary feeding, and incidence of stunting.

Table 2. Univariate Analysis

Variable	N	(%)
Maternal height		
< 150 cm	42	18.7
≥ 150 cm	183	81.3
Maternal MUAC		
< 23.5 cm	66	29.3
≥ 23.5 cm	159	70.7
LBW		
≥ 2500 g	189	84.0
< 2500 g	36	16.0
History of Infectious Disease		
No	178	79.1
Yes	47	20.9
Family Support		
Weak	101	44.9
Strong	124	55.1
Maternal Education		
<senior high school	130	57.8
≥senior high school	95	42.2
Exclusive Breastfeeding		
No	86	38.2
Yes	139	62.2
Complementary Feeding		
Inappropriate	85	37.8
Appropriate	139	62.2
Stunting		
Normal	150	66.7
Stunting	75	33.3

Table 2 shows that of the 225 study subjects, most mothers had a height of >150 cm (81.3%), maternal pregnancy at >23.5 cm (70.7%), toddlers with birth weight> 2500 grams (84.0%), toddlers did not have history of diarrhea and ARI in the last 6 months (79.1%), mothers with high family support (55.1%), mothers with low education (57.8%), children under five received exclusive breastfeeding (62.2%), and the first administration of MP-ASI on time (62.2%)) Toddlers who experienced stunting were 75 toddlers (33.3) and non-stunting alites for about 150 children (66.7%).

3. Bivariate Analysis

Bivariate analysis was used to see the correlation of independent variables (maternal height, maternal MUAC during pregnancy, LBW, history of infectious disease, family support, maternal education, exclusive breastfeeding, and first administration of MP-ASI) and the local variables (incidence of stunting).

Table 3 shows that maternal height, maternal MAUC, LBW, history of infectious disease, family support, maternal education, exclusive breastfeeding, and complementary feeding had a statistical significant effect on the incidence of stunting.

4. Path Analysis

Table 4 shows the association between independent variables and dependent variable directly and indirectly. The risk of stunting in children under five was directly and positively affected by LBW (b= 1.64; 95% CI = 0.69 to 2.59; p= 0.001) and history of infectious disease (b= 1.80; 95% CI= 0.94 to 2.67; p<0.001).

The risk of stunting in children under five was directly and negatively affected by maternal height ≥150 cm (b= -1.57; 95% CI= -2.43 to -0.71; p<0.001), and appropriate complementary feeeding (b= -1.80; 95% CI= -2.53 to -1.08; p<0.001).

The risk of stunting in children under five was indirectly affected by maternal MUAC, maternal education, family income, and exclusively breasfeeding.

LBW decreased with maternal MUAC ≥23.5 cm (b= -1.94; 95% CI= -2.78 to -1.11; p<0.001) and strong family support (b= -1.47; 95% CI= -2.39 to -0.55; p= 0.002).

History of infectious diseases among children reduced by high maternal education (b= -0.71; 95% CI= -1.45 to 0.04; p= 0.063) and strong family support (b= -0.93; 95% CI= -1.63 to -0.24; p = 0.008).

Appropriate complementary feeding increased with high maternal education (b= 1.26; 95% CI= 0.55 to 1.97; p<0.001), exclusive breastfeeding (b= 1.94; 95% CI= 1.27 to 2.61; p<0.001), and strong family support (b = 0.72; 95% CI= 0.04 to 1.39; p= 0.037).

Exclusive breastfeeding increased with high maternal education (b= 0.81; 95% CI= 0.20 to 1.42; p= 0.010) and strong family support (b= 1.28; 95% CI= 0.69 to 1.87; p<0.001).

Table 3. Bivariate analysis of life-course biopsychosocial determinants on stunting

Independent Variable	Stunting				OR	95% CI		p
	No		Yes			Lower limit	Upper limit	
	n	%	n	%				
Maternal height								
< 150 cm	16	38.1	26	61.9	0.22	0.11	0.46	<0.001
≥ 150 cm	134	73.2	49	26.8				
Maternal MUAC								
< 23.5 cm	14	21.2	52	78.8	0.05	0.02	0.10	<0.001
≥ 23.5 cm	136	85.5	23	14.5				
LBW								
≥ 2500 g	140	74.1	49	25.9	7.43	3.34	16.51	<0.001
< 2500 g	10	27.8	26	72.2				
History of infectious disease								
No	137	77.0	41	23.0	8.74	4.22	18.10	<0.001
Yes	13	27.7	34	72.3				
Family support								
Low	45	44.6	56	55.4	0.14	0.08	0.27	<0.001
High	105	84.7	19	15.3				
Maternal education								
Low	71	54.6	59	45.4	0.24	0.13	0.46	<0.001
High	79	83.2	16	16.8				
Exclusive breastfeeding								
No	35	40.7	51	59.3	0.14	0.08	0.26	<0.001
Yes	115	82.7	24	17.3				
Complementary feeding								
Not on time	33	38.8	52	61.2	0.12	0.07	0.46	<0.001
On time	117	83.6	23	16.4				

DISCUSSION

1. The relationship between maternal height and stunting

The results of the analysis showed that maternal height had a statistically significant effect on the incidence of stunting (b = -1.57; 95% CI= -2.43 to -0.71; p<0.001). This shows that mothers who have a height of> 150 cm reduce the risk of stunts by 1.57 times compared to children of mothers who have a height of <150 cm.

The results of this study are in line with the research of Addo et al. (2013), which states that short mothers (<150 cm) are more likely to have children who are stunting in the first 2 years. Stunting events continue to be passed on to the next generation because maternal height was one of the genetic factors that played a role as the basis of achieving a child's growth and development.Walker *et al.* (2015) added thatstunting mothers significantly gave birth to stunting children and toddlers with lower cognitive abilities. Intergenerational intervention would be maximized if it was applied for the first 1000 days of life, which was the pregnancy period up to the first 2 years of birth.

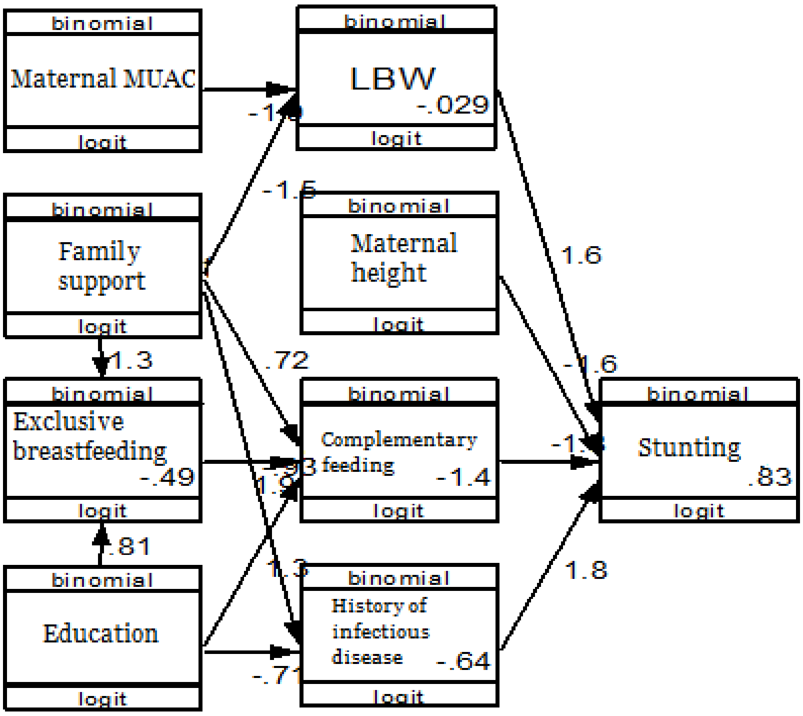

Figure 1. Structural Model of Path Analysis with Estimation

Table 4. The Results of Path Analysis

Dependent Variable		Independent variable	b	95% CI Lower Limit	95% CI Upper Limit	p
Direct Effect						
Stunting	←	Maternal height	-1.57	-2.43	-0.71	<0.001
Stunting	←	LBW	1.64	0.69	2.59	0.001
Stunting	←	History of infectious disease	1.80	0.94	2.67	<0.001
Stunting	←	Complementary feeding	-1.80	-2.53	-1.08	<0.001
Indirect Effect						
LBW	←	Maternal MUAC	-1.95	-2.78	-1.11	<0.001
LBW	←	Family Support	-1.47	-2.39	-0.55	0.002
History of infectious disease	←	Maternal Education	-0.71	-1.45	0.04	0.063
History of infectious disease	←	History of Infectious Disease	-0.93	-1.63	-0.24	0.008
Complementary feeding	←	Maternal Education	1.26	0.55	1.97	<0.001
Complementary feeding	←	Exclusive Breastfeeding	1.94	1.27	2.61	<0.001
Complementary feeding	←	Family Support	0.72	0.04	1.39	0.037
Exclusive breastfeeding	←	Maternal Education	0.81	0.20	1.42	0.010
Exclusive breastfeeding	←	Family Support	1.28	0.69	1.87	<0.001
n Observation = 225						
Log likelihood = -522.06						

2. The relationship between maternal MUAC on stunting

The result of analysis showed that maternal MUAC through LBW has an effect on the incidence of stunting (b=-1.94; 95% CI=-2.78 up to -1.11; p<0.001). The result of this study was in line with a study by Viridula *et al.* (2016), which stated that normal maternal MUAC decreased the incidence of stunting through LBW by 4 times.

Most mothers (78.8%) of stunting toddlers had MUAC of <23.5 cm. Maternal nutritional status before and during pregnancy affected the quality of the baby, success in breastfeeding, and child growth (Rahayu *et al.*, 2016). One assessment of nutritional status that was easy to do was to measure the upper arm circumference (MUAC), so that it could indicate whether the mother was experiencing lack of chronic energy (LCE) or not. The supplementation strategies for supplementary feeding (SF) for pregnant women aimed at improving maternal nutritional status during pregnancy and give birth to quality children (Ministry of Health RI, 2017).

3. The relationship between LBW on stunting

The result of analysis showed that LBW has an effect on the incidence of stunting which was statistically significant (b=1.64; 95% CI=0.69 to 2.59; p=0.001). This showed that infants with a birth weight <2500 grams increased the risk of stunting by 1.64 times compared to infants with birth weight >2500 grams.

The result of this study was in line withAryastami *et al.* (2017), who stated thatthe incidence of LBW increased the risk of stunting in children aged 12-23 months old by 1.74 times. Low birth weight incident was related to premature birth, intra uterine growth retardation, or both. Generally, in developing countries like Indonesia, LBW was caused by IUGR. This indicated that there was an obstacle of growth in the uterus which could adversely affect and even caused permanent damage after birth including less optimal height (Zohdi *et al.*, 2012).

4. The relationship between history of infectious disease on stunting

The result of analysis showed that history of infectious disease has an effect on the incidence of stunting which was statistically significant (b=1.80; 95% CI= 0.94 to 2.67; p<0.001). This showed that toddlers who have a history of diarrhea or pneumonia in the last 6 months increased the risk of stunting by 1.80 times compared to toddlers who did not have infectious diseases.

The result of this study was in line witha study by Namangboling *et al.* (2017), which stated thathistory of infectious diseases was the dominant factor in determining children'snutritional status. The presence of infectious diseases caused a decrease in appetite which resulted in a decrease in health conditions and children nutritional status. Akombi *et al.* (2017), stated thatthe occurrence of fever and recurrent diarrhea affected the nutrients that should be used as growth and development, which caused growth failure including the risk of stunting.

5. The relationship between family support on stunting

The result of analysis showed that family support through LBW has an effect on the incidence of stunting (b=-1.47; 95% CI=-2.39 to -0.55; p=0.002). This showed that mothers who have high family support were 1.47 times less likely to have babies with LBW compared to mothers with lack of family support. The result of this study was in line with a study byViridula *et al.*(2016), which stated thatmothers who have strong family support were 0.52 time more likely to deliver a baby with birth weight ≥ 2500 gram.

The result of analysis showed that family support through history of infectious disease has an effect on the incidence of stunting (b=-0.93; 95% CI=-1.63 to -0.24; p=0.008).This showed that mothers who have high family supportwere 0.93 time less likely to have history of infectious diseases compared to mothers with lack of family support.Psychosocial factors were closely related to problems that occur in human's life, not to mention health problems. Mothers who got lack of family support were more likely to experience stress or depression after gave birth which affected child care (Upadhyay and Srivastava, 2016).

The result of analysis showed that family support through first complementary feeding has an effect on the incidence of stunting (b=0.72; 95% CI=0.04 up to 1.39; p=0.037).This showed that mothers who have high family support were 0.72 time more likely to give complementary food on time compared to mothers who got lack of family support.The accuracy of the first complementary feeding was affected by education or knowledge from the family as the closest people to the mother. The family type also affected the maternal authority in deciding how to take care of their children, including the provision of nutrition (Rao *et al.*, 2011).

The result of analysis showed that family support through exclusive breastfeeding has an effect on the incidence of stunting (b=1.28; 95% CI=0.69 up to 1.87; p<0.001).This showed that mothers who have high family support were 1.28 times more likely to give exclusive breastfeeding compared to mothers with lack of family support. The result of this study was in line with a study by Fahriani *et al.* (2014), which stated that family support increased exclusive breastfeeding in infants (OR= 6.25; 95% CI: 1.92 to 20.35; p=0.002). Breastfeeding played an important role in the health, growth, and development of babies. A mother would need help from the closest person to run and through the difficulties while breastfeed her baby. The presence of the husband and baby's grand-mother was often regarded as one of the factors that could affect the process of breastfeeding, however, it was the support and active involvement of the family that actually contributed to changes in the sustainable behavior of mothers in the breastfeeding process (Horii *et al.*, 2017).

6. The relationship between maternal education on stunting

The result of analysis showed that maternal education through history of infectious diseases has an effect on the incidence of stunting (b= -0.71; 95% CI=-1.45 to 0.04; p= 0.063). This showed that toddlers with highly-educated mothers decreased the risk by 0.71 time to have history of infectious diseases than toddlers with low-educated mothers. The result of this study was in line with a study bySinmegn*et al.* (2014) and Luthfiyana (2018), which stated that toddlers with low-educated mothers were 1.81 times more likely to have diarrhea and 0.81 time more likely to experience pneumoniathan toddlers who have highly-educated mothers.

The result of analysis showed that maternal education through exclusive breastfeeding has an effect on the incidence of stunting(b=0.81; 95% CI=0.20 up to 1.42; p=0.010). this showed that highly-educated mothers were 0.81 time more likely to give exclusive breastfeeding than low-educated mothers. The result of this study was in line with a study byAcharya and Khanal (2015), which stated that mothers with middle or high level of education increased the risk of exclusive

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breastfeeding and early breastfeeding initiation was higher than mothers with low level of education.

The result of analysis showed that maternal education through first complementary feeding has an effect on the incidence of stunting (b=1.26; 95% CI=0.55 up to 1.97; p<0.001). This showed that highly-educated mothers were 1.26 times more likely to give first complementary food on time than mothers with low level of education. The introduction of complementary food at the age of 6 months old was the right time to complete the nutritional needs beside breastmilk. The introduction of complementary food must be considered carefully, if it was too early (before 6 months), it could disturb the baby's respiratory tract or exposure to microbes which contained in unhygienic food or drinks. If it was delayed (more than 6 months), it could lead to lack of food intake, delays in the development of eating behavior, and oral motor skills (chewing, swallowing, talking), even could lead to difficulties in eating(Saleem *et al.*, 2014). According to Yılmaz *et al.* (2017), giving nutrition to children would be more effective if both partners have a high level of education and mothers joined the classes for pregnant women to increase their knowledge and prepare for breastfeeding.

7. The relationship between exclusive breastfeeding and complementary feeding on stunting

The result of analysis showed that exclusive breastfeeding through first complementary feeding has an effect on the incidence of stuntingand it was statistically significant (b=1.94; 95% CI=1.27 up to 2.61; p<0.001). This showed that toddlers who got exclusive breastfeeding were 1.94 times more likely to get complementary food than toddlers who did not get exclusive breastfeeding. In this study, most subjects gave exclusive breastfeeding (62.8%) and first complementary food on time (62.2%). This was in line withSeptiani (2014)who stated thatthe low level of exclusive breastfeeding was inversely proportional to the high risk of early breastfeeding (infants aged <6 months old).

WHO recommended the time to exclusively breastfeed the infants up to the first 6 months and continue with appropriate complementary foods. However, globally only 40% of babies under 6 months old who received exclusive breastfeeding. This study revealed that exclusive breastfeeding was affected by family support and maternal education factors. Mensah *et al.* (2017) added thatthere were other factors that also affected exclusive breastfeeding which were maternal employment and maternal belief.

The result of analysis showed that first complementary feeding has an effect on the incidence of stuntingand it was statistically significant (b=-1.80; 95% CI=-2.53 to -1.08; p<0.001). This showed that toddlers who received the first complementary food on time (at the age of 6 months old) reduced the risk of stunting by 1.80 times compared to toddlers who did not get first complementary food on time.

The first provision of complementary food also determined the nutritional status of a child, the result of this study was in line with Tessema *et al.* (2013), who stated thatbabies who did not get complementary food on time were 5.15 times more likely to have malnutrition compared to babies who got the complementary food on time.Good and proper nutrition intake was a prerequisite for achieving optimal health and development. Breastfeeding was the best method to fulfill the nutritional, metabolic, and psychological needs of babies.

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