The effect of complementary food combinations on stunted children aged 6 months and over: a cross sectional study

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Abstract

Background: Complementary feeding practice, starting from when children are 6 months old, is one of the associated factors of stunted growth.

Objectives: To assess the correlation between complementary food combinations, mothers' occupation, basic immunisation history, birth weight and stunted growth.

Method: A cross-sectional study was conducted in Karangroto village, Central Java, Indonesia in November 2019. Data were collected using infant's weight and length/height and stunting was determined using WHO Child Growth Standards. Independent variable data were collected using a structured questionnaire. Bivariate analysis was performed using Chi-Squared and Fisher's exact test whilst multivariate analysis used logistic regression.

Result: Of the total 117 respondents, 24.8% were categorised as stunted and 37.3% children who did not receive different food combinations were categorised as stunted. Bivariate analysis found that stunting in children was related to unvaried food combinations (p=0.001, OR 6.845; 95% CI 2.199, 21.304), incomplete basic immunisations based on age (p=0.028, OR 2.951; 95% CI 1.211, 7.191) and low birth weight (p=0.032, OR 3.344; 95% CI 1.150, 9.720). Logistic regression showed that children who did not receive different food combinations were at a higher risk of experiencing stunting (p<0.001, OR 12.355; 95% CI 3.139, 48.629).

Conclusions: In this study stunting in children was significantly related to unvaried food combinations, incomplete basic immunisations based on age and low birth weight according to bivariate analysis. However, logistic regression showed that children who did not receive different food combinations were at a higher risk of stunting

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(Key words: Breastmilk, child nutrition, complementary feeding, stunting, different food combinations).

Background

Globally, about 156 million children are affected by stunting[1]. Indonesia is ranked as the fifth highest country for stunted children[2]. Data show that prevalence has now reached 30.8%, comprising 19.3% children with stunted growth and 11.5% children classed as severely stunted[3]. Stunted children are considered more prone to sickness, a suboptimal intelligence quotient (IQ) score, physical and mental developmental disorders and poor health status[4]. Stunting often starts *in utero* and its severity increases, reaching a plateau at about two years of age[5]. The first 1000 days of life is a critical period of growth and development. Parents and health professionals can optimise this period to prevent stunting through routine screening to detect children with a low height for their age[6].

Nutritional requirements can be fulfilled starting from pregnancy. Exclusive breastfeeding is recommended up to the age of six months[1]. After six months, breastmilk alone is not sufficient to meet the nutritional requirements of infants[7]. Breastmilk is only sufficient to provide around half the total energy needs of infants aged 6-12 months and one third of energy needs between 12 and 24 months[8]. Therefore, other foods and liquids are needed, along with breastmilk[9]. Complementary food should be given appropriately according to the child's age, frequency, texture of the food, amount, as well as considering hygiene and ensuring there are variations in the food provided[10].

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A preliminary study in Karangroto Village, Semarang City, Central Java Province, Indonesia found that 12 of 38 infants (30%) had a Height-for-Age Z score (HAZ) of < -2 SD on the Growth Chart. Studies on the factors related to stunting in that region have not been done before. It was therefore decided to conduct a study related to the causes of stunting so that appropriate community-based interventions could be soon implemented to reduce the incidence of stunting.

Objectives

To assess the correlation between complementary food combinations, mothers' occupation, basic immunisation history, birth weight and stunted growth

Method

This study used a cross-sectional design and was conducted from November to December 2019. Five out of 12 posyandu (*pos pelayanan terpadu* /integrated service post in Indonesia) in Karangroto Village were chosen. In July 2018, Bangetayu Health Centre reported that there were more than 20% of children categorised as stunted in each of the five posyandu, which totalled 320 children aged 6-36 months.

Respondents in this study were mothers or nannies caring for children 6-36 months old.

Inclusion criteria of the respondents were:

- Age >18 years
- Actively involved in Family Planning Service Post-Integrated Health (Posyandu) activities
- Signed the informed consent
- Able to speak Bahasa Indonesia fluently
- Can remember the complementary food menus for one week within the time-span of the study conducted.

Exclusion criteria were:

- Children with chronic disease history or disability
- Mothers or nannies who could not remember the complementary food menus.

Sample size:

Total number of respondents needed was calculated based on the following formula:

$$n = \frac{NZ^2_{1-\alpha/2}P(1-P)}{Nd^2 + Z^2_{1-\alpha/2}P(1-P)}$$

$$= \frac{320\,(1.96)^2\,0.5\,(1-0.5)}{320\,(0.1)^2 + (1.96)^2\,0.5\,(1-0.5)} = 73.87 = 74 +$$

Anticipation of drop out 10% = 81 participants

After receiving the explanation of the study, respondents answered all questions in the questionnaire during 20-30 minutes. Researchers assisted and facilitated respondents during the filling out of the questionnaire.

Children's height measurement by microtoise and infants' length measurement by infantometer were carried out before determining categories. Height/age or length/age was determined by the WHO height-for-age Growth Chart and was categorised as normal if the Z-score was -2 SD, stunted if the Z-score was -3 SD up to < -2 SD and severely stunted if the Z-score was < -3 SD.

Instrument of complementary food combinations: This was a questionnaire comprising questions regarding types of food consumed by the children every day for one week. It was filled out by mothers or nannies using the recall method.

Ethical issues: This study was approved by the Ethics Research Committee of Sultan Agung Islamic University, Semarang, Indonesia (No. 735/ A.I/FIK-SA/X/2019). Written informed consent was signed by respondents after they were given an explanation regarding procedures, rights and obligations during the research.

Statistical analysis*:* This was done with statistical software and encompassed univariate, bivariate and multivariate analysis. Univariate analysis was executed for each study variable descriptively using frequency and percentage. Chi-squared test and Fishers exact test were used in bivariate analysis to see correlation between independent variables and dependent variables. Multivariate analysis used logistic regression to analyse which variable was the most influential factor on prevalence of stunting in the Karangroto village.

Results

Respondents who were eligible based on inclusion criteria totalled 130 but only 117 filled in all of the questionnaire. Respondent response rate was around 90%. Table 1 shows the stunting related factors in children aged 6-36 months.

Table 1: ***Stunting related factors in children aged 6 – 36 months*** **(n=117)**

Variable	Stunted		p-value	Odds ratio	95% CI
	Yes (%)	No (%)			
Mothers' age					
Young adults	05 (17.2)	07 (08)	0.168**	2.411	0.701 – 8.287
Middle-aged to older adults	24 (82.8)	81 (92)			
Mothers' education					
High school or below	26 (89.7)	79 (89.8)	1.000**	0.987	0.248 – 3.924
College or above	03 (10.3)	09 (10.2)			
Mothers' occupation					
Working mothers	16 (55.2)	62 (70.5)	0.198*	0.516	0.218 – 1.224
Full time housewives	13 (44.8)	26 (29.5)			
Family income					
Upah minimum regional or lower	13 (44.8)	37 (42)	0.963*	1.120	0.481 – 2.608
Above Upah minimum regional	16 (55.2)	51 (58)			
Family members					
> 4 people	07 (24.1)	21 (23.9)	1.000*	1.015	0.380 – 2.709
<= 4 people	22 (75.9)	67 (76.1)			
Sanitation					
Public	02 (06.9)	01 (01.1)	0.151**	6.444	0.562 – 73.862
Private/at home	27 (93.1)	87 (98.9)			
Mothers' BMI					
Underweight	02 (06.9)	04 (04.5)	0.637**	1.556	0.270 – 8.968
Normal-overweight	27 (93.1)	84 (95.5)			
Gender					
Male	14 (48.3)	47 (53.4)	0.791*	1.228	0.530 – 2.846
Female	15 (51.7)	41 (46.6)			
Birth weight					
Low	08 (27.6)	09 (10.2)	**0.032****	3.344	1.150 – 9.720
Normal	21 (72.4)	79 (89.8)			
Breastfeeding histories					
Not exclusive	13 (44.8)	25 (28.4)	0.159*	2.048	0.861 – 4.868
Exclusive	16 (55.2)	63 (71.6)			
Gestational age					
Premature	11 (37.9)	37 (42.0)	0.863*	0.842	0.356 – 1.993
Term	18 (62.1)	51 (58.0)			
Children's age					
> 2 years old	09 (31.0)	45 (51.1)	0.095*	0.430	0.176 – 1.048
6 – 24 months old	20 (69.0)	43 (48.9)			
Basic immunisations history					
Incomplete	13 (44.8)	19 (21.6)	**0.028***	2.951	1.211 – 7.191
Complete	16 (55.2)	69 (78.4)			
Complementary food combinations					
Unvaried	25 (86.2)	42 (47.7)	**0.001***	6.845	2.199 – 21.304
Varied	04 (13.8)	46 (52.3)			

**bivariate test result with Chi-Square; **bivariate test result with Fisher's exact test*

The most influential variable in stunting incidence

Variables in bivariate analysis that got score <0.25 were included in logistic regression. They were mothers' age, mothers' education, sanitation, birth weight, breastfeeding history, children's age, basic immunisation history and complementary food combination. Table 2 show the analysis results of the multivariate logistic regression test.

Table 2: ***Analysis results of the multivariate logistic regression test***

Variable	Coefficient	S.E	Wald	df	p-value	OR	95% CI
Mothers' age	0.608	0.783	0.604	1	0.437	1.837	0.396 – 8.516
Mothers' occupation	**-1.678**	**0.635**	**6.977**	**1**	**0.008**	**0.187**	**0.054 – 0.649**
Sanitation	0.500	1.779	0.079	1	0.779	1.648	0.050 – 53.914
Birth weight	**1.713**	**0.775**	**4.884**	**1**	**0.027**	**5.547**	**1.214 – 25.349**
Breastfeeding history	0.927	0.588	2.490	1	0.115	2.528	0.799 – 7.999
Children's age	-1.130	0.651	3.015	1	0.082	0.323	0.90 – 1.156
Basic immunisation history	0.504	0.616	0.671	1	0.413	1.656	0.495 – 5.538
Complementary food combination	**2.514**	**0.699**	**12.934**	**1**	**0.000**	**12.355**	**3.139 – 48.629**
Constant	**-2.231**	**0.761**	**8.558**	**1**	**0.003**	**0.107**	

SE: Standard error, OR odds ratio, CI confidence interval

Discussion

The majority of mothers in this study were in the adult-age group category. Mature parents are considered as having more experience in parenting so they realise that children are not miniature adults[11]. Every child is unique; they have their own strengths and weaknesses and different feelings as well[12]. Furthermore, mothers' age is related to psychological factors that include accepting the pregnancy and this influences parenting style, particularly regarding feeding patterns[13]. Educational background of mothers and feeding behaviour are closely related to nutritional status[14]. Information and knowledge of nutrition are more easily accepted by educated people[15]. However, it is possible for someone with a low educational background to have a better nutritional status[15]. In this digital era, information regarding ability of preparing food menus which fulfil balanced nutrition is easy to source.

Mothers can obtain a wealth of information from many sources and working mothers are considered to have easier access to it than housewives[14]. However, validity of information depends on the place where mothers work. Working mothers who love to share their experiences about how to care for children will enrich information for each other. Unfortunately, working mothers may have less time to implement their knowledge-related childcare[16,17]. This concern was conveyed by most respondents who were working mothers – they had to divide their time between work and childcare. Inappropriate childcare, like not paying attention to children's diet, can impact children's welfare causing nutritional problems[15]. A serious problem with children nowadays is stunting that can be led by family wellbeing status that is influenced by the total family members who need to be covered[14]. The number of family members can affect the distribution and provision of food in the family[18]. However, the total number of family members coupled with balanced and equal distribution and provision of food can decrease the risk of stunted children[19]. Food availability needs to be in line with adequate facilities and infrastructure to optimise growth and development of children[20]. Good sanitation is a factor related to health problems. Data in this study report that 2.6% (3 of 117) respondents still use shared/public sanitation. A previous study reported that some stunting is caused by poor sanitation and poor access to clean water[21].

Theoretically, stunting begins in utero and continues for at least the first two years (1,000 days of life); therefore it is important to plan the pregnancy well. This study shows that most mothers were in the normal-overweight category. The crosstab results interestingly showed that more mothers were included in the underweight category and their children did not experience stunting. A previous study reported that the mothers' BMI influences more in terms of the wasting incidence and it is the mothers' height that influences the stunting incidence[22]. Over 50% of children in this study were 6-24 months old. The first two years of life is the golden period of children's growth and development. Inadequate nutrition can influence physical and intellectual growth, and result in a low quality of human resources in the future. Majority of child respondents in this study were male. Females usually grow faster than males but that is not significantly related to the causes of stunting in either males or females and both genders are equally likely to be at risk of stunting[24].

The history of infant health status is also an important factor related to stunting incidence. Majority of respondents were exclusively breastfed. Breastmilk contains growth hormones that promote child growth and development in the baby's digestive system and protect them from bacteria and viruses[25]. Exclusive breastfeeding is essential for child growth because it prevents and decreases the likelihood of infectious disease in children[26]. Another important factor that emerged from the study is the history of preterm birth. Premature babies have growths delays due to a short gestational age and the lack of linear growth in the womb[27]. Term babies could also fail to thrive if they do not receive adequate nutrition. This will get worse when coupled with exposure to infectious diseases[28].

Fortunately, premature babies with growth faltering can catch up with normal growth if they receive adequate nutrition.

The multivariate analysis showed that the mothers' occupation does have a slight effect on stunting although the strength of the relationship was statistically very low. Moreover, bivariate analysis depicted that there was no significant relationship between mothers' occupation and stunting. A family's purchasing power to provide nutritional foods depends on the amount of family income. The index of household welfare is a factor that significantly correlates with stunting[21]. Data in this study showed that stunting in children was mostly experienced by those whose mothers work. Mothers' occupation can impact on children's feeding patterns further leading to inadequate nutrition in children[25]. Bivariate analysis figures showed a significant relationship between birth weight and stunting. Children with a low birth weight history coupled with inadequate nutritional intake experienced frequent infections during their growth[29]. This gets worse when combined with a poor health service, further leading to stunted growth. Basic immunisations given to babies up to 9 months of age aim to prevent infections. Repeated infections can interfere with a child's growth and development if it happens over a long period of time[30]. One previous study reported a significant relationship between immunisations and stunting[31]. Although BCG vaccine does not influence stunting in children its timing is crucial[32]; BCG is related to a lower risk of stunting if carried out in early life.

Complementary food combination is defined as the various kinds of complementary food consumed everyday by infants. This study noted that the kinds of food rarely consumed included vegetables and fruits (42.3%), vegetable protein (31.2%) and animal protein (24.6%). In Indonesia there is a 4 star diet in complementary feeding practice including carbohydrate, animal protein, vegetable protein, fat, vegetables and fruits and also snacks[10]. This study showed that complementary food combination was the most significant factor leading to stunting. Correct complementary food combination can be seen in children who consume more protein[33]. In this study, children who consumed more carbohydrate and fat, compared to those who consumed animal and vegetable protein, experienced stunting. Children require approximately 1.5-2g of protein for every kg of body weight. The amount of protein is considered adequate if it contains sufficient essential amino acids. Essential nutrition for children includes the correct amount of energy, protein, fat, water, vitamins and minerals. Each food component has a specific role in the growth and development of children. A previous study showed that there was a significant correlation between complementary food combinations and stunting, that is, if a food combination is provided that fulfils children's nutritional requirements then that can further prevent stunted growth[7]. Malnutrition can gradually be treated by increasing the consumption of good complementary food combinations because it is a good indicator of food quality and micronutrient density for children. Complementary feeding practice that is appropriate for age, meal frequency and time has an important role in determining complementary food quality. The fulfilment of the child's nutritional needs results in optimal growth and development.

Conclusions

In this study stunting in children was significantly related to unvaried food combinations, incomplete basic immunisations based on age and low birth weight according to bivariate analysis. However, logistic regression showed that children who did not receive different food combinations were at a higher risk of stunting

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