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Analyzing Nutritional Factors that Affect Toddler's Stunting in Malang Regency, Indonesia

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Abstract

BACKGROUND: The proportion of short and very short toddlers in Indonesia is 30.8%. East Java is among the 18 provinces with high prevalence (30%–<40%), having made Malang Regency included among the 100 regencies/cities prioritized for intervention.

AIM: This study aimed to analyze sociodemographic and nutritional factors affecting toddler's stunting in Malang Regency, Indonesia.

DESIGN AND METHODS: A case–control analytic survey research with retrospective approach was used: An epidemiologic observation design to study the effect of exposures to diseases or other health problems occurrences. The investigation was conducted during July to August time period through observation, weight measurement and interview in order to collect the data about mother's knowledge, childcare practices, household food security, healthcare services, access to clean water, economic and socio-cultural background, parenting practices, and causes of stunting. The data were processed using SPSS 16.0, bivariate analysis (Chi-square), and multivariate analysis using multiple logistic regression testing with odds ratio and confidence interval calculation.

RESULTS: Parenting practices of the toddlers were not ideal, with only 60% of mothers had good knowledge about stunting. About 76% of the stunted toddlers' households had insecure food availability and security. Up to 98% of the mothers with stunted toddlers received blood-boosting tablets during pregnancy from health-care services; however, interview results disclosed that they were not consumed. As many as, 98% of the households got access to clean water from Malang Municipal Waterworks and 2% from closed well. A total of 96% of the households made income fewer than Malang Regency's minimum wage. The stunted toddlers' households who had eating restrictions during pregnancy and breastfeeding were 13%. Most stunted toddlers as many as 76% were taken care of by their biological mothers, while the remaining 24% by grandmothers or other relatives. Thus, the causes of stunting from the most to the least dominant were as follows: Household's income, exclusive breastfeeding, household size, father's education, mother's nutritional knowledge, household's food security, mother's level of education, toddler's energy intake, appropriate feedings of weaning food, toddler's fat intake, toddler's history of infectious diseases, sociocultural background, toddler's protein intake, mother's occupation, household's nutritional awareness behavior, and the completeness of immunization.

CONCLUSION: Stunting main risk factors are household income, size, history of breastfeeding, father's education and occupation. Factors which are not significantly related to stunting include household nutritional awareness and behavior, hygiene, socio-economic status, energy and micronutrients intake, toddler's food and vitamin A compliment, toddler's status and characteristics, and maternal health services.

Introduction

Stunting is a failed growth and development in toddlers (children under 5 years old) as a result of chronic nutritional deficiency occurring during the first 1000 days of life (the golden period), making children too short for their age [1]. The nutritional deficiency might happen from fetal stage to infancy to early childhood, but stunted growth is visible for 2 years of age [2]. A toddler is stunted if his or her z score is <–2SD and severely stunted if <–3SD [3].

According to the UNICEF published report, there are 7.8 million cases of stunting in Indonesia, putting Indonesia in the top five countries of highest prevalence. The proportion of nutritional status of short and very short is 30.8%. East Java is one of 100 regencies/cities prioritized for intervention [4].

Short-term impact of stunting can be disrupted nervous, intellectual and physical growth and development, and metabolic disorders. While in the long run, it can cause decline in cognitive abilities and learning achievements, immunity weakening causing children prone to diseases, and high risk of obesity, heart diseases, artery diseases, stroke, cancer, and disability during old age, which may decrease the quality of Indonesia's human resources, productivity, and national competitiveness, and will result in nation's burden [5].

The risk factors of stunting may include poor child care practices, limited health-care services, households' lacking access to nutritious food, sanitation, and clean water [4]. Other factors might influence, such as the practice of breastfeeding, eating frequency, immunization, diseases suffered, and child's height [6]. In addition, stunting can also be caused by lack of essential amino acids, low household income, underweight, lack of exclusive breastfeeding, and lack of food variation [7]. Lacking in protein intake is also one of the factors causing children stunting. Stunted toddlers tend to only consume plant-based protein and prefer snacks more [8].

According to Illahi (2017), 38.2% of stunted toddlers occur in families who make less than the standard minimum income, but in families who make the standard minimum income stunting occurrence is 17.9. Using the analysis of the Spearman correlation test, the study found that there was a relationship between family income and the incidence of stunting under five with p= 0.08 ($p < \alpha$=0.05) [9]. Family incomes affect the ability of the household to meet the primary, secondary, and tertiary needs of life. Low income affects the quality and quantity of food consumed [10]. Meanwhile, families with adequate income have the ability to provide all needs, both primary and secondary. Families with good economic status also have access to better health services [11].

Exclusive breastfeeding is one of the efforts to meet the nutritional needs of toddlers [12]. Sampe *et al*. (2020) using Chi-square test found that there was a relationship between exclusive breastfeeding and the incidence of stunting with $p < 0.05$. With odds ratio test OR value showing 61, the study concluded that toddlers who were not given exclusive breastfeeding were 60 times more likely to experience stunting compared to infants who were exclusively breastfed [13]. Mothers' higher exclusive breastfeeding yield in better nutritional status of children, and conversely mothers' lower exclusive breastfeeding yield in worse children nutritional status, which may cause stunting [14]. According to Uwiringiyamana (2019), the lack or absence of exclusive breastfeeding and use of deworming tablets in the previous 6 months were predictors of stunting in children >12 months old of age; while exclusive breastfeeding and the use of deworming tablets are protective [15]. Exclusive breastfeeding is known to provide all essential nutrients for growth and immunity of a child within the first 6 months of life, thus offering a protective effect against stunting [16].

Design and Methods

This study used a case–control analytical survey research with a retrospective approach – an epidemiologic observation design to study the relation of exposure to diseases occurrences or other health problems. This case–control study had been checked by STROBE. The observation was based on the occurrences of disease of stunting that had already happened to allow the researchers to analyze one case group (with stunting) and one control group (without stunting), each consisting of 45 toddlers. The study took place from June to August 2019 in three representative districts in Malang Regency: Tajinan (lowland), Pujon (highland), and Bantur (coastal area).

Figure 1 shows that this study was using cluster random sampling technique, 90 participants of mothers with babies and toddlers age 6–59 months old where chosen. From each of the three district clusters, Tajinan, Pujon, and Bantur, 30 toddlers were randomly chosen. The total 90 samples derived from the three districts were parted equally into two groups: One case group and one control group. The criteria for samples inclusion were as follows: 6–59 months old babies and toddlers (6–59 months old) with below -2SD z-score index based on height for age, living with birth mother, the mothers' agreeing to be respondent, living within the areas of the research settings (Malang Regency), registered in the local integrated health center, and owning a growth chart.

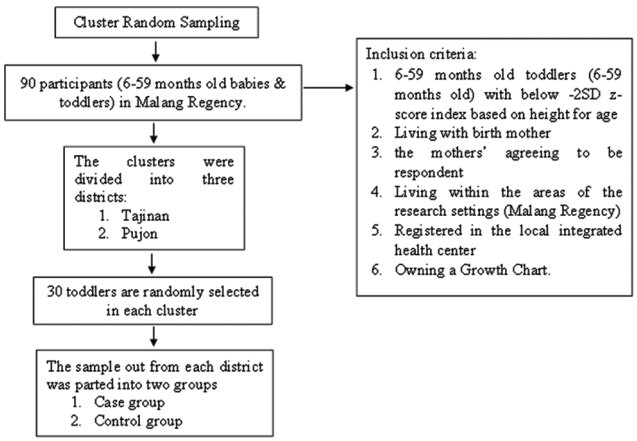

Figure 1: Participant recruitment flowchart

The data collection was gathered through interview, observation, and 3 × 24 h food recall. Observation was used to obtain data of socioeconomic status, history of infectious diseases, breastfeeding status, feeding of weaning food, completeness of immunization, nutritional awareness, smoking behavior, hygiene, and sanitation (condition of home and toilet). 3 × 24 food recalls were applied to collect the data on energy, protein, fat, and carbohydrate intake variables. The study had passed ethical clearance from Malang Regency Administration's Department of Research and Development with registration number 070/563/35.07.203/2019.

The study used SPSS 16.0 data analysis software. Univariate analysis was done to discover frequency distribution from the variables that were

being researched. The bivariate analysis used non-parametric statistical testing with Chi-square with $p < 0.05$. If the table had an expected value of <5% and more than 20%, then Fisher's exact test was used. The multivariate analysis used multiple logistic regression with odds ratio and confidence interval calculation.

Results and Discussion

Table 1 shows that of the 45 mothers of normal toddlers, 29 (65%) had adequate nutritional knowledge, while 5 (11%) fell in inadequate category. Meanwhile, of the 45 mothers of stunted toddlers, 17 (38%) had adequate nutritional knowledge, while 14 (31%) fell equally in good and inadequate categories.

With regard to childcare practices, on the history of breastfeeding, Table 1 shows that 27 (60%) toddlers in non-stunting group were exclusively breastfed, while 18 toddlers (40%) were non-exclusively. On the other hand, in stunting group, as many as, 30 (67%) stunted toddlers received exclusive breastfeeding, while 15 (33%) were not breastmilk exclusive. For reference, the standard practice of exclusive breastfeeding coverage is 93.7% [4]. Thus, by comparison, the exclusive breastfeeding coverage of normal toddlers in the villages of Madiredo, Jambearjo, and Rejosari was 60%, which was below the standard. Meanwhile, for stunted toddlers in the same villages, the exclusive breastfeeding coverage was 67% which was still below standard.

In relation to complementary/weaning food feeding practices, as many as, 35 (78%) normal toddlers were fed with weaning food at the age of 6 months and 10 toddlers (22%) before 6 months of age, as indicated in Table 1. Whereas 38 (84%) stunted toddlers received complementary feeding at the age of 6 months, 7 (16%) did before age 6 months.

With regard to household nutritional awareness behavior, as shown in Table 1, the number of normal toddlers who often weighed in at Integrated Health Center (Posyandu) was 43 persons (95%), while those who did not weigh in often were 2 persons (5%). Whereas, for stunted toddlers, the number who frequently weighed in at the Integrated Health Center was 40 (89%), while 5 (11%) toddlers did not weigh in frequently.

With regard to breastfeeding and complementary feeding, Table 1 shows that as many as, 35 (78%) normal toddler received exclusive breastfeeding, while 10 persons (22%) had not. Meanwhile, stunted toddlers who received exclusive breastfeeding were 40 persons (89%) and those who did not were 5 persons (11%).

The number of toddlers who had started to eat household regular food was 41 persons (91%), while 4

Table 1: Factors affecting stunted growth (n = 90)

Category	Subcategory	Normal		Stunting		p-value
		n	%	n	%	
Nutritional knowledge						
Mother's nutritional knowledge	Good	11	24	14	31	0.063
	Adequate	29	65	17	38	
	Inadequate	5	11	14	31	
Parenting/childcare practices						
Breastfeeding history	Exclusive	27	60	30	67	0.025
	Not exclusive	18	40	15	33	
Accuracy of weaning feeding	<6 months	10	22	7	16	0.174
	≥6 months	35	78	38	84	
Household's nutritional awareness behavior						
Weighing	Yes	43	95	40	89	0.240
	No	2	5	5	11	
Exclusive breastfeeding and weaning feeding	Exclusive	35	78	40	89	0.160
	Not exclusive	10	22	5	11	
Toddlers already eating family food	Family food	41	91	40	89	0.727
	Have not started yet	4	9	5	11	
Household's salt use	Table salt	42	94	39	87	0.306
	Cubed salt	2	4	5	11	
	Rough salt	1	2	1	2	
Toddlers given Vitamin A	Yes	44	98	43	96	0.559
	No	1	2	2	4	
Toddlers in cigarette smoking household	Yes	27	60	33	73	0.182
	No	18	40	12	27	
Food diversity	Diverse	31	69	35	78	0.343
	Not diverse	14	31	10	22	
Food availability						
Household food security	Secure	13	29	5	11	0.069
	Vulnerable	4	9	6	13	
	Inadequate	20	44	22	49	
	Insecure	8	18	12	27	
Energy intake	Severe deficit	15	33	30	67	0.998
	Medium deficit	14	31	5	11	
	Mild deficit	7	16	9	20	
	Normal	7	16	0	0	
	Excessive	2	4	1	2	
Protein intake	Severe deficit	7	16	13	29	0.634
	Medium deficit	4	9	5	11	
	Mild deficit	5	11	4	9	
	Normal	18	40	17	38	
	Excessive	11	24	6	13	
Fat intake	Severe deficit	21	47	35	78	0.188
	Medium deficit	3	7	4	9	
	Mild deficit	5	11	2	4	
	Normal	16	35	4	9	
Carbohydrate intake	Severe deficit	23	51	23	51	0.115
	Medium deficit	7	16	11	24	
	Mild deficit	2	4	3	7	
	Normal	7	16	7	16	
	Excessive	6	13	1	2	
Mother's health service during pregnancy						
Red blood-boosting tablet	Yes	42	93	44	98	0.309
	No	3	7	1	2	
Vitamin A (during birth)	Yes	34	76	38	84	0.295
	No	11	24	7	16	
Access to clean water and sanitation						
Final garbage disposal	Landfills	30	67	30	67	0.561
	Empty land	4	9	12	27	
	Others	11	24	3	6	
Clean water source	Open well	3	7	0	0	0.293
	Close well	0	0	1	2	
	Municipal waterworks	42	93	44	98	
Toileting	Sit toilet	2	4	3	7	0.417
	Squat toilet	42	93	42	93	
	Others	1	3	0	0	
Ventilation	Good	43	95	40	89	0.240
	Bad	2	5	5	11	
Livestock shed location from household	Close	28	62	28	62	1.000
	Far	17	38	17	38	
Household economic background						
Father's education	Elementary school graduate	13	29	17	38	0.039
Family income	Below minimum wage	24	53	43	96	0.002
	Above minimum wage	21	47	2	4	
Father's occupation	Unemployed	0	0	3	7	0.046
	Government official	4	9	0	0	
	Employee	13	29	10	22	
	Business	6	13	11	24	
	Others (farmers and construction laborers)	22	49	21	47	
Father's education	Elementary school graduate	13	29	17	38	0.039
	Junior high school graduate	10	22	15	33	
	High school graduate	18	40	10	22	
	Higher education	4	9	3	7	

(contd...)

Table 1: ***(continud)***

Category	Subcategory	Normal		Stunting		p-value
		n	%	n	%	
Mother's education	Elementary school graduate	0	0	1	2	0.119
	Junior high school graduate	9	20	10	22	
	High school graduate	21	47	17	38	
	Higher education	9	20	13	29	
Sociocultural background						
Mother's dietary restrictions	Yes	11	24	10	22	0.804
	No	34	76	35	78	
Breastfeeding mother's dietary restrictions	Yes	5	11	5	11	1.000
	No	40	89	40	89	
Toddlers' eating frequency	1–2 times a day	11	24	11	24	0.422
	3 times a day	26	58	31	69	
	>3 times a day	8	18	3	7	
Number of household members	<3 people	0	0	2	4	0.029
	3–4 people	29	64	23	51	
	>4 people	16	36	20	44	
Nutritional knowledge	Yes	58	27	60	26	0.774
	No	42	18	40	19	
Parenting practices						
Mother's age	19–29	18	40	29	64	0.971
	30–49	27	60	16	36	
Mother's occupation	Housewives	33	73	34	76	0.743
	Government Official	3	7	2	4	
	Employee	3	7	2	4	
	Entrepreneur	4	9	4	9	
	Others	2	4	3	7	
Factors affecting stunting occurrences						
Sex	Boys	18	40	18	40	1.000
	Girls	27	60	27	60	
Age	7–12	5	11	6	13	0.737
	13–24	13	29	10	22	
	25–36	8	18	10	22	
	37–48	14	31	11	25	
	49–59	5	11	8	18	
Toddlers' nutritional status based on height for age	Very short	0	0	31	69	0.973
	Short	0	0	14	31	
	Normal	45	100	0	0	
History of infectious disease	Yes	37	82	36	80	0.288
	No	8	18	9	20	
Immunization completeness	Completed	45	100	39	16	0.998
	Not Completed	0	0	6	84	

Using Chi-square testing, $\alpha = 0$.

persons (9%) had not. Meanwhile, for stunted toddlers, 40 persons (89%) had started eating household food, while 5 persons (11%) had not.

Regarding salt use, normal toddlers mostly used refined salt totaling to 42 persons (94%) and rough salt was least used by 1 person (2%). Meanwhile, for stunted toddlers, the most salt used in the household was refined salt, amounting to 39 persons (87%) while the least used was rough salt, amounting to 1 person (2%).

Regarding Vitamin A capsules consumption, as shown in Table 1, in normal toddler's group, 44 persons (98%) received Vitamin A, while 1 person (2%) did not. Meanwhile, for stunted toddlers, the number of toddlers who received Vitamin A was 43 persons (96%) and those who did not were 2 persons (4%).

The data on toddlers who lived in cigarette smoking households were also collected. In Madiredo, Jambearjo, and Rejosari villages, the number of cigarette smoking household members in normal and stunting households was 60% and 73%, respectively. Meanwhile, the proportion of daily smokers in the population aged above 10 years in the East Java region was 23.9% [4]. Thus, by comparison, it could be concluded that the percentage of both normal and stunted toddlers smoking households exceeded the average.

Food diversity was another variable whose data collection was required. As shown in Table 1, the food composition variety in both normal and stunted toddlers in the villages of Madiredo, Jambearjo, and Rejosari was 69% and 78%, respectively. Meanwhile, the recommended variety of household food compositions was 48% [4]. By comparison, the percentage of food variety in normal toddlers and stunted toddlers was both above recommended standard.

With regard to childcare practices, factors that could interfere with children stunting include the accuracy of complementary feeding, exclusive breastfeeding, and levels of behavior. As shown in Table 1, for normal toddlers, 27 persons (60%) received exclusive breastfeeding. Meanwhile, for stunted toddlers, 30 persons (67%) received exclusive breastfeeding.

Concerning with the variable of household's food availability, based on Table 1, 20 persons (44%) of the normal toddlers were in vulnerable level, while only 4 persons (9%) in insecure level. Meanwhile, for stunted toddlers, as high as 22 persons (49%) had inadequate food security, while only 2 persons (11%) had adequate food security.

Regarding energy intake, Table 1 shows that most normal toddlers had severe deficit energy intake amounting to 15 people (33%), while only 2 persons (4%) were in the excessive category. Meanwhile, the energy intake of most stunted toddlers was in the severe deficit category which amounted to 30 persons (67%) and 1 person (2%) was in the excessive category.

On protein intake, as shown in Table 1, most normal toddlers mostly were in the normal category amounting to 18 persons (40%), while 4 persons (9%) were in the moderate deficit category. Meanwhile, the highest protein intake for stunting group was in the normal category, amounting to 17 persons (38%), while the least number of 4 persons (9%) were in the mild deficit category.

On fat intake, Table 1 shows that the normal toddlers' fat intake was mostly in the severe deficit category, amounting to 21 persons (47%), while the least 3 persons (7%) were in the moderate deficit category. Meanwhile, the stunted toddlers; fat intake was mostly in the severe deficit category, amounting to 35 persons (78%), while the least number of 4 persons (9%) were in the moderate deficit category.

On carbohydrate intake level, most normal toddlers were in the severe deficit category, amounting to 23 persons (51%), while the least number of 2 persons (4%) was in the mild deficit category. Meanwhile, for stunted toddler's carbohydrate intake level, most of them lied in the severe deficit category, amounting to 23 persons (51%), while the least number 1 person (2%) fell in the excessive category.

Concerning with the variable of maternal health services, blood-boosting tablets were also an important issue. The number of pregnant mothers with

normal children in the villages of Madiredo, Jambearjo, and Rejosari who received iron tablets supplement was 93%. This was already above the national average of pregnant women iron supplement consumption, which is 89.4% [4]. Meanwhile, the provision of blood-boosting tablets for women who were pregnant with stunted toddlers in the same villages was 98%, which was also above the national average.

On Vitamin A consumption during childbirth, as shown in Table 1, for normal toddlers, there were 34 persons (76%) who received Vitamin A during childbirth, while mothers of normal toddlers who did not receive Vitamin A during childbirth were 11 persons (24%). As for stunted toddlers, mothers who received Vitamin A during childbirth were 38 persons (84%), while those who did not receive Vitamin A were 7 persons (16%).

Household access to clean water and sanitation was another important data needed for collection. As shown in Table 1, 30 persons (67%), normal toddler's households mostly disposed of their final household waste in the sanitary landfill, while only 4 persons (9%) disposed of their waste in vacant lots. Meanwhile, for families of stunted toddlers, most households disposed of their domestic waste in the sanitary landfill, which was 30 persons (67%), while only 3 persons (6%) dumped their garbage on vacant land.

On clean water sources, mostly 42 persons (93%) of normal toddler's households used tap water from Malang Regency's municipal waterworks, while only as few as 3 persons (7%) used open wells. As for the stunted toddlers households and 44 persons (83%) got the source of clean water was municipal waterworks tap water, while only as few as 1 person (2%) used closed well.

On defecation, Table 1 shows that the most common places to defecate for normal toddler's households were squatting pans, amounting to as many as 42 persons (93%), while others as few as 1 person (3%) used plunge lap. As for the families of stunted toddlers, 42 people (93%) used squatting pans, while 3 persons (7%) used toilet seat.

On ventilation, as shown in Table 1, as many as, 43 (95%) normal toddlers' households had adequate ventilation, while only 2 persons (5%) did not. As for the households of stunted toddlers, 40 persons (89%) had adequate ventilation, while 5 persons (11%) did not.

Regarding the position of livestock shed from household, the data in Table 1 show that 28 (62%) normal toddler's households had livestock sheds within 1–15 m from the house, while as many as 17 households (38%) did not have livestock sheds. Meanwhile, the number of stunted toddler's households who had livestock sheds was 28 persons (62%) and those who did not have livestock shed were as many as 17 households (38%).

Household economic level was an important variable in children stunting issues. As shown in Table 1, for normal toddlers, 24 (53%) households made income lower the Malang Regency's regional minimum wage, while a total of 21 persons (47%) made income above the minimum wage. As for stunted toddlers, 43 persons (96%) made income below the minimum wage, while persons (4%) made above the minimum wage.

On father's occupation, as shown in Table 1, the most common occupations of fathers of normal toddlers were farmers with a total of 22 persons (49%) and government officials with a total of 4 persons (9%). As for the work of fathers of stunted toddlers, the most common were farm laborers and construction workers with a total of 21 persons (47%), and the least occupation was jobless, which were 3 persons (7%).

On father's education, the average Indonesia's fathers education levels were as follows: 24.8% elementary school graduate, 26.2% junior high school graduates, 28.7% high school graduates, and 17% college graduates [4]. In comparison, the proportion of normal toddlers' father's education levels in the villages of Madiredo, Jambearjo, and Rejosari was as follows: Elementary school graduates 29% which was above standard, junior high school graduates 22% which was below standard, high school graduates 40% which was above standard, and the tertiary education graduate's fathers 9% which was below the standard.

On mother's education, according to Kementrian Kesehatan RI, Badan Penelitian, and Pengembangan (2018), 24.8% of Indonesian mothers were elementary school graduates, 26.2% junior high school graduates, 28.7% high school graduates, and 17% college graduates. Comparatively, normal toddlers' mother education in the villages of Madiredo, Jambearjo, and Rejosari showed elementary school graduates 20% (above standard), junior high school graduates 47% (below standard), high school graduates 20% (above standard), and higher education graduates 13% (below standard).

With regards to sociocultural factors, Table 1 shows that 34 (76%) normal toddlers conceiving women had dietary restrictions during pregnancy, while 11 (24%) did not. Meanwhile, mothers of stunted toddlers were 35 mothers (78%) had not any dietary restrictions, while 10 mothers (22%) had taboos or restrictions. Table 1 also indicates that as many as, 40 (89%) mothers of normal toddlers had dietary restrictions during breastfeeding, while 5 persons (11%) had not. Meanwhile, 40 (89%) mothers pregnant with stunted toddlers were with dietary restrictions during pregnancy, whereas 5 mothers (11%) had not dietary restrictions.

On frequency of feeding, Table 1 shows that there was 26 (58%) normal toddlers ate three meals a day, while 8 (18%) ate more than 3 meals. Meanwhile, stunted toddlers who ate three meals a day were 31 persons (69%), while 3 persons (7%) ate more than 3 meals.

Concerning with household size, Table 1 shows 29 or (64%) normal toddlers households comprised 3–4 household members, while only 16 households (36%) comprised over four members. Meanwhile, for stunted toddlers, 23 (51%) household had 3–4 members, while 2 households (4%) had <3 members.

Regarding nutritional knowledge, Table 1 shows that 26 (58%) normal toddlers' households had good knowledge, while 19 (42 %) households had inadequate knowledge. Meanwhile, 27 (60%) households of stunted toddlers had good nutritional knowledge, while 18 (40%) had not. Table 1 also shows that 18 (40%) normal toddlers' mothers were aged 19–29 years, while those aged 30–49 years were 27 (60%) mothers. Meanwhile, mothers of stunted toddlers aged 19–29 years were a total of 29 persons (64%), while those aged 30–49 years were a total of 16 persons (36%). In addition, most normal toddlers' mothers' occupation was housewives amounting to 33 (73%) mothers, while only 2 (4%) mothers had job in farming. Meanwhile, 34 (76%) of stunted toddlers' mothers' occupation was housewives and 2 (4%) were public and private employees.

Table 1 also shows data on risk factors affecting stunting incidence. The composition of genders or sexes in both normal and stunted toddlers groups sampled out in this study was equal, 18 (40%) male and 27 (60%) female. Most normal toddlers were aged 37–48 months amounting to 14 (31%) persons, while those normal toddlers aged the youngest 7–12 months and the oldest 49–59 months comprised of only the least 5 (11%). In the stunted toddlers group, the oldest aged 37–48 months amounted to 11 (25%) persons and the youngest 7–12 amounted to 6 (13%) persons.

With regard to the toddlers' nutritional status based on height and weight to age ratio, the data showed that 69% of the stunted toddlers in the villages of Madiredo, Jambearjo, and Rejosari were in very short category and 31% in short category. Meanwhile, the national data on toddlers' nutritional status show that very short category was 15.2%, short 18.4%, and normal 66.4% (Kementrian Kesehatan RI, Badan Penelitian, and Pengembangan, 2018). Thus, in comparison, stunted toddlers' nutritional status in the three sampled villages was far below the national standard figures.

On history of infectious diseases, Table 1 shows that normal toddlers who had been sick were totaled 37 persons (82%), while 8 toddlers (18%) had never been sick. Meanwhile, stunted toddlers who had been sick were 36 persons (80%), while 9 persons (20%) had never been sick. Table 1 also shows the toddlers' immunization status. Forty-five (100%) normal toddlers had complete immunization. Whereas, 39 (84%) stunted toddlers had complete immunization, while 6 (16%) had not.

Test results of the variables/factors affecting stunting

Based on the study results, income variable was a risk factor in the incidence of stunting (p = 0.002), in line with Kawulusan *et al*. (2019) who stated that there was a significant relationship between income and stunting rates in children under 5 [17]. Low income had caused less than optimal growth and development of toddlers because households could not afford healthy food with balanced nutrition; therefore, toddlers had not obtained optimal nutrition [18].

Breastfeeding was another variable affecting stunting (p = 0.025), in line with Lestari and Dwihestie (2020) who stated that there was a significant relationship between breastfeeding and the incidence of stunting [19]. Sampe *et al*. (2020) also stated that toddlers who were not exclusively breastfed had a 61 times more chance of experiencing stunting compared to toddlers who were exclusively breastfed [13]. This could happen because breastmilk was a nutrient helping the development and growth of children. Exclusive breastfeeding could support children's growth, especially in height because breastmilk had calcium that was easily absorbed compared to formula milk [20].

Number of household members was also related variable that was a factor in the incidence of stunting (p = 0.029), in line with Rakotomanana *et al*. (2017) who stated that the number of household members was significantly related to stunting [21]. According to Ntshebe *et al*. (2019), household size was related to stunting due to competition in getting food between household members and reduced food supplies [22].

Father's education variable was also a factor in stunting incidence (p = 0.039), in line with Sarma *et al*. (2017) who stated that parental education affected the incidence of stunting [23]. This was because the father's low education caused an understanding of children's health and the fulfillment of children's food was low, besides, lack of education also caused lack of understanding of health information [24].

Father's occupation variable was also related in the incidence of stunting (0.046), in line with Ariati's research (2019) who stated that father's work was related to stunting because father's work was related to household income and economic status. The better the father's occupation, the better the income and economic status of the household would be so that the fulfillment of energy and protein intake for children could be met [25].

As indicated in Table 2, stunting could be influenced by the history of breastfeeding, number of household members, household income, father's occupation, and father's level of education. History of breastfeeding also had a significant relationship with the incidence of stunting with p = 0.025 and OR value of

Table 2: Logistic regression analysis of factors affecting stunting occurrences (n = 90)

Category	Subcategory	B	SE	Wald	df	p-value	OR	95% CI	
								Min	Max
Nutritional knowledge									
Mother's nutritional knowledge	Bad	3.4	1.279	6.9	1	0.063	29	2.332	350.8
	Fair	−0.2	0.536	0.2	1	0.653	0.79	0.275	2.247
	Good	0[b]			0				
Parenting/childcare practices									
Breastfeeding history	Not exclusive	−2.6	1.096	5.5	1	0.025	0.100	0.009	0.660
	Exclusive	0[b]			0				
Accuracy of weaning feeding	<6 months	13.4	1134.7	0.000	1	0.174	0.25	0.000	.[b]
	≥6 months	0[c]			0				
Household's nutritional awareness behavior									
Weighing	Yes	0[b]			0				
	No	0.98	0.865	1.306	1	0.253	2.7	0.493	14.6
Exclusive breastfeeding and weaning feeding	Exclusive	−0.8	0.595	1.933	1	0.164	0.44	0.136	1.403
	Not exclusive	0[b]			0				
Toddlers already eating household food	Have not started	0.25	0.707	0.123	1	0.726	1.3	0.321	5.119
	Have started	0[b]			0				
Household's salt use	Rough salt	0.07	1.432	0.003	1	0.959	1.1	0.065	17.814
	Cubed salt	0.9	0.866	1.309	1	0.253	2.7	0.493	14.690
	Table salt	0[b]			0				
Toddlers given Vitamin A	No	0.716	1.243	0.332	1	0.565	2.04	0.179	23.409
	Yes	0[b]			0				
Toddlers in cigarette smoking household	Yes	31	2313.6	0.000	1	0.989	40000	0.000	.[b]
	No	0[c]			0				
Household food diversity	Diverse	−0.5	0.482	0.902	1	0.342	0.633	0.246	1.627
	Not diverse	0[b]			0				
Household food availability									
Household food security	Insecure	1.4	0.697	3.817	1	0.069	11.60	0.996	15.276
	Inadequate	1.1	0.610	2.965	1	0.085	2.86	0.865	9.458
	Vulnerable	1.4	0.833	2.671	1	0.102	3.9	0.762	19.951
	Secure	0[b]			0				
Energy intake	Severe deficit	0.51	6889.16	0.000	1	0.998	0.01	0.000	.[b]
	Medium deficit	−34	6330.85	0.000	1	0.996	2.47	0.000	.[b]
	Mild deficit	1.09	8464.11	0.000	1	1.000	3	0.000	.[b]
	Normal	−19	6662.70	0.000	1	0.998	9.2	0.000	.[b]
	Excessive	0[c]			0				
Protein intake	Severe deficit	−35	6889.16	0.000	1	0.996	6.9	0.000	.[b]
	Medium deficit	−35	6889.16	0.000	1	0.996	4.7	0.000	.[b]
	Mild deficit	−36	6889.16	0.000	1	0.996	3.7	0.000	.[b]
	Normal	−19	5761.2	0.000	1	0.997	5.3	0.000	.[b]
	Excessive	0[c]			0				
Fat intake	Severe deficit	72	0.000		1		200,000	20,000	20,000
	Medium deficit	37	4885.8	0.000	1	0.99	15,600	0.000	.[b]
	Mild deficit	35	9766.7	0.000	1	0.99	1060	0.000	.[b]
	Normal	0[c]			0				
Carbohydrate intake	Severe deficit	−37	0.000		1		1.57	1.57	1.57
	Medium deficit	−1.1	4294.9	0.000	1	1.000	0.331	0.000	.[b]
	Mild deficit	0.1	8728.3	0.000	1	1.000	1.07	0.000	.[b]
	Normal	0.00	8464.11	0.000	1	1.000	1.000	0.000	.[b]
	Excessive	0[c]			0				
Mother's health service during pregnancy									
Red blood-boosting tablet	No	−0.8	1.275	0.405	1	0.525	0.444	0.037	5.406
	Yes	0[b]			0				
Vitamin A (during birth)	No	−0.4	0.589	0.458	1	0.499	0.671	0.211	2.130
	Yes	0[b]			0				
Household access to clean water and sanitation									
Final waste disposal	TPA	1.20	0.712	2.857	1	0.091	3.33	0.825	13.465
	Empty land	2.30	0.876	6.916	1	0.973	10	1.798	55.630
	Other	0[b]			0				
Clean water source	Open well	−31.2	2455.5	0.000	1	0.990	2.75	0.000	.[b]
	Closed well	0.59	3728.2	0.000	1	1.000	1.805	0.000	.[b]
	Municipal Waterworks	0[b]			0				
Toileting	Sit toilet	30.6	1736.27	0.000	1	0.986	195,000	0.000	.[b]
	Squat toilet	14.9	0.000		1		32,654	32,654	32,654
	Others	0[b]			0				
Ventilation	Good	−1.13	0.922	1.527	1	0.216	0.320	0.053	1.949
	Bad	0[b]			0				
Livestock shed location from home	Close	0.22	0.471	0.225	1	0.635	1.250	0.497	3.144
	Far	0[b]			0				
Household economic background									
Household income	Below minimum wage	2.94	0.783	14.06	1	0.002	62.95	4.057	87.225
	Above minimum wage	0[b]			0				
Father's occupation	Unemployed	20.2	0.000		1	0.046*	2.94	6225999	6225999
	Government official	−20.1	0.000		1	0.973	1.76	1.76	1.76
	Employee	−0.21	0.520	0.173	1	0.678	0.806	0.291	2.231
	Business	0.65	0.592	1.215	1	0.270	1.92	0.602	6.130
	Others (farm labors and construction laborers)	0[b]			0				
Father's level of education	Elementary school graduate	0.21	0.800	0.067	1	0.039*	3.57	0.257	5.900
	Junior high school graduate	0.41	0.816	0.247	1	0.619	1.50	0.303	7.432
	High school graduate	−0.58	0.810	0.527	1	0.468	0.556	0.114	2.716
	Higher education	0[b]			0				
Mother's level of education	Elementary school graduate	18.8	0.000		1	0.119	0.28	0.28	-
	Junior high school graduate	−0.26	0.632	0.172	1	0.678	0.769	0.223	2.654
	High school graduate	−0.58	0.543	1.139	1	0.286	0.560	0.193	1.623
	Higher education	0[b]			0				

(contd...)

Table 2: ***(continud)***

Category	Subcategory	B	SE	Wald	df	p-value	OR	95% CI	
								Min	Max
Sociocultural									
Mother's dietary restrictions	Yes	−0.12	0.499	0.062	1	0.803	0.883	0.332	2.348
	No	0[b]			0				
Breastfeeding mother's dietary restrictions	Yes	0.000	0.671	0.000	1	1.000	1.000	0.269	3.724
	No	0[b]			0				
Toddlers' eating frequency	1–2 times a day	0.98	0.800	1.503	1	0.220	2.67	0.556	12.794
	3 times a day	1.15	0.727	2.529	1	0.112	3.18	0.764	13.228
	>3 times a day	0[b]			0				
Number of household members	>4 people	0.18	1402.87	0.000	1	0.029	0.18	0.000	.[b]
	3–4 people	−16.9	0.000		1		4.3	4.3	4.3
	<3 people	0[c]			0				
Nutritional knowledge	Yes	−0.08	0.288	0.083	1	0.774	0.921	0.524	1.618
	No	0[b]			0				
Parenting/childcare practices									
Mother's age	19–29	17.3	1402.87	0.000	1	0.990	35,534,295	0.000	.[b]
	30–49	0[c]			0				
Mother's occupation	Housewives	0.00	12006.6	0.000	1	0.749	0.97	0.000	.[b]
	Government Officials	0.00	0.000		1		1.000	1.000	1.000
	Employee	0.00	0.000		1		1.000	1.000	1.000
	Business	0.00	12284.8	0.000	1	1.000	1.000	0.000	.[b]
	Others	0[c]			0				
Factors affecting the occurrence of stunting									
Sex	Boys	0.00	18,543.2	0.000	1	1.000	1.000	0.000	.[b]
	Girls	0[c]			0				
Toddlers' age	7–12	0.00	26,237	0.000	1	1.000	1.000	0.000	.[b]
	13–24	0.00	25,758.5	0.000	1	1.000	1.000	0.000	.[b]
	25–36	0.00	18,262.9	0.000	1	1.000	1.000	0.000	.[b]
	37–48	0.00	15,793.4	0.000	1	1.000	1.000	0.000	.[b]
	49–59	0[c]			0				
Toddlers' nutritional status based on height	Very Short	−40.4	6183.6	0.000	1	0.995	2.83	0.000	.[b]
for age	Short	−40.406	10,114.394	0.000	1	0.997	2.83	0.000	.[b]
	Normal	0[c]			0				
History of infectious disease	Yes	0.00	16,041.9	0.000	1	0.228	0.29	0.000	.[b]
	No	0[c]			0				
Immunization completeness	Completed	21.3	0.0		1	0.998	0.01	0.01	21.3
	Not Completed	0[b]			0				0[b]

*Using multiple logistics regression test p<0.05,.[b]= Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

0.100. OR value <1; thus, the history of breastfeeding was a variable protective against stunting. Toddlers who were given exclusive breastfeeding could reduce the risk of stunting than toddlers who were not given exclusive breastfeeding. This was in line with the study of Sampe *et al*. (2020) who stated that there was a significant relationship between history of breastfeeding and the incidence of stunting (p = 0.0001) [13]. The first breastmilk given to a baby contained colostrum which could boost immunity. Babies previous breastmilk consumption could affect their nutrition when they were toddlers [26]. Babies who were exclusively breastfed had better growth than babies who were not given exclusive breastfeeding, thus avoiding stunting [27].

From Table 2, household income below the regional minimum wage had a significant correlation with the incidence of stunting with p = 0.002 (p < 0.05) and OR value = 62.95 which means that household income below the MSE had a risk of 62.95 times experiencing stunting compared to household income above the minimum wage. This was in line with the research of Nurmalasari *et al*. (2020) who stated that there was a significant relationship between household income and the incidence of stinting (p = 0.000) [10]. It happened because low household income could affect the quality and quantity of food to be consumed. Low income would also cause low purchasing power which could hinder the improvement of nutrition for children. This was the risk of children experiencing stunting [28].

Father's occupation had a significant correlation to the incidence of stunting with p = 0.046 (p < 0.05) and the value of OR = 2.94, which means that unemployed fathers of toddlers were at risk of 2.94 times higher experiencing stunting compared to fathers of toddlers who were employed (civil servants, private employees, entrepreneurs, farm laborers, and construction workers). Ariati's research (2019) stated that father's work was related to stunting because father's work is related to household income and economic status. If the father was well-employed, the income and economic status of the household would be better, thus the fulfillment of energy and protein intake for children can be met [25].

The father's level of education also had a significant correlation with the incidence of stunting with p = 0.039 and OR value of 3.57, which means that fathers of toddler whose level of education was elementary school had 3.57 times greater risk of having toddlers who experienced stunting compared with fathers of toddlers who graduated from junior high school, high school, or higher education. This was in line with the research by Gunardi *et al*. (2017) who stated that fathers of toddlers whose level of education was fewer than 9 years were at risk of having toddlers who experienced stunting 1.6 times greater than fathers of toddlers whose level of education was more than 9 years [29]. The level of education influenced nutritional status, higher education was more likely to know a healthy lifestyle so that it could choose the right food to avoid stunting [11].

Household size was one of the factors causing stunting. From the results of the study, the p-value was 0.029 with RR value of 0.18, which means that household size had a significant correlation with

stunting. OR value <1 meant that household size was a protective variable for stunting. Large households with 2–3 members and <3 people could reduce the risk of stunting under 5. This was in line with the research of Rahmawati *et al*. (2020) who stated that the number of household members with >4 persons was at risk of having stunted toddlers 10.8 times greater than households with <4 persons [30]. According to Ntshebe *et al*. (2019), household size was related to stunting due to competition in getting food between household members and reduced food supplies [22].

The timing of weaning feeding did not have a significant relationship with the incidence of stunting (p = 0.174). This was in line with the research of Prihutama *et al*. (2018) who stated that there was no significant relationship between the timeliness of giving weaning feeding and the incidence of stunting (p = 0.680) [31]. Household's Nutrition Awareness Behavior (weighing, exclusive breastfeeding, and weaning feeding, toddlers who start eating household food, salt used by the household, toddlers who got Vitamin A, toddlers in cigarette smoking household, and diverse foods in the household) did not have a significant relationship. This was in line with the research of Sriyanti (2017) who stated that there was no significant relationship between Household Nutrition Awareness behavior (KADARZI) and the incidence of stunting in the Singotrunan Health Center Work Area, Banyuwangi Regency (p = 0.170) [32].

The availability of food in the household (household food security level, energy intake, protein intake, fat intake, and carbohydrate intake) did not have a significant relationship with the incidence of stunting. In addition, maternal health services during pregnancy (mothers who received iron tablets during pregnancy and mothers who received Vitamin A during childbirth) also did not have a significant relationship with stunting. Access to clean water (source of clean water, garbage disposal, defecation area, ventilation, and position of livestock sheds) did not have a significant relationship with stunting. The household economic level, the mother's level of education, did not have a significant relationship with stunting. Maternal age, mother's occupation, gender of the toddler, age of toddler, nutritional status of the toddler by height for age, history of infectious disease, and immunization completeness also did not have a significant relationship with stunting.

Conclusion

Based on the results and discussion, the most influencing variables on stunting are household income, history of breastfeeding, and household size. The variables serving as the main risk factors are income, household size, father's level of education, and father's occupation. As for the history of breastfeeding and household size, they are protective factors for the main risk factors; if the protective factors are carried out, then the income, father's level of education, and father's occupation are not the main factors causing stunting in toddlers in Malang Regency.

The timing of weaning food introduction and administration do not have significant relationship with stunting. Household's nutritional awareness and behavior such as weighing, toddlers' sharing of household food, household salt use, toddler's vitamin A consumption, toddlers with cigarette-smoking household, seemingly do not have significant effect to stunting either. Factors related to household food availability, namely food security level, energy intake level, micronutrient intakes of protein, fat and carbohydrate and food diversity apparently are insignificant factors to stunting incidents. Maternal health services during pregnancy such as iron tablets and vitamin A consumption are also insignificant factors to stunting. Hygiene-related factors which include clean water access, waste disposal, toileting, ventilation and livestock cages distance from home give do not give significant impact to stunting. The other factors which do not have significant relationship with stunting include household socio-economic status (mother's education, age, and occupation), and toddler's status and characteristics (gender, age, nutritional status according to height for age, history of infectious disease and immunization completeness).

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Significance for Public Health

Based on the results of the study above, income, breastfeeding, number of household members, father's education, and father's occupation were a variable that was a factor in the incidence of stunting. The most influencing variables on stunting are household income, history of breastfeeding, and household size. The variables serving as the main risk factors are income, household size, father's level of education, and father's occupation. As for the history of breastfeeding and household size, they are protective factors for the main risk factors; if the protective factors are carried

out, then the income, father's level of education, and father's occupation are not the main factors causing stunting in toddlers in Malang Regency.

Authors' Contributions

IDNS, IF, ES, DW, AA, and HP, concept, design, protocol writing, and approval; K and RA, manuscript writing, revision, and approval.

Ethics Approval and Consent to Participate

This study was submitted to the evaluation of the Department of Research and Development, Malang Regency and approved under registration number 070/563/35.07.203/2019.

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