ORIGINAL ARTICLE

Stunting and its association with feeding problem among under five children: a case-control study in Kuantan district, Malaysia

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ABSTRACT

Introduction: Stunting is the most prevalent form of malnutrition among infants and young children population, both globally and locally. It refers to low height-for-age children and is primarily caused by chronic under nutrition. The objective of this study is to determine the association between stunting and feeding problems and to explore the risk factors for stunting among children aged 6 to 59 months attending health clinics in the Kuantan district.

Materials and Methods: A case-control study involving 160 children that attended six health clinics in Kuantan from August to October 2021 with a ratio of 1 case: 3 controls. Data were collected from mothers using a questionnaire consisting of sociodemographic and feeding assessment adapted from a validated World Health Organization (WHO) integrated management of childhood illness (IMCI) assessment form. The data was analysed using IBM SPSS version 26.0. Binary logistic regression analysis was used to identify factors associated with stunting. The odds ratio was used to measure the strength of the association between outcome and predictor variables. The significance value was set at p<0.05.

Results: Children with identified feeding problems have more than four-time significantly higher risk of becoming stunted (Odds Ratios, OR: 4.2; 95% Confidence Intervals, 95%CI: 1.4, 12.8) as compared to children with no feeding problems. Specifically, children with inadequacy in feeding components; amount, variety and frequency of meal each have significantly six-time higher risk (OR: 6.2; 95%CI: 2.7, 14.5), four-time higher risk (OR: 4.2; 95%CI: 1.4, 12.3), and three-time higher risk (OR: 2.8; 95%CI: 1.1, 6.9), of becoming stunted as compared to children with adequate feeding. Additionally, with a decrease of one week in delivery week, one kilogram in birth weight and one centimetre in maternal height, there is a respectively significant 40.0% (OR: 0.6; 95%CI: 0.4, 0.9), 80.0% (OR: 0.2; 95%CI: 0.1, 0.7) and 11.0% (OR: 0.89; 95%CI: 0.82, 0.98) increase in the risk of become stunted among children.

Conclusion: Feeding problems specifically inadequate food amount, food variety and meal frequency not following the recommendation contribute to stunting in young children. Other factors identified are lower maternal height and children with lower birth weight and delivery week. This highlights the need for more excellent detection and intervention of nutritional concerns and risk factors to prevent stunting.

KEYWORDS:
Stunting, growth disorder, feeding problem, nutritional, under 5

INTRODUCTION

Stunting is the most prevalent form of malnutrition in the under-five population. Globally, an estimated 149.2 million children or almost a quarter of the number of children under the age of 5 are suffering from stunting[1] with as many as 79 million stunting cases are in Asia region. Likewise, in Malaysia, according to the National Health Morbidity Survey (NHMS) 2022, the prevalence of stunting in children under five was 21.8% in 2019 with the highest cases of stunting occurred in the state of Pahang at 28.2%.[2] Out of 11 districts in Pahang, the incidence in Kuantan in 2022 was 0.6% out of 6339 new attendances to the health clinics.

Stunting is a condition where a child's height is shorter than his/her height for age which mainly caused by chronic under nutrition. Stunting might leads to an increase in illnesses and deaths, as well as a decline in cognitive and psychomotor development.[5] It could later affect their academic and career opportunities and perpetuate poverty in later life.[7] It is a vicious cycle that will continuously impacts one's health. Stunting frequently starts during pregnancy until at least the first three years of a child's life thus the pregnant woman's nutritional status will impact the foetus growth. Stunting has also been identified as the target for nutritional initiatives as the majority is caused by the inadequacy of children's diets. Therefore, nutrition is one of the modifiable risk factors for stunting, which will be explored in more detail in this study.

The screening for malnutrition and assessment for feeding problem among under 5 children at the primary care level in Malaysia has been adopted from World Health Organization (WHO) Integrated Management of Childhood Illness (IMCI) program and adapted into local Approach to Unwell Children under 5 (ATUCU5 modules) in 2018. This was

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complemented by the guidelines for the prevention and management of under 5-year-old children with risks for malnutrition *(Panduan Pencegahan & Pengendalian Kes Berisiko Malnutrisi Dalam Kalangan Kanak-Kanak Bawah 5 Tahun)* which was developed by Family Health Development Division, Ministry of Health Malaysia in 2019. It strategizes the clinical algorithm for identification and management of malnutrition and lifestyle intervention including dietary component.[3]

MATERIALS AND METHODS

This was an unmatched case-control study, conducted for 18 months, from October 2021 to March 2023. With a ratio of 1:3, 40 cases of stunting and 120 controls with normal height for age were selected. The study design was chosen since it is the best method to examine the association between stunting and feeding problems. This study's operational definition of stunting is low height-for-age (< -2 standard deviation, SD) during the recruitment period. Operational definition for feeding problem is impaired oral intake that is not followed age-appropriate, while amount, variety, and frequency of feeding were considered inadequate if not following recommendations. It involved children aged 6 to 59 months old (paired with their mothers) who attended six government health clinics in Kuantan district in Pahang. The study tool used was from WHO IMCI programme and was adapted into local ATUCU5 modules in 2018. IMCI is a validated clinical clerking protocol developed by WHO.

The sample size was computed using OpenEpi version 3.1. The total sample size calculated was 160. Exclusion criteria for both cases and controls was children with underlying medical illnesses that could affect growth and development. Examples of chronic diseases that had been excluded were thyroid disorder (e.g., hypothyroidism), growth hormone disorder, cardiac disease and chronic lung disease. The data collection used a questionnaire which consists of child and maternal socio demographic data, child anthropometric measurements and feeding assessment adapted from IMCI. The data was analysed using IBM SPSS version 26.0. Binary logistic regression analysis was used to identify factors associated with stunting. The odds ratio was used to measure the strength of the association between outcome and predictor variables. A p-value of <0.05 was taken as statistical significance in multivariate binary logistic regression analysis.

RESULTS

Characteristics of Children

A total of 160 children (40 cases and 120 controls) participated in this study. Table I showed that the mean age of cases and controls were 27.2 (±14.1) and 22.4 (±10.5) months respectively. The majority of children in both cases and controls were girls (59.4%), Malay (91.9%), had one to two siblings (65.6%), had received complete vaccinations up to their age (99.4%), and had no history of multiple hospitalisations (96.9%). All of them were singleton birth. The mean delivery week and mean birth weight were both lower in cases than controls, being 37.5 (±1.4) and 38.3 (±1.6) weeks, and 2.6 (±0.5) and 3.0 (±0.5) kilograms, correspondingly. In terms of underlying chronic disease were five cases (5%) in this study, two of them were bronchial asthma in treatment.

Characteristics of Mother

From Table II, the mean maternal height for cases (151.0±5.1cm) was lower than controls (155.4±6.0cm). Majority of the mother in both cases and controls were housewives and had secondary level of education. The mean household income for cases (MYR2567.5±1843.3) was lower than the controls (MYR3,813.6±2604.7). Almost all caregivers have treated water as a water source (98.8%) and refrigerator for food storage (98.1%) at their homes.

Feeding Profile of Children

Exclusive breastfeeding occurred more in cases than controls. In general, children with stunting had more feeding problem (75%) than controls (25%). They had higher percentage for taking less than the recommended meal frequency for both main meal and snack. They also had higher percentage for inadequacy in the food variety (energy food, protein, vegetables, fruit and drinks) and inadequacy in the amount of food intake (energy food, protein and milk).

Factors Associated with Stunting

In the multiple binary logistic regression analysis shown in Table IV and V, delivery week, birth weight, maternal height, feeding problems (amount, variety and frequency of meal) were significant independent factors associated with stunting. Other factors were not significantly associated with stunting after adjusting for other cofounders.

It was shown that a decrease of 1 week in delivery week, 1 kg in birth weight and 1 cm in maternal height, there is a respectively significant 40.0% (Odds Ratios, OR: 0.6; 95% Confidence Intervals, 95%CI: 0.4, 0.9), 80.0% (OR: 0.2; 95%CI: 0.1, 0.7) and 11.0% (OR: 0.89; 95% CI 0.82, 0.98) increase in the risk of become stunted among children.

For feeding profile as shown in Table V, firstly, children with feeding problems have more than four times higher odds of becoming stunted (OR: 4.2; 95%CI: 1.4, 12.8) than children with no feeding problems. The findings revealed that higher risk occurred among children with inadequate intake of food amount, inadequate food variety and inadequate meal frequency. Children with inadequate feeding amounts have more than six times higher odds of becoming stunted (OR: 6.2; 95%CI: 2.7, 14.5). Secondly, children with inadequate feeding variety have more than four times higher odds of becoming stunted (OR: 4.2; 95%CI: 1.4, 12.3) and lastly, children with inadequate feeding frequency have almost three times higher odds of becoming stunted (OR: 2.8; 95%CI: 1.1, 6.9) than children with adequate feeding frequency.

DISCUSSION

Feeding Problem as a Determinant of Stunting

Adequate complementary feeding is critical to support children's optimal physical growth and to prevent stunting. Complementary foods need to be energy and nutrient-rich and be fed frequently. The most significant proportion of stunting occurs during the complementary feeding period (6-23 months), i.e., the 500-day transition from exclusive breastfeeding in the first six months of life to consuming a

Table I: Description on sociodemographic characteristic of the children.

Variables	Stunting				Total	
	Yes		No		N	%
	n	%	n	%		
Age (months), ±SD	27.2±14.1*		22.4±10.5*		23.6±11.6*	
Gender						
Boy	16	40.0	49	40.8	65	40.6
Girl	24	60.0	71	59.2	95	59.4
Race						
Malay	34	85.0	113	94.2	147	91.9
Orang Asli	5	12.5	3	2.5	8	5.0
Chinese	1	2.5	0	0.0	1	0.6
Others	0	0.0	4	3.3	4	2.5
Number of siblings						
1-2	24	60.0	81	67.5	105	65.6
3-4	16	40.0	31	25.8	47	29.4
>5	0	0.0	8	6.7	8	5.0
Immunization status						
Not complete up to age	1	2.5	0	0.0	1	0.6
Complete up to age	39	97.5	120	100.0	159	99.4
Underlying growth problem						
No	40	100.0	120	100.0	160	100.0
Yes	0	0.0	0	0.0	0	0.0
Underlying chronic disease						
No	38	95.0	117	97.5	155	96.7
Yes	2	5.0	3	2.5	5	3.1
History of multiple hospitalization						
No	37	92.5	118	98.3	155	96.9
Yes	3	7.5	2	1.7	5	3.1
Birth history						
Term	35	87.5	107	89.2	142	88.8
Premature	5	12.5	13	10.8	18	11.3
Delivery week	37.5 ± 1.4 *		38.3 ± 1.6 *		38.1 ± 1.6 *	

*Mean and standard deviation (SD)

Table II: Description on sociodemographic characteristic of the mothers.

Variables	Stunting				Total	
	Yes		No		N	%
	n	%	n	%		
Maternal height (cm), ±SD	151.0±5.1*		155.4±5.9*		154.3±6.0*	
Para						
1-2	26	65.0	81	67.5	107	66.9
3 4	14	35.0	32	26.7	46	28.7
>5	0	0.0	7	5.8	7	4.4
Maternal occupation						
Housewife	28	70.0	76	63.3	104	65.0
Working	12	30.0	44	36.7	56	35.0
Maternal education status						
Primary school	1	2.5	3	2.5	4	2.5
Secondary school	24	60.0	59	49.2	83	51.9
Higher education	15	37.5	58	48.3	73	45.6
Household income	2567.5± 1843.3 *		3813.6 ± 2604.7*		3502.2 ± 2490.8*	
Water source at home						
Non treated water	1	2.5	1	0.8	2	1.3
Treated water	39	97.5	119	99.2	158	98.8
Availability of fridge for food storage						
No	3	7.5	0	0.0	3	1.9
Yes	37	92.5	120	100.0	157	98.1

*Mean and standard deviation (SD)

Table III: The feeding profile of children.

Variables	Stunting				Total	
	Yes		No		N	%
	n	%	n	%		
Exclusively breastfeeding						
No	10	25.0	51	42.5	61	38.2
Yes	30	75.0	69	57.5	99	61.8
Frequency						
1. Frequency of main meal/ day						
0	1	2.5	0	0.0	1	0.6
1	2	5.0	1	0.8	3	1.9
2	12	30.0	21	17.5	33	20.6
3	24	60.0	89	74.2	113	70.6
4	1	2.5	9	7.5	10	6.3
2. Frequency of snack/ day						
0	3	7.5	0	0.0	3	1.9
1	15	37.5	31	25.8	46	28.8
2	15	37.5	69	57.5	84	52.5
3	7	17.5	18	15.0	25	15.6
4	0	0.0	2	1.7	2	1.3
Variety						
1. Energy type of food taken						
No	1	2.5	0	0.0	1	0.6
Yes	39	97.5	120	100.0	159	99.4
2. Protein type of food taken						
No	2	5.0	0	0.0	2	1.3
Yes	38	95.0	120	100.0	158	98.7
3. Vegetable type of food taken						
No	13	32.5	18	15.0	31	19.4
Yes	27	67.5	102	85.0	129	80.6
4. Fruit type of food taken						
No	19	47.5	44	36.7	63	39.4
Yes	21	52.5	76	63.3	97	60.6
5. Drink						
No	6	15.0	0	0.0	6	3.8
Yes	34	85.0	120	100.0	154	96.2
Amount						
1. Amount of energy food taken						
Not adequate	13	32.5	20	16.7	33	20.6
Adequate	27	67.5	100	83.3	127	79.4
2. Amount of protein intake						
Not adequate	12	30.0	3	2.5	15	9.4
Adequate	28	70.0	117	97.5	145	90.6
3. Amount of milk intake						
Not adequate	9	22.5	1	0.8	10	6.3
Adequate	31	77.5	119	99.2	150	93.7

wide range of family foods while breastfeeding continues. The adequate intake amount of food especially from the energy rich source is the most important factor that could impact child's growth followed by food variety and adequate meal frequency. A case-control study in Vietnam also showed that after adjusting for other factors in the model, children whose mothers inappropriately provided food had a 1.9 times greater risk of getting stunted than those whose mothers fed them appropriately.[20] A study has found that feeding frequency less than four times a day was 3.6 times higher among the cases than in controls.[12] Another findings indicate that 63.0% of the children had an inadequate minimum dietary diversity score (DDS).[21] The finding is similar to a study conducted in Ghana in which only 24.7% of the children had a dietary diversity score of at least four out of seven food groups.[22] Moreover, the causative factors in stunted children are micronutrient insufficiency, food scarcity and protein-energy malnutrition, which is an obvious cause of stunting.

Child Factor as a Determinant of Stunting

Several studies have shown low birth weight as a strong determinant of child stunting. Low birth weight was 4.47 times more in stunted children than those not stunted, in line with a study done in Kelantan Malaysia, which found that low birth weight had a 0.61 higher risk for stunting.[13] Moreover, researchers found that a history of low birth weight increased the risk of stunting more than 12 times compared to those with average birth weight.[14] Low birth weight can potentially have an intergenerational impact according to research that links it to mothers' nutritional quality during pregnancy and the preconception period. These findings explain the concept of stunting during the first 1000 days of life.[15] Infants have a better chance of growing to an average body height if they can catch up on their growth during the first six months of life.

Table IV: The association between factors among children and maternal with stunting.

Variables	Stunting			
	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age	1.0(1.0, 1.1)	0.028	1.0 (0.9, 1.1)	0.321
Gender				
Boy	1.0			
Girl	1.0(0.5, 2.1)	0.926	-	-
Race				
Malay	1.2(0.1, 11.1)	0.870		
Orang Asli	6.7(0.5, 91.3)	0.155		
Others	1.0		-	-
Number of siblings				
1-2	1.0	0.116	-	-
3-4	1.8(0.9, 3.9)			
>5	0.0			
Underlying chronic disease				
No	1.0			
Yes	1.6(0.1, 17.8)	0.717	-	-
History of multiple hospitalization				
No	1.0	0.086	-	-
Yes	5.0(0.8, 30.8)			
Birth history				
Term	1.0			
Premature	1.2(0.4, 3.7)	0.721	-	-
Delivery week	0.7(0.6, 0.9)	0.006	0.6(0.4, 0.9)	0.035*
Birth weight	0.2(0.1, 0.5)	<0.001	0.2 (0.1, 0.7)	0.009*
Maternal height	0.9(0.8, 0.9)	<0.001	0.89 (0.82, 0.98)	0.016*
Para				
1-2	1.0	0.359	-	-
3-4	1.4(0.7, 3.1)	0.999		
>5	0.0			
Maternal occupation				
Housewife	1.0			
Working	0.7(0.3, 1.5)	0.308	-	-
Maternal education status				
Primary school	1.3(0.1, 13.3)	0.831	-	-
Secondary school	1.5(0.7, 3.1)	0.300	-	
Higher education	1.0			
Household income	1.0	0.009	1.0 (0.9, 1.0)	0.096
Water source at home				
Non treated water	0.3(0.0, 5.2)	0.420	-	-
Treated water	1.0			

*Statistically significant at p<0.05
$ Analysis for availability of fridge for food storage vs stunting status cannot be executed as all respondents who were not stunted, have fridges at home.

Table V: The association between feeding problem status among children and stunting.

Variables	Stunting			
	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Feeding problem				
Yes	4.7 (2.1, 10.4)	0.0001	4.2 (1.4, 12.8)	0.011*
No	1.0			
Frequency				
Not adequate	3.7(1.7, 8.3)	0.001	2.8 (1.1, 6.9)	0.029*
Adequate	1.0			
Variety				
Not adequate	3.9(1.5, 1.0)	0.004	4.2(1.4, 12.3)	0.010*
Adequate	1.0			
Amount				
Not adequate	5.5(2.5, 12.0)	<0.0001	6.2 (2.7, 14.5)	<0.0001*
Adequate	1.0			
Breastfeeding history				
No	2.0(0.2, 17.0)	0.532	1.0 (0.44, 2.4)	0.95
Yes	1.0			

*Statistically significant at p<0.05

Maternal Factor as a Determinant of Stunting

Various studies have shown maternal stature as a strong determinant of child undernutrition. In a study done in Vietnam, maternal height and weekly weight gain during pregnancy were identified as significant predictors of a child's future risk of stunting by OR 0.86.[16] This finding is supported by a previous study that found that for each standard deviation increase in maternal height, offspring height for age at two years increased by 0.30 SD ($p<0.001$). This is in line with the cohorts study examining five prospective birth cohorts in which shorter women (<150.1 cm) were three times more likely to have a stunted child at two years.[18,19] Shorter women will likely have reduced protein and energy stores, smaller uterine volume, limited room for foetal development, reduced placental size and function and decreased quantity and quality of breast milk.

Preventive Strategies for Stunting

In primary care, prevention is the principle of healthcare service. Generally, these consist of primordial, primary, secondary and tertiary prevention. Combined, these strategies aim to prevent disease onset through risk reduction and downstream complications of a manifested disease such as stunting.[16]

Primordial prevention is done by empowering woman to practice healthier diets prior to conception and throughout the pregnancy and postnatal period. Mothers also need to be empowered to learn and adopt proper feeding recommendations for their infants and young children with particular focus should be given to adequate energy-rich food and the appropriate meal frequency and variety.[8,23] This nutritional education must be given early from the pre-pregnancy phase and delivered by the first tier (staff nurse and medical officer) with the nutritionist's guidance.

Primary prevention is also essential by identifying children at risk of stunting, such as infants with feeding problems, short maternal stature, low birth weight and pre-term delivery and children whom the growth chart crosses the centile. Delivering early intervention for identified modifiable risk factors to avoid the clinical outcome of stunting is critical.[24] As secondary prevention, a focused and intensified feeding counselling and nutritional support needs to occur in children with risk or already diagnosed with stunting to avoid complications. Lastly, further research is needed to determine which interventions could be best efficiently and economically implemented.

CONCLUSION

Feeding problems in under five years old children may lead to negative sequelae particularly stunting which is the most prevalent form of malnutrition (undernutrition) in this age group. This case control study aimed to explore feeding problems as the risk factors for stunting among infants and young children in district of Kuantan, Pahang. Identifying determinants of stunting would help to set priorities for action and design a preventive strategies and early intervention to prevent stunting. This study may offer an opportunity to review the strategies, target the significant predictors which had been identified, and empower the community and healthcare providers for early identification and intervention to break the vicious cycle of stunting.[24]

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FUNDING AND CONFLICT OF INTEREST

This study was self-funded, and we declare no conflicts of interest.

ETHICAL APPROVAL

The ethical approval was obtained from Medical Research & Ethics Committee (MREC) (NMRR ID: NMRR-21-1264-60135 (IIR)), Ministry of Health Malaysia (KKM/NIHSEC P21-1393(3).

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