RISK FACTORS FOR UNDERNUTRITION IN CHILDREN UNDER FIVE YEARS OF AGE IN TENOM, SABAH, MALAYSIA

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ABSTRACT

Undernutrition is the result of complex interplay of factors such as household food security, childcare, feeding practices, nutrition and sanitation. Therefore, this study aimed to determine the prevalence of stunting, wasting, underweight based on WHO child growth standards 2006 and undernutrition based on Composite Index Anthropometric Failure (CIAF) and its association with the biological, behavioural, socio-economic and physical environment factors among children under-5 years. This was a cross sectional study involving children aged between 6 and 59 months recruited through stratified random sampling from the Tenom district. Sociodemographic background was obtained from mothers via a questionnaire. Height and weight measurements were measured using standardised instrument. The height-for-age, weight-for-age and BMI-for-age were classified according to the WHO Child Growth Standard 2006. Bivariate analysis and multivariate logistic regression analysis were conducted. The prevalence of undernutrition based on CIAF was 42.3%, underweight 34.7%, stunting 33.3% and wasting 10.0%. After adjusting for all confounders, childhood undernutrition was significantly associated with unimproved sanitation (adjusted OR 2.98, 95% CI: 1.082 to 8.225) and frequent illness (adjusted OR 2.07, 95% CI: 1.015 to 3.274). These findings support the association of biological and physical environmental factors with the nutritional status of children under-5 years old.

Keywords: undernutrition, risk factor, malnutrition, children, Malaysia

INTRODUCTION

Undernutrition remains to be the underlying cause to the mortality and morbidity of children globally despite being preventable[7]. Double burden of malnutrition is an emerging public health concern in countries which are saddled with undernutrition while having concurrent rise of overweight and obesity. Undernutrition is widespread in the developing countries as compared to the developed countries and unfortunately children is the most vulnerable group to undernutrition.

Malaysia is an emerging upper middle-income country however the country is now facing the double burden of malnutrition. The National Health and Morbidity survey (NHMS) 2016 reported that the prevalence of stunting, underweight and wasting in 2016 among Malaysian children under-5 years were 20.7%, 13.7% and 11.2% respectively[8]. Meanwhile based on NHMS 2006, prevalence of stunting, and underweight in Malaysia were reported as 17.2% and 12.9% respectively[10].In contrast, prevalence of stunting, underweight and wasting in Sabah and Labuan based on NHMS 2016 were 23.5%, 15.2% and 5.3% respectively which signifies that the prevalence of stunting and underweight were higher than the national average[8].

Undernutrition is the result of complex interplay of factors such as infections, inadequate feeding, child care practices, sanitation and poor access to healthcare. However, as yet little is known about the role of these complex factors on undernutrition among children under-5 years from the east of Malaysia namely Sabah. Therefore, this study aimed to determine the prevalence of stunting, wasting, underweight and undernutrition based on Composite Index Anthropometric Failure (CIAF) and its association with the biological, behavioural, socio-economic and physical environment factors among children under-5 years in Tenom, Sabah.

METHODS

The study design of this research was a cross sectional analytical study which was conducted in the district of Tenom in the state of Sabah from 1st of March to 31st of March 2018. The sampling frame is children under-5 years who is under follow up with the 12 public funded health clinics in the district of Tenom within the study period

and samples were collected via stratified random sampling method from this health facilities. Children under-5 years were eligible for the study if they are a Malaysian citizen and resident of Tenom. Children who had mental disorder, physically disability or suffering any serious disease were excluded from this study. Prior to the commencement of the study, written approvals were obtained from the Medical Research and Ethics Committee from the Ministry of Health Malaysia (NMRR-17-3000-38960) and from University Malaysia Sabah (JKEtika1/18(8)). There were two sets of respondents, the children and their mothers or caregivers. Informed consent was obtained from the adult respondents and conformed to the Malaysian ethical standard for research.

The sample size of 300 was calculated according to the formula outlined by Daniel[3] is used for calculation of the sample size $n = Z^2 P(1-P)/d^2$ where n is the sample size Z represents the confidence interval, P is the prevalence (23.5%) and d is precision. The absolute precision value in this research study is set at 5 percentage points which is 0.05 as suggested by Naing et al[13] that if the prevalence is between 10% to 90%, then the precision value of 5% is the suitable value. Assuming 95% of confidence level, the sample size for this study is calculated as $n = 1.96^2 \times (0.235(1-0.235)/0.05^2) = 276$. Therefore, 300 samples were collected for this research study. Sample data was collected through an interview.

Questionnaire

Community nurses from all the 12 health facilities in the district of Tenom were trained by the researcher for the administration of the questionnaires and interview sessions. Face to face interviews were conducted on all respondents. These questionnaires were pretested on 25 children's mother or caretaker to ensure that the format, the wording and sequencing is correct. Back-to-back translation was done to translate the questionnaire from English to Malay language. The questionnaire is divided into four sections such as demographic information of the child, background information regarding the parents/caregiver, classification of the nutritional status of the child and finally physical environment factors (water supply and sanitation).

Anthropometric measurements

The weight measurements of infants or children less than 2 years old were conducted in the recumbent position on a Seca infant weighing scale. The length of the infant or children less than 2 years were measured on a recumbent measuring board (accuracy of 0.1 cm). The measurement of children aged between 2 years to 5 years old were asked to step on the Seca digital weighing scale (accuracy of 0.1 kg) barefooted in light weight clothing and standing straight on a flat surface with eyes looking straight forward. Besides that, to obtain the height of the children under-5 years, the child is required to stand upright against a wall where the child height is measured with a Seca stadiometer. The anthropometric readings were measured twice and the mean of those two readings were calculated and used for the data analysis. Z-scores for BMI-for-age and height-for-age, weight-for-age were determined and classified using WHO AnthroPlus software into stunting, wasting and underweight.

Statistical analysis

Data that were obtained from the questionnaires were then cleaned, edited, coded and analysed with IBM Statistical Program for Social Sciences (SPSS) version 25. The prevalence of undernutrition is measured based on the Composite Index of Anthropometric Failure (CIAF) which includes the prevalence of stunting, wasting and underweight among children under-5 years in the district of Tenom. Composite Index of Anthropometric Failure (CIAF) is measured via totalling up all the subgroup anthropometric failure such as wasting only, wasting and underweight, wasting, stunting and underweight, stunting and underweight and stunting only.

Descriptive analysis was conducted on the demographic and socioeconomic characteristics of the study participants. The descriptive statistics were presented as count and percentages for each categorical variable. Univariate analysis with Chi square were used to evaluate the association between the outcome which was undernutrition based on Composite Index Anthropometric Failure (CIAF) on each of the separate independent variable to identify any independent factors that were associated with undernutrition among children under-5 years. Variables that were being analysed and recorded probability less than 0.05 were considered statistically significant as it would reject the null hypothesis. Chi square can measure the strength of the relationship between the independent and dependent variable. However, chi square cannot measure the direction of the relationship between the independent and dependent variable. Hence, multivariate analysis by Logistic regression was done as a risk assessment for the selected variables that shows significant difference in the bivariate analysis producing adjusted odds ratio and 95% confidence interval.

RESULTS

A total of 300 children living in the district of Tenom were included in this analysis with a 92% response rate and among which 50% were boys. The mean age of the children were 3.38 ± 1.44

years. Nutritional status among under-5 children in Tenom 2018 is presented in Table 1. The prevalence of undernutrition based on CIAF among under-5 children in Tenom in 2018 was 42.3%. Prevalence of underweight, stunting and wasting were 34.7%, 33.3% and 10.0% respectively. Demographics and socioeconomic characteristics of children aged 0-60 months in Tenom 2018 is presented in Table 2. With regards to ethnicity, majority is Murut (69.3%) followed by Kadazan-dusun (15%), Malay (3.3%), Chinese (2.7%) and other ethnicities such as Indian and other mixed ethnicities (10%).

Overwhelming of the children's birthweight were above 2 kilograms (96.3%). Almost all the children were immunised (99%) as per schedule of immunisation. Majority of the children had preceding birth interval greater than 24 months (72%). Majority of the mothers or caretakers had secondary school education (65.7%) followed by primary school education (20.7%), diploma or tertiary education (11.0%) and only 2.7% of them did not attend school. In contrast, majority of father them had secondary school education (65.7 %) followed by primary school education (23.6%), diploma or tertiary education (8.3%) and only 3.4% of them did not attend school. It was reported that most of the households earned less than RM 1050 per month (71.7%). More than half of the children were living in households with 5 or less members (62%). Overwhelming majority of the mothers were housewife 215 (85.3%).

Behavioural practices and physical environment of the respondents and children aged 0-60 months in Tenom 2018 is presented in Table 3. An overwhelming majority of children were being taken care by mother (96.3%). Most of the mothers had less than 4 times history of pregnancy (70%). Majority of mothers breastfed their children up to 12 months (44%) whereas 40% of mothers breastfed beyond 12 months and only 16% mothers breastfed less than 6 months. Majority of the mothers started to introduce complementary feeding at the age of 6 months and above (96.7%). The longest duration of complementary feeding was 6 months and above (96.7%). Majority of the frequency of complementary feeding was 4 or more than 4 times per day (62.7%). Overwhelming majority of mothers reported that their daily food supplies were adequate (97%). Most of parents were found to be smokers (65.3%). It has been reported that most of households received treated water (88%) and improved sanitation (69%).

Relationship of the undernutrition in children with the risk factors was observed using chi-square test (Table 4a,4b). Birthweight of the child, frequency of illness, deworming status, smoking status, education level of father and mother, mother's occupation, total household income, source of water supply and type of sanitation were found to be significant risk factors for undernutrition using univariate analysis (p<0.05). Statistically significant factors were further assessed using multivariable logistic regression analysis (Table 5) to adjust for confounders.

Frequent illness and unimproved sanitation have been found to be independently associated with undernutrition in children under-5 years in Tenom. The risk of being undernourished among children using unimproved sanitation were 2.9 times higher compared to using proper improved sanitation (adjusted odds ratio 2.983, 95% confidence interval between 1.082 to 8.225). Frequent illness was 2.1 times higher risk of being undernourished compared to not frequently falling sick (adjusted odds ratio 2.068, 95% confidence interval between 1.015 to 3.274).

Table 1: Nutritional status among under-5 children in Tenom 2018

Nutritional status	Frequency (%)
Underweight	104 (34.7)
Stunting	100 (33.3)
Wasting	30 (10.0)
Undernutrition based on CIAF	127 (42.3)
No undernutrition	173 (57.7)

Table 2: Socio-demographic characteristics of the children and respondents

Characteristics	N	%
Age group of children (months)		
<10	22	7.3
10 – 20	81	27.0
21 – 30	58	19.3
31 – 40	67	22.3
41 – 50	43	14.3
51 – 60	29	9.7
Sex of the children		
Male	150	50.0
Female	150	50.0
Ethnic group of the children		
Murut	208	69.3
Dusun	45	15.0
Malay	10	3.3
Chinese	7	2.3
Others	30	10.0
Birth weight (kg) of the child		
≤ 2	11	3.7
> 2	283	96.3
Immunization status of the child		
Completed as per schedule	297	99.0
Not complete	3	1.0
Preceding birth interval		
< 24 months	35	11.7
≥ 24 months	216	72.0
Primigravida	49	16.3
Education qualification of mother/caretaker		
No schooling	8	2.7
Primary school	62	20.7
Secondary school	197	65.7
Diploma and above	33	11.0
Education qualification of father		
No schooling	10	3.4
Primary school	68	22.6
Secondary school	197	65.7
Diploma and above	25	8.3
Occupation of mother		
Working mother	44	14.7
Housewife	256	85.3
Total Household income (RM)		
Above poverty rate	85	28.3
Below poverty rate	215	71.7
Household family size		
Five and less	186	62.0
Six and above	114	38.0

Table 3: Behavioural practices and physical environment of the respondents and children aged 0-60 months in Tenom 2018

Characteristics	N	%
Childcare		
Mother	289	96.3
Others	11	3.7
Number of mother's pregnancies		
<4	210	70.0
≥ 4	90	30.0
Duration of breastfeeding (months)		
<6	48	16.0
6-12	132	44.0
>12	120	40.0
Age of introduction of complementary feeding (months)		
<6	10	3.3
≥ 6	290	96.7
Duration of complementary feeding (months)		
<6	10	3.3
≥ 6	290	96.7
Frequency of complementary feeding		
<4 times per day	112	37.3
≥ 4 times per day	188	62.7
Marital status of mother		
Married	297	99.0
Others	3	1.0
Food supply daily		
Sufficient	291	97.0
Insufficient	9	3.0
Parental smoking status		
Parent does not smoke	104	34.7
Parents smokes	196	65.3
Source of water supply		
Treated water	264	88.0
Others	36	12.0
Type of sanitation		
Improved sanitation	265	88.3
Unimproved sanitation	35	11.7

Table 4a: Bivariate analysis of risk factors leading to Undernutrition among under-5 children in Tenom 2018

Factors	Undernutrition		p-value
	Yes (n)	No (n)	
Biological			
Age of the children (months)			
< 10	3	19	0.1
10-20	35	46	
21-30	25	33	
31-40	28	39	
41-50	22	21	
51-60	14	15	
Sex of the children			
Male	66	84	0.6
Female	61	89	
Birth weight (kg) of the child			
≤ 2	8	3	**0.038**
> 2	119	170	
Immunization status of the child			
Completed as per schedule	126	171	0.751
Not complete	1	2	
Frequency of illness			
Infrequent	61	23	**<0.001**
Frequent	66	150	
Deworming status			
Yes	81	83	**0.001**
No	31	38	
Others	15	52	
Behavioural			
Childcare			
Mother	121	168	0.4
Others	6	5	
Number of mother pregnancies			
< 4	87	123	0.628
≥ 4	40	50	
Preceding birth interval			
< 24 months	15	20	0.2
≥ 24 months	97	119	
Primigravida	15	34	
Duration of breastfeeding (months)			
< 6	19	29	0.3
6-12	51	81	
> 12	57	63	
Age of introduction of complementary feeding (months)			
< 6	4	6	0.9
≥ 6	123	167	
Duration of complementary feeding (months)			
< 6	3	7	0.4
≥ 6	124	166	

Table 4b: Bivariate analysis of risk factors leading to Undernutrition among under-5 children in Tenom 2018

Factors	Undernutrition		p-value
	Yes (n)	No (n)	
Frequency of complementary feeding			
<4 times per day	51	61	0.4
≥ 4 times per day	76	112	
Smoking status			
Parent does not smoke	33	71	**0.007**
Parents smokes	94	102	
Socioeconomic			
Household family size			
Five and less	81	105	0.586
Six and above	46	68	
Education qualification of mother/ caretaker			
No schooling	6	2	**<0.001**
Primary school	40	22	
Secondary school	76	121	
Diploma and above	5	28	
Education qualification of father			
No schooling	4	6	**<0.001**
Primary school	44	24	
Secondary school	77	120	
Diploma and above	2	23	
Occupation of mother			
Working mother	8	36	**<0.001**
Housewife	119	137	
Total Household income			
Above poverty level	20	73	**<0.001**
Below poverty level	107	100	
Food supply daily			
Adequate	124	167	0.6
Inadequate	3	6	
Physical environment			
Source of water supply			
Treated water	105	159	**0.02**
Others	22	14	
Type of sanitation			
Septic tank/sewage system	103	162	**0.001**
Others	24	11	

Table 5: Logistic regression analysis for selected risk factors for undernutrition

Variables	aOR (95% CI)
Birth weight (kg) of the child	
≤ 2	1
> 2	0.535 (0.121 – 2.359)
Frequency of illness	
Infrequent	1
Frequent	**2.068 (1.015 – 3.274)**
Smoking status	
Parent does not smoke	1
Parents smokes	1.328 (0.709 – 2.488)
Deworming status	
Yes	1
No	0.663 (0.329 – 1.337)
Others	0.224 (0.099 – 0.506)
Education qualification of mother/ caretaker	
No schooling	1
Primary school	0.510 (0.078 – 3.314)
Secondary school	0.217 (0.034 – 1.368)
Diploma and above	0.377 (0.039 – 3.628)
Education qualification of father	
No schooling	1
Primary school	3.271 (0.623 – 17.173)
Secondary school	2.441 (0.455 – 13.097)
Diploma and above	0.314 (0.028 – 3.558)
Occupation of mother	
Working mother	1
Housewife	2.822 (0.829 – 9.607)
Total Household income	
Above poverty rate	1
Below poverty rate	0.823 (0.350 – 1.939)
Source of water supply	
Treated water	1
Others	1.286 (0.537 – 3.077)
Type of sanitation	
Septic tank/sewage system	1
Others	**2.983 (1.082 – 8.225)**

DISCUSSION

The study results revealed that the prevalence of underweight, stunting and wasting in Tenom were higher than the national average[8]. This could be due to the presence of several independent risk factors of undernutrition that are present in Tenom namely unimproved sanitation and frequent illnesses. Furthermore, undernutrition was observed to be the highest frequency among children age of 10-20 months. Thus, it is crucial to devise strategies to address undernutrition in children by focusing its interventions on the critical 1000 days window-period from conception to 2 years of age among the population of Tenom.

Unimproved method of sanitation was a significant predictor of undernutrition with an adjusted odds ratio of 2.983 (95% confidence interval between 1.082 to 8.225). This finding is further corroborated with a study in Mali[16] which shows that provision of improved sanitary

facilities can improve the growth of the child by reducing frequency of diarrhoea. Without an improved sanitation system, the faeces that were defecated were not properly disposed resulting in contamination of the rivers or the nearby surroundings. This is further complicated by the fact that some household in the rural areas do not receive water treated water resulting in family members of those household resort to collect water from the nearby rivers that may be contaminated with faeces causing outbreak of faecal-oral infections namely cholera and typhoid fever.

However, a study conducted in Kenya[14] reported no significant improvement of child growth despite improvement in the sanitation facilities. This lack of association could be explained as it compares intervention that of households from unimproved sanitation rather than from a lower baseline sanitation coverage such as open defecation with high prevalence of diarrhoea to a better improved sanitation. Similarly, another previous study conducted in Terengganu, Malaysia[23] also failed to find any association between sanitation and undernutrition A possible explanation could be that the coverage of improved sanitation is higher in peninsular Malaysia, thus no association are observed. This lack of association is consistent with previous study conducted in other developing countries such as Zambia[12], Ghana[19] and Vietnam[6].

Frequent illness increased likelihood of being undernourished by 2 folds among under 5 children in Tenom. This finding is corroborated with previous study by Endris et al[5] which reported that frequent illness is an important determinant for child malnutrition. Previous studies conducted in Terengganu, Malaysia[23] and Bangladesh[9] also reported similar findings of which health and biological factors associated with nutritional status of children. In contrast, an earlier study conducted in Kelantan, Malaysia[22] did not find any association between the frequency of illness of the child with stunting, wasting and underweight. The correlation between frequency of illness and undernutrition are evident because recurrent episodes of illness such as diarrhoea can cause large amount of water and nutrient to be loss from the body leading eventually to undernutrition. In addition, recurrent illness also may impair the appetite of the child resulting in reduction of dietary intake which subsequently leads to undernutrition. Undernutrition in turn would weaken the immune system causing the children to be susceptible to more severe, frequent and prolonged illness perpetuating somewhat of a vicious cycle.

This present study has limitations that warrant for discussion. The study is a cross-sectional study which does not allow for causal inferences to be made. In addition, the data collection is only confine to one district in Sabah, hence may not be able to be generalised to the entire state of Sabah and may not represent the whole country. Another limitation of the present study was that the information that was obtained from mothers and caretakers of the child was subject to information bias. A thorough dietary assessment for instance dietary recall were not conducted in this present study to determine the dietary intake and appetite of the child. The study was conducted on Malaysian children in the district of Tenom that were under the follow up with the respective health facilities which excludes the non-citizen children that did not seek healthcare services from the Ministry of Health of Malaysia.

CONCLUSION

Undernutrition remains to be the underlying health problems potentially lead to the mortality and morbidity among children under-5 years in Tenom district of Sabah. After adjusting for all confounders, childhood undernutrition was significantly associated with unimproved sanitation (adjusted OR 2.98, 95% CI: 1.082 to 8.225) and frequent illness (adjusted OR 2.07, 95% CI: 1.015 to 3.274). These findings support the association of biological and physical environmental factors with the nutritional status of children under-5 years old. Further studies should perform dietary assessment of the children to determine their dietary intake and to evaluate its relationship with undernutrition. Since undernutrition is the result of complex interplay of factors such as biological factors and physical environment factors hence a multisectoral approach with local communities, non-governmental organizations, governments and international agencies is essential to combat undernutrition.

CONFLICT OF INTEREST

The authors declare that they have no competing financial interest. This is a self-funded research.

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