

Nutritional Status of Under-Five Children and The Relationship with Household Food Wastage and Food Security in Samarahan, Malaysia

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ABSTRACT

INTRODUCTION: Malnutrition is prevalent among children in developing countries. The cause of malnutrition, although complex, can be attributed to demographic factors, household food wastage, and food insecurity. This study aims to determine the under-five nutritional status of children and its association with household food wastage and food security in the Samarahan division in Sarawak, Malaysia. **MATERIALS AND METHODS:** This is a cross-sectional study involving 304 children from rural areas of Asajaya and Samarahan District using a random sampling technique. An interviewer-administered questionnaire was used to collect data from the parents. The nutritional status of the children was assessed by anthropometry. IBM SPSS Version 27.0 and WHO Anthro version 3.2.2 were used for data analysis. A p -value < 0.05 was considered statistically significant. **RESULTS:** Analysis revealed that 9.5% of the children were moderately wasted, followed by 5.9% who were severely wasted; 20.4% were moderately stunted and 8.9% were severely stunted. Hierarchical regression analysis indicated that male gender (AOR = 1.931, 95% CI: 1.139, 3.274; $p < 0.05$), low birth weight (AOR = 2.645, 95% CI: 1.245, 5.618, $p < 0.05$), poor appetite (AOR = 2.547; 95% CI: 1.298, 4.995, $p < 0.05$), and preventive attitude (AOR = 0.460, 95% CI: 0.227, 0.929, $p < 0.05$) of household food wastage appeared to be significant predictors of nutritional status. However, household food insecurity had a negative correlation but did not significantly impact the nutritional status. **CONCLUSION:** Under-five malnutrition was prevalent in the study area and still a public health concern. Although the study did not find any significant association between household food wastage and food security towards the nutritional status of children, addressing the nutritional problem warranted an appropriate Public Health approach for the specific group, especially the modifiable risk factors such as birth weights, appetite, and attitude.

Keywords

Wasting, stunting, underweight, food wastage, food security

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INTRODUCTION

Balanced nutrition allows children to gain optimum expectancy of their lives; to live, grow, develop physically and mentally, learn as much as possible, play, participate and contribute to their surroundings, while malnourished children will not be able to do so.¹ Malnutrition has a complex mechanism that can be attributed to many factors.² It was suggested that household food insecurity is associated with the adverse nutritional status of children, where stunting and of them being underweight were found to be significantly related to household food insecurity.³ Food loss is food with reduced quality or

quantity, making it unfit for consumption by humans.⁴ The terms food loss and food wastage are frequently used interchangeably. However, they differ in terms of which part of the food supply chain they belong to.⁵ Food wastage or waste occurs at the consumer or retail stages that are ready for consumption.⁴ Reducing food loss and waste will improve food and thus, would increase the proficiency of resources used in food manufacturing.⁶ On the other hand, food insecurity means there is uncertain individual or household level access to food which can directly (through compromised diets) and indirectly

(through inadequate feeding, or disordered eating pattern) cause an insufficient intake of protein, calories, minerals, and vitamins leading to micronutrient deficiencies, wasting and stunting.⁷ Children under five years of age are at greatest Risk of poor health, lower intellectual and academic accomplishment, and psychosocial difficulties due to undernutrition and micronutrient deficiencies.^{8,9} However, the association between nutrition, food waste, or food security is still lacking in the literature. The negative impact on nutrition was related to quality and nutrient loss. The other factor was the variable nature of food production and consumption that defied the stability dimension of food security.¹⁰ Several studies on household food insecurities and nutritional status have been done in West Malaysia.^{3,11} However, little is known on the association between the nutritional status of children under five years old and household food wastage and food insecurity in the rural areas of East Malaysia. Thus, this study aims to determine the under-five nutritional status of children and its association with household food waste and food security.

MATERIALS AND METHODS

Study settings and population

This is a cross-sectional study conducted among children under the age of five years in Samarahan Division, Sarawak, Malaysia. The sample size was calculated using the single proportion formula¹², with the base population proportion of children aged five years and below who were underweight of 20%¹³, and standard critical value of 1.96 and 5% absolute precision.¹⁴ The sample size was further inflated using a non-response rate of 20% to ensure more than 80% response rate and representation of the general population. This makes the final estimated sample size 296. After adjusting with family size and proportion of under-five children within the family, 2300 households from the selected district need to be visited to get the desired sample size. Children aged six months to 59 months, irrespective of gender, had parents or caregivers who resided in the study area for more than six months and had no reported mental retardation, physical disability, or chronic illness were included as sample. Parents who did not agree to participate or non-Malaysian

citizens were excluded. The Samarahan division consists of three districts, of which two districts were randomly selected. The total number of households in the villages were obtained from the village chiefs to calculate the sampling interval. Thus, the selection of the households was systematically made according to the nth interval, starting from the village chief's house in each village. Only the families with children who met the inclusion criteria from every nth visited house were selected in this study (8th interval was used). All the houses starting from the house of the Ketua Kampung (village chief) and right direction onwards were visited. Finally, 304 samples were obtained with eight extra children. This happened because some of the villages had more children. The sampling procedure is illustrated in Figure 1.

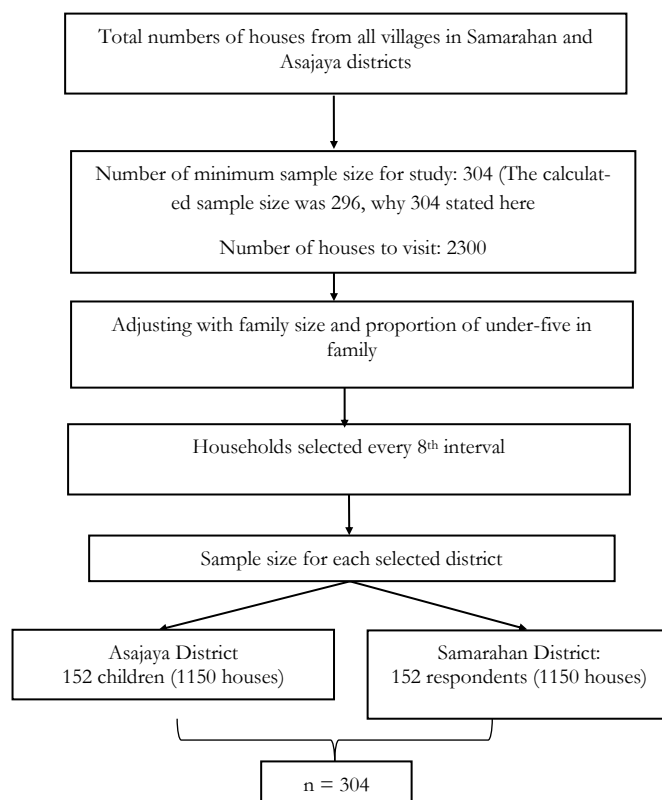


Figure 1: Sampling method flowchart

Data collection

Data was collected by face-to-face interviews using an interviewer-administered questionnaire and anthropometric measurements. The questionnaire consisted of six parts using the national language 'Bahasa Melayu.' Before data collection, the parents and the respondents were given a briefing with a brief

introduction and explanation. Informed and written consent were taken from the parents before the interview. The anthropometric measurements included the body weights and heights of the children. For weight measurement, the SECA weighing scale (electronic) was used. Children who could stand were weighed on an electronic platform scale, barefoot, and with minimal clothing. Infants were weighed on a platform scale and held by the mothers. Weight was taken to the nearest 0.1 kg. The weight of the mothers was then subtracted from the initial reading (mother and infant). The standing height was measured without shoes using a portable stadiometer (SECA 217) to the nearest 0.1 cm. A pre-test of the questionnaire was done in the non-sampled village in the same district. The objective of this pre-test was to assess the quality of the questions in terms of reliability, logical sequencing, understandability, and average duration of time to answer the questionnaire. After the pre-test, the questionnaire was modified as needed and analysed statistically.

Measurements

Characteristics of the parents and children: The anthropometric data were collected from children; however, the parents were the proxy respondents. Characteristics of the parents included parental age, education, occupation, monthly household income, ethnicity, and religion whereas for the children were age, gender, birth weight, breastfeeding, two-week morbidity, clinic visit, hospital admission, and appetite.

The knowledge, attitude, and practice (KAP) of food wastage were adapted from a previous study in Samarahan.¹⁵ The preventive knowledge of food wastage was measured by a 14-item questionnaire with 'yes', 'no' and 'do not know' responses. The reliability index of the scale was 0.764. The corrected item-total correlation varied from 0.187 to 0.512, indicating good item discrimination. A 13-item Likert scale measured the Protective attitude towards food wastage from strongly disagree to strongly agree, and the score ranged from 1 to 5. The internal consistency of the reliability index was 0.902, and the corrected item-total correlation varies from 0.475 to 0.710. Composite knowledge and attitude scores

were calculated based on the correct answer on food wastage. After summation of correct responses, the KAP were further categorised into poor, average, and good based on mean and standard deviation. Four questions measured the amount of food wasted during food preparation and served food during breakfast, lunch, and dinner. It ranged from none, one-fourth, half, and three-fourth and the total amount of served foods. The Cronbach's alpha was 0.814, and the corrected item-total correlation varies from 0.439 to 0.730. The summative score of food wastage was further classified into four groups: no wastage, minimum, average, and substantial based on percentile.

Household food security: Household food security for the previous three months was adapted and modified from Bickel et al.¹⁶ and Segall-Correa et al.¹⁷ It was a 14-item Likert's scale with answers of never (1), rarely (2), sometimes (3), very often (3), and always (4). A composite mean score was calculated for the 14 items, with an increased score indicating food insecurity. The items were specifically restricted for the food security of children under-five years. The reliability analysis indicated an excellent Cronbach's alpha of 0.934 and the corrected item-total correlation varies from 0.365 to 0.827.

Nutritional status was measured by the heights and weights of the under-five children. According to the World Health Organisation (WHO), overweight was defined if weight-for-length/height z-score (WHZ) was greater than two SD with WHO Child Growth Standard median.¹⁸ Low WHZ, which is wasting, was defined by applying the cut-off < -2 SD and the stunting was identified by $HAZ < -2$ SD. Based on two variables viz. HAZ (low (< -2 SD) and normal (-2 to > 2 SD)) and three levels of WHZ [Normal (≥ -2 to ≤ 2 SD), low (< -2 SD) and high (> 2 SD)], the nutritional status was further classified into six categories viz. eutrophic, wasting (acute undernutrition), overweight, stunting (chronic undernutrition), concurrent stunting and wasting (decompensated chronic undernutrition) and stunted and overweight (short stature with overweight).¹⁹

Data entry and data analysis

The completeness of data was manually checked and

verified. Incomplete data were discarded. IBM SPSS version 27.²⁰ Anthropometric data of the under-five children were recorded into Microsoft Office Excel 2010 and then transferred and analysed using the Anthro software version 3.2.2,²¹ and the results were reported in z-scores. The data were presented in frequency, percentage, mean, median, and standard deviation for descriptive statistics. A hierarchical binary logistic regression analysis was performed to determine the factors associated with wasting and stunting among under-five children. The dependent variable was dummy coded as '0' for the normal weight-for-height and '1' for wasted. Similarly, the height-for-age was dummy coded as '0' for normal and '1' for stunted. Initially, bivariate analysis was done using socio-demographic and children characteristics, and WHZ and HAZ. Ethnicity, children's gender, birth weight, and appetite were statistically significant in bivariate analysis. These variables were entered into the first model, followed by knowledge, attitude, food wastage, and food entered as continuous variables to estimate the potential impact of WHZ and HAZ. In the model fitting information, such as the omnibus model chi-square, Hosmer and Lemeshow Chi-Square, predictive classification was reported.^{22,23} $P < 0.05$ was set as statistically significant.

RESULTS

Characteristics of the parents

Table 1 illustrates the socio-demographic characteristics of the parents. The father's mean (SD) age was 35.16 (7.6) years with a minimum of 21 and a maximum of 68 years. The highest percentage was in the age group of 25–34 years (45.1%). The mother's mean (SD) age was 32.43 (6.8) years, with a minimum of 17 and a maximum of 61 years. Two-thirds of the parents had secondary school level education (father 65.5%, mother 64.8%), followed by primary school level education (father 18.1%, mother 18.8%) and diploma and above level of education (16.4% of both father and mother). Almost three-quarters of the fathers were employed (71.1%), followed by self-employed (25.7%), and only a few of them were unemployed (3.3%). Meanwhile, two-thirds (65.5%) of the mothers were unemployed (65.5%), compared to employed (26.6%) and self-employed (7.9%). The highest percentage of

household income ranges from MYR 501 to MYR 1000 per month (31.6%), followed by more than MYR 2000 per month (25.3%). The highest percentage of household expenditure ranged from MYR 501 to MYR 1000 per month (39.5%), followed by less than MYR 500 per month (24.3%).

Table 1: Characteristics of the parents (n = 304)

Characteristics	Frequency	%	Mean(SD)
Father's age			
< 25	19	6.3	35.16 (7.6)
25 - 34	137	45.1	
35 - 44	102	33.6	
≥45	46	15.1	
Mother's age			
< 25	34	11.2	32.43(6.8)
25 - 34	167	54.9	
35 - 44	90	29.6	
≥45	13	4.3	
Father's education			
Diploma and above	50	16.4	65.5
Secondary school	199	65.5	
Primary school	55	18.1	
Mother's education			
Diploma and above	50	16.4	64.8
Secondary school	197	64.8	
Primary school	57	18.8	
Father's occupation			
Employee	216	71.1	25.7
Self-employed	78	25.7	
Not working	10	3.3	
Mother's occupation			
Employee	81	26.6	65.5
Self-employed	24	7.9	
Not working	199	65.5	
Household income (MYR)			
< RM 500	25	8.2	1334.38(665.5)
RM 501 – 1000	96	31.6	
RM 1001 – 1500	63	20.7	
RM 1501 – 2000	43	14.1	
> RM 2000	77	25.3	
Ethnicity			
Malay	279	91.8	8.2
§Others	25	8.2	
Religion			
Muslim	282	92.8	7.2
Non-Muslim	22	7.2	

§Others includes Iban, Bidayuh, Chinese, Hatus etc.

Characteristics of the children

The mean age of the children (SD) was 30.9 (16) months with a minimum of six and a maximum of 59 months. Majority (88.8%) of the birth weights of the children was more or equal to 2.5 kg, with a mean (SD) of 2.91 (0.47) kg. The mean (SD) duration of breastfeeding was 12.49 (11.4) months. One-fourth (26.6%) of the children had a history of illnesses in the last 14 days. They made at least

three visits to clinics in the previous year. However, most of the children were not admitted to hospitals in the previous year (91.8%). One-fourth of the children had poor appetite (Table 2).

Table 2: Characteristics of the children (n = 304)

Characteristics	Frequency	%	Mean(SD)
Age in years			
1	37	12.2	30.87 (16.0) month
2	74	24.3	
3	63	20.7	
4	54	17.8	
5	76	25.0	
Gender			
Girl	155	51.0	
Boy	149	49.0	
Birth weight (kg)			
<2.5 kg	34	11.2	2.91 (0.5)
≥2.5 kg	270	88.8	
Duration of breastfeeding (months)			
1-6	137	45.1	12.49 (11.4) month
>6	167	54.9	
Morbidity in last 14 days			
No	223	73.4	
Yes	81	26.6	
Clinic visit in last year			
No	32	10.5	4.41 (4.6)
1-3	127	41.8	
4-6	87	28.6	
≥7	58	19.1	
Hospital admission in last year			
No	279	91.8	
Yes	25	8.2	
Appetite			
Good	226	74.3	
Poor	78	25.7	

Nutritional status

Analysis revealed that 77.0% and 66.1% (out of 304) of the children had normal weight for height and height for age, respectively. One-tenth of the children were moderately wasted (9.5%), followed by 5.9% severely wasted. Meanwhile, 20.4% of the children were moderately stunted, and another 8.9% were severely stunted (Table not shown). A combination of weight-for-height and height-for-age indices indicated that 55.3% of the children had normal nutritional status (eutrophic). Analysis showed that one-fourth (21.7%) of the children were stunted (chronic undernutrition), followed by 11.5% wasted and 3.9% with concurrent stunting and wasting. Another 3.6% were stunted and overweight, that is, short stature with overweight (Table 3).

Table 3: Percentage distribution of under-five Nutritional status according to the combination of height-for-age (HAZ) and weight-for-height (WHZ) indexes applying the cut-off ± 2 standard deviation (n = 304)

Height for age (SD)	Weight for height (SD) (Wasting)		
	Normal (≥ -2 to ≤ 2)	Low (< -2)	High (> 2)
Normal (≥ -2)	55.3 (Eutrophic)	11.5 Wasting (Acute undernutrition)	3.9 (Overweight)
Low (< -2)	21.7 Stunting (Chronic undernutrition)	3.9 Concurrent stunting and wasting (Decompensated chronic undernutrition)	3.6 Stunted and overweight (Short stature with overweight)

Factors affecting nutritional status: Hierarchical binary logistic regression analysis

Hierarchical binary logistic regression analysis revealed that the appetite of the children and preventive attitude towards household food wastage appeared to be potential factors that contributed to wasting of the children. This indicated that children with poor appetite were 2.547 times more likely to be wasted than those with good appetite (AOR = 2.547; 95% CI: 1.298, 4.995). Preventive attitude towards household food wastage appeared to be an important associated factor of child wastage with one unit point increase of attitude, 54% decrease of child wastage (AOR = 0.460; 95% CI: 0.227, 0.929). In contrast to height for age (stunted), gender and birth weight appeared to be associated factors of stunting. Analysis indicated that children with low birth weight (< 2.5 kg) were 2.645 times more likely to be stunted (AOR = 2.645, 95% CI: 1.245, 5.618), and boys were 1.931 times more likely to be stunted than the girls (AOR = 1.931, 95% CI: 1.139, 3.274). However, no statistically significant association was found between nutritional status and ethnicity, knowledge of food wastage, amount of household food wastage, and household food insecurity ($p > .05$) (Table 4).

DISCUSSION

Community nutrition is a key component in public health. Apart from the widespread cases of malnutrition among children around the world, food wastage is also increasing in trend, and the losses that occurred throughout the entire food chain could directly or indirectly lead to malnutrition.²⁴ In terms of food security, though some countries reported having sufficient food at the national

Table 4: Factors affecting nutritional status: Hierarchical binary logistic regression analysis

Variables	Weight for height (Wasted)					Height for age (Stunted)				
	Unstd.	SE	AOR	LL	UL	Unstd.	SE	AOR	LL	UL
Ethnicity										
Malays	.570	.681	1.769	.466	6.715	1.228	.648	3.413	.958	12.155
Others			1.000					1.000		
Gender										
Boy	.031	.339	1.031	.531	2.005	.658	.269	1.931**	1.139	3.274
Girl			1.000					1.000		
Birth weight										
<2.5 kgs	.557	.467	1.746	.699	4.360	.973	.384	2.645*	1.245	5.618
≥2.5 kgs			1.000					1.000		
Appetite										
Poor	.935	.344	2.547**	1.298	4.995	-.275	.311	.760	.413	1.397
Good			1.000					1.000		
Knowledge on food wastage	.066	.082	1.069	.909	1.256	.084	.075	1.088	.940	1.259
Preventive attitude on food wastage	-.777	.359	.460*	.227	.929	.010	.293	1.010	.569	1.793
Food wastage	-.028	.063	.973	.860	1.100	.006	.050	1.006	.913	1.109
Food insecurity	.028	.018	1.029	.994	1.065	-.001	.018	.999	.965	1.034
Constant	-.683	1.892	.505			-3.453	1.647	.032		
N			281					290		
Classification			84.0%					71.4%		
Lemeshow GOF			2.58(8); p>.05					8.674(8); p>.05		
Model Chi-square			18.589(8); p<.05					18.621(8); p<.05		

level, it did not necessarily mean that the people were food secure in their households.²⁵ The findings of our study indicates that a higher proportion of children with stunting and wasting were among boys rather than girls. This finding is similar to the NHMS 2016, where the prevalence was 14.9% for boys and 12.4% for girls. While our study found a higher prevalence of underweight among Malays, the finding was different from the NHMS 2016, where the highest prevalence of underweight was seen among Indians. Apart from that, children aged 1 to 2 years were more prone to wasting and stunting. This finding coincides with NHMS 2016, wherein the highest prevalence of stunting and wasting were within the age of 12 to 23 months.²⁶

Our study findings indicates that children with poor appetite were likely to be wasted compared to children with good appetite. This finding could be attributed to the lack of a solid family system that actively promotes and sets proper eating behaviours in children, such as food restriction, as well as the family's poor socio-economic condition, leading to adverse consequences of the child's nutritional status.²⁷ On the other hand, the higher likelihood of stunting among the children with poor birth

weight in the study indicated that birth weight is an important predisposing factor to growth attainment and survival of the children, which could also be affected by maternal poor nutritional status due to the poor socio-economic status.²⁸

The prevalence of stunting and wasting were on the high threshold, which indicated poor overall wellbeing of children and could indicate social inequalities among the community.²⁹ The number of children with concurrent stunting and overweight, although on the low prevalence threshold, was still higher than the study done in Thailand, indicating that the double burden of malnutrition among the children was significant, which could be related to inadequate breastfeeding and complementary feeding practices.³⁰

The present study shows that a good preventive attitude against household food wastage decreases wasting among children. Hospital-based research done by Simzari et al.³¹ concluded that plate waste, apart from contributing to complications related to malnutrition among patients in hospital, alongside hospital malnutrition, came hand-in-hand in increasing the prevalence of population with nutrition at-risk. Our study also found that the majority of the parents had poor attitudes towards preventing food waste. This finding may be due to the surplus of food in Malaysia and the attitude of some of the consumers were alike to those of rich, industrialised countries where people could afford to waste food. However, in some places or among people, food loss and waste decreased food availability either in the market or in households, leading to an increase in food price. This would affect the accessibility of food to the poor, low socio-economic groups invariably causing malnutrition.⁵

Our analysis found that one-fifth of the households in Samarahan were food insecure. This result is significantly lower than the result of the research done in West Malaysia by Naser et al.³² where less than a quarter of households were food secure. However, unlike our study, Naser et al.³² reported a high prevalence of underweight, stunting, and wasting among children with food insecurities. Among the significant risk factors towards household food insecurity were large household size,

numbers of children in the households, total income, low education level, and expenditure on food.³³ Mullany et al.³⁴ argued that older household age would be more likely to be food insecure with the comparison of households aged more than 45 years old and under 25 years old indicating that the older households were more food insecure. The above study also suggested that as the number of children in the house increased, there would be likelihood of adult food insecurity. In the analysis of our study, no significant correlation was found between household food security and nutritional status.

There were several limitations encountered in this study. Although the sample could represent the rural population of the Samarahan Division, there was minimal participation from different ethnic groups apart from the Malays. One of the reasons for these discrepancies could be the inconvenience of home visits. Since the study focused on the rural area of Samarahan, the findings cannot be generalised to the households in urban areas or to other areas of Sarawak, where the demographic pattern of the population might be different. Additionally, the scale measuring the independent variables such as the questionnaires for household food wastage and household food security was based on self-report and perception. Household food wastage accounted for almost half of total daily wastage. Moreover, the quantification method of household food wastage is important. While the technique used in this study was less invasive, less time-consuming, and less expensive than direct measurements, it required the respondents to recall correctly the events or amount of the food wastage that occurred, thus leading to bias. On the other hand, although the waste sample collections for quantification and classification were more accurate, it was not suitable for this study since it was more invasive, expensive, and time-consuming. Finally, we collected data from children under-five years of age with a cross-sectional research design, so the causal linkages between dependent and independent variables could not be inferred.

CONCLUSION

Our findings concluded that malnutrition of children under five years old in the Samarahan division is prevalent

and comparable to the national data. Furthermore, our analysis revealed that gender, birth weights, appetite, and attitude towards household food wastage significantly affected nutritional status of children. However, our study did not find any significant relationship between household food security and nutritional status of children, although there was a preponderance of stunted and underweight children among the food-insecure households in the previous three months. Public health practitioners could utilise our results to improve the nutritional status among children under-five to prevent morbidity and mortality through public health interventions to strengthen and ensure appropriate measures to improve nutritional status.

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CONFLICT OF INTEREST

The authors declare that there are no known conflicts of interest associated with this publication.

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REFERENCES

1. United Nations Children's Fund, World Health Organization, World Bank Group. Levels and trends in child malnutrition: UNICEF/WHO/World Bank Group joint child malnutrition estimates, key findings of the 2018: Data and Analytics Section of the Division of Data, Research and Policy, UNICEF, Department of Nutrition for Health and Development, WHO and the Development Data Group of the World Bank; 2018.
2. Bhutta ZA, Salam RA. Global nutrition epidemiology and trends. *Annals of Nutrition and Metabolism*. 2012

- 2012;61(Suppl. 1):19-27.
3. Ihab A, Rohana A, Manan WMW, Suriati WNW, Zalilah M, Rusli AM. Nutritional outcomes related to household food insecurity among mothers in rural Malaysia. *Journal of Health, Population and Nutrition*. 2014;31(4):480-489.
 4. Gustavsson J, Cederberg C, Sonesson U. Global food losses and food waste: extent, causes and prevention. Rome, Italy: Food and Agriculture Organization of the United Nations; 2011.
 5. FAO, IFAD, UNICEF, WFP, WHO. The State of Food Security and Nutrition in the World 2018: Building climate resilience for food security and nutrition. Rome, Italy: FAO, IFAD, UNICEF, WFP,WHO,; 2018.
 6. Kumm M, de Moel H, Porkka M, Siebert S, Varis O, Ward PJ. Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use. *Science of The Total Environment*. 2012/11/01/ 2012;438:477-489.
 7. Webb P, Stordalen GA, Singh S, Wijesinha-Bettoni R, Shetty P, Lartey A. Hunger and malnutrition in the 21st century. *BMJ*. 2018/06/13/ 2018;361:k2238.
 8. Ivers LC, Cullen KA. Food insecurity: special considerations for women. *The American Journal of Clinical Nutrition*. 2011/12// 2011;94(6):1740S-1744S.
 9. Ali D, Saha KK, Nguyen PH, et al. Household Food Insecurity Is Associated with Higher Child Undernutrition in Bangladesh, Ethiopia, and Vietnam, but the Effect Is Not Mediated by Child Dietary Diversity. *The Journal of Nutrition*. 2013;143(12):2015-2021.
 10. High Level Panel of Experts. Food losses and waste in the context of sustainable food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. Rome: Committee on World Food Security,; 2014.
 11. Pei CS, Appannah G, Sulaiman N. Household food insecurity, diet quality, and weight status among indigenous women (Mah Meri) in Peninsular Malaysia. *Nutrition Research and Practice*. 2018 2018;12(2):135.
 12. Daniel WW, Cross CL. *Biostatistics: A Foundation for Analysis in the Health Sciences*. 10th ed. USA: John Wiley & Sons, Inc; 2013.
 13. Melisa JE, Cheah WL, Lee PY. Factors influencing malnutrition among young children in a rural community of Sarawak. *Malaysian Journal of Nutrition*. 2014;20(2):145-164.
 14. Dattalo P. *Determining Sample Size: Balancing Power, Precision, and Practicality*: Oxford University Press; 2008.
 15. Rahman MM, Jantan Z, Viknesraj S. Knowledge, Attitude and Practice of Household Food Wastages among Villagers in Sekuau, Sibiu, Sarawak. *Community Medicine and Public Health Bulletin* 2018;1(1):27-34.
 16. Bickel G, Nord M, Price C, Hamilton W, Cook J. *Guide to Measuring Household Food Security*. VA, USA: USDA Food and Nutrition Service (FNS), Office of Analysis, Nutrition, and Evaluation, and Mark Nord, USDA Economic Research Service (ERS), Food and Rural Economics Division. ; 2000.
 17. Segall-Correa AM, Marin-Leon L, Melgar-Quinone H, Perez-Escamilla R. Refinement of the Brazilian Household Food Insecurity Measurement Scale: Recommendation for a 14-item EBIA. *Revista de Nutrição*. 2014;27:241-251.
 18. World Health Organization. *Nutrition Landscape Information System (NLIS) Country Profile Indicators: Interpretation Guide*. Geneva, Switzerland: World Health Organization,; 2010.
 19. Ferreira HA-O. Anthropometric assessment of children's nutritional status: a new approach based on an adaptation of Waterlow's classification. *BMC Paediatrics*. 2020;20(65).
 20. IBM SPSS Statistics for Windows [computer program]. Version 27. Armonk, New York, USA: IBM SPSS; 2020.
 21. WHO Anthro and macros: *Child Growth Standards [computer program]*. Version 3.2.2: World Health Organization; 2011.
 22. Hair JF, Black WC, Babin BJ, Anderson RE. *Multivariate Data Analysis*. 8 ed. United Kingdom: Pearson Education Limited; 2019.
 23. Tabachnick BG, Fidell LS. *Using multivariate statistics*. 7th Edition ed. United States: Pearson Education, Inc; 2019.
 24. Konecka-Matyjek E, Jarosz M, Kolomyjski K. Undernutrition, malnutrition and wastage of food.

- Postępy Nauk Medycznych. 2012;XXV(12):958-964.
25. Chinnakali P, Upadhyay RP, Shokeen D, et al. Prevalence of household-level food insecurity and its determinants in an urban resettlement colony in North India. *Journal of Health, Population, and Nutrition*. 2014;32(2):227-236.
 26. Baharudin A, Man CS, Ahmad MH, et al. Associated factors to prevalence of childhood under nutrition in Malaysia: findings from the National Health and Morbidity Survey (NHMS 2016). *Health Science Journal*. 2019;13(1):1-9.
 27. Scaglioni S, De Cosmi V, Ciappolino V, Parazzini F, Brambilla P, Agostoni C. Factors Influencing Children's Eating Behaviours. *Nutrients*. 2018/05/31/ 2018;10(6):706.
 28. Aryastami NK, Shankar A, Kusumawardani N, Besral B, Jahari AB, Achadi E. Low birth weight was the most dominant predictor associated with stunting among children aged 12–23 months in Indonesia. *BMC Nutrition*. 2017;3(1):16.
 29. de Onis M, Borghi E, Arimond M, et al. Prevalence thresholds for wasting, overweight and stunting in children under 5 years. *Public health nutrition*. 2019;22(1):175-179.
 30. Okubo T, Janmohamed A, Topothai C, Blankenship JL. Risk factors modifying the double burden of malnutrition of young children in Thailand. *Maternal & child nutrition*. 2020;16:e12910.
 31. Simzari K, Vahabzadeh D, Nouri Saeidlou S, Khoshbin S, Bektas Y. Food intake, plate waste and its association with malnutrition in hospitalized patients. *Nutricion Hospitalaria*. 2017;34(5):1376-1381.
 32. Naser IA, Rohana A, Manan W, Suriati W, MS Z, Rusli M. Assessment of food insecurity and nutritional outcomes in Bachok, Kelantan. *Journal of Nutrition & Food Sciences*. 2014 2015;5(3):373.
 33. Ahmed F, Siwar C. Food security status, issues and challenges in Malaysia: A review. *Journal of Food, Agriculture and Environment*. 2013;11(2):219-223.
 34. Mullany B, Neault N, Tsingine D, et al. Food insecurity and household eating patterns among vulnerable American- Indian families: associations with caregiver and food consumption characteristics. *Public Health Nutrition*. 2013/04// 2013;16(04):752-760.
 35. Agho KE, Mukabutera C, Mukazi M, et al. Moderate and severe household food insecurity predicts stunting and severe stunting among Rwanda children aged 6–59 months residing in Gicumbi district. *Maternal & child nutrition*. 2019;15(3):e12767.
 36. Mank I, Vandormael A, Traoré I, Ouédraogo WA, Sauerborn R, Danquah I. Dietary habits associated with growth development of children aged < 5 years in the Nouna Health and Demographic Surveillance System, Burkina Faso. *Nutrition Journal*. 2020/08/09 2020;19(1):81.