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Demographic characteristics are associated with children's nutritional status: Findings from a pilot study on food insecure households in Simunjan district, Sarawak

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ABSTRACT

Introduction: Food insecurity is a public health concern that may lead to malnutrition in children. The purpose of this study was to determine the relationship between demographic characteristics and food security level with nutritional status among children from food-insecure households in Simunjan District, Sarawak. **Methods:** This study involved a total of 171 mother-and-child pairs from two Maternal and Child Health Clinics (Simunjan and Gedong) using non-probability convenience sampling technique. Food insecurity status was determined using Radimer/Cornell Hunger Food Insecurity Instrument, while child's weight and height were measured following standard procedures. Chi-squared test of independence and binary logistic regression were used during data analysis. **Results:** The prevalences for household food insecurity, individual food insecurity, and child hunger were 70.8%, 15.2%, and 14.0%, respectively. The main nutritional problems for children aged 24–59 months were underweight (17.9%) and stunting (17.9%), while for children aged 60–144 months were overweight and obesity (27.5%). Children of mothers over 34 years old (*AOR*=2.367; 95% *CI*: 1.085, 5.164), and those aged 60–144 months (*AOR*=3.619; 95% *CI*: 1.521, 8.613) had increased odds of being overweight or obese. Meanwhile, children of working mothers (*AOR*=6.526; 95% *CI*: 1.108, 38.449) were more likely to have a thinness problem than children of unemployed mothers. However, no association was found between the severity of food insecurity with children's nutritional status. **Conclusion:** Malnutrition in children remains a public health concern in Simunjan District, and it is linked to mother's age and employment status. An intervention programme is required to ameliorate the situation.

Keywords: children, nutritional status, demographic characteristics, food insecurity

INTRODUCTION

Food is a vital component of life, and getting enough food is a basic human right. Therefore, food security is an important agenda in a country. The National Plan of Action for Nutrition of Malaysia (NPANM) III, 2016–2025, is the master plan to achieve optimal nutritional well-being for Malaysians. Out of 46 NPANM III indicators, nine are related to food and nutrition security (NCCFN, 2016). Food security

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is described as a scenario in which all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2002).

In 2021, an estimated 29.3% of the world's population, or approximately 2.3 billion people, were moderately or severely food insecure. In the Asia Region, the subregion that recorded the highest level of food insecurity was Southern Asia, where 40.6% of the population experienced moderate or severe food insecurity in 2021, followed by Western Asia (33.7%), South-eastern Asia (20.7%), and Central Asia (20.2%); Eastern Asia recorded the lowest level of food insecurity, which was 6.2% (FAO, IFAD, UNICEF, WFP & WHO, 2022). In Malaysia, according to the National Health and Morbidity Survey (NHMS) in 2014, food insecurity in terms of inadequate food quantity of purchased foods was 24.9%. By comparison between regions, East Malaysia was found to have a much higher prevalence of food insecurity (39.2%) than West Malaysia (21.1%) (IPH, 2014).

Food insecurity is caused by various comprehensive factors, including population growth, natural disasters, international commerce, demographic characteristics, economic factors, environmental factors, institutional factors, and socio-cultural factors (Sewnet & Sewnet, 2015). Family structure, number of children, household size, education level of mothers, household income, and poverty are factors under economy and demography that influence the level of food security (Hannum, Liu & Frongillo, 2014). Food insecurity is a public health issue that has various effects and may ultimately result in malnutrition (Ali Naser *et al.*, 2014). Children from food-insecure households were reportedly more likely to be underweight and stunted than children from food-secure households (Betebo *et al.*, 2017). With that, it is important to focus on addressing the problem of food insecurity because it will directly improve the nutritional status of children.

Since food insecurity is still an important issue and has a significant impact on health status, various efforts and intervention programmes have been planned and implemented by relevant agencies, such as the Ministry of Agriculture, Ministry of Higher Education, and Economy Planning Unit to improve Malaysia's situation (NCCFN, 2016). Based on studies conducted in Malaysia over the past two decades, research areas have mainly focused on the prevalence of food insecurity, severity of food insecurity, factors associated with food insecurity, and the association between food insecurity and health status among indigenous people, low-income households, university students, elderly population, and migrant workers. There is a lack of exploration on food insecurity issues, particularly among Sarawakians.

In this respect, this pilot study aimed to determine the relationship between demographic characteristics and food security level with nutritional status among children from food-insecure households in Simunjan District, Sarawak.

MATERIALS AND METHODS

Study design and samples

A cross-sectional study was conducted for two months, from March to April 2022 in Simunjan District, which is one of the 40 districts under the administration of the Sarawak State Government. It is approximately 2,217.7km^2, located about 176km from Kuching, the capital city of Sarawak. Simunjan District reportedly has the highest incidence of poverty among the administrative

districts in the southern region of Sarawak (DOSM, 2020). Given the close association between poverty and food insecurity, as indicated by Hannum *et al.* (2014), and the specific focus of this study on households experiencing food insecurity, the rationale for selecting this district as the research setting is thus justified.

As this pilot study was conducted among children from households experiencing food insecurity to determine the relationship between demographic characteristics and food security level with their nutritional status, a non-probability convenience sampling method was used. After discussions were held with the Samarahan Division Health Office, taking into consideration logistics feasibility and financial factors, study respondents were recruited from the Maternal and Child Health Clinics (MCHC) in Simunjan and Gedong, two clinics in the Simunjan District that serve populations with similar demographic characteristics. The study inclusion criteria were children aged 2–12 years old with mothers aged 15–49 years old from food insecure households, while the exclusion criteria were children suffering from delays in mental development and with physical disability. All children attending the clinics during the data collection period (March to April 2022) who met the inclusion and exclusion criteria were screened for food security status using the Radimer/Cornell Hunger and Food Insecurity Instrument (Radimer, Olson & Campbell, 1990). Only mother-and-child pairs from food insecure households were invited to participate in this study.

Study protocol

Ethical clearance was obtained from the Medical Research Ethics Committee, Universiti Malaysia Sarawak (Ethics Approval code: FME/21/13). Approval from the Medical Research Ethics Committee (MREC), Ministry of Health Malaysia was subsequently obtained, registered in the National Medical Research Register (NMRR) system [Approval code: NMRR ID-21-02001-HDV (IIR)]. All invited participants were given the respondent's information sheet and consent form. Only participants who provided consent were recruited in the study.

Data collection

Demographic characteristics

A questionnaire in the Malay language was used for data collection. All pertinent research information were collected through individual face-to-face interviews with the mothers. The demographic characteristics of the respondents consisted of age, gender, mother's age, ethnicity, religion, marital status, number of children, household size, parent's highest education level, parent's occupation, and household income.

Household food insecurity measurement

The Radimer/Cornell Hunger and Food Insecurity Instrument was used to assess the degree of household food insecurity (Radimer *et al.*, 1990). There were ten items and each item had three options: "not true," "sometimes true," or "often true." The ten items were then translated into the Malay language version by Sharif & Ang (2001) with good internal consistency (Cronbach's alpha ranged from 0.8-0.9). Ten items reflected four levels of food insecurity with increasing severity as shown in Table 1.

Anthropometric measurements

Anthropometric measurements were conducted by two trained research assistants in accordance with established standard protocols (IPH, 2020). Each measurement was taken twice, then the mean value of the two measurements was recorded and used for further analyses.

Table 1. Classification of food security according to the Radimer/Cornell Scale

Food security status	*Indicator*
Food security	Negative answers to all hunger and food insecurity items†
Individual food insecurity	Positive answer to at least one of items 1 to 4‡
Household food insecurity	Positive answer to at least one of items 5 to 8‡
Child hunger	Positive answer to items 9 and 10‡

†Negative answer is referred to as "not true".
‡Positive answer is referred to as "sometimes true" or "often true".
(Radimer *et al.*, 1996)

Body weight of children was measured using a calibrated weighing scale (Tanita HD-662, Japan), with minimum clothing, barefooted, and in a straight posture. The reading was recorded to the nearest 0.1 kg. Height of the children was measured using a portable stadiometer (SECA 213, Germany), with head, shoulders, buttocks, knees, and heels touching the board, and without shoes. The reading was recorded to the nearest 0.1 cm. The age of the children were calculated in months from their date of birth.

The World Health Organization (WHO) Anthro 3.2 software and WHO AnthroPlus software were used to obtain z-scores for four nutritional indicators, namely weight-for-age (WAZ), height-for-age (HAZ), weight-for-height (WHZ), and BMI-for-age (BAZ). The status of malnutrition for children aged 24–60 months was categorised according to the WHO Child Growth Standards (WHO, 2006), based on the six conditions, namely underweight [WAZ<-2 standard deviation (*SD*)], stunting (HAZ<-2*SD*), wasting (BAZ<-2*SD*), possible risk of overweight (BAZ>+1*SD* to ≤+2*SD*), overweight (BAZ>+2*SD* to ≤+3*SD*), and obese (BAZ>+3*SD*). Meanwhile, for children aged 61 to 144 months, the status of malnutrition was categorised according to the Growth Reference Data for 5-19 Years (WHO, 2007), based on the five conditions, namely underweight (WAZ<-2*SD* for children aged 61 to 120 months), stunting (HAZ<-2*SD*), thinness (BAZ<-2*SD*), overweight (BAZ>+1*SD* to ≤+2*SD*), and obese (BAZ >+2*SD*) (WHO, 2006; WHO, 2007).

Data analysis

Data were analysed using the IBM SPSS Statistics for Windows version 26.0 (IBM Corporation, Armonk, New York, USA). The frequency, mean, percentage, and standard deviation for demographic characteristics, food insecurity status, and nutritional status of children were determined using descriptive analysis. Chi-squared test, Fisher's Exact test or Likelihood Ratio were used to determine the associations between demographic characteristics and food insecurity status with nutritional status of children. Then, determinant factors (variables of demographic characteristics and food insecurity status with $p<0.05$ in the Chi-squared test) for nutritional status of children were subsequently determined by performing a simple logistic regression analysis.

RESULTS

The descriptive statistics for demographic characteristics, level of food insecurity, and children's nutritional status are illustrated in Table 2. A total of 171 children participated in this study. The age of children ranged 24–140 months, with a mean age of 65.9±30.6 months. The proportions of children aged 24–59 months and 60–144 months were equally distributed, at 50.3% and 49.7%, respectively. The maternal age ranged

Table 2. Characteristics of mothers, children and households (*N*=171)

Characteristics	*n*	*%*	*Mean±SD*
Age of children (months)			65.9±30.6
24-59	84	49.1	
60-144	87	50.9	
Sex of children			
Male	75	43.9	
Female	96	56.1	
Maternal age			32.6±6.1
<25 years	13	7.6	
25-34 years	96	56.1	
35-44 years	54	31.6	
≥45years	8	4.7	
Ethnicity			
Malay	145	84.8	
Iban	19	11.1	
Others	7	4.1	
Religion			
Islam	147	86.0	
Christianity	24	14.0	
Marital status			
Married	165	96.5	
Divorced/Separated	6	3.5	
Number of children in the household			3±1
<3	76	44.4	
≥3	95	55.6	
Household size			6±2
<7	115	67.3	
≥7	56	32.7	
Maternal highest education			
No formal/Primary education	18	10.5	
Secondary education	120	70.2	
Tertiary education	33	19.3	
Paternal highest education (*N*=165)†			
No formal/Primary education	28	17.0	
Secondary education	120	72.7	
Tertiary education	17	10.3	
Maternal occupation			
Housewife	123	71.9	
Self-employed	20	11.7	
Private	16	9.4	
Government	12	7.0	
Paternal occupation (*N*=165)†			
Self-employed	75	45.5	
Private	64	38.8	
Government	20	12.1	
Unemployed	6	3.6	

Table 2. Characteristics of mothers, children and households (*N*=171) *[continued]*

Characteristics	*n*	*%*	*Mean±SD*
Household income‡			1,935.64±1,506.00
<RM1096 (hard core poor)	51	29.8	
RM1096 – <RM2130 (poor)	76	44.4	
≥RM2131	44	25.7	
Food insecurity status			
Household food insecure	121	70.8	
Individual food insecure	26	15.2	
Child hunger	24	14.0	
Nutritional status of children			
24-59 months (*n*=84)			
Underweight	15	17.9	
Stunting	15	17.9	
Wasting	12	14.3	
Possible risk of overweight	0	0.0	
Overweight	4	4.8	
Obese	4	4.8	
60-144 months (*n*=87)			
Underweight (*n*=73)	10	13.7	
Stunting	14	16.1	
Thinness	6	6.9	
Overweight	7	8.0	
Obese	17	19.5	

†6 respondents divorced
‡Department of Statistics, Malaysia Sarawak, 2020

from 21 to 47 years old, with a mean age of 32.6±6.1 years old and majority were Malays (84.8%). Three-quarters (74.2%) of the respondents were living in a poor household. Of the 127 respondents from poor households, 51 of them (40.2%) were in the range of hard-core poor. With regards to the level of food insecurity, of the 171 respondents from food-insecure households who agreed to participate in this study, the majority were experiencing household food insecurity (70.8%), followed by 15.2% adult food insecurity, and 14.0% child hunger. In terms of children's nutritional status, the descriptive analysis revealed that children in this study had both undernutrition and overnutrition problems. For children aged 24–59 months, it was found that the main nutritional problems were underweight (17.9%), stunting (17.9%) and wasting (14.3%); while for children aged 60–144 months, the main nutritional problems were overweight/obesity (27.5%) and stunting (16.1%).

Association between demographic characteristics, level of food insecurity, and nutritional status of children

The associations between demographic characteristics, level of food insecurity, and nutritional status of children are presented in Table 3. Out of twelve variables, three variables were found to be significantly associated with a child's nutritional status, namely age of mother [$\chi^2(1, N=171) = 4.846$, $p=0.028$], occupation of mother ($p=0.040$), and

Table 3. Associations between demographic characteristics, level of food insecurity, and nutritional status of children aged 2–12 years old

Characteristics	*Weight-for-age* [a] *(WAZ)*			*Height-for-age* [b] *(HAZ)*			*Weight-for-height* [c] *(WHZ)*			*BMI-for-age* [d] *(BAZ)*			*BMI-for-age* [e] *(BAZ)*		
	Non-underweight (n=132) (%)	*Underweight (n=25) (%)*	χ^2 *(p-value)*	*Non-stunting (n=142) (%)*	*Stunting (n=29) (%)*	χ^2 *(p-value)*	*Non-wasting (n=72) (%)*	*Wasting (n=12) (%)*	χ^2 *(p-value)*	*Non-thinness (n=81) (%)*	*Thinness (n=6) (%)*	χ^2 *(p-value)*	*Non-overweight/ Obese (n=129) (%)*	*Overweight/ Obese (n=32) (%)*	χ^2 *(p-value)*
Age of children															
24–59 months	69 (82.1)	15 (17.9)	0.505 (0.478)	69 (82.1)	15 (17.9)	0.095 (0.758)	Nil	Nil	Nil	Nil	Nil	Nil	76 (90.5)	8 (9.5)	9.166 (0.002)
60–144months	63 (86.3)	10 (13.7)		73 (83.9)	14 (16.1)								63 (72.4)	24 (27.6)	
Sex of children															
Male	58 (81.7)	13 (18.3)	0.551 (0.458)	63 (84.0)	12 (16.0)	0.087 (0.768)	28 (82.4)	6 (17.6)	(0.534)†	37 (90.2)	4 (9.8)	(0.415)†	61 (81.3)	14 (18.7)	0.000 (0.989)
Female	74 (86.0)	12 (14.0)		79 (82.3)	17 (17.7)		44 (88.0)	6 (12.0)		44 (95.7)	2 (4.3)		78 (81.3)	18 (18.8)	
Maternal age															
≤ 34 years old	88 (84.6)	16 (15.4)	0.067 (0.796)	94 (86.2)	15 (13.8)	2.183 (0.140)	52 (82.5)	11 (17.5)	(0.279)†	43 (93.5)	3 (6.5)	(1.000)†	94 (86.2)	15 (13.8)	4.846 (0.028)
≥ 35 years old	44 (83.0)	9 (17.0)		48 (77.4)	14 (22.6)		20 (95.2)	1 (4.8)		38 (92.7)	3 (7.3)		45 (72.6)	17 (27.4)	
Marital status															
Married	126 (83.4)	55 (16.6)	(0.590)†	136 (82.4)	29 (17.6)	(0.591)†	69 (86.3)	11 (13.8)	(0.467)†	79 (92.9)	6 (7.1)	(1.000)†	134 (81.2)	31 (18.8)	(1.000)†
Divorced/ Separated	6 (100.0)	0 (0.0)		6 (100.0)	0 (0.0)		3 (75.0)	1 (25.0)		2 (100.0)	0 (0.0)		5 (83.3)	1 (16.7)	
Number of children															
< 3	64 (85.3)	11 (14.7)	0.169 (0.681)	66 (86.8)	10 (13.2)	1.404 (0.236)	41 (83.7)	8 (16.3)	0.400 (0.527)	27 (100.0)	0 (0.0)	(0.171)†	64 (84.2)	12 (15.8)	0.769 (0.381)
≥ 3	68 (82.9)	14 (17.1)		76 (80.0)	19 (20.0)		31 (88.6)	4 (11.4)		54 (90.0)	6 (10.0)		75 (78.9)	20 (21.1)	
Household size															
< 7	87 (82.9)	18 (17.1)	0.352 (0.553)	97 (84.3)	18 (15.7)	0.426 (0.514)	48 (87.3)	7 (12.7)	(0.744)†	55 (91.7)	5 (8.3)	(0.661)†	92 (80.0)	23 (20.0)	0.382 (0.536)
≥ 7	45 (86.5)	7 (13.5)		45 (80.4)	11 (19.6)		24 (82.8)	5 (17.2)		26 (96.3)	1 (3.7)		47 (83.9)	9 (16.1)	
Maternal highest education															
Primary/No formal education	12 (80.0)	3 (20.0)	(0.710)†	15 (83.3)	3 (16.7)	(1.000)†	7 (87.5)	1 (12.5)	(1.000)†	9 (90.0)	1 (10.0)	(0.530)†	17 (94.4)	1 (5.6)	(0.201)†
Secondary/ Tertiary education	120 (84.5)	22 (15.5)		127 (83.0)	26 (17.0)		65 (85.5)	11 (14.5)		72 (93.5)	5 (6.5)		122 (79.7)	31 (20.3)	

Table 3. Associations between demographic characteristics, level of food insecurity, and nutritional status of children aged 2–12 years old [continued]

Characteristics	*Weight-for-age* [a] *(WAZ)*			*Height-for-age* [b] *(HAZ)*			*Weight-for-height* [c] *(WHZ)*			*BMI-for-age* [d] *(BAZ)*			*BMI-for-age* [e] *(BAZ)*		
	Non-underweight (n=132) (%)	*Underweight (n=25) (%)*	χ^2 *(p-value)*	*Non-stunting (n=142) (%)*	*Stunting (n=29) (%)*	χ^2 *(p-value)*	*Non-wasting (n=72) (%)*	*Wasting (n=12) (%)*	χ^2 *(p-value)*	*Non-thinness (n=81) (%)*	*Thinness (n=6) (%)*	χ^2 *(p-value)*	*Non-overweight/ Obese (n=129) (%)*	*Overweight/ Obese (n=32) (%)*	χ^2 *(p-value)*
Paternal highest education [f]															
Primary/No formal education	18 (78.3)	5 (21.7)	(0.542)†	22 (78.6)	6 (21.4)	(0.588)†	9 (90.0)	1 (10.0)	(1.000)†	15 (83.3)	3 (16.7)	(0.106)†	23 (82.1)	5 (17.9)	0.019 (0.890)
Secondary/ Tertiary education	108 (84.4)	20 (15.6)		114 (83.2)	23 (16.8)		60 (85.7)	10 (14.3)		64 (95.5)	3 (4.5)		111 (81.0)	26 (19.0)	
Maternal occupation															
Unemployed	95 (82.6)	20 (17.4)	0.692 (0.406)	104 (84.6)	19 (15.4)	0.711 (0.399)	50 (84.7)	9 (15.3)	0.711 (1.000)	62 (96.9)	2 (3.1)	(0.040)†	102 (82.9)	21 (17.1)	0.775 (0.379)
Employed	37 (88.1)	5 (11.9)		38 (79.2)	10 (20.8)		22 (88.0)	3 (12.0)		19 (82.6)	4 (17.4)		37 (77.1)	11 (22.9)	
Paternal occupation [g]															
Unemployed	2 (50.0)	2 (50.0)	(0.128)†	3 (50.0)	3 (50.0)	(0.068)†	2 (100.0)	0 (0.0)	(1.000)†	3 (75.0)	1 (25.0)	(0.258)†	6 (100.0)	0 (0.0)	(0.595)†
Employed	124 (84.4)	23 (15.6)		133 (83.6)	26 (16.4)		67 (85.9)	11 (14.1)		76 (93.8)	5 (6.2)		128 (80.5)	31 (19.5)	
Household income															
≤ RM2,130	99 (84.6)	18 (15.4)	0.100 (0.752)	108 (85.0)	19 (15.0)	1.400 (0.237)	52 (85.2)	9 (14.8)	(1.000)†	63 (95.5)	3 (4.5)	(0.149)†	104 (81.9)	23 (18.1)	0.118 (0.731)
≥ RM2,131	33 (82.5)	7 (17.5)		34 (77.3)	10 (22.7)		20 (87.0)	3 (13.0)		18 (85.7)	3 (14.3)		35 (79.5)	9 (20.5)	
Level of food insecurity															
Household food insecurity	96 (84.2)	18 (15.8)	‡	102 (84.3)	19 (15.7)	‡	57 (89.1)	7 (10.9)	‡	53 (93.0)	4 (7.0)	‡	95 (78.5)	26 (21.5)	‡
Individual food insecurity	21 (84.0)	4 (16.0)	0.009 (0.995)	21 (80.0)	5 (19.2)	0.472 (0.790)	7 (70.0)	3 (30.0)	2.488 (0.288)	15 (93.8)	1 (6.3)	0.013 (0.993)	21 (80.8)	5 (19.2)	5.164 (0.138)
Child hunger	15 (83.3)	3 (16.7)		19 (79.2)	5 (20.8)		8 (80.0)	2 (20.0)		13 (92.9)	1 (7.1)		23 (95.8)	1 (4.2)	

Chi-squared test; †Fisher's Exact Test; ‡Likelihood Ratio

(α) Non-underweight: z-score ≥ -2*SD*; Underweight: z-score < -2SD; Total subjects 157, 6 subjects >120 months were excluded

(α) Non-stunting: z-score ≥ -2*SD*; Stunting: z-score < -2*SD*

(α) Non-wasting: z-score ≥ -2*SD*; Wasting: z-score < -2*SD*; Total subjects 84, 87 subjects ≥ 60 months were excluded

(α) Non-thinness: z-score ≥ -2*SD*; Thinness: z-score < -2*SD*; Total subjects 87, 84 subjects <60 months were excluded

(α) Non-overweight/Obese: z-score ≤ +1SD (for children aged ≥ 60 months) and ≤ +2*SD* (for children aged < 60 months); Overweight/ Obese: z-score > +1*SD* (for children aged ≥ 60 months) and > +2*SD* (for children aged < 60 months)

(f) &(g) Total subjects different with other variables due to marital status of 6 subjects being divorced/separated

Table 4. Children's nutritional status with associated demographic characteristics by simple logistic regression

Nutritional status	*Demographic characteristics*		*N*	*Adjusted OR*	*95% CI*	*p-value*
Overweight/ Obese	Age of children	24–59 months	84	(Ref)	(Ref)	(Ref)
		60–144 months	87	3.619	(1.521, 8.613)	0.004
	Maternal age	≤ 34 years old	109	(Ref)	(Ref)	(Ref)
		≥ 35 years old	62	2.367	(1.085, 5.164)	0.03
Thinness	Occupation of mothers	Unemployed	64	(Ref)	(Ref)	(Ref)
		Employed	23	6.526	(1.108, 38.449)	0.038

OR: Odds Ratio
CI: Confidence Interval
Omnibus Test of Model Coefficient; Total subjects 171.

age of child [$\chi^2(1, N=171) = 9.166$, $p=0.002$]. Variables with a significant *p*-value were further analysed with simple logistic regression (Table 4). The analysis indicated that children with mothers aged at or more than 35 years old were 2.367 times more likely to be overweight or obese compared to children of mothers less than or equal to 34 years old (*AOR* = 2.367; 95%*CI*: 1.085, 5.164). Children aged 60–144 months possessed increased odds of being overweight or obese, almost 3.5 folds compared to children aged 24–59 months (*AOR*=3.619; 95%*CI*: 1.521, 8.613). This study showed that children of working mothers had a higher percentage (17.4%) or were 6.526 times more likely to have a thinness problem than children of unemployed mothers (*AOR*=6.526; 95%*CI*: 1.108, 38.449). However, no statistically significant association was found between the level of food insecurity and children's malnutrition status ($p>0.05$).

DISCUSSION

This study showed that among the three categories of food insecurity, the highest proportion was household food insecurity, while the proportions for individual food insecurity and child hunger were approximately the same. There are slight differences in the results of this study with previous studies in terms of the proportion of child hunger (Hamid *et al.,* 2021; Mamat, Norhasmah & Mesbah, 2019). Hamid *et al.* (2021) conducted a study on 114 women aged 18–45 years old in Tuba Island, Kedah and found that of the 74 respondents who experienced food insecurity, the highest proportion was household food insecurity (64.9%), and the proportion of child hunger was 23.0%. Another study conducted by Mamat *et al.* (2019) in Mentakab, Pahang on 139 mothers aged 20–59 years old showed that the proportion of child hunger among food-insecure households was 29.3%. Both studies showed higher proportions of child hunger than this study, which was 14.0%. Although the age range of respondents for both studies were almost the same as this study, differences might be due to other demographic characteristics, such as lower percentage of married respondents, lower education attainment (Hamid *et al.*, 2021), different proportion of ethnicity, and bigger household size (Mamat *et al.*, 2019), compared with this study.

The current study findings indicated that more children aged 24–59 months were undernourished than overnourished. This finding is consistent

with NHMS (2019), where the prevalence of undernutrition (underweight 14.1%; stunting 21.8%; wasting 9.7%) was higher than overnutrition (overweight 5.6%; obese 5.6%) (IPH, 2020). In Sarawak, a study conducted by Rahman, Kiyu & Seling (2021) reported that the proportion of wasting was lower than in the present study, which was 6.9%. The difference in proportion may be due to different demographic characteristics, as the previous study was conducted among the Dayak community and in all divisions of Sarawak. In contrast, the current study was only conducted in the district of Simunjan only. Besides that, it might be due to the difference in the proportion of poor households between these two studies. Poor household is one of the factors related to wasting in children (Rahman *et al.*, 2021). Undoubtedly, the proportion of poor households in this study (74.2%) was much higher than the study conducted by Rahman *et al.* (2021), which was 27.3%. According to the Nutrition Landscape Information System's proposed prevalence thresholds, which are set to map countries based on severity levels, the prevalences of underweight and wasting in this study were categorised as medium and serious public health significance, respectively (de Onis *et al.*, 2019).

For children aged 60–144 months in this study, it was found that the prevalence of underweight was similar to the national prevalence (15.4%) and the same trend was also observed in the proportion of overweight or obesity (29.8%). Conversely, the prevalence of thinness in the present study (6.9%) was lower compared to the national prevalence (10.0%) (IPH 2020). The prevalence of overweight and obesity is inconsistent with the result of Cheah (2019), which reported a much higher rate (36.9%) than this study. It might be due to the differences in study areas. Both studies were conducted in Sarawak with the majority of Malay ethnicity. Still, the difference was the study area, which was conducted in a rural area, while the study of Cheah (2019) was conducted in an urban area. According to Agbozo *et al.* (2016), children who live in urban areas will have more problems with being overweight than underweight.

In the present study, the analysis indicated that older children (60–144 months) have a higher prevalence and significantly increased odds of being obese (almost fourfold) than younger children (24–59 months). The finding is consistent with previous research, where the proportion of overweight subjects increased with age (Abdelkarim *et al.*, 2020). In the United States, being overweight is more prevalent among girls aged 2–5 years old. Although there was no gender difference of being overweight among 2–5 years old in this study (data not shown), it did show the same trend in the increasing percentage of obese children with the advancement of age during childhood. This situation is due to changes in eating patterns and physical activity. Unhealthy eating patterns (excessive calorie intake) and too little physical activity as age increases during childhood contribute to this phenomenon (New York State Department of Health, 2012).

This study documented a significant association between the mother's age and the child's overweight and obese status. Children of mothers over 34 years old were more likely to be overweight or obese compared to children of mothers less than or equal to 34 years old. This finding is similar to a previous study (Barclay & Myrskyla, 2016), which found that children of older mothers were more likely to be overweight or obese than children of younger mothers. However, this contrasts with a study conducted by Farajian *et al.* (2014), in which children

whose mothers were older had reduced risk of being overweight or obese, with a possible explanation that family health awareness was better in older mothers. The difference in study population might also explain the disparity between these findings. While the study by Farajian *et al.* (2014) was based on children aged 10–12 years old in Greece, the present study was conducted among 2–12 years old children in Simunjan.

In this study, it was found that children of working mothers have higher risk of thinness than those of non-working mothers. Contrary to a previous study conducted among children aged 5–10 years in Sri Lanka by Shinsugi *et al.* (2019), thinness was highly prevalent among children of mothers who were housewives or not working. Therefore, the impact of maternal employment on child malnutrition is debatable. According to Ghosh (2020), children with working mothers will be well-nourished because involvement in work will mean more empowerment for the mothers. This will allow them to make better decisions in nutrition and child care. However, with employment, mothers with long working hours will have limited time spent with their children, and this could lead to malnutrition among children. Nonetheless, a theory stated that employment status is related to maternal education level and knowledge. In the study conducted by Fernández-Cornejo *et al.* (2015) among 2383 university students, it was found that female students were more likely to accept some sacrifice in their career progression for family reasons. This could be because they believed that their caregiving responsibilities require more time and effort than their career responsibilities. A woman who attains a higher level of education and possesses significant knowledge, but chooses to be a housewife or to not engage in formal employment tends to have a child with better health status. Therefore, the findings in this study, where working mothers have higher risk of having thin children than non-working mothers, may be due to the mother's education and knowledge; whereby only one out of five mothers in this study attained tertiary education.

Household food insecurity has been identified as a possible underlying determinant of childhood malnutrition (Drammeh, Hamid & Rohana, 2019). From previous studies, it was indicated that food security status increases the likelihood of children being malnourished – both undernutrition and overnutrition (Ali Naser *et al.*, 2014; Shahraki *et al.*, 2016; Papas *et al.*, 2016). However, there was no statistically significant association found between severity of food insecurity and children's malnutrition status in this study. There is overwhelming consensus in the research literature supporting the association between food insecurity and malnutrition in children as most studies conducted globally consistently demonstrate a strong link between food insecurity and adverse nutritional outcomes in children. However, the respondents in this study were mother-and-child pairs from food-insecure households, focusing on the relationship between the severity of food insecurity (household food insecurity, individual food insecurity, and child hunger) and child's malnutrition status, not between food security (food-secure household and food-insecure household) and child's malnutrition status. Furthermore, due to the small sample size of this study, causing the analyses to be inadequately powered, we were eventually unable to demonstrate the association between the severity of food insecurity and a child's malnutrition status.

Strengths and limitations

This study attempted to assess the severity of food insecurity among food-insecure households in the district that reportedly had the highest incidence of poverty in the southern region of Sarawak, which provided some insights into factors that contribute to the conditions of malnutrition in children. Besides providing information for designing, developing, and implementing intervention programmes at a later phase, this study would also provide the local authorities or related agencies with ideas on how resources can be allocated and the steps necessary to improve the food insecurity situation, which would eventually help improve the nutritional status of children. Additionally, trained researchers measured and collected all of the data and information in this study, which reduced potential bias compared to a study based on self-reported data. Furthermore, the study equipment and tools used were non-invasive, less time-consuming, and cheaper.

As this was only a cross-sectional study, it could only describe the relationship between demographic characteristics, the severity of food insecurity, and a child's malnutrition status, but not explain its causal effect. In addition, the sampling technique used was non-probability convenience sampling, hence, the present study findings would not apply to a broader population in general. Furthermore, there is a possibility that the statement regarding food insecurity given by the respondent was untrue due to embarrassment, which may cause bias (Shahraki *et al.*, 2016). Lastly, because of the small sample size and the fact that it only included households with children aged 2–12 years old, the findings may have overlooked the impact of other factors on the severity of food insecurity and children's malnutrition status.

CONCLUSION

Among the three food insecurity indicators, household food insecurity was more prevalent than individual food insecurity and child hunger among the household in Simunjan, Sarawak. At the same time, childhood underweight, stunting, overweight and obesity remained the main malnutrition problems in this district. The present study illustrated that the age of mother, employment status, and child's age are associated with malnutrition in children. However, no association was found between the severity of food insecurity and children's malnutrition status. As the prevalence of underweight and wasting in this study were categorised as medium and serious public health significance, respectively, therefore a programme focusing on improving household food insecurity and children's nutritional status should be conducted so that the situation will not worsen. Programmes, such as home gardening or small-scale farming, can be conducted to promote diverse and nutritious food production that can positively impact food availability and accessibility. Besides that, nutrition education campaigns can be undertaken to promote proper feeding practices and encourage healthy food consumption. These programmes focus on food security and nutrition aspects, which will benefit children's nutritional status. Further studies need to be carried out to determine children's dietary intake and quality, which may also contribute to malnutrition.

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Author's contributions

Tan BC, conceptualised and designed the study, conducted the study, conducted data collection, data analysis and interpretation, and prepared the draft of the manuscript; Cheah WL, principal investigator, conceptualised and designed the study, reviewed data analysis, interpretation, and the manuscript; Law LS, the grant owner, conceptualised and designed the study, reviewed data analysis, interpretation, and the manuscript.

Conflict of interest

The authors declare no conflicts of interest in undertaking this study.

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