Available online: https://journal.ipb.ac.id/index.php/jgizipangan ***J. Gizi Pangan, September 2025, 20(Supp.1):107-116***
Accredited based on DGHE, Republic of Indonesia 79/E/KPT/2023
ISSN 1978-1059 EISSN 2407-0920

Association between Minimum Dietary Diversity and Nutritional Status among Children Aged 6 to 24 Months in Terengganu, Malaysia

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ABSTRACT

This cross-sectional study aimed to determine the association between food consumption quality, as determined by Minimum Dietary Diversity (MDD), and children's nutritional status using anthropometric measurements. A total of 287 children (150 boys, 147 girls) aged 6 to 24 months from Kuala Nerus and Kuala Terengganu participated in this study through purposive sampling. Socio-demographics and food consumption of children were collected through interviews with the mother. Anthropometric comprised weight, height, while nutritional status was determined based on WHO Child Growth Standards. MDD was assessed using WHO Infant and Young Child Feeding (IYCF) Indicators Questionnaire. Children achieving the MDD were rated on four or more dietary variety scores, while those receiving less than four were categorized as "not achieving" the MDD. Most of the children (98.6%) were Malay, with 69.3% aged between 12 to 24 months and 30.7% aged between 6 to 11 months. The prevalence of stunting, wasting, and underweight was 25.8%, 6.6% and, 14.6%, respectively. The proportion of children achieving MDD was 90.2%. No significant association existed between MDD and stunting, wasting, or underweight. However, Pearson's Chi-Square test affirms that consumption of dairy products was significantly associated with stunting among children (p=0.001). In conclusion, dairy products significantly prevent stunting in children, and their continuation should be emphasized for the first two years of life after exclusive breastfeeding in health promotion programs.

Keywords: children, dietary diversity, nutritional status

INTRODUCTION

The period between birth & two years of age is crucial for optima growth (NCCFN 2013). The greater nutrient needs associated with rapid growth and development, along with an inadequate diet, predispose children to malnutrition during this crucial period (Ocampo *et al.* 2016). One of the long-term and efficient approaches to enhance child nutrition is to improve the quality of the child's diet beginning at age six months (Ocampo *et al.* 2016). One of the key factors for evaluating baby and early child feeding practices is Minimum Dietary Diversity (MDD) (WHO 2008). MDD refers to the consumption of four or more food groups from the seven food groups which are grains, roots and tubers, legumes and nuts, dairy products, flesh food, eggs, vitamin A-rich fruits and vegetables, and other fruits and vegetables (WHO 2008). Out of 7 food groups within MDD, a study conducted in Sarawak for Penan children revealed that grains, roots, and tubers were the most eaten food groups followed by fruits and vegetables high in vitamin A, and flesh foods. Dairy foods become the third least consumed food groups with only 47.9% of Penan children consumed it (Bong *et al.* 2018). Meanwhile, anthropometric measurements like height and weight can be used to assess how poor nutrition affects a child's growth (IPH 2020). Using a global reference standard, this data can be used to describe a child's nutritional status, such as underweight, stunted, wasted, or overweight (IPH 2020).

Dietary diversity has been found to be connected to nutrient intake and nutritional status in several studies from various nations (Ahmad *et al.* 2018b; Berhe *et al.* 2019; Geng *et al.* 2018; Kuche *et al.* 2019; Nti *et al.* 2011). In impoverished countries, switching from a monotonous diet to one that contains a greater range of meals improves energy and micronutrient intake (Kennedy *et al.* 2007; Moursi *et al.* 2008; Nti *et al.* 2011; Rah *et al.* 2010; Torheim *et al.* 2004). However, some studies found no association

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(Received 18-02-2025; Revised 26-05-2025; Accepted 21-08-2025; Published 15-09-2025)

between dietary diversity and nutritional status (Bong *et al.* 2018; Bentley *et al.* 2015; Ersino *et al.* 2016) whereas other studies found that dietary diversity was associated with only one or two nutritional status indicators. For example, a study found dietary diversity was only associated with wasting but not stunting and underweight (Kavle *et al.* 2016).

As reported by the National Health and Morbidity Survey (NHMS) 2016, the overall prevalence of MDD (children aged 6 to 24 months who reported to achieved four or more food groups) in Malaysia was 66.4% (IPH 2016). By state, Terengganu had the highest prevalence of MDD (89.6%). Nevertheless, despite having the highest prevalence of MDD, Terengganu still recorded a high prevalence of stunting (26.1%), wasting (14.0%) & underweight (10.8%) among children below 5 years old (IPH 2016). Terengganu has become the second-highest state in terms of stunting prevalence, after Kelantan state. This study also found that children above one year (12 to 24 months) was more likely to achieved the MDD at 95% compared to children below one year (6 to 11 months) at 79.5% (IPH 2016).

However, it should be noted that the data for nutritional status was for children below five and not two years of age. Meanwhile, the data on dietary diversity was for children under the age of two, more specifically children between 6 to 24 months. Therefore, the relationship between MDD and nutritional status cannot be concluded from this survey due to the differences in the age groups measured. There are currently no studies that have been done to evaluate the relationship between MDD and nutritional status among children in Terengganu, which is located on the eastern coastal of Peninsular Malaysia. To fill the research gap, this study aims to determine the MDD and its association with the nutritional status among children aged 6 to 24 months in Kuala Nerus and Kuala Terengganu

METHODS

Design, location, and time

A cross-sectional study was conducted among children aged 6 to 24 months residing in two districts in Terengganu, namely Kuala Nerus and Kuala Terengganu. Before the study begin, ethical approval was obtained from the UniSZA Human Research Ethics Committee (UHREC) [UniSZA/UHREC/2022/391]. Permission to obtain data on mothers with children below two years old was received from Terengganu Family Development Foundation.

Sampling

Purposive sampling was used to select the participants and screening was done for inclusion and exclusion criteria. Participants selected should be children between 6 to 24 months, mothers or parents of the children, and mothers who can read, write and understand Malay language. The exclusion criteria were children with known diseases and physical disabilities, and children who cannot be measured because they are too ill or because of post-operative immobilization. A total of 287 children participated in this study.

Data collection

The data collection commenced from September to November 2022, with written informed consent from the participants. Questionnaires consisted of socio-demographic information namely the number of children, estimated household income, mother's age, mother's educational level, and the children's age, gender, and ethnicity.

For anthropometric measurement, the SECA 374 Baby Scale (SECA, Germany) was used to measure the subjects' weight without any clothing, accessories or shoes, to the nearest 0.1 kg. The recumbent length of the children was measured to the nearest 0.1 cm using SECA 233 Baby Scale (SECA, Germany). Both instruments were calibrated before each session. Stunting, underweight, and wasting were classified based on the WHO Child Growth Standard (2006). Weight-for-Age Z-Scores (WAZ), Length/ Height-for-Age Z-Scores (LAZ), and Weight-for-Length Z-Scores (WLZ), were determined using WHO AnthroPlus software (version 3.2.2). The classification of underweight, stunting, and wasting for WAZ, LAZ, and WLZ, respectively, employed a cut-off value of less than 2 Standard Deviations (SD) from the median value for the reference population (WHO 2006).

The Infant and Young Children Feeding Guidelines (IYCF) of the WHO were used to develop the questionnaire to assess dietary diversity as a globally recognized complementary feeding guideline (WHO 2008). A pilot study

was conducted to evaluate and assess the validity of the modified IYCF questionnaire before it was distributed to the respondents. The internal consistency was assessed using Cronbach's Alpha Coefficient with a score of 0.823. This questionnaire was used to gather data on food groups consumed by the child the day before the data collection for 24 hours. It recorded the consumption of seven food groups, which are grains, roots and tubers, legumes and nuts, dairy products, flesh food, eggs, vitamin A-rich fruits and vegetables, and other fruits and vegetables. In order to prevent bias, every food that the mother recall was asked either it was really given yesterday or it was just their usual intake. Dietary diversity score was calculated using this questionnaire. The child is considered to have achieved MDD if they had been given foods from at least four food groups the previous day of the data collection (WHO 2008).

Data analysis

All data were checked and cleaned before the data analysis. Statistical analysis was performed using IBM SPSS software for Windows, version 26.0 (Armonk, NY: IBM Corp). Appropriate statistical analysis was carried out with a two-sided alpha level of 0.05 or 95% confidence interval. The relationship between MDD and nutritional status was examined using the Chi-square test, whereas the sociodemographic information and dietary diversity were examined using descriptive statistics to ascertain mean, standard deviation, frequency, and percentage.

RESULTS AND DISCUSSION

Socio-demographic characteristics

Socio demographic characteristics of the children were shows in Table 1. A total number of 287 children took part in this study, where 52.3% were male and 47.7% were female. The majority of the children were between 12 to 24 months (69.3%), and almost all were Malay (98.6%). Most (62.4%) of the mothers aged between 30 to 39 years old and half of them completed tertiary education (50.5%). Less than half (31.0%) of the mother had their first pregnancy while most (74.9%) of the household have less than three children.

Table 1. Socio-demographic characteristics of study participants

Characteristics (n=287)	n (%)
Race	
Malay	283 (98.6)
Others	4 (1.4)
Gender of child	
Male	150 (52.3)
Female	137 (47.7)
Child's age (Mean (IQR))	14 (9)
6–11 months	88 (30.7)
12–24 months	199 (69.3)
Mother's age (Mean (IQR))	32 (6)
20–29 years	87 (30.3)
30–39 years	179 (62.4)
40–49 years	21 (7.3)
Mother's education	
No formal education	3 (1.1)
Primary school	7 (2.4)
Secondary school	132 (46.0)
Tertiary education	145 (50.5)
First pregnancy	
No	198 (69.0)
Yes	89 (31.0)
Number of children in the household	
≤3	215 (74.9)
≥4	72 (25.1)

IQR: Interquartile Range

Nutritional status

Table 2 summarizes the nutritional status of the children of which 25.8% of children were stunted, 6.6% were wasted & 14.6% were underweight. Prevalence of stunting among children aged 6 to 24 months in this study is similar with the stunting prevalence for children

Table 2. Prevalence of stunting, wasting and underweight among study participants

Nutritional status	Mean±SD/ Median (IQR)	6–11 months (n=88)	12–24 months (n=199)	Total (n=287)
		n (%)	n (%)	n (%)
Length-for-Age (LAZ)	-1.46 (1.44)**			
Stunting		20 (22.7)	54 (27.1)	74 (25.8)
Not stunting		68 (77.3)	145 (72.9)	213 (74.2)
Weight-for-Length (WLZ)	-0.32±1.19*			
Wasting		2 (2.3)	17 (8.5)	19 (6.6)
Not wasting		86 (97.7)	182 (91.5)	268 (93.4)
Weight-for-Age (WAZ)	-0.90 (1.04)**			
Underweight		9 (10.2)	33 (16.6)	42 (14.6)
Not underweight		79 (89.8)	166 (83.4)	245 (85.4)

*Mean±SD score; **Median score; SD: Standard Deviation: IQR: Interquartile Range

under five years old in Terengganu (26.1%), as reported by National Health & Morbidity Survey of 2016 (IPH 2016). However, it is lower than the stunting prevalence for Penan children below two years old in a study in Sarawak (43.9%) (Bong *et al.* 2018). This study also found 6.6% of children were wasted which is much lower than Terengganu state (14.0%). Underweight prevalence in this study was 14.6%, which is higher in comparison to Terengganu's children under the age of five (10.8%). The possible reasons for the differences in the prevalence of undernutrition in the existing study may be explained by variations in the ages of the children and the regions involved. Data from the NHMS was for children under five years old and scattered throughout Terengganu districts. Meanwhile, this study focused on children below two years old and focus at Kuala Nerus and Kuala Terengganu districts only. According to Bong *et al.* (2019), higher underweight and stunting prevalence in young Penan children may be attributed by high poverty and food insecurity in the Penans community, as it is located in rural areas of Sarawak. Meanwhile, this current study in Kuala Nerus and Kuala Terengganu covered random rural and urban areas in which poverty and food insecurity are quite rare.

As shown in the same table, children over one year (12 to 24 months) are more likely than children under one year to be stunted, wasted, and underweight (6 to 11 months). Stunting is more common in children between the ages of 12 and 24 months than between the ages of 6 and 11 months at 27.1% and 22.7%, respectively. Both the prevalence of wasting and underweight was observed to follow a similar pattern. Compared to children aged 6 to 11 months, children aged 12 to 24 months had a higher prevalence of wasting at (2.3% versus 8.5%). Children aged 12 to 24 months had a higher prevalence rate of underweight (16.6%) than those aged less than 12 months (10.2%). This is consistent with studies from the Philippines and Rwanda, which indicated that as children aged, the incidence of undernutrition rose. Ocampo *et al.* (2016), in their study on Filipino children, stated that the incidence of stunting, wasting and being underweight increased with increasing age, indicating that this malnutrition had become chronic and that its effects are often irreversible. Meanwhile, a study in Rwanda found that children 12 to 17 months, 18 to 24 months, and 24 to 30 months of age were more likely to be affected by stunting than those age 5 to 11 months (Uwiringiyimana *et al.* 2019). This confirms the increase in stunting observed during the complementary feeding period (Uwiringiyimana *et al.* 2019). This is because as the children get older, there are more factors that lead to stunting. A combination of factors such as low birth

length, a lack of exclusive breastfeeding in the first 6 months of life, suboptimal complementary feeding, and the presence of infection expose older children to risk of becoming stunting (Dewey & Huffman 2009).

Dietary diversity

Table 3 shows the dietary diversity of the children. The Median (IQR) for the dietary diversity score in this study was 6 (2). The proportion of children who achieved minimum dietary diversity (those who scored 4 or above) was 90.2%, while only 9.8% did not achieve the Minimum Dietary Diversity (MDD).

Pattern of food consumption

The proportion of children in terms of their food consumption was also examined. It was found that out of seven food groups, grains, roots, and tubers were the highest consumed food group, with 96.5% of children consuming them. Meanwhile, legumes and nuts were the least consumed food groups with only 40.4% of children consuming them.

The proportion of children who achieved MDD in this study (90.8%) was identical with Terengganu's proportion of MDD which was 89.6% as reported by NHMS 2016 (IPH 2016). This study also discovered that children above one year (12 to 24 months) were more inclined to achieve MDD at 95% compared to children below one year (6 to 11 months) at 79.5%. A similar finding was reported by another study in Philippines that found meeting the MDD was positively associated with the child's age (Ocampo *et al.* 2016). The reason is that children older than one year old may already have developed a regular eating schedule and switched from exclusive or predominate breastfeeding to the addition of solid food, compared to children below one year old (Ocampo *et al.* 2016). For food consumption patterns, similar results were found in a study of Penan children in Sarawak (Bong *et al.* 2018). In both studies, the food groups with the highest consumption rates were grains, roots, and tubers, followed by fruits and vegetables high in vitamin A, flesh foods (chicken, beef, fish, shellfish, and other seafoods). The food groups with the lowest consumption rates were nuts and legumes. This indicates that despite living in a different state, culture and environment, Malaysian children have a relatively low intake of legumes and nuts compared to other food groups. Examples of legumes and nuts are chickpeas, beans, soybeans, lentils, and tamarind. As this plant is not grown commercially in Malaysia, it is not eaten regularly in this country, which explains why fewer mothers give this type of food to their children. Moreover, as legumes and nuts are categorized as plant-based foods, parents or mothers are more prefer to give familiar plant-based food such as kale, spinach, cabbage, carrot and other fruits to their children. This explains why the proportion of children received vitamin A rich fruits and vegetables (92.3%) and also other fruits and vegetables (77.7%) are higher compared to legumes and nuts (40.4%).

Table 3. Dietary diversity of study participants

Dietary diversity (n=287)	n (%)
Dietary diversity score	6 (2)
1	3 (1.0)
2	7 (2.4)
3	18 (6.3)
4	40 (13.9)
5	48 (16.7)
6	92 (32.1)
7	79 (27.5)
Minimum dietary diversity	
Achieved	259 (90.2)
Not achieved	28 (9.8)

IQR: Interquartile Range

Association between MDD and nutritional status

Table 4 shows no significant association between MDD and all three nutritional status indicators (stunting, wasting and underweight) with $p>0.05$. However, one food group of MDD, dairy products, was found to be significantly associated with stunting ($p<0.05$), as shown in Table 5.

The outcome of this study, which discovered no significant association between

Table 4. Association between minimum dietary diversity and nutritional status

Nutritional status (n=287)	Minimum dietary diversity		*p*
	Achieved (n=259)	Not achieved (n =28)	
	n (%)	n (%)	
Length-for-Age (LAZ)			
Stunting	65 (25.1)	9 (32.1)	0.418[a]
Not stunting	194 (74.9)	19 (67.9)	
Weight-for-Length (WLZ)			
Wasting	18 (6.9)	1 (3.6)	0.705[b]
Not wasting	241 (93.1)	27 (96.4)	
Weight-for-Age (WAZ)			
Underweight	39 (15.1)	3 (10.7)	0.779[b]
Not underweight	220 (84.9)	25 (89.3)	

[a]:Pearson's Chi-Square test ; [b]:Fisher's exact test

MDD and stunting is in line with studies from Indonesia and Philippines. Ahmad *et al.* (2018a) stated that no association was found between indicators of Complementary Feeding (CF), including MDD and stunting among children between 6 to 23 months in Aceh. Ocampo *et al.* (2016) also reported MDD was not significantly associated with stunting among Filipino children aged 6 to 24 months. According to Ocampo *et al.* (2016), inadequate fetal growth and poor maternal health and nutrition are major factors to stunting. In light of this, it is possible that a child's diet diversification does not accurately reflect the root reasons of childhood stunting. Next, a significant association between MDD and stunting discovered in this study was consistent with a study from Tanzania that found dairy consumption was associated with reduced stunting among children below two years old (Khamis *et al.* 2019). According to Duan *et al.* (2020), the unique stimulating impact of milk on linear growth may be connected to a number of milk components, such as high-quality protein, amino acids, bioactive peptides, insulin-like Growth Factor-1 (IGF-1), or minerals, including calcium. Therefore, this explains why children without dairy consumption in this study are stunted compared to those with dairy consumption.

The absence of significant association between MDD and underweight and wasting in this study was consistent with a study from Ethiopia that found MDD was not a significant indicator of wasting and underweight (Motbainor *et al.* 2015). This insignificant result could be attributed to the fact that wasting and underweight can happen as a result of recent rapid weight loss. Children may have just experienced a sudden weight loss due to a health problem that happened before, such as a fever. This indicates that, although the children achieve MDD based on their previous day's intake, their weight is still not back to normal during our data collection. This is supported by Motbainor *et al.* (2015) that found wasting was more likely to be related with diseases than dietary diversity among children in Ethiopia. Meanwhile, Ahmad *et al.* (2018a) found that underweight was linked to the occurrence of fever and diarrhoea over the previous two weeks among children below two years old in Aceh. Thus, rather than nutritional diversity, underweight is more likely to be linked to disease.

However, it should be noted that the lack of association between undernutrition and MDD may be clarified by using merely a one-day, 24-hour food recall as a reference period and assuming this is the usual feeding pattern of children under

Table 5. Association between food groups of MDD and LAZ

Food groups (n=287)	Length-for-Age (LAZ)		p^*
	Not stunting (n=213)	Stunting (n=74)	
	n (%)	n (%)	
Grains roots & tubers			
Consumed	206 (96.7)	71 (95.9)	0.721[a]
Not consumed	7 (3.3)	3 (4.1)	
Legumes & nuts			
Consumed	86 (40.4)	30 (40.5)	0.980[b]
Not consumed	127 (59.6)	44 (59.5)	
Dairy products			
Consumed	190 (89.2)	54 (73.0)	0.001[ab]
Not consumed	23 (10.8)	20 (27.0)	
Flesh foods			
Consumed	181 (85.0)	65 (87.8)	0.545[b]
Not consumed	32 (15.0)	9 (12.2)	
Eggs			
Consumed	155 (72.8)	48 (64.9)	0.198[b]
Not consumed	58 (27.2)	26 (35.1)	
Vitamin A rich fruits & vegetables			
Consumed	195 (91.5)	70 (94.6)	0.396[b]
Not consumed	18 (8.5)	4 (5.4)	
Other fruits & vegetables			
Consumed	168 (78.9)	55 (74.3)	0.418[b]
Not consumed	45 (21.1)	19 (25.7)	

[a]: Fisher's exact test; [b]: Pearson's Chi-Square test; MDD: Minimum Dietary Diversity; LAZ: Length-for-Age

study. There is a possible variation from one day to another. One-day food recalls may not be an accurate indicator of nutritional status because stunting, wasting, and underweight are signs of persistent malnutrition in children (Ocampo *et al.* 2016).

Several limitations had been acknowledged in this study. The method used to assess MDD from a food consumption questionnaire depended on the mother's ability to recall their child's food intake on the previous day. As a result, there is the possibility of under- or over-reporting during the data collection. Moreover, since the quantity and amount of food are equally important and were not covered in this study, therefore malnutrition cannot only depend on dietary diversity. No cut-off or minimum consumption of a given food group was established to support the inclusion in the dietary diversity scores. Besides, the breastfeeding status and birth weight that could affect the children's nutritional status were not collected in this study. However, the results of this

study can still be used to provide the information on nutritional status of children below two years old and their minimum consumption of food, which was not reported in other study in Malaysia.

CONCLUSION

Despite having a high incidence of achieving MDD (90.2%), the prevalence of stunting for children aged 6 to 24 months in this study was high (25.8%). Meanwhile, the prevalence of underweight and wasting were 14.6% and 6.6%, respectively. This study found no significant association between the minimum dietary diversity and all three indicators of nutritional status (stunting, wasting, and underweight) ($p>0.05$). However, it is noted that there is a significant association between dairy product consumption and Length-for-Age Z-Scores (LAZ). In other words, children who do not consume dairy products showed significantly lower LAZ compared to those who do. The additional recommendations for obtaining more accurate results should consider the potential for employing a longer food recall period to investigate the effect of food quality using dietary diversity and nutritional status. The findings of this study emphasize the importance of continuation of dairy products for the first two years in early life after exclusive breastfeeding in health promotion programs.

ACKNOWLEDGEMENT

The authors would like to express their deepest gratitude to all mothers, and their children who took part in this study, and Terengganu Family Development Foundation (YPKT) for their assistance in this study.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest**.**

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