BMC Medicine

RESEARCH

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Prevalence and associated factors of complementary feeding practices of mothers having children 6–23 months in rural disadvantaged areas, Ben Tre province, Vietnam: a cross-sectional study

Thuy Ngoc Vuong[1*†] and Hang Thi Diem Tran[1†]

Abstract

Background Appropriate complementary feeding practices (CFPs) play a key role for ensuring optimal health, growth and development for children 6–23 months. The purpose of this study was to determine the prevalence and associated factors of CFPs of mothers or primary caregivers having children 6–23 months in Thanh Phu rural district of Ben Tre province, Vietnam.

Methods Three hundred fifty eight child-mother pairs participated in a cross-sectional study. Weight and height of children were measured by trained nutritionists using standard measurement tools and procedure. Mothers or primary caregivers were interviewed about maternal, child, and household characteristics, awareness of the food environment, household food insecurity (HFI), and CFPs using a structured questionnaire. Chi square test, Fisher exact test, *t*-test, and multivariate logistic regression were used to evaluate associations between CFPs and independent variables.

Results The percentages of children with appropriate minimum dietary diversity (MDD), minimum meal frequency (MMF), and minimum acceptable diet (MAD) were 71.5%, 40.8%, and 31.6%, respectively. MDD was negatively associated with younger child, the child's sickness in the last 2 weeks, caregivers being fathers, not breastfeeding, lower monthly household income, and use of untreated drinking water after controlling for covariates ($p < 0.05$). Factors associated with poorer MMF included older child, not breastfeeding, and maternal biological status. Conversely, purchasing foods at the street vendors and appropriate MDD was positively associated with better MMF ($p < 0.05$). Maternal biological status, marital status of mothers, breastfeeding, and HFI were all associated with MAD ($p < 0.05$).

Conclusions These results revealed that inappropriate complementary feeding practices among children aged 6–23 months in rural disadvantaged areas of Southern region remained a significant challenge for nutrition improvement of young children in Vietnam. Child age, HFI, use of untreated drinking water, lower monthly income,

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mother's marital status, not breastfeeding, and source of purchased foods were associated with poor CFPs. Solutions for improving CFPs for children should address these underlying causes.

Keywords Complementary feeding practices, Children 6–23 months, Breastfeeding, Disadvantaged areas, WASH, Household food insecurity, Vietnam

Introduction

Complementary feeding is defined as the process by which an infant begins to consume other foods and liquids along with breastmilk as nutritional needs are increasing with age [1]. Appropriate complementary feeding practices (CFPs) are important for children's growth, development, and health outcomes due to their long-term influence on child nutritional status and survival [2].

During the period of 6–23 months of age, children who consumed inadequate complementary foods may be at greater risk of malnutrition [3]. Malnutrition is a major cause of morbidity and mortality in children under 5 years old and is responsible for approximately 45% of all child deaths [4]. Globally, rates of stunting, wasting, and overweight of children under 5 years old were 22.3, 6.8, and 5.6%, respectively [5]. A higher percentage of malnourished children live in African (43%) and Asian countries (52%) [5]. In Southeast Asian countries, approximately 26.4, 7.8, and 6.4% of children under 5 were stunted, wasted, and overweight/obese, respectively [5].

Inadequate complementary feeding is one of the main causes of childhood malnutrition [6]. A systematic review analyzing the results of national surveys on complementary feeding practices in 80 low-middle-income countries (LMICS) found that only 1 in 4 children had diverse diets, 1 in 2 consumed the recommended number of meals per day, and only 1 in 6 children had diets which complied with both diet diversity and meal frequency [3]. Previous research indicated that complementary feeding practices are influenced by a number of factors, including child age, the employment status of the parents, the marital status of the mothers, parents' education levels, number of children under 5 years old in the household, and household food security status [7–10]. Very few studies have investigated the relationship between complementary feeding practices and factors such as safe drinking water, sanitation, and hygiene, or the awareness of mothers or caregivers regarding the food environment.

In Vietnam, 19.6% of children under 5 were stunted and 5.6% of children were wasted [11]. The South-western region had a higher prevalence of stunted children than the average of the country (20.3% versus 19.6%), especially in isolated coastal villages of the provinces such as Ben Tre and Ca Mau [12]. A recent Unicef report found that only half of the Vietnamese children aged 6–23 months were fed the recommended minimum number of meals per day and one third of children had adequate minimum food diversity [7]. Less than 50% of children aged 6–23 months met the minimum acceptable diet criteria, encompassing both food diversity (at least five out of eight food groups) and meal frequency (at least two to three meals per day for breastfed children and at least four meals per day for non-breastfed children). About 20% of children did not consume adequate vitamin A-rich foods such as eggs, orange fruits, and green leafy vegetables [7]. Additionally, about 14% did not have iron-rich foods in their daily diet [7].

Previous studies showed that parents' residential place, ethnicity, child age, mother's education, and household economic status were associated with inadequate complementary feeding practices in Vietnam [13–15]. Children who live in urban areas and households with higher income or middle to high scores on a wealth index are more likely to have more diverse diets and are fed more frequently compared to their counterparts [7]. Children whose mothers have higher education level are more likely to have sufficient diets in terms of both quantity and quality [13]. Children who belong to Kinh/Hoa had more diverse foods compared to children from other ethnic groups such as the Mong and Khmer [13]. Most of the research on complementary feeding practices were conducted in the mountainous areas of the Northern provinces and coastal and mountainous areas of the central region of Vietnam, whereas research in the Southwest region was very limited. Since the WHO's indicators of infant and young child feeding (IYCF) were modified in 2021 [1], there have been few studies reporting on the magnitude and related factors of complementary feeding practices.

In addition, studies which investigated the associations between complementary feeding practices and household food insecurity (HFI), water, sanitation, and hygiene (WASH) or food environmental awareness were limited. Therefore, this study was conducted to determine the prevalence of complementary feeding practices for children aged 6–23 months and to investigate associated factors in disadvantaged areas of a southern region of Vietnam.

Methods

Study area and population

The research was conducted in Ben Tre province in 2023. Ben Tre was one of five southern provinces of Vietnam with coastal communes designated as economically disadvantaged according to Decision number 353 (QD-353/QD-TTg) issued by the Prime Minister on 15 March 2022 [16].

Sampling methods

A multi-stage sampling method was used to select the child-mother pairs for this study. Firstly, we randomly selected one province from the list of five southern provinces (including Long An, Ben Tre, Soc Trang, Ca Mau, and Kien Giang). Secondly, we randomly selected a rural district within the chosen province, ensuring that the district included communes designated as economically disadvantaged areas according to Decision number 353 (QD-353/QD-TTg) issued by the Prime Minister on 15 March 2022 [16]. A disadvantaged region (a commune, district, or province) was designated by the Government annually based on poverty level and several other indicators such as access to social services, including education, clean water, and sanitation (16). Then, all children aged 6–23 months residing in the five economically disadvantaged communes of the selected district at the time of the survey were invited to participate in the study. A total of 362 child-mother pairs completed the survey. However, four records were excluded from the analysis due to missing data on key variables, which could potentially affect the overall results of the study.

Inclusion and exclusion criteria

Respondents were mothers or primary caregivers of 358 children aged 6–23 months who participated in the study.

Children who had congenital abnormalities affecting nutrient absorption, those with medical conditions requiring hospitalization (as prescribed by a doctor), and those participating in any special nutritional supplement programs at the time of the survey were excluded.

Data collection tools and procedures

A structured questionnaire, adapted from valid questions used in previous national nutrition surveys, was employed to collect data on child, maternal, and household characteristics; complementary feeding practices; WASH; and food environmental awareness. Data were collected through face-to-face interviews conducted by trained nutritionists or masters of public health personnel from the Ho Chi Minh City Institute of Public Health (IPH).

Before implementing the main survey, we conducted a pilot test of the research tool with 20 mothers in a commune in Ben Tre province who were not included in the main study. We then made several modifications, primarily using local language to enhance participant understanding. Results of reliabilities of the child diet diversity and Food Insecurity Experience Scale (FIES) of the pilot which were assessed using Chronbach's alpha (α) = 0.65 and α = 0.75, respectively. Results for reliabilities of the child diet diversity and FIES of the main survey were α = 0.70 and α = 0.83 respectively.

Measurement of variables

Outcome variables

Three complementary feeding practice indicators including minimum dietary diversity (MDD), minimum meal frequency (MMF), and minimum acceptable diet (MAD) for children aged 6–23 months were collected and computed using the standardized questions and guidelines of WHO [1]. Every outcome was binary variable (yes and no).

MMF (yes) was defined as the proportion of children who met the following criteria:

Breastfed children: Consuming solid, semi-solid, or soft foods at least twice (children aged 6–8 months) or 3 times (children aged 9–23 months) during the previous day.

Non-breastfed children: Receiving ≥ 4 feeds during the previous day, including at least one feed of solid, semi-solid, or soft foods.

MDD (yes) was defined as the proportion of children aged 6–23 months who consumed foods and beverages from ≥ 5 out of 8 food groups (breastmilk; cereals and grains; legumes and nuts; dairy products; flesh foods; eggs; vitamin A-rich fruits and vegetables; other fruits and vegetables) during the previous day.

MAD was defined as follows:

- Breastfed children: receiving at least the minimum dietary diversity and minimum meal frequency for their age during the previous day;
- Non-breastfed children: receiving at least the minimum dietary diversity and minimum meal frequency for their age during the previous day as well as at least two milk feeds.

Covariates

Child and maternal characteristics

Child and maternal characteristics included child's gender, place of delivery, prematurity, low birthweight, breastfeeding status, child's sickness in the last 2 weeks, child's nutritional status, maternal age, religion, ethnicity,

maternal biological status, marital status, maternal education, and maternal occupation.

Nutritional status of children (stunting, wasting, underweight, overweight/obesity) were calculated based on weights and heights according to child's age. Child weight was measured using a digital SECA scale. Parents of children were requested to wear light clothes and put off the shoes for the child before weighing. The calibrated SECA scale has ranges/sensitivities of 0.1 kg with a maximum capacity of 130 kg. The recumbent length was measured using an infant length board with a precision of 0.1 cm.

Underweight was defined as weight-for-age less than − 2 standard deviations (SD) of the WHO Child Growth Standards median, wasting as weight for length *z*-score less than − 2 SD, stunting as length for age less than − 2 SD, and overweight as weight for length *z*-score above + 2 SD [17].

Household characteristics

Data on household characteristics included relationship between the interviewee and the child (mothers, fathers, grand-parents, and others); the child currently living with whom (mother, father, both parents, none), household size, total monthly household income in Vietnamese dong (< 5 million VND, 5– < 10 million VND, ≥ 10 million VND); livestock ownership (Yes, No), land ownership (Yes, No), cooking fuel (Gas/electricity, Others), and asset and utensil scores. Initially, the presence of 10 household assets (television, radio, phone, washing machine, motorcycle, car, hot water machine, air conditioner, computer/laptop/iPad, and internet access) and 6 kitchen assets (pressure cooker, rice cooker, blender, fridge, kettle, and gas stove) were recorded with a score of 0 for No and a score of 1 for Yes. Subsequently, two total scores were calculated: one for household assets (sum of scores for all 10 assets) and one for kitchen assets (sum of scores for all 6 kitchen assets).

HFI, WASH, and awareness of food environment

HFI was assessed using the Food Insecurity Experience Scale (FIES) and analyzed according to the standard guide of FAO [12]. Households were categorized as food secure (total FIES score of zero) and food insecure (total FIES score of ≥ 1). In terms of severity classification of FIES, a total score of 1–3, 4–6, and 7–8 was categorized as mild, moderate, and severe food insecurity, respectively [18, 19].

Sanitation facilities were categorized into "basic" (households use flush or pour flush toilets, pit toilets, or composting toilets which they do not share with other households), "limited" (households use flush or pour flush toilets, pit toilets, or composting toilets and share with other households), and "unimproved" (households use hanging toilets, and have "no facilities" when households do not have a dedicated toilet) [20].

The source and location of water were combined to generate "drinking water source" variable with two categories: "safely managed drinking water" (water from an improved water source that is located on premises) and "basic drinking water" (water from an improved source that is not located on premises) [20].

The source and treatment of the drinking water after collection were used to generate a "drinking water treatment" variable with three categories: "point-of-use treated" (POUT) (households boiled water irrespective of its source before use), "outside treated" (households used bottled or piped drinking water which was not boiled before use), and "untreated" (households used untreated water from environmental sources such as river/canal water, rainwater and tube-well or drilled well water which was not boiled before use) [21].

Handwashing facilities were categorized as "basic" (households had handwashing facilities with water and soap available), "limited" (households had handwashing facilities but lacked water, soap, or both), and "no facilities" (households do not have handwashing facilities) [20].

Six questions were used to assess accessibility, availability, quality, and prices of foods [22]: (1) Food source (purchasing, household production, and combination of purchase and household production); (2) Respondent's opinions about food shopping place, for example "There are good quality foods near my residence", "Food prices are reasonable", "There are various fresh vegetables and fruits near my residence"; (3) Frequency of purchasing food (daily, weekly, monthly, and other); (4) Food shopping place (market, street vendor, stores near house, supermarket, and many places); (5) Vehicles for food purchasing (walking, bicycles, motorcycles, taxi/grab); (6) Reasons for choosing a food shopping place (e.g., near the residence, near the workplace or child's school, recommended by friends and relatives).

Data analysis

Data were entered and coded using Epi 4.1 and analyzed using Stata 15.0 (16). Categorical variables were described by frequencies and percentages, whereas means and standard deviations were reported for continuous variables. Associations between MAD, MDD, MMF and child, maternal, household characteristics, and awareness of the food environment were evaluated using chi-square tests, Fisher exact tests, and *t*-tests in bivariate analysis, and backward stepwise logistic regression in the multivariate analysis. Variables with a *p*-value of ≤ 0.25 in the bivariate analysis were then included in

the multivariate logistic regression models. Significance was set up for p values less than 0.05.

Ethics approval

This study was approved by the IPH and local permission. Written informed consent was obtained from all mothers or primary caregivers who agreed to participate in the study. Participants who could not read and write were informed verbally by the interviewer and gave verbal consent in the presence of a commune health worker as a witness. Each household received a cash compensation of 70,000 VND (approximately $2.7 USD) for their participation.

Results

Maternal, child, and household characteristics

Characteristics of the sample are presented in Table 1. Most of the mothers of the sampled children (358) were from the Kinh majority ethnic group (98%), had no religion (91.9%), aged 21–40 years old (88.2%), were married (95.5%), and had medium to high education level (86.6%). Approximately half of mothers were housewives and unemployed.

The percentage of male and female children was almost equal. Most children (98.6%) were born in a hospital. Few children had low birthweight (3.1%) and were premature (7.8%). Child nutritional status included stunting (10.9%), wasting (5.9%), underweight (4.8%), and overweight/obesity (4.5%).

On average, there were 5 people per household. Most children were living with their parents (91.3%) and 89.1% of the interviewees were the child's mothers. Eighty seven percent of households had monthly income equal to or above 5 million Vietnamese dong (VND). On average, every household owned 5 assets. Most households used electricity or gas for cooking. Approximately half of the households owned land and livestock.

HFI and WASH

The proportion of households experiencing food insecurity during the previous year was markedly high, at 37.7% (including 26.6, 8.9, and 2.2% of households being mildly, moderately, and severely food insecure).

51.4% of the households used a safely managed drinking water source. The percentage of households that used an unimproved sanitation facility was 7.8%. In terms of drinking water treatment, 77.4% of households used point of use treated water. Only 3.4% of households did not have a handwashing facility.

Complementary feeding practices

Table 2 reported the percentages of children with appropriate MAD, MDD, and MMF. The percentage of children with adequate MAD was 31.6%, indicating that almost one in three children aged 6–23 months had adequate food diversity and meal frequency. Only 41% of children were breastfed at the time of the survey.

The percentage of children with adequate MDD was 71.5%, while 40.8% of children had adequate MMF. The percentages of appropriate MMF and MAD were significantly lower among non-breastfed children compared to breastfed children (10.1% vs. 30.7% for MMF and 7.0% vs. 24.6% for MAD, $p < 0.05$).

Food consumption in the preceding day

The most frequently consumed food groups for children in the previous day included grains/cereals (98.0%), flesh foods (93.3%), dairy products (84.9%), and vegetables and fruits rich in vitamin A (84.4%) (Fig. 1). However, lower proportions of children consumed other vegetables (59.2%), eggs (38.0%), and legumes/nuts (28.2%).

Associated factors of complementary feeding practices

Bivariate associations between CFPs and child, maternal, and household characteristics and food environment awareness are shown in Supplement Table 1 and 2. Associated factors of CFPs after the adjustment for covariates are presented in Table 3. Results showed that MDD was negatively associated with child age, the child's sickness in the last 2 weeks, the interviewees being fathers, not breastfeeding, lower monthly household income, and use of untreated drinking water after controlling for covariates ($p < 0.05$). Associated factors of poorer MMF included higher child age, not breastfeeding, whereas MDD and source of purchased foods were positively associated with better MMF ($p < 0.05$). Maternal biological status and marital status, breastfeeding, and HFI were significantly associated with MAD ($p < 0.05$).

Discussion

This study is the first to report the prevalence and associated factors of complementary feeding practices among mothers or primary caregivers of children aged 6–23 months in Ben Tre province, a Southern region of Vietnam. Results revealed that the prevalence of MAD (31.6%) and MMF (40.1%) was markedly low. The study identified several important factors associated with poor CFPs, including child age, low monthly income, the caregivers being fathers, marital status, not breastfeeding, HFI, use of untreated drinking water, and source of purchased foods.

Firstly, the percentages of children with the recommended MAD (31.6% versus 45.4%) and MMF (40.8% versus 77.8%) in this current study were lower than the average proportions reported in the national nutritional survey [11]. The low proportion of children who were

Table 1 Maternal, child, and household characteristics of the sample ($n = 358$)

Characteristics	*n*	(%)
Maternal characteristics		
Mother's age		
≤ 20 years	31	8.7
21–30 years	177	49.4
31–40 years	139	38.8
> 40 years	11	3.1
Religion		
None	329	91.9
Buddhism	21	5.9
Other	8	2.2
Ethnicity		
Kinh	351	98.0
Other	7	2.0
Maternal biological status		
Breastfeeding	124	34.6
Pregnant	9	2.5
Normal	225	62.9
Marital status		
Single/Divorced/Other	16	4.5
Married	342	95.5
Education		
Low (≤ 5 grades)	48	13.4
Medium (6–9 grades)	167	46.7
High (10 + grades)	143	39.9
Employment		
Employed	161	45.0
Unemployed/housewives	197	55.0
Characteristics of children		
Age in months		
6–11	123	34.4
12–17	110	30.7
18–23	125	34.9
Gender		
Female	177	49.4
Male	181	50.6
Delivery place		
Hospitals	353	98.6
Others (communal medical station, district medical station…)	5	1.4
Premature		
Yes	28	7.8
Low birth weight		
Yes	11	3.1
Breastfeeding		
Yes	147	41.1
Child's sickness in the last 2 weeks		
Yes	156	43.6
Nutritional status		
Stunting		
Yes	39	10.9

Table 1 (continued)

Characteristics	*n*	(%)
Wasting		
Yes	21	5.9
Underweight		
Yes	17	4.8
Overweight / obesity		
Yes	16	4.5
Relationship between interviewee and the child		
Mothers	319	89.1
Fathers	11	3.1
Grandparents	28	7.8
Characteristics of households		
Person that child currently living with		
Either mother or father	31	8.7
Parents	327	91.3
Number of people in the house		
≤ 4	138	38.5
> 4	220	61.5
Number of children		
One	127	35.5
Two	179	50.0
≥ Three	52	14.5
Monthly household income in VND		
< 5 million	46	12.9
5– < 10 million	158	44.1
≥ 10 million	154	43.0
Owning livestock or other animals		
Yes	220	61.5
Owning land		
Yes	177	49.4
Fuels for cooking		
Gas/electricity	357	99.7
Others (coals, bio-fuel)	1	0.3
Household food security		
Food insecure	135	37.7
Food secure	223	62.3
Sanitation facilities[a]		
Basic	321	89.7
Limited	9	2.5
Unimproved (open defecation, hanging toilet)	19	7.8
Drinking water source	**n**	**%**
Safely managed	184	51.4
Basic	174	48.6
Drinking water treatment[b]		
Point-of-use treated	277	77.4
Outside treated	19	5.3
Untreated	62	17.3
Handwashing facilities[c]		
Basic	326	91.0
Limited	20	5.6

Table 1 (continued)

Characteristics	*n*	(%)
No facility	12	3.4
Continuous variables	**Mean (standard deviation)**	
Birth weight (in kilogram)	3130.3 (385.1)	
Number of people in the house	5.1 (0.1)	
Mother's age	29.1 (6.1)	
Assets score	4.8 (1.7)	
Utensils score	4.7 (0.9)	

VND Vietnamese dong

Utensil score (6 assets): pressure cooker, rice cooker, blender, fridge, kettle, and gas stove

Assets score (10 assets): television, radio, phone, washing machine, motorcycle, car, hot water machine, air conditioner, computer/laptop/ipad, and internet access

[a] Basic: Households use flush or pour flush toilets, pit toilets, composting toilets, and do not share with other households; Limited: Households use flush or pour flush toilets, pit toilets, composting toilets, and share with other households; Unimproved: Households use hanging toilets

[b] POUT: Households use boiled water for drinking; Outside treated: Households use unboiled outside treated water for drinking; Untreated: Households use unboiled, untreated water for drinking

[c] Basic: Households had handwashing facilities with water and soap available at the time of observation; Limited: Households have handwashing facilities but lacked either water or soap or both

Table 2 Complement feeding practices by breastfeeding status

Complement feeding practices (*n* = 358)	*n*	(%)
MDD for all studied children		
Yes	256	71.5
MDD for breastfed children		
Yes	113	31.6
MDD for non-breastfed children		
Yes	143	39.9
MMF for all studied children		
Yes	146	40.8
MMF for breastfed children		
Yes	110	30.7
MMF for non-breastfed children		
Yes	36	10.1
MAD for all studied children		
Yes	113	31.6
MAD for breastfed children		
Yes	88	24.6
MAD for non-breastfed children		
Yes	25	7.0

MDD minimum dietary diversity, *MMF* minimum meal frequency, *MAD* minimum acceptable diet

fed the recommended MAD in our study was comparable with findings of several countries such as Ethiopia and Indonesia (37.6%) [23–25] and higher than the results of studies conducted in Bangladesh (16.3%) and Ghana (14.3%) [26, 27]. A systematic review highlighted that the percentage of the children 6–23 months in LMICS with adequate MDD, MMF, and MAD was extremely low, at 27.1%, 48.7%, and 17.3%, respectively [3]. Our study also found a low proportion of children, particularly among those aged from 18 to 23 months and those who were not breastfed, with adequate MMF. This could be due to the fact that mothers believed that their 18–23-month children were older and that they had to stop breastfeeding to return to work leaving them with insufficient time to feed their children more frequently. In rural areas, mothers and grand-parents often consider children who have celebrated their first birthday or who have "enough teeth" to be "old enough" to have three meals a day and share the same foods with other family members. This misconception and practice is considered a significant cultural and belief-based barrier to nutrition programs aimed at improving complementary feeding practices in Vietnam [13]. Additionally, percentages of appropriate MDD, MMF, and MAD for non-breastfed children were all lower than breastfed counterparts in our study. It could be that a lack of knowledge on benefits and methods of breastfeeding and complementary feeding practices in mothers and caregivers is problematic in Vietnam, especially in rural areas [28]. In fact, our study recorded a low percentage of breastfeeding, approximately 41%. Thus, it is necessary to integrate breastfeeding and complementary feeding practices into nutrition education and communication measures to improve complementary feeding practices for children comprehensively.

Previous research has highlighted that the diets of young Vietnamese children often lack diversity and rely heavily on starchy staples such as rice [15]. However, our findings indicated that children consumed not only starchy foods but also significant amounts of meats, vegetables and fruits rich in vitamin A, and dairy products

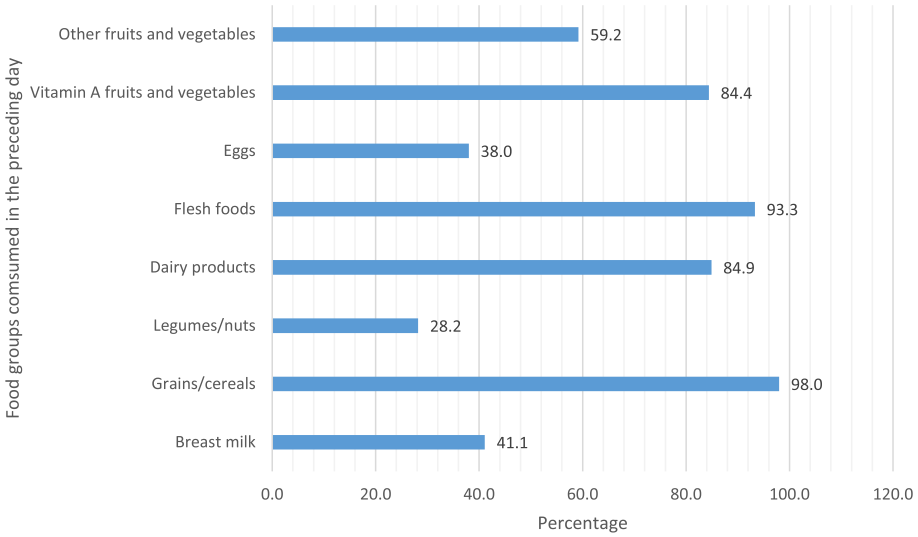

Fig. 1 Food groups consumed in the preceding day ($n = 358$). Vitamin A: Vegetables and fruits rich in vitamin A such as pawpaws, carrots, pumpkins, tomatoes, and yellow sweet potatoes

in the preceding day. As a result, the overall minimum dietary diversity was relatively high, suggesting a potential improvement in the dietary quality of Vietnamese children aged 6–23 months towards a more nutrient-rich food intake. This improvement of diet diversity may be attributed to the governmental commitments and efforts to improve the nutritional status and overall well-being of the Vietnamese population over the past 20 years [29]. However, it should be noted that the consumption of legumes/nuts, eggs, and breastmilk by children in the preceding day was relatively low in our study. Nutrition education and communication should promote breastmilk, pulses, and eggs for children to diversify their diets as these foods are accessible, affordable and nutritious. For legumes/nuts, previous studies also highlighted a very low percentage of consumption in households in the Vietnamese Mekong Delta (VMD) [30]. Dietary guidelines including Vietnam recommend legumes/nuts as part of a healthy diet as they are an important plant-based source of protein, carbohydrates, good fatty acids, and dietary fibre [31]. It is recommended that parents provide their children with protein from a variety of sources to ensure adequate intake of essential amino acids [32]. This recommendation is reasonable as Vietnamese people often use pulses as one of the ingredients to prepare many types of dishes because pulses are cheap and nutritious [33]. Many rural households can also grow pulses for their own use or to sell. Global recommendations also encourage the consumption of a combination of animal and plant-based sources of protein for improved health, nutrition, and environmental sustainability [34]. However, the preparation of pulses may require time and effort. This may discourage mothers and caregivers from including pulses in their children's diets. Therefore, nutritionists need to provide guidance on simple preparation methods for pulses, along with information on their nutritional benefits, to encourage their inclusion in children's diets.

In terms of associated factors, our study showed a significant association between HFI and MAD, which was reported in several LMICS such as Ethiopia, Indonesia, and Bangladesh [9, 10, 35]. Children living in food insecure households who did not consume adequate energy and nutrients may have higher risk of malnutrition [9]. Although our study did not find a significant association between household economic status and MAD, results showed that children living in families with monthly household income under 5 million VND (about 196 USD) had poorer MDD. Thus, food-insecure households may be more vulnerable to economic hardships, limiting their ability to purchase diverse and nutritious foods for their children. The association between HFI and MMF in our study was marginally significant. It is possible that adults in food insecure households may have limited time to prepare frequent meals for their children due to the demands of earning a living or may lack the resources to provide a variety of foods. However, we suggest that further research is needed to investigate this relationship.

Our study also showed that children aged 6–11 months old had higher MMF compared to children aged 18–23 months old, which was opposite the result of Terefe, Jembere, and Mekonnen [36]. This could be due to the misconception that children aged 18–23 months old are "older enough" to have the same three main meals

Table 3 Associated factors of complementary feeding practices of mothers having children 6–23 months old in Ben Tre province, Vietnam, in multivariate analysis

Characteristics	MAD[α], aOR (95% CI)	*p* value	MDD[β], aOR (95% CI)	*p* value	MMF[¥], aOR (95% CI)	*p* value
Child age in month						
6–11 (ref)			1	-	1	-
12–17			1.8 (0.9–3.4)	0.06	0.5 (0.2–1.1)	0.075
18–23			2.0 (1.1–3.8)	0.02	0.3 (0.2–0.7)	0.002
Child's sickness (No: ref)						
Yes			0.4 (0.2–0.6)	< 0.0001		
Number of children in the house						
One (ref)	1	-	1	-		
Two	1.6 (0.8–2.8)	0.14	1.6 (0.9–2.9)	0.09		
≥ Three	0.7 (0.3–1.7)	0.47	1.3 (0.6–3.1)	0.57		
Number of people in the house						
≤ 4 people (ref)					1	-
> 4 people					0.6 (0.3–1.1)	0.075
Relationship between interviewee and the child						
Mothers (ref)			1	-		
Fathers			0.08 (0.02–0.35)	0.001		
Grandparents			1.03 (0.33–3.15)	0.95		
Maternal marital status						
Married (ref)	1	-				
Single/Divorced/Other	3.5 (1.1–11.3)	0.04				
Mother's education level						
Illiterate / Primary (ref)			1	-		
Secondary			1.7 (0.8–3.9)	0.15		
High school and above			1.2 (0.5–2.8)	0.61		
Breastfeeding (No: ref)						
Yes	7.1 (3.4–14.6)	< 0.001	3.1 (1.6–5.8)	< 0.01	8.0 (3.7–17.3)	< 0.001
Maternal biological status						
Normal (ref)	1	-			1	-
Pregnant	0.6 (0.1–5.1)	0.62			0.4 (0.04–3.3)	0.38
Breastfeeding	17.9 (8.9–36.5)	< 0.0001			10.9 (5.9–20.1)	< 0.001
Monthly household income in VND						
< 5 million			1	-	1	
5– < 10 million			3.1 (1.4–6.5)	0.003	0.9 (0.3–2.3)	0.96
≥ 10 million			2.7 (1.3–5.9)	0.01	1.0 (0.3–2.4)	0.91
Household food security						
Food insecure (ref)	1	-			1	0.07
Food secure	2.1 (1.05–4.06)	0.04			1.7 (0.9–3.1)	
Drinking water treatment						
Untreated (ref)			1	-		
POUT			1.8 (0.9–3.5)	0.06		
Outside treated			7.2 (1.3–39.2)	0.02		
Place of food shopping						
Traditional market (ref)					1	-
Street vendor shop					8.0 (2.6–22.6)	< 0.0001
Stores near home					0.3 (0.1–1.7)	0.18
Supermarket					0.4 (0.1–1.8)	0.26
Multiple places					0.8 (0.1–6.5)	0.85

Table 3 (continued)

Characteristics	MAD[α], aOR (95% CI)	*p* value	MDD[β], aOR (95% CI)	*p* value	MMF[¥], aOR (95% CI)	*p* value
Reasons for choosing a food shopping place						
Relatives/friends often purchase food there (No: ref)		0.09				
Yes	2.5 (0.6–7.8)					
Prices are reasonable (No: ref)	1	0.29				
Yes	0.7 (0.4–1.3)					
MDD (No: ref)						
Yes					3.3 (1.7–6.5)	$p < 0.01$

ref reference, *ns* non-significant ($p > 0.05$), *aOR* adjusted odds ratio, *CI* confidence interval, *ns* non-significant, *VND* Vietnamese dong, *POUT* point of use treated, *MDD* minimum dietary diversity, *MMF* minimum meal frequency, *MAD* minimum acceptable diet

[α] Variables included in the final MAD model: breastfeeding, maternal biological status, maternal marital status, number of children in the household, HFI, friends and relatives often buy food at the chosen food shopping place, food prices are reasonable

[β] Variables included in the final MDD model: child age, child's sickness, household income, number of children in the household, mother's education, relationship between primary caregivers and the child, drinking water treatment, and breastfeeding

[¥] Variables included in the final MMF model: child age, number of people in the house, maternal biological status, breastfeeding, HFI, place of food shopping, household income, MDD

(frequently including breakfast, lunch, and dinner in rural areas) and the same foods with adults in the family. In contrast, we found that children who were older than 11 months old had better MDD compared to the youngest children. It is possible that parents suppose that their 6–11-month-old children are too young to feed a variety of food. In fact, many mothers and grandparents avoid feeding young children certain nutritious foods, such as pulses or seafoods, due to concerns about choking or allergies. Therefore, education and communication programs on complementary feeding practices should emphasize the importance of providing children with adequate meals and a diverse range of foods according to their age. Besides, our results indicated that children whose primary caregivers were fathers may have had poorer MDD compared to children whose mothers were the primary caregivers. This finding is likely due to the fact that the interviewees in this study were the primary caregivers. Surprisingly, this current study found that children whose mothers were single or divorced had better MAD compared to children whose mothers were married. It could be that Vietnamese single or divorced mothers often choose to live in extended families so that their parents or sisters/brothers can help them to take care of their child. Finally, our results showed a positive association between MDD and MMF. This is plausible as children who are fed more frequently may be given a wider variety of foods. Additional meals, such as snacks, can introduce new food groups and contribute to increased dietary diversity for the child. Thus, children should be fed the recommended MMF at their age so that they can receive adequate energy and nutrients for their optimal growth and development.

The finding which made our study outstanding compared to previous studies is the significant association between MDD and drinking water treatment. We found that children living in households using outside treated water (bottled water or purchased water) had better MDD compared to children in households that used untreated drinking water. Furthermore, our findings showed a marginally significant association between POUT and MDD. This suggests that households using treated drinking water (outside-treated and POUT) may have better MDD compared to children lived in households that used untreated water. For this study, "untreated drinking water" was defined as water from river/canal water, rainwater, or tube-well/drilled well water that was not boiled before consumption. This definition aligns with evidence highlighting the potential health risks associated with these water sources in the VMD [21]. In addition, POUT was defined as households that boiled water before consumption. Our findings, therefore, indicated that households used treated drinking water (outside and boiled water) may have better MDD. This implication can be explained in several ways including economic status and awareness of studied households. In the surveyed households, 77% of households had to collect rainwater for drinking. However, the adverse impacts of climate change have resulted in a lack of rainwater in the VMD in recent years [37]. Furthermore, many households in the VMD were unable to purchase rainwater containers, and thus, they often lack water for use in the hot season [21]. Previous research has also shown that households in the VMD using untreated drinking water often experience food insecurity, as poverty is a shared underlying factor

[21]. Conversely, households using outside-treated or POUT drinking water may have higher socioeconomic status. This may enable them to not only afford safe drinking water but also to purchase nutritious food for their children. Alternatively, wealthier mothers or caregivers may have more time to devote to child feeding as they are not burdened with the time-consuming tasks of collecting or fetching water from sources such as rainwater, rivers/canals, or tube-wells. Households that boil water before use or purchase outside drinking water may also have a greater awareness and knowledge of the importance of nutritious and safe food and water for their children's health. Thus, this may contribute to better complementary feeding practices. However, these interpretations are speculative, and thus it needs further research to explore the association between MDD and drinking water treatment.

Our findings contribute to the current understanding of the determinants of complementary feeding practices by revealing significant associations between these practices and the use of untreated drinking water, HFI, and awareness of the food environment. For the ongoing National Objective Program in the period of 2021–2025, which aims to improve the nutritional status of children under 5 [38], our findings suggest the need for interventions to improve complementary feeding practices. Our study also pointed out that children aged 6–23 months old living in rural households that were food insecure, had low income, and used untreated drinking water should be prioritized in nutrition programs.

Strengths and limitation

Our study has several strengths. We used validated questions to assess complementary feeding practices and other variables such as HFI and WASH. In addition, a sound statistical analysis methodology was used to examine associations between outcomes and independent factors. These strengths contributed to our reliable results. However, the associations between complementary feeding practices and investigated factors in this study should be interpreted considering a number of limitations. First, this study focused on rural disadvantaged districts in Southern Vietnam. Thus, generalizability to other regions is limited. Second, the cross-sectional design of this study does not allow for interpreting the causal associations between complementary feeding practices and independent variables. Despite these limitations, the findings provide valuable evidence to support the development of interventions aimed at improving complementary feeding practices and the nutritional status of children in rural regions of Vietnam.

Conclusion

This study showed that inappropriate complementary feeding practices among children aged 6–23 months in rural disadvantaged areas of Southern region of Vietnam remained a significant challenge for improving young children nutrition. Child age, HFI, use of untreated drinking water, lower monthly income, mother's marital status, not breastfeeding, and source of purchased foods were associated with poor complementary feeding practices. These underlying causes should be addressed to improve complementary feeding practices for children in rural areas.

Abbreviations

CFPs	Complementary feeding practices
FAO	Food and Agriculture Organization
FIES	Food Insecurity Experience Scale
HFI	Household food insecurity
IPH	Ho Chi Minh City Institute of Public Health
LMICS	Lower and middle income countries
MAD	Minimum acceptable diet
MDD	Minimum dietary diet
MMF	Minimum meal frequency
ns	Non-significant
UNICEF	The United Nations Children's Fund
VMD	Vietnamese Mekong Delta
VND	Vietnamese dong
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

Acknowledgements

We acknowledge support from local commune staff and participants in the study areas. We are also grateful to the staff of the Ho Chi Minh Institute of Public Health (IPH) for their assistance in data collection.

Authors' contributions

VNT and TTDH designed the study. TTDH coded and entered the data. Both authors analyzed and interpreted the data, and wrote the manuscript. Both authors read and approved the final manuscript.

Funding

This research was funded by the Ministry of Health in implementing Improving Nutrition activity, one of the key projects of the National Objective Program (2021–2025). The views presented in the article are of the authors and not necessarily express the views of the funding organization. Ministry of Health was not involved in the design of the study, data collection, analysis, and interpretation.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

About the survey component, the study protocol was approved by the Institute of Public Health in Ho Chi Minh City.
After the objective of the study was explained, written informed consent was obtained from all participants. The full right of all study subjects to participate or to withdraw from the study at any time was informed. Participants' personal information is completely confidential.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 26 June 2024 Accepted: 3 February 2025
Published online: 21 February 2025

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