

## Nutritional status and related factors among ethnic preschool children in Northern Thailand: a cross-sectional study

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**Purpose:** This study investigated the nutritional status of ethnic (belonging to minority groups) preschool children in Northern Thailand. **Methods:** In this cross-sectional descriptive study, the sample group included 147 parents and 147 preschool children (2-6 years old). Participants volunteered to complete a questionnaire on the personal information of children and parents, as well as family- and school-related factors. Data were analyzed using descriptive statistics, a nutritional status calculator, and logistic regression analysis. **Results:** A birth weight of less than 2,500 g was related to weight-for-age and weight-for-height. Not having been breastfed and having been breastfed for less than 6 months were related to weight-for-height. An elementary school education level among parents was related to children's height-for-age. Familial unhealthy food consumption for 1-2 days per week was related to weight-for-age and height-for-age. **Conclusion:** This study reflects the importance of nutritional care for children at the beginning of pregnancy and continuing to the preschool age, as well as the importance of breastfeeding. Families were found to be a key factor in supporting good nutrition among children.

**Key words:** Nutritional status; Parents; Ethnic groups; Children

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## INTRODUCTION

Many children under the age of 5 years old are experience malnutrition, which is associated with a tendency to become obese later in life. Globally, the prevalence of underweight children has increased by 14.3% since 2020, both in low- and middle-income countries and in higher-income countries [1]. In Thailand, a report in 2019 from the Thai Ministry of Public Health indicated that children under the age of 6 experienced a range of health problems, including wasting in 5.62% of children, obesity in 8.34%, and stunting in 9.84%[2]. Thus, nutritional care of children must be the duty of all parties involved-including primary caregivers, child development centers, and schools-to establish normal nutritional status among these children.

Malnutrition is the cause of many problems in children's physical and mental development. From a physical standpoint, acute malnutrition can affect a child's organ systems,

with impacts including impaired phagocytosis, reduced secretion of immunoglobulin A, loss of skeletal muscle, cardiac myofibrils, and delays in global function, motor function, and memory [3]. In addition, the prevalence of developmental delays is higher in children with malnutrition than in normal children [4]. Anthropometry has been widely used to assess the nutritional status of children at the population level. Measurements and analyses of anthropometric data-particularly, weight-for-age (W/A), height-for-age (H/A), and weight-for-height (W/H) are therefore critical for helping healthcare workers and researchers understand the nutritional status of the target population [5], which could lead to an accurate classification of children in terms of malnutrition, obesity, and disease risk.

Many factors are related to children's nutritional status. Low birth weight has often been associated with the occurrence of undernutrition and stunting [6-8]. Furthermore, the duration for which an infant is breastfed [9] is affected by ma-

ternal factors such as a low level of education and occupation [10-12]. Low birth weight is caused by the nutritional status of the mother during pregnancy, along with other prominent factors such as genetics and growth hormone deficiency [13]. Obesity, another health concern in children, is associated with both controllable and uncontrollable factors. The uncontrollable factors include sex, genetics, and hormones, while the controllable factors include food consumption behavior within the family, especially any unhealthy foods that the family commonly consumes [14]. Inadequate physical activity, both at school and in the family, has also been linked to the nutrition status of children [14,15].

In Northern Thailand, Mae Wang District is home to a number of rural villages with ethnically diverse cultures and people with differing food consumption behaviors. The area has more children coming from underprivileged families than the general Thai population, with minimal or no access to the public healthcare system, including limited medical services regarding basic health information and health-promoting practices. This is often due to limitations in their financial status [16]. Furthermore, parents with no formal education or low levels of education may exhibit poor child care practices and food consumption behavior [12]. Therefore, the nutritional status of children in this district was chosen as a topic for this study. Nonetheless, previous studies have also reported higher percentages of over- and under-nourished children in other areas than in the intended target area of our study [6-8]. Those studies mainly focused only on individual and family factors, not school-related factors. Therefore, this study aimed to explore the nutritional status and food consumption behavior of preschool children attending child development centers and preschools in Mae Wang District, Chiang Mai Province, Thailand, through an assessment of the local situation, as well as both family- and school-related factors associated with nutritional status. This study aimed to describe the nutritional status of ethnic preschool children in Northern Thailand and to analyze factors related to the nutritional status of these children.

## METHODS

**Ethics statement:** This study was approved by the Human Ethics Committee of the University of Phayao (No. 2/016/63). Informed consent was obtained from all participants.

This cross-sectional study investigated the nutritional status of ethnic preschool children in Northern Thailand and associated factors.

### 1. Population and Sample

The subjects in this study comprised the parents of preschool children, and the preschool children themselves, who attended child development centers and preschools in Mae Wang District, Chiang Mai Province. Sample subjects were selected using the stratified simple random sampling process. Child development centers were divided into two strata: public schools located in municipal areas and private schools. Two public development centers and two private child development centers were included in the sampling process, in which random classrooms in each development were chosen. The sample group consisted of 147 primary parents or child care providers—that is, the fathers, mothers, grandfathers, and grandmothers of the preschoolers—as well as 147 preschoolers aged 2 to 6 years old from four child development centers and preschools. The inclusion criteria were as follows: 1) preschool children aged 2 to 6 years old from four child development centers and preschools; and 2) the fathers, mothers, or primary caregivers aged 18 years and older.

### 2. Research Instrument

The questionnaires consisted of three parts, as follows:

**Part 1.** General characteristics: 1) the general characteristics of children including sex, weight and height (at present), birth weight, duration of breastfeeding, initiation of age-based feeding, and any health problems and/or underlying diseases they may have experienced; and 2) the general characteristics of parents including education level, occupation, income sufficiency, and their knowledge of nutrition.

**Part 2.** Questionnaires prepared for child caregivers: These questionnaires were adapted from those established by Yuenyong et al. [17] and were divided into two sections: 1) ten questions reflecting the food consumption behavior of families, with a possible total score ranging from 0 to 30; and 2) eight questions reflecting the family activities, with a possible total score ranging from 0 to 24 points. The answers were recorded according to a 4-level rating score (0-3 points), including "never practicing", "practicing occasionally" (1-2 days a week), "practicing sometimes" (3-4 days a week), and "practicing regularly" (5-7 days a week).

**Part 3.** Questionnaires focusing on nutritional health-promoting and physical activities at schools: These were developed through a review of relevant literature [4-5,13]. The questionnaires consisted of six questions in each part with a possible total score ranging from 0 to 18 points. The answers were recorded according to a 4-level rating score, just as the questionnaires in Part 2.

Three levels of behavior were derived for interpreting the

results based on the mean ( $\bar{x}$ ) and standard deviation (SD) for each behavior: a score lower than  $\bar{x} - 1$  SD corresponded to a low level of the correct behavior, a score in the range of  $\bar{x} \pm 1$  SD reflected a moderate level of the correct behavior, and a score higher than  $\bar{x} + 1$  SD indicated a high level of the correct behavior.

**Assessment of research tools (content validity):** The research tools used in this experiment were examined by six experts, who calculated the content validity index of the questionnaires with regard to children's nutritional health-promoting and physical activities at schools. The content validity index values were .88 and .85, respectively. The questionnaires were then tested in trials with sample groups that were similar to those of our study. However, the 20 people in the tested sample group were not the same people who were included in the sample groups of the child development centers located in Mae Wang District, Chiang Mai Province. In this study, the Cronbach's  $\alpha$  values were .82 for the food consumption behavior of the families, .71 for the families' activities, and .79 for nutritional health-promoting and physical activities.

### 3. Ethical Considerations and Data Compilation

After receiving approval from the Human Ethics Committee of University of Phayao (no. 2/016/63), the researchers explained the research details including objectives, procedures of data collection and compilation, and the rights of the participants (parents/primary caregivers) to accept or reject participation without affecting the schools' admission process. Next, the participants filled out the questionnaires by themselves, which took approximately 30 minutes. All participants were requested to sign a consent form for participation in the study. It was clarified that participants' general characteristics and names would be held in confidence and would only be presented as aggregated statistical data. The heights and weights of the students on the questionnaires were measured and recorded by the director of the child development center or the classroom teachers. The researchers handed out, collected, and checked all questionnaires. The questionnaires were then analyzed in terms of the relevant statistical data.

### 4. Data Analysis

The statistical analysis was conducted using SPSS 22 for Windows (IBM Corp., Armonk, NY, USA). First, descriptive statistics were used to present the frequency distribution, percentage, mean, and SD values. Nutritional status was analyzed using the INMU-NutriStat software program (Mahidol University, Nakhon Pathom, Thailand). Multiple logistic re-

gression analysis was then performed to estimate adjusted odds ratios (adj. ORs), including the following factors: 1) factors related to W/A (being underweight and severely underweight), and 2) factors related to H/A (being stunted and severely stunted). Multinomial logistic regression was then performed to estimate adjusted relative risk ratios (adj. RRRs), including factors related to W/H (being overweight, overweight, obese, wasted, and severely wasted). The results were presented with 95% confidence intervals (CIs).

## RESULTS

### 1. General Characteristics

The preschool children were mostly male (56.0%), and 85.7% of them had a birth weight in the range of 2,500-4,000 g. Most of the children were breastfed for longer than 6 months (73.6%), and 76.1% of them began eating solid food at the age of 6 months or older. Most of the children had no health problems or underlying diseases (91.2%). Additionally, 31.3% of the parents had graduated with a bachelor's degree or higher. With regard to occupation, most of the parents were employees (39.5%). Moreover, most parents had sufficient income for their families (45.6%) and described themselves as having an adequate knowledge of nutrition (81.0%) (Table 1).

According to the criteria of the World Health Organization [4,18], the W/A scores were mostly in the normal weight range (72.1%), followed by the excess weight category (10.2%). Meanwhile, most of the H/A scores were in the normal height range (70.1%), followed by severely stunted (15.0%). The W/H scores were mostly normal (69.4%), followed by obese (10.2%) (Table 2).

### 2. Information on Family Factors

#### 1) Food consumption behavior

Participants' food consumption behavior is shown in Table 3. Most families reported infrequent meal preparations (1-2 days a week) for children, in both the healthy and unhealthy behavior categories. The foods consumed by the family included fried meats (48.3%), snacks and candy (51.1%), fast food or items from delicatessens (59.2%), and meat with fat (62.2%). In addition, 53.1% of the families tried to minimize high-fat food at each meal. Nearly two-thirds (62.7%) of the families regularly drank sweetened beverages such as soda, sweetened drinks, and flavored juices. Furthermore, many families ate snacks while watching television (32.2%), and a similar proportion (32.6%) of families infrequently (3-4 days a week) consumed fruit with little sugar. Meanwhile, 32.0% of the families ate greater quantities of food at dinner than at oth-

**Table 1.** Percentage of General Characteristics in Preschool Children and Parents (N=147)

Variables	Characteristics	Categories	n (%)
Preschool children	Sex	Male	82 (56.0)
		Female	65 (44.0)
	Birth weight (g)	< 2,500	20 (13.6)
		2,500 - 4,000	126 (85.7)
		> 4,000	1 (0.7)
	Duration of breastfeeding (month)	< 6	39 (26.4)
		≥ 6	108 (73.6)
Initiation of age-based feeding (month)	< 6	35 (23.9)	
	≥ 6	112 (76.1)	
Health problems and/or underlying diseases	No	134 (91.2)	
	Yes	35 (8.8)	
Parents	Education level	Uneducated	26 (17.7)
		Elementary school	22 (15.0)
		High school/vocational certificate	41 (27.9)
		Diploma/high vocational certificate	12 (8.1)
		Bachelor's degree or higher	46 (31.3)
	Occupation	Housewife	10 (6.8)
		Business owner/trade	13 (8.8)
		Employee	58 (39.5)
		Agriculture	23 (15.6)
		Government employee of state enterprise	36 (24.5)
		Others	7 (4.8)
	Income sufficiency	Sufficient	67 (45.6)
		Occasionally sufficient	48 (32.7)
		Insufficient	32 (21.7)
	Knowledge of nutrition	Yes	119 (81.0)
		No	28 (19.0)

**Table 2.** The Nutritional Status of Preschool Children (N=147)

Variables	Categories	n (%)
Weight-for-age*	Severely underweight (< -2 SD)	5 (3.4)
	Underweight (-1.5 SD to -2 SD)	13 (8.8)
	Normal weight (-1.5 SD to +1.5 SD)	106 (72.1)
	Mildly overweight (+1.5 SD to +2 SD)	8 (5.5)
	Excess weight (> +2 SD)	15 (10.2)
Height-for-age*	Severely stunted (< -2 SD)	22 (15.0)
	Stunted (-1.5 SD to -2 SD)	2 (1.3)
	Normal height (-1.5 SD to +1.5 SD)	103 (70.1)
	Tall (+ 1.5 SD to +2 SD)	9 (6.1)
	Tallness (> +2 SD)	11 (7.5)
Weight-for-height*	Severely wasted (< -2 SD)	9 (6.1)
	Wasted (-1.5 SD to -2 SD)	7 (4.8)
	Normal weight (-1.5 SD to +1.5 SD)	102 (69.4)
	Possible risk of overweight (+ 1.5 SD to +2 SD)	5 (3.4)
	Overweight (+ 2 SD to +3 SD)	9 (6.1)
	Obese (> +3 SD)	15 (10.2)

\*Z-score; SD, standard deviation.

**Table 3.** Food Consumption Behaviors of Families, Family Activities, Nutritional Health-Promoting Activities, and Physical Activities at Schools (N=147)

Variables	Categories	Not practiced	1-2 days a week	3-4 days a week	5-7 days a week
		n (%)	n (%)	n (%)	n (%)
Food consumption behavior of families ( $\bar{X}$ =12.51, SD=3.90, moderate level)	Eating fried meats	8 (5.5)	71 (48.3)	64 (43.5)	4 (2.7)
	Preparing some snacks and candy	38 (25.7)	75 (51.1)	27 (18.4)	7 (4.8)
	Preparing fast food or snacks from a delicatessen	31 (21.1)	87 (59.2)	26 (17.7)	3 (2.0)
	Eating meat with fat	9 (5.9)	91 (62.2)	39 (26.5)	8 (5.4)
	Trying to minimize high-fat food	16 (10.8)	78 (53.1)	42 (28.6)	11 (7.5)
	Drank sweetened beverages	23 (15.7)	92 (62.7)	25 (16.8)	7 (4.8)
	Eating snacks while watching television	42 (28.5)	47 (32.2)	45 (30.6)	13 (8.7)
	Eating fruit with little sugar	14 (9.5)	45 (31.3)	48 (32.6)	40 (26.6)
	Eating greater quantities of food at dinner than at other meals	43 (29.3)	33 (22.4)	47 (32.0)	24 (16.3)
	Eating vegetables	1 (0.7)	10 (6.9)	20 (13.6)	116 (78.8)
Family activities ( $\bar{X}$ =13.27, SD=3.59, moderate level)	Exercising together	14 (9.5)	60 (40.8)	58 (39.5)	15 (10.2)
	Planting trees/cleaning the house	0 (0.0)	67 (45.6)	62 (42.2)	18 (12.2)
	Encouraging children to engage in outdoor exercise	6 (4.1)	66 (44.9)	57 (38.8)	18 (12.2)
	Watching television/videos/playing games	4 (2.2)	79 (54.2)	35 (23.8)	29 (19.8)
	Going to the mall/eating out	8 (5.1)	53 (36.1)	69 (47.2)	17 (11.6)
	Simple exercise: walking/jogging	11 (7.6)	50 (34.1)	72 (48.8)	14 (9.5)
	Participation in community activities	10 (6.8)	49 (33.3)	52 (35.4)	36 (24.5)
	Taking a rest	5 (3.4)	51 (34.5)	58 (39.7)	33 (22.4)
Nutritional health-promoting activities at schools ( $\bar{X}$ =14.16, SD=4.93, high level)	Providing plain milk/low-fat milk	0 (0.0)	57 (38.8)	50 (34.0)	40 (27.2)
	Presence of snack and soda vendors	25 (17.0)	85 (57.8)	28 (19.0)	9 (6.2)
	Explaining how to eat healthy food	1 (0.7)	18 (12.3)	65 (44.2)	63 (42.8)
	Teaching about the 5 food groups	2 (1.4)	10 (6.8)	69 (46.9)	66 (44.9)
	Child growth assessments	0 (0.0)	58 (39.5)	70 (47.6)	19 (12.9)
	Allowing food or snack vendors to operate in front of the schools	10 (6.8)	15 (10.2)	88 (59.9)	34 (23.1)
Physical activities at schools ( $\bar{X}$ =11.02, SD=3.19, moderate level)	Rhythm/movement activities	1 (0.7)	65 (44.2)	50 (34.0)	31 (21.1)
	Playing sports with the school's equipment	0 (0.0)	62 (42.2)	59 (40.1)	26 (17.7)
	Playing videos to promote simple exercises	3 (2.1)	78 (53.1)	53 (36.0)	13 (8.8)
	Simple exercises after school	0 (0.0)	57 (38.8)	52 (35.4)	38 (25.8)
	Exercise activities before starting classes	1 (0.7)	61 (41.5)	69 (46.9)	16 (10.9)
	Physical tasks	2 (1.4)	43 (29.2)	82 (55.8)	20 (13.6)

SD, standard deviation.

er meals. Notably, 78.8% of the families often ate vegetables at almost every meal (5-7 days a week).

**2) Family activities**

The family activities are shown in Table 3. Responses to the questionnaires revealed that 40.8% of families spent 1-2 days a week exercising together. During their free time, family members participated in activities together by doing things such as planting trees and cleaning the house (45.6%). Many families also encouraged their children to engage in outdoor exercise such as running, swimming, or riding their bicycles (44.9%). Many families spent most of their time watching television, videos, and playing video games (54.2%). Families did the following activities 3-4 times a week: going to the mall or eating out together (47.2%), walking/jogging (48.8%), and partic-

ipating in community activities (35.4%). In addition, 39.7% of families rested in their homes 3-4 days per week.

**3. Information on School Factors**

**1) Nutritional health-promoting activities at schools**

Table 3 presents information on nutritional health-promoting activities at schools. Most schools occasionally operated nutritional health-promoting activities (3-4 days a week). Teachers explained to parents that eating healthy food would help keep their children healthy (44.2%) and taught them about the five food groups (46.9%). The growth of 47.6% of children was estimated by weighing them and measuring their height. Furthermore, 59.9% of schools allowed food or snack vendors to operate in front of the schools, 38.8% of

schools infrequently (1-2 days a week) provided plain milk or low-fat milk for the children, and 57.8% of schools allowed the presence of snack and soda vendors.

## 2) Physical activity at schools

Information on physical activity at schools is shown in Table 3. Most schools infrequently (1-2 days a week) required students to engage in physical activity. Some of the participants participated in rhythm/movement activities in classrooms (44.2%), while 42.2% of the preschoolers played sports with the school's equipment (e.g., footballs, jump ropes, and playground equipment). Some teachers played videos to promote simple exercises (53.1%) and taught certain simple exercises after school such as jumping and running (38.8%). Exercise activities were occasionally practiced (3-4 days a week) before starting classes (46.9%) and certain physical tasks were encouraged, such as carrying things and sweeping the classroom (55.8%).

## 4. Descriptive Statistics of Family- and School-Related Factors

The family- and school-related factors are shown in Table 3. A moderate score was found for families' food consumption behavior, with a mean value of 12.51. Family activities were at a moderate level, with a mean value of 13.27, while a high level of nutritional health-promoting activities at schools was found, with a mean value of 14.16. Lastly, a moderate level of physical activity at schools was recorded, with a mean value of 11.02.

## 5. Relationship between Relevant Factors and Nutritional Status in Preschool Children

Factors related to the nutritional status of preschool children were analyzed according to three indicators: W/A, H/A, and W/H. For W/A, children with birth weights of less than 2,500 g had a 5.02 times greater likelihood of being underweight and severely underweight (adj. OR=5.02; 95% CI=1.16-21.71). For H/A, children who had parents with an elementary school education level had a significant risk of being stunted and severely stunted (adj. OR=4.78; 95% CI=0.42-53.92). For W/H, children with birth weights of less than 2,500 g had a 3.48 times greater likelihood of being at possible risk of overweight, overweight, and obese (adj. RRR=3.48; 95% CI=1.04-11.57). Furthermore, participants who were not breastfed or who were breastfed for less than 6 months had a 43% lower likelihood of being at possible risk of overweight, overweight, and obese (adj. RRR=0.57; 95% CI=0.16-2.00) (Table 4).

Factors associated with families' food consumption behav-

ior, families' activities, nutritional health-promoting activities, and physical activity at schools in relation to children's nutritional status were analyzed. Unhealthy food consumption behavior among families who practiced this behavior for 1-2 days per week was associated with a 2.83 times greater risk of being underweight and severely underweight (adj. OR=2.83; 95% CI=4.62-17.33). In terms of the H/A index, this group also had a 1.26 times greater risk of being stunted and severely stunted (adj. OR=1.26; 95% CI=6.40-25.02) (Table 5).

## DISCUSSION

### 1. Nutritional Status and Family- and School-Related Factors of Preschool Children

The data were analyzed using the W/A, H/A, and W/H criteria; a study in the Philippines using these variables found that 5.0%, 30.3%, and 7.9% of 0- to 5-year-old children were overweight, stunting, and wasting, respectively [19]. However, the results from the present study were found to be different from those of studies carried out in other developing countries in Asia. Our study showed lower rates of wasting and underweight than studies in Vietnam and Indonesia [20,21]. It is believed that this was caused by the greater healthcare inequality in those countries compared to Thailand. Nonetheless, these studies revealed that many countries are experiencing the problem of stunting among children.

In this study, most children had normal weight (72.1%), followed by obesity (10.2%), which is consistent with the results of Tong-on et al. [10] in Phayao Province. Our W/A results also aligned with those reported by Anukunwathaka et al. [22], who found that most children were in the normal weight category (78.3%), followed by overweight (7.1%). This may have resulted from the fact that relatively many parents in this study had a bachelor's degree or higher education and could provide suitable care, food selection, and food preparation for their children. However, the widespread access to unhealthy food, which parents prefer, is a noteworthy concern, since the consumption of unhealthy food can lead to obesity. The finding that 15% of children were severely stunted is similar to a study by Sk et al. wherein the prevalence of stunting among preschool children aged 36-59 months in Malda, India was 40%, which was a very high prevalence according to the WHO's cut-off values ( $\geq 40\%$ ) for public health significance [6].

The family's food consumption behavior scores were moderate. Parents play an important role in promoting nutrition and the dietary health of preschool children, and the local food in Mae Wang District is mostly composed of vegetables [16]. This is related to the high percentage of vegetable consumption (78.8%) in this study. However, inappropriate

**Table 4.** General Characteristics Related to Nutritional Status of Preschool Children: Multiple and Multinomial Logistic Regression Analysis

		Weight-for-age	Height-for-age	Weight-for-height	
		Underweight and severely underweight	Stunted and severely stunted	Possible risk of overweight, overweight, and obese	Wasted and severely wasted
		Adj. OR (95% CI)	Adj. OR (95% CI)	Adj. RRR (95% CI)	Adj. RRR (95% CI)
Preschool children	Sex				
	Male	1	1	1	1
	Female	0.21 (0.01-3.48)	0.19 (0.01-3.11)	0.28 (0.01-11.12)	0.28 (0.02-4.57)
	Birth weight (g)				
	> 2,500	1	1	1	1
	< 2,500	5.02*(1.16-21.71)	1.78 (0.51-6.17)	3.48*(1.04-11.57)	3.15 (0.62-15.85)
	Duration of breastfeeding (month)				
	< 6	1	1	1	1
	≥ 6	0.91 (0.24-3.51)	0.24 (0.05-1.22)	0.57*(0.16-2.00)	2.61 (0.80-8.55)
	Initiation of age-based feeding (month)				
	≥ 6	1	1	1	1
	< 6	0.38 (0.09-1.66)	1.45 (0.42-4.98)	1.20 (0.39-3.72)	1.02 (0.27-3.89)
Health problems and/ or underlying diseases					
No	1	1	1	1	
Yes	1.98 (0.20-20.07)	2.79 (0.28-27.63)	0.97 (0.20-4.61)	2.36 (0.23-24.77)	
Parents	Income sufficiency				
	Occasionally sufficient	1	1	1	1
	Sufficient	0.49 (0.11-2.14)	0.64 (0.15-2.66)	0.80 (0.23-2.85)	0.92 (0.22-3.92)
	Insufficient	0.51 (0.10-2.59)	1.15 (0.28-4.82)	1.25 (0.30-5.13)	0.99 (0.18-5.44)
	Education level				
	Bachelor's degree or higher		1		
	Uneducated		1.97 (0.19-20.64)		
	Elementary school	-	4.78*(0.42-53.92)	0.09 (0.01-1.21)	-
	High school/vocational certificate		1.78 (0.22-14.48)		
	Diploma/high vocational certificate		0.86 (0.06-11.40)	0.51 (0.08-3.26)	
	Occupation				
	Housewife			1	
	Business owner/trade			1.88 (0.09-39.67)	
	Employee	-	-	1.36 (0.05-35.32)	
Agriculture			2.84 (0.21-39.44)		
Government employee/ state enterprise			5.63 (0.19-25.39)		
Other			2.21 (0.19-25.39)		

\*Significant association at .050; adj. OR, adjusted odds ratio; adj. RRR, adjusted relative risk ratios; CI, confidence interval.

food consumption was also found in some families because of the ease of accessing convenience shops near the children's houses. These foods are composed of sweets, snacks, and candy toffees (consumed by 51.1% of participants) and soda, sweetened drinks, and flavored juices (consumed by 62.7% of participants). Moderate levels of families' activities were recorded, agreeing with the findings of Lo et al. [23] in Hong Kong showing a relationship between the nutritional care of parents and the food consumption behavior of preschool children. Because most parents had an adequate knowledge

of nutrition (81.0%), they were able to properly support their children's nutritional intake.

A high level of nutritional health-promoting activities at schools was revealed. This aligns with the findings of Lotaree [24] in terms of certain contributing factors (food sales in schools, student income management, and schools' policies on nutrition), while supplementary factors (information on dietary consumption and supportive behavior of teachers, family members, and friends) were significantly associated with children's dietary consumption behavior. This is also

**Table 5.** Associations of Food Consumption Behavior of the Families, Family Activities, Nutritional Health-Promoting Activities at Schools, and Physical Activity at Schools with the Nutritional Status of Preschool Children: Multiple and Multinomial Logistic Regression Analysis

Variables	Weight-for-age	Height for age	Weight for height	
	Underweight and severely underweight	Stunted and severely stunted	Possible risk of overweight, overweight, and obese	Wasted and severely wasted
	Adj. OR (95% CI)	Adj. OR (95% CI)	Adj. RRR (95% CI)	Adj. RRR (95% CI)
<b>Food consumption behavior of families</b>				
Not practiced	1	1	1	
1-2 days a week	2.83*(4.62-17.33)	1.26*(6.40-25.02)	8.04 (5.82-11.13)	-
3-4 days a week	4.57 (4.58-45.71)	1.17 (1.78-7.68)	3.76 (5.10-27.70)	
5-7 days a week	2.06 (0.09-45.80)	1.04 (1.09-10.39)	1.30 (1.30-13.00)	
<b>Family activities</b>				
Not practiced	1		1	
1-2 days a week	0.87 (0.03-25.08)	-	1.12 (0.03-49.08)	-
3-4 days a week	0.23 (0.01-4.19)		1.05 (0.08-14.76)	
5-7 days a week	0.52 (0.02-6.33)		0.33 (0.05-2.09)	
<b>Nutritional health-promoting activities at schools</b>				
Not practiced				
1-2 days a week	-	-	-	-
3-4 days a week				
5-7 days a week				
<b>Physical activities at schools</b>				
Not practiced	1			
1-2 days a week	0.07 (0.01-0.69)	-	-	-
3-4 days a week	0.90 (0.25-3.23)			
5-7 days a week	0.25 (0.08-0.81)			

\*Significant association at .050; adj. OR, adjusted odds ratio; adj. RRR, adjusted relative risk ratios; CI, confidence interval.

consistent with a high degree of social support from teachers [25]. The reason for these findings is that the child development centers and schools have established healthy behavior promotional campaigns and promoted food consumption guidelines following the National Health Act in Academic Institutions, according to the policy of the Ministry of Public Health. A moderate level of physical activity at schools was found. For 3-4 days a week, children were encouraged to engage in physical activities through specific exercises before starting classes (46.9%) and to engage in certain physical tasks (55.8%). However, children were encouraged to play at schools on a routine schedule of only 1-2 days a week (42.2%) on school playgrounds or with available sports equipment. The relatively low frequency of these scheduled activities limited students' opportunities to physically exercise at school.

## 2. Factors Related to Nutritional Status in Preschool Children

The findings of a roughly five-fold (5.02) greater risk of being underweight and severely underweight, according to the

W/A criteria, in children with birth weights of less than 2,500 g in this study agrees with the report from Puriso et al. [9] showing a 5.15 times higher risk. This finding is also consistent with a previous study in Phayao Province [11] and the study of Sk et al. (2.22 times) [6]. Unhealthy food consumption behavior for 1-2 days a week was associated with a 2.83 times greater risk of being underweight and severely underweight in children. This finding is consistent with the link between nutritional care of parents and food consumption behavior of preschool children in Hong Kong [23]. These findings confirm the importance of family members as role models for their children. In the society of Mae Wang, families often consumed meals together and ate the same foods at each meal, which was mostly composed of vegetables. As a result, these children exhibited similar food consumption behavior to that of their families.

In term of H/A, unhealthy food consumption behavior for 1-2 days a week was associated with a 1.26 times greater risk of children being stunted and severely stunted. Because children at this age received adequate parental care, they consumed many of the same foods as their parents in terms of



vegetables. This was consistent with the high rate of vegetable consumption of family members at every meal (78.8%). However, a high frequency of sweetened beverage and soda consumption was found (62.7%). The consequences of drinking sweetened beverages and soda, which is associated with lower consumption of milk, fruits, and high-fiber foods [26], include excess phosphoric acid consumption from soda. The resultant low calcium levels, decreased bone density, and increased risk of osteoporosis affect children's height [27]. The parental level of education is also related to children's nutritional status [11]. Children who had parents with an elementary school education had a greater risk of being stunted and severely stunted according to H/A. A previous study also confirmed that the maternal education level affected children's weight [10], since the maternal education level reflected mothers' maturity and readiness to have a child. Conversely, mothers or parents with higher education levels are able to access more information and acquire greater amounts of knowledge from the healthcare system.

Children who were not breastfed or who were breastfed for less than 6 months had a 43% lower likelihood of being overweight, overweight, and obese (in terms of W/H criteria) than those who were breastfed for at least 6 months (0.57 times). A similar study conducted by Aphikulchatkit [28] also reported that infants who were breastfed gained less weight than those who received modified powdered milk because powdered milk contained higher sugar and protein content than breast milk. Children receiving high-protein diets gained significantly more weight (body weight per height) and exhibited significantly higher body mass index than those receiving low-protein diets [29]. In the study conducted by Francois et al., children with low birth weights (< 2,500 g) had a 3.48 times greater risk of being overweight, overweight, and obese [30].

Factors that were not related to nutritional status in preschool children included the initiation of age-based feeding, health problems and/or underlying diseases, income sufficiency, education level, occupation, the families' activities, and both nutritional health-promoting and physical activities at schools [12-13]. Moreover, child development centers and schools often have supplementary food programs (school milk) and serve dried milk products. Accordingly, the findings for certain individual factors such as the child's sex, age-related diet, and health problems were inconsistent with previous studies. Tudsri [12] reported that sex and the initiation of age-based feeding had no relationship with the nutritional status of preschool children. Smith and Becker [31] also stated that there was no difference in weight gain at 16 – 26 weeks between infants who were breastfed and who had received supplementary food from the age of 4 months old and

infants who were only breastfed for the first 6 months of their lives. Although health conditions were not found to be related to nutritional status, most parents (81%) had a fair amount of knowledge on nutrition to manage their children's diets effectively when they were ill. Additionally, certain parental factors, including the parent's occupation, income, the families' activities, and physical activities at schools, were not associated with the nutritional status of preschool children, in agreement with the outcomes of a previous study [12]. With regard to family activities and physical activities, preschoolers who were active exhibited playful behavior, often wanted to play all the time, and did not want to eat and nap, resulting in less attention toward eating [23].

### 3. Strengths and Limitations

A limitation of this study is that our participants were limited to ethnic children in Northern Thailand, and thus our sample cannot be considered representative of other races, ethnicities, and countries. In addition, information on family-related factors (food consumption behavior and family activities) was measured by the parents, which could be a source of bias. Nonetheless, our findings could provide basic information on the nutritional status of preschool children in Mae Wang District, including associated factors related to families and schools. These findings can help caregivers (teachers and parents), as well as nurses, to construct guidelines and educational programs to promote nutritional knowledge for the healthy behavior of children. This study can also improve the existing knowledge of nutritional care for preschool children. However, factors influencing the nutritional status of preschool children in other areas should be studied. In addition, factors influencing good nutrition and malnutrition should be compared to identify potential differences in the level of care provided by caregivers in urban and rural areas. Finally, the effectiveness of existing health education programs for preschool children should be determined, since this program has been promoted in every school.

## CONCLUSION

This study focused on the nutritional status of preschool children and related factors. Underweight, obesity, and stunting were found among ethnic preschool children in Northern Thailand. In the sample group, the nutritional status was related to birth weights of less than 2,500 g and the duration of time the children had been breastfed. This study demonstrated the importance of nutritional care for children starting at pregnancy and continuing to preschool age. The results also revealed the importance and benefits of breastfeeding.

Moreover, parents' education level and knowledge, as well as families' food consumption behavior, played important roles in the nutritional care of children. Families are important in supporting good nutritional intake of children.

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## Conflict of interest

No existing or potential conflict of interest relevant to this article was reported.

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## Data availability

Please contact the corresponding author for data availability.

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