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Prevalence and determinants of underweight among children in the Myanmar-China border region: A cross-sectional study

Htu Lum[1], Kyaw Min Htike[1], Wor Mi Thi[2], Roshan Kumar Mahato[3*]

[1]MPH, Faculty of Public Health, Khon Kaen University, Khon Kaen, Thailand
[2]DrPH, Faculty of Public Health, Khon Kaen University, Khon Kaen, Thailand
[3]Department of Health Management Innovative Technology, Faculty of Public Health, Khon Kaen University, Khon Kaen, Thailand

*Corresponding author: Asst. Prof. Dr. Roshan Kumar Mahato, roshan@kku.ac.th

ABSTRACT

Background: Underweight in children remains a significant nutritional problem in low- and middle-income countries, affecting growth and development. It is linked to higher risks of infections, developmental delays and long-term cognitive impairments.

Objectives: This study aimed to identify the prevalence and determinants of underweight along the Myanmar-China border of Kachin state, Myanmar where socio-political instability and limited resources exacerbate the problem.

Methods: This cross-sectional analytical study was conducted from April 2024 to March 2025 in the Myanmar-China border region of Kachin State, focusing on children aged 6-59 months. A multistage random sampling method was used to enrol the study population. Data collection took place after getting ethical approval. A Generalized Linear Mixed Model (GLMM) was utilized to investigate factors associated with underweight.

Results: Among the 518 children studied, the prevalence of underweight was 17.8% (95% CI: 14.70-21.30). Several significant factors were associated to children being underweight including birth weight, vaccination completion by 18 months, household size (specifically, having ≥2 children under five years old), the father's level of education, birth interval and waste management practices. Multivariable analysis revealed that children in households with ≥2 children under five (AOR: 1.99, 95% CI: 1.07-3.70), mothers engaged in farming (AOR: 2.67; 95% CI: 1.33–5.37), a shorter birth interval of <2 years (AOR: 2.08, 95% CI: 1.19-3.65) and inadequate waste disposal (AOR: 2.07, 95% CI: 1.17-3.64) were at greater risk of being underweight.

Conclusion: Almost one-fifth of children in the Myanmar-China border region were underweight with higher risks associated to households with ≥2 children under five, mother who were farmers and shorter birth intervals. Inadequate garbage disposal was also strongly associated with increased odds of being underweight. This highlights the need to address household dynamics and sanitation practices to reduce the prevalence of underweight children in the region.

Keywords: Kachin state, GLMM, Under-5 children, Underweight

1. Introduction

Underweight is a significant nutritional issue particularly in low- and middle-income countries [1]. Characterized by a low weight-for-age ratio, it reflects insufficient nutrition for growth and development [2]. Underweight children face higher risks of infections, developmental delays and poor cognitive outcomes which can have long-term consequences for their overall well-being and future potential [3]. The severity of underweight varies from mild to severe forms [4]. Severe underweight is often linked to increased morbidity and a higher risk of mortality especially when compounded by infections, lack of medical care and poor hygiene [5]. Additionally, severely underweight children typically suffer from stunted growth and developmental delays affecting both their cognitive and physical health in the long term [6].

The factors contributing underweight are complex and varied. Short intervals between births, inadequate maternal care, suboptimal breastfeeding practices, and insufficient complementary feeding all contribute to underweight [7, 8]. Poor sanitation and improper waste disposal also increase infection risks that hinder growth [9]. Socioeconomic factors such as low maternal education and household wealth exacerbate the risk particularly among children from less-educated families [10].

Kachin State, located in northern Myanmar, shares a porous border with China, especially Yunnan Province. This region faces unique challenges due to cross-border migration, conflict, remoteness and limited trades which disrupt food systems, healthcare access and social stability. Armed conflict and displacement along the Myanmar-China border further worsen child health, nutrition and service delivery. These dynamics significantly impact the nutritional status of children living in this border zone. In Myanmar, underweight remains prevalent especially among children under five years old. In Kachin State, household food insecurity, inadequate maternal care, lack of proper sanitation and limited access to healthcare services are key contributors [11]. This study aimed to determine the prevalence and key determinants of underweight among children in Kachin State.

2. Methods

2.1 Study Area

This study was conducted in the Myanmar-China border region of Kachin State, Myanmar focusing on children aged 6-59

months. Kachin state is located in the northernmost part of Myanmar faces significant challenges like poor healthcare infrastructure, malnutrition and infectious diseases which disproportionately impact young children [12]. This study specifically targeted in Waingmaw and Momauk townships of Kachin state, which are affected by conflict and limited access to healthcare.

2.2 Study Design

This cross-sectional analytical study, conducted from April 2024 to March 2025, included mothers with children aged 6 to 59 months, who had lived in the study area for at least one year, and were able to communicate in the Myanmar or Kachin languages. The exclusion criteria encompassed children with severe illnesses, those with physical conditions that complicated body measurements or who had missing limbs, as well as participants unwilling to partake in the study.

2.3 Sample Size and Sampling

The sample size was estimated using *Hsieh et al.'s (1998)* multiple logistic regression formula [13] based on a previous study in Myanmar [14]. The calculation assumed 50% stunting rate for first- and second-born children (P_0 = 0.50) and 69% for third and later-born children (P_1 = 0.69) with a 95% confidence level and 80% power. The initial sample size of 223 was adjusted to 518 and further increased to 544 to account for a 5% non-response rate. A multistage random sampling method was employed selecting Myitkyina and Bhamo districts from the three along the Myanmar-China border. Within these selected districts, Waingmaw and Momauk townships were randomly chosen by using simple random sampling method. In each township, one town and two villages were selected: Laiza town, Maga Yang village, and Sha-it Yang village in Waingmaw township and Maijayang town, Nhkawng Pa village and Hpumlum Yang village in Moamauk township. Finally, households with children aged 6-59 months were listed, and participants were selected through systematic random sampling.

2.4 Data collection

Data were collected using a structured questionnaire developed based on literature and theoretical concepts ensuring reliability and validity through expert reviews and a pre-test with 30 child-mother pairs. A structured questionnaire, developed from relevant literature and theoretical frameworks was used for data collection. It covered eight sections: child's

characteristics, socio-demographics, parental background, nutrition, maternal knowledge and attitudes on nutrition, WASH practices and anthropometric measurements. Standardized tools such as the United States Department of Agriculture (USDA) food security questionnaire and dietary diversity scoring were applied. The internal validity and reliability of the maternal attitude and household food security section were confirmed with a Cronbach's alpha of 0.76 and 0.84, respectively. The questionnaire was translated into Myanmar and Kachin languages using a forward-backward process. The data collection team consisting of six trained research assistants conducted face-to-face interviews with privacy ensured. Written informed consent was obtained before interviews which were conducted using Kobo Collect (v2024.2.4.). Anthropometric measurements including height and weight for both children and mothers were taken under specific guidelines for accuracy.

2.5 Data Analysis

Data were imported from Microsoft Excel to STATA version 18.0 (College Station, Texas 77845 USA). Descriptive statistics were used to summarize baseline characteristics. Categorical variables were presented using frequency counts and percentages. For continuous variables were reported as mean, Standard Deviation (SD), median and range. Inferential statistics involved the use of a Generalized Linear Mixed Model (GLMM) with logistic regression employing both forward selection and backward elimination. Bivariate analysis was conducted using simple logistic regression to quantify the Crude Odds Ratio (COR) and 95% Confidence Interval (CI) for underweight. Variables with P-values < 0.25 were included in the model selection process for further analysis.

3. Results

The prevalence of underweight in this study was 17.76% (95% CI: 14.70-21.30). The study identified several significant factors associated with underweight prevalence among children. Children those born with low birth weight (<2500g) had a notably higher prevalence of underweight at 42.11% (95% CI: 20.25-66.50) compared to children with normal birth weight. Children with completed vaccination status also showed a higher underweight prevalence (23.00%, 95% CI: 17.36-29.46) than those with incomplete vaccinations. Households with two or more under-five children had a greater proportion of underweight children (22.84%, 95% CI: 16.62-30.08) than those with only

one under-five child. Maternal employment status played a role with the highest underweight prevalence found among children of housewives or unemployed mothers (21.48%, 95% CI: 16.85-26.72) while the lowest was among farmer or self-employed mothers. Regarding paternal education, underweight prevalence was highest among children of fathers with a high school education (24.23%, 95% CI: 18.38-30.88) and lowest among those with fathers holding a bachelor's degree or higher. Environmental factors were also significant: children in households practicing improper garbage disposal had a much higher underweight rate (29.53%, 95% CI: 22.35-37.55) and those in households using safe water disposal methods had a higher prevalence (21.53%, 95% CI: 17.28-26.30) than those using unsafe methods (Table 1).

Table 1: Prevalence of underweight among children (n=518).

Characteristic	Samples	Underweight			P-value*
		n	%	95 % CI	
Overall	518	136	17.76	14.70-21.30	
Child's age (Months)					0.083
Infant (< 1 year)	75	10	13.33	6.58-23.16	
Toddlers (1-3 year)	294	47	15.99	11.99-20.69	
Pre-school (≥3 years)	149	35	23.49	16.94-31.12	
Child Gender					0.747
Female	268	49	18.28	13.84-23.44	
Male	250	43	17.20	12.74-22.46	
Birth weight of child (grams)					0.005
Normal (≥2500g)	499	84	16.83	13.66-20.41	
Abnormal (<2500g)	19	8	42.11	20.25-66.50	
Child vaccination status till 18 months					0.013
Completed	200	46	23.00	17.36-29.46	
Uncompleted	318	46	14.47	10.79-18.82	
Number of under 5 children in the household					0.041
1	356	55	15.45	11.86-19.63	
≥ 2	162	37	22.84	16.62-30.08	
Total number of children in the household					0.251
1	157	23	14.65	9.52-21.17	
≥2	361	69	19.11	15.19-23.56	
Mother's education level					0.462
No formal education /Primary school / Secondary school	167	26	15.57	10.43-21.97	
High school	268	53	19.78	15.18-25.06	
Bachelor and above	83	13	15.66	8.61-25.29	
Mother's work status					0.049
Housewife/unemployed	284	61	21.48	16.85-26.72	
Farmer/Self-employment	135	17	12.59	7.51-19.39	
Government staff non-government office staff	99	14	14.14	7.95-22.59	

Characteristic	Samples	Underweight			P-value*
		n	%	95 % CI	
Birth interval (birth to birth spacing) in month					0.143
< 2 years	314	62	19.75	15.49-24.58	
≥ 2 years	204	30	14.71	10.15-20.32	
Father's education level					0.006
No formal education/ Primary school/Secondary school	258	39	15.12	10.98-20.08	
High school	194	47	24.23	18.38-30.88	
Bachelor and above	66	6	9.09	3.41-18.74	
Father's occupation					0.972
Farmer/Self-employment /Unemployed	337	60	17.80	13.87-22.31	
Government staff /non-government office staff	181	32	17.68	12.42-24.03	
Drinking water services level					0.214
Basic	341	57	16.72	12.91-21.11	
Limited	42	5	11.90	3.98-25.63	
Unimproved/surface water	135	30	22.22	15.52-30.18	
Sanitation services level					0.090
Safely managed	66	6	9.09	3.41-18.74	
Basic	253	52	20.55	15.75-26.06	
Limited/unimproved	199	34	17.09	12.13-23.05	
Disposing of garbage method					<0.001
Proper disposal	369	48	13.01	9.75-16.87	
Improper disposal	149	44	29.53	22.35-37.55	
Used household water disposing type					0.002
Safe and Proper Disposal (Improved Methods)	339	73	21.53	17.28-26.30	
Unsafe Disposal (Unimproved Methods)	179	19	10.61	6.51-16.08	

Note: *P-value from Chi2 test

Several significant factors were associated with underweight status among children in the study. Households with two or more children had a significantly higher likelihood of underweight cases compared to those with only one child (AOR: 1.99, 95% CI: 1.07-3.70). Mothers who were farmers or housewives had 2.67 times higher odds of having underweight children compared to those who were self-employed (AOR: 2.67; 95% CI: 1.33-5.37). A shorter birth interval of less than two years was also significantly associated with underweight status (AOR: 2.08, 95% CI: 1.19-3.65) compared to a birth interval of three or more years. Environmental factors were also significant with improper garbage disposal methods linked to a higher prevalence of underweight children (AOR: 2.07, 95% CI: 1.17-3.64) compared to proper disposal methods (Table 2).

Table 2: Factors associated with underweight along the Myanmar-China border of Kachin state using simple logistic regression for bivariate analysis and GLMM with multiple logistic regression for multivariable analysis (n=518).

Factors	Total samples	% of underweight	Crude OR	95% CI	P-value	AOR	95% CI	P-value
Child's age (Months)					0.089			
6 - 11	75	13.33	1			-		
12 – 35	294	15.99	1.24	0.59-2.58		-		
36 - 59	149	23.49	2.00	0.93-4.29		-		
Child Gender					0.747			
Male	250	17.20	1			-		
Female	268	18.28	1.08	0.69-1.69		-		
Birth weight of child (grams)					0.012			
Normal (≥2500g)	499	16.83	1			-		
Abnormal (<2500g)	19	42.11	3.59	1.40-9.20		-		
Child vaccination status till 18 months					0.014			
Incomplete	318	14.47	1			-		
Complete	200	23.00	1.77	1.12-2.78		-		
Number of under 5 children in the household					0.045			
1	356	15.45	1			-		
≥ 2	162	22.84	1.62	1.02-2.58		-		
Total number of children in the household					0.215			0.029
1	157	14.65	1			1		
≥ 2	361	19.11	1.38	0.82-2.30		1.99	1.07-3.70	
Mother's education level					0.461			
No formal education /Primary school / Secondary school	167	15.57	1			-		
High school	268	19.78	1.34	0.80-2.24		-		
Bachelor and above	83	15.66	1.01	0.49-2.08		-		
Mother's work status					0.020			0.014
Self-employment	111	10.81	1			1		
Farmer	308	21.43	2.25	1.17-4.34		2.67	1.33-5.37	
Government staff non-government office staff	99	14.14	1.36	0.60-3.10		1.62	0.70-3.88	
Birth interval (birth to birth spacing) in month					0.139			0.017
≥ 2 years	204	14.71	1			1		
< 2 years	314	19.75	1.43	0.89-2.30		2.08	1.19-3.65	
Father's education level					0.006			
Bachelor and above	66	9.09	1			-		
No formal education/ Primary school/ Secondary school	258	15.12	1.78	0.72-4.41		-		
High school	194	20.38	3.20	1.30-7.87				
Father's occupation								
Self-employment	239	17.57	1		0.985			
Unemployed/ Farmer	98	18.37	1.06	0.57-1.94				

Factors	Total samples	% of underweight	Crude OR	95% CI	P-value	AOR	95% CI	P-value
Non-government staff/ Government staff	181	17.68	1.01	0.61-1.67				
Drinking water services level					0.391			
Basic	341	16.72	1			-		
Limited/ Unimproved/ surface water	135	19.77	1.23	0.77-1.96		-		
Sanitation services level					0.069			
Safely managed	66	9.09	1			-		
Basic	253	20.55	2.59	1.06-6.32		-		
Limited/unimproved	199	17.09	2.06	0.82-5.15		-		
Disposing of garbage method					<0.001			0.012
Proper disposal	369	13.01	1			1		
Improper disposal	149	29.53	2.80	1.76-4.46		2.07	1.17-3.64	
Used household water disposing type					<0.001			
Unsafe Disposal (Unimproved Methods)	179	10.61	1			-		
Safe and Proper Disposal (Improved Methods)	339	21.53	2.31	1.34-3.97		-		

4. Discussion

This study found a prevalence of underweight at 17.76%, aligning with findings from similar research in other low- and middle-income countries, though notable regional variations exist. For instance, the prevalence observed in this study is higher than in Ukraine (4.4%) [15] and China (3.9%) [16] which may be attributed not only to better socioeconomic conditions but also to more stable political environments, higher health literacy levels and well-established child health monitoring systems in those countries. In contrast, the Myanmar-China border region has long experienced sociopolitical instability, marginalization of ethnic groups, limited healthcare access and weak public infrastructure, all of which may contribute to higher levels of undernutrition. Conversely, the prevalence is lower than in Ethiopia (19.5%) [17], India (23.8%) [18] and Pakistan (44.6%) [19] where persistent food insecurity, poverty and limited access to healthcare may contribute to a higher burden of undernutrition. Additionally, the prevalence in this study is more than twice as high as that reported in Mangaung, Bloemfontein, South Africa (7.7%) likely due to differences in maternal education, child feeding practices and healthcare accessibility [20]. Unlike South Africa, the study area has limited coverage of early childhood nutrition programs and cultural

beliefs about feeding practices may also play a role in early undernutrition. Such regional disparities emphasized the multifactorial nature of childhood undernutrition, calling for a deeper understanding of local context.

Households with two or more children had a significantly higher likelihood of underweight cases nearly two times compared to those with only one child. This finding aligned with previous studies indicating that larger family sizes often result in resource constraints, leading to inadequate nutrition and healthcare for younger children. When multiple young children coexist in a household, financial, food and caregiving resources may be stretched thin, reducing the quality and quantity of nutrition available to each child. Additionally, competition for parental attention and healthcare services may contribute to poorer health outcomes, including undernutrition. A study in Ethiopia similarly found that households with more children under five had a higher prevalence of malnutrition due to limited maternal time for breastfeeding and childcare [21]. Furthermore, research from South Asia, including Bangladesh and India, has shown that larger family sizes are associated with increased child malnutrition, as parents may struggle to provide adequate food, healthcare and education for multiple dependents [22, 23]. Studies in Myanmar have also highlighted that children from larger families face a higher risk of undernutrition due to economic limitations and maternal workload which can reduce the frequency and quality of child feeding practices [11]. Moreover, the dilution hypothesis suggested that in larger families, parental resources such as time, income and nutritional support are distributed among multiple children potentially leading to inadequate dietary intake and higher vulnerability to underweight. In contrast, children in smaller families may benefit from greater parental investment in terms of both nutrition and healthcare.

Mothers who were farmers had 2.67 times higher odds of having underweight children compared to those who were self-employed. This association may be explained by the intensive physical workload and long hours associated with farming and household duties, which can reduce the time and energy available for childcare, breastfeeding and meal preparation. In contrast, self-employed mothers may have more flexible working hours allowing them greater opportunity to attend to their children's nutritional needs and health care. Similar findings were reported in a study conducted in Ethiopia

where children of mothers engaged in agricultural work were more likely to be undernourished compared to those whose mothers had non-agricultural occupations [24]. Additionally, farmer households may face seasonal food insecurity and economic instability, which can further affect the quality and quantity of food available to children [25]. On the other hand, self-employed women might have more consistent income and better access to health-related information which can positively influence child nutrition outcomes. Furthermore, maternal occupation may interact with family size and caregiving capacity, mothers in larger households who are also engaged in labour-intensive occupations such as farming may have less time and energy to provide individualized care leading to compounded nutritional risks for their children.

A shorter birth spacing of less than two years was also significantly associated with underweight status compared to a birth spacing of three or more years. This finding was consistent with previous studies indicating that closely spaced pregnancies can negatively impact both maternal and child nutrition [22]. A study from Ghana found that longer birth intervals (24–35 months, 3647 months and beyond 47 months) are associated with significantly lower odds of stunting and underweight in children compared to intervals of less than 24 months suggesting that increasing birth spacing may improve child nutritional outcomes [26]. Shorter birth intervals often lead to maternal nutritional depletion as mothers may not have sufficient time to recover from the physiological demands of a previous pregnancy before conceiving again. This can result in inadequate foetal growth, lower birth weight and increased susceptibility to undernutrition in early childhood. In households with multiple children and short birth intervals, caregiving demands are significantly increased, often coinciding with reduced maternal energy and attention per child which together heighten the risk of underweight. This interaction between family size and birth spacing emphasizes the need to view these risk factors collectively rather than in isolation.

Studies in Sub-Saharan Africa have demonstrated that children born within short birth intervals are at a greater risk of malnutrition due to competition for limited household resources, including food, healthcare and parental attention [27, 28]. In Bangladesh, researchers found that children

with birth intervals shorter than 24 months had a significantly higher risk of being underweight compared to those born with longer spacing mainly due to suboptimal breastfeeding and complementary feeding practices [23]. Similarly, in Ethiopia, a study reported that short birth intervals were associated with stunting and wasting as mothers with closely spaced pregnancies often experience exhaustion and reduced ability to provide adequate breastfeeding and nutrition to each child [21]. Furthermore, shorter birth intervals can affect breastfeeding duration as mothers may need to stop breastfeeding earlier due to a subsequent pregnancy, depriving the child of essential nutrients during a critical period of growth. The World Health Organization recommends a birth interval of at least 24 months to ensure optimal maternal recovery and improve child health outcomes [29].

Environmental factors were also significant with improper garbage disposal methods linked to a two folds higher prevalence of underweight children compared to proper disposal methods. This finding aligned with research highlighting the critical role of sanitation and waste management in child health and nutrition [30]. Poor waste disposal can contribute to an unhygienic environment, increasing the risk of infections, diarrhoea and other gastrointestinal illnesses that impair nutrient absorption and lead to undernutrition. Children living in areas with inadequate waste management are often exposed to contaminated food and water further exacerbating their vulnerability to malnutrition. A study in Bangladesh found that households with poor sanitation and waste disposal practices had a significantly higher prevalence of childhood malnutrition due to recurrent infections and reduced dietary intake [9]. Additionally, improper waste management can attract disease-carrying vectors such as flies, rodents and mosquitoes which can transmit infections that contribute to childhood underweight [31]. Notably, households with more children and poor sanitation may face a compounded burden of undernutrition as higher exposure to infection and limited caregiving capacity reduce the ability to manage child illnesses effectively. Moreover, when mothers are engaged in time-intensive occupations like farming, the capacity to maintain hygienic conditions may decline, further reinforcing environmental risk factors for child undernutrition. These interlinkages underscore the importance of integrated interventions that consider household size,

maternal occupation and environmental hygiene in combination.

Interestingly, children from households with proper wastewater management and those who had completed vaccination showed unexpectedly higher rates of underweight. These findings contradicted conventional assumptions and warrant deeper exploration. One possible explanation could be the presence of unmeasured confounding factors such as underlying health conditions, recent illnesses or inadequate dietary intake that were not captured in the survey. Another possibility is reverse causality, households with underweight children might be more likely to complete vaccination or adopt improved sanitation practices in response to health concerns. Alternatively, biases in data collection including misclassification or reporting errors, may have influenced the results. It is also possible that while facilities like latrines or drainage exist, actual hygienic practices may still be suboptimal. This suggests the need for more qualitative assessments to understand how sanitation infrastructure and immunization behaviours relate to child nutrition in practice. Overall, integrating these factors reveals a complex interplay between socioeconomic, occupational, reproductive, and environmental determinants. For instance, farmer mothers with multiple young children may face cumulative disadvantages, high physical burden, low income, limited healthcare access and time constraints which when combined with poor sanitation increase the risk of child undernutrition. Therefore, multifaceted interventions that simultaneously address maternal workload, reproductive planning, sanitation and health education are essential.

The study's strengths include its cross-sectional design which provides a comprehensive snapshot of childhood nutrition and its use of multistage random sampling ensuring representativeness and reducing selection bias. Multivariable analysis including logistic regression controls for confounding variables and clarifies factors associated with underweight. The focus on the Myanmar-China border region offers valuable, context-specific insights. However, the study has limitations such as its inability to establish causality due to its cross-sectional nature, potential recall bias in parental reports and limited generalizability due to its regional focus. Measurement bias may arise from inconsistencies in anthropometric assessments and unmeasured factors like

healthcare access, parental mental health and community support are not accounted for.

5. Conclusion

Nearly one-fifth of the children in the Myanmar-China border region were underweight highlighting a significant public health concern. Several factors were associated with an increased risk of underweight including household size, maternal occupation, birth interval and waste management practices. Children from households with two or more children under five and those born with less than two years between siblings and those mothers where farmers were more likely to be underweight. Improper garbage disposal was strongly linked to undernutrition. These findings emphasized the need for targeted, area-specific interventions. Strategies should include family planning education and promotion of adequate birth spacing along with community-based waste management programs to improve sanitation. Additionally, supportive measures for farmer mothers, such as flexible childcare support and access to health and nutrition services, could help reduce the burden on caregivers and improve child health outcomes. A comprehensive, multisectoral approach is essential to effectively address the interconnected factors contributing to childhood undernutrition in this vulnerable region.

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Author Contribution

HL, KMH, and WMT contributed to the study conception and design, data collection, data analysis, and manuscript drafting. RKM contributed to study supervision, critical revision of the manuscript, and final approval of the version to be published. All authors read and approved the final manuscript.

Declaration

Ethical approval and consent to participate

Ethical approval for this study was obtained from “the Centre of Ethics in Human Research, Khon Kaen University, Thailand” under the reference number HE672257 on January 15, 2025.

Competing interests

No competing interests.

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