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Prevalence and determinants of malnutrition and its association with some infant and young child feeding practices among children under-five in Mongolia

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Abstract

Background

Malnutrition among children under five years of age in low- and middle-income countries remains a major global public health concern. The National Center for Public Health has conducted the National Nutrition Survey every five years since 1993, and our team conducted the sixth survey in 2023 to update national nutrition estimates and inform future policies. The goal of this study was to estimate the prevalence of under-five malnutrition including wasting, stunting, underweight and overweight and its associations with socio-demographic determinants as well as infant and young child feeding (IYCF) practices among children between 6–23 months of age.

Methods

Data from a nationally representative sample of 2786 randomly selected under-five children from the VI National Nutrition Survey 2023 in Mongolia, were analyzed. Cross-sectional study and a cluster sampling method was used. Descriptive statistics and weighted logistic regression models with univariate and multivariable analysis were implemented.

Results

The prevalence of wasting in this population was 1.3%, stunting was 8.4%, underweight was 1.5% and overweight was 11.3%. While overweight prevalence was higher than most low and middle income countries, the prevalence of wasting, stunting and underweight was significantly lower. Low-birth weight increased the risk of stunting and underweight, while high-birth weight increased the risk of overweight. Younger children were more prone to malnutrition. Kazakh ethnic children had a higher risk of undernutrition. From the IYCF practices, not having age-appropriate breastfeeding and not meeting the minimum dietary diversity were associated with an increased odds ratio for stunting, and children who did not consume egg and/or flesh food had an increased odds ratio for underweight.

Conclusions

Current nutritional interventions should be strengthened in quantity and quality, notably interventions targeting childhood overweight and double burden of malnutrition. In-depth studies of the Kazakh ethnic population are vital for designing culturally appropriate interventions.

Introduction

Moderate and severe food insecurity affected 2.33 billion people globally in 2023[(1)]. Early childhood malnutrition in low resource countries has been a global public health concern. Globally, around 148 million children were stunted, 45 million were wasted and 37 million were overweight in 2022[(2)]. Asia's population

contains half the world's children under-five, but has 52% of stunted children, 70% of wasted children and 48% of overweight children under-five[2]. Recent studies have suggested that the triple burden of malnutrition is on the rise, specifically in low- and middle-income countries where individuals with overweight also experience childhood stunting and/or micronutrient deficiency[1,3–6].

Since the 1990 peaceful democratic revolution, Mongolian people have had the right to choose their residency within the country, which led to a drastic shift from rural to urban life. Currently, half of the population resides in the capital city Ulaanbaatar, and 69 percent live in urban areas, including small cities and province centers [7]. With the open trade economy, the availability and affordability of foreign processed foods with low nutrient quality have increased drastically, significantly altering traditional diets in urban areas. Due to this change, the double burden of malnutrition has been on the rise, with 11.7% of under-five children overweight and 6.1% stunted in 2017[8]. In Mongolia, health policy efforts to reduce childhood malnutrition have been implemented but the current status of malnutrition and its association with infant and young child feeding (IYCF) practices needs to be studied repeatedly to evaluate these efforts. The objective of this study was to identify the prevalence and determinants of malnutrition among children under five years of age and its association with IYCF practices.

Methods

Study data

We utilized data from the 6th National Nutrition Survey (VI NNS) in Mongolia, 2023[9]. The VI NNS, a cross-sectional study was conducted by our organization, the National Center for Public Health, with the support from the Ministry of Health and United Nations Children's Fund (UNICEF). In brief, the purpose of the survey was to evaluate the nutritional status of the population. A two-stage cluster sampling design was used within all five socio-economic regional groups (Western, Khangai, Central, Eastern, and the capital city Ulaanbaatar). A total of 2,789 households in 200 randomly selected clusters were included in the survey, of which 2786 children under-five years of age participated in the survey with a response rate of 99.5%. The study method was reviewed and approved by the Medical Ethics Committee of the Ministry of Health. An informed consent was obtained from mothers or caregivers who completed the questionnaire on behalf of their children. Data collection took place from September to December 2023. The full description of the survey methodology and design is published for public use[9].

Variables

World Health Organization (WHO) Child Growth Standards[10] were used to define the nutritional status among children. Z-scores less than − 2.00 SD were considered stunting (height-for-age), wasting (weight-for-age), or underweight (weight-for-age), and a z-score greater than + 2.00 SD was considered overweight (weight-for-height). Six IYCF indicators by WHO [11] for children aged 6–23 months were included in the analysis, namely, age-appropriate breastfeeding (children who are currently breastfed and receiving complementary foods), children who consumed egg and/or flesh food (at least one egg and/or any flesh

food), children who consumed unhealthy foods (foods or beverages high in sugar, salt, or unhealthy fats, including sugar-sweetened beverages, sweets, sweet baked goods, and salty snacks), minimum meal frequency (MMF), minimum dietary diversity (MDD), and minimum acceptable diet (MAD). MMF is defined as children 6–23 months of age who received the appropriate number of meals/snacks/milk feeds in the previous day. The minimum feeding frequency is two for breastfed infants aged 6–8 months, three for children aged 9–23 months, and four for non-breastfed children aged 6–23 months. MDD is defined as children 6–23 months of age who consumed foods and beverages from at least five of eight defined food groups (breast milk; grains, roots, tubers and plantains; pulses (beans, peas, lentils), nuts and seeds; dairy products (milk, infant formula, yogurt, cheese); flesh foods (meat, fish, poultry, organ meats); eggs; vitamin-A rich fruits and vegetables; and other fruits and vegetables.) during the previous day. MAD is defined as children 6–23 months of age who received at least the MDD and MMF for their age during the previous day for breastfed children, plus at least two milk feeds for non-breastfed children. The dietary intake of children was assessed from 24-hour dietary recall data from the survey.

A total of 13 demographic independent variables were included in the statistical analysis as confounding variables, and 8 of them had a significant association with the malnutrition status of under-five children (Table 2 and Table 3). The Household Food Insecurity Scale was measured using the Food Insecurity Experience Scale by the Food and Agriculture Organization of the United Nations. Maternal education was divided into 4 categories: no education or less than primary; primary and basic; secondary completed; and university/college (a higher degree). The Wealth Index Quintile is based on the methodology used in the Social Indicator Sample Survey (SISS) 2023 [(12)].

Statistical analysis

Logistic regression models with univariate and multivariable analysis were implemented to analyze the predictors of childhood malnutrition. Model independent variables as well as covariates were selected according to a significant level of $P < 0.05$. The independent variables were adjusted for the cluster sampling or complex sample design. Data analyses were conducted using IBM SPSS Version 25.0 and results are expressed as adjusted odds ratios (AOR 95% CI), and a two-sided significance level was used (p= .05).

Results

A total of 2,786 children under-five were included in the analysis. Two-thirds of children (69.7%) lived in urban areas and one-third (30.3%) lived in rural areas. The majority of children lived in a food secure or mildly food insecure household (79.7%) with a mother who had a higher degree education (60.6%). Children aged 0–5 months were the least represented (6.7%), while children aged 36–59 months were the most represented (38.8%). Male (51.3%) and female (48.7%) children were equally represented. The weighted prevalence of wasting, stunting, underweight and overweight was 1.3%, 8.4%, 1.5% and 11.3%, respectively (Table 1). Table 1 indicates that child age, birth weight, and ethnicity were significantly associated with several forms of childhood malnutrition.

Children under 6 months of age were at higher risk of being wasted (AOR = 4.92; 95% CI: 1.70–14.22) or overweight (AOR = 3.80; 95% CI: 2.15–6.74) compared with children over 36 months old. For stunting,

children aged 12–23 months old, born with low birth weight, or born in a Kazakh ethnic household were more likely to be stunted compared with children aged over 36 months, born with normal birth weight, and born in a Khalkh household (the main ethnic group). Children from Kazakh households had higher odds of stunting compared with those from Khalkh households, although this association was not statistically significant (AOR = 1.43; 95% CI: 0.87–2.32). Children living in a household with severe food insecurity (AOR = 2.15; 95% CI: 1.03–4.51), and children in households belonging to the poorest (AOR = 2.33; 95% CI: 1.12–4.88) or second (AOR = 2.09; 95% CI: 1.05–4.16) wealth index quintile were more likely to be stunted compared with those in food secure/mildly insecure and wealthiest households. However, these associations were not statistically significant for the cluster sampling design after accounting for the population weight (Table 2).

Low birth weight (AOR = 8.37; 95% CI: 3.28–21.41) and Kazakh ethnic background (AOR = 4.07; 95% CI: 1.51–10.98) were indicators for underweight. Children of mothers with completed secondary education had 2.6 times higher odds of being underweight compared to those whose mothers had university/college education; however, this association was not significant after adjustment (AOR = 2.60; 95% CI: 1.07–6.34). Furthermore, high birth weight (AOR = 8.37; 95% CI: 3.28–21.41) and younger age were indicators of childhood overweight. Compared with the 36 + months age group, all younger age groups were more likely to be overweight; notably, children under 6 months of age had 3.8 times higher odds of being overweight after adjustment (Table 2).

Among children 6–23 months old, 51.9% fulfilled the minimum meal frequency (MMF), 49.4% fulfilled the minimum dietary diversity (MDD), and only one-third (30.4%) of children fulfilled the minimum acceptable diet (MAD) requirements. Furthermore, 89.3% of children consumed egg and/or flesh food and 42.2% consumed unhealthy foods in the previous 24 hours. The associations between the malnutrition indicators and the IYCF indicators were assessed after adjusting for selected independent variables.

Maternal body mass index (BMI) and age-appropriate breastfeeding were significantly associated with minimum meal frequency (MMF). Mothers with normal BMI were more likely to provide adequate meal frequency to their children compared with overweight or obese mothers ($p = 0.001$). Breastfed children were 1.9 times more likely to meet the MMF requirement than non-breastfed children ($p < 0.005$).

Furthermore, child age, area of residence, region, household wealth index quintile, maternal education, maternal BMI, marital status, and age-appropriate breastfeeding status were significantly associated with minimum dietary diversity (MDD). Children living in urban areas were more likely to meet the MDD requirement than those living in rural areas (52.8% vs. 41.2%). Similarly, breastfed children were more likely to achieve MDD compared with non-breastfed children (57.3% vs. 30.4%). MDD prevalence also increased with household wealth, ranging from 33.1% among children from the poorest households to 64.9% among those from the richest households. In contrast, children of mothers with no education or less than primary education, unmarried mothers, and overweight or obese mothers were less likely to meet the MDD requirement.

For minimum acceptable diet (MAD), ethnicity showed the strongest association. Only 6.1% of children from Kazakh ethnic households met the MAD requirement, compared with 32.8% of children from Khalkh ethnic

households.

All selected IYCF indicators were not significantly associated with wasting and overweight after adjustment. Not meeting the minimum dietary diversity (AOR = 3.55; 95% CI: 1.55–8.13) and no age-appropriate breastfeeding (AOR = 1.89; 95% CI: 1.02–3.49) were associated with stunting. Eating egg and/or flesh food was statistically associated with underweight. Those who did not eat egg and/or flesh food were more likely to be underweight (AOR = 10.91; 95% CI: 2.13–55.88) (Table 3).

Discussion

According to the WHO cut-off values for public health significance, our study estimated prevalence of very low wasting, low stunting, and high overweight among the children under five[10]. Birthweight, age, and ethnicity were the main determinants of childhood malnutrition. We estimated among children aged 6–24 months, 7 in 10 children did not meet the minimum acceptable diet, 3 in 10 children did not eat fresh fruits and vegetables and 4 in 10 children ate unhealthy foods. One in five households in Mongolia experienced moderate food insecurity (19.0%), including 2.7% of household with severe food insecurity. Limited but specific associations were found regarding IYCF such as not meeting the MDD and not having age-appropriate breastfeeding were associated with stunting and lack of egg and/or flesh food consumption was associated with underweight.

Among the LMICs, the predominant epidemiological pattern is a higher prevalence of undernutrition and a lower prevalence of over nutrition [12,13]. However, overweight (11.3%) has emerged as the leading form of childhood malnutrition in Mongolia over the past three decades (Fig. 1). The prevalence is higher in urban areas and exceeds the global average (8.3%), as well as the prevalence in countries with an HDI below 0.8 (7.6%), upper-middle-income countries (8.5%), and lower-middle-income countries (8.6%), while remaining comparable to that in high-income countries (9.3%) [14–16]. With stunting prevalence as a second leading childhood malnutrition, we estimated prevalence of double burden of malnutrition to be 2.0%, which is higher than the global median prevalence (1.4%) and east Asia and Pacific region (1.1%) [17].

*The respective prevalence data were obtained from the I–VI National Nutrition Surveys conducted in Mongolia between 1992 and 2023 [9].

We estimated lower prevalence of low birth weight (3.9%) and higher prevalence of high birth weight (11.8%) among the children had the strongest association with childhood malnutrition. Similarly, recent studies in Mexico, Sub-Saharan African countries, China, and Iran reported high birth weight as one of the risk factors of childhood overweight [18–22]. Moreover, age was the strong determinant of wasting, stunting and overweight. Our study showed children at younger ages exhibited greater susceptibility to all forms of malnutrition, which was similar result to studies done in several countries including South Asian countries [23–26]. However, a study conducted in China reported higher odds of overweight was linked to younger age, but stunting was associated with older age [27] and a study conducted in Bangladesh found that older age was one of the determinants of overweight [28]. In depth factors effecting higher malnutrition prevalence in younger age are not explored by this study.

Age-appropriate breastfeeding and consumption of egg and/or flesh food were protective factors of stunting and underweight, respectively. Multiple studies have shown breastfeeding reduced the risk of stunting [29,30] but other studies have reported that continued breastfeeding while delaying solid food, or inadequate feeding practice, resulted in increased risk of malnutrition [31,32]. This protective association should be interpreted cautiously, as mixed feeding practices and residual confounding may influence the observed relationship. Our data did not show an association with exclusive breastfeeding, possibly due to the smaller sample size of children under 6 months old. Similar to our study, randomized controlled trial and cross-sectional studies from Namibia, Nepal, Bangladesh, Ethiopia, as well as USA, indicated that animal source foods were a protective factor for underweight [33–37]. In 2023, Mongolia's livestock number was estimated to be 64.7 million [38] compared with a population of over 3 million people. With abundant resources and a meat-heavy cuisine culture, 89.3% of children consumed egg and/or flesh food and our childhood underweight prevalence was very low compared to the global prevalence [2].

Adequate dietary diversity reduced the risk of stunting, but only half of the children met the minimum requirement. Due to the harsh and long winter, Mongolia lacks dietary diversity, including fresh fruits and vegetables [39–41]. During the cold season, we import fresh foods to diversify our market, but residents in rural areas continue to have an inadequately diverse diet. For instance, 27.5% of children in urban areas did not eat fruits and vegetables, compared with 42.2% of children in rural areas. Moreover, maternal education, ethnic background, and wealth quintile were associated with a lack of fruit and vegetable consumption.

With the high prevalence of overweight and the double burden of malnutrition, the primary focus should be on increasing adequate dietary diversity and nutrient density in households and promoting evidence-based infant and young child feeding practices in Mongolia. Over the past 20 years, Mongolia has successfully implemented a high-dose vitamin A supplementation program for children under 5 years old, with a coverage prevalence of 61.2% in 2023. However, the coverage prevalence of the multiple micronutrient supplement program for children aged 6–23 months was only 7.9%. Following the Fifth National Nutrition Survey, the government enacted the Law on Food Fortification [42], accompanied by three related standards. However, further policy guidance is required to facilitate effective implementation, as many food manufacturers lack the technical capacity and appropriate support systems to comply with these regulations.

Following the Fourth National Nutrition Survey, the distribution of free multiple micronutrient supplements for pregnant women was introduced in Mongolia in 2017. However, procurement is decentralized to primary health centers, and the limited number of importers restricts product availability and choice options, potentially affecting quality. Strengthened and coordinated policy support for procurement and supply chain management is therefore needed to ensure consistent access to high-quality supplements. In addition, a more holistic approach is needed, including strengthened health promotion and education programs that emphasize healthy diets for pregnant women and their families, as birth weight has been identified as a key risk factor for stunting, underweight, and overweight.

Furthermore, although Mongolia reports a higher prevalence of exclusive breastfeeding during the first six months (59.6%) compared with the global average (48%) [43], bottle feeding remains common (33.4%), and a

notable proportion of children under six months (20.7%) were overweight. Following the Fifth National Nutrition Survey, the government enacted the Law on Infant and Young Child Feeding [44] in 2017, with specific provisions to restrict the marketing of infant formula. However, implementation remains suboptimal, particularly in regulating the rapidly expanding influence of social media marketing. Thus, there is a need to systematically evaluate the implementation of the law and identify effective strategies to strengthen its enforcement.

Children from Kazakh ethnic households were more vulnerable to malnutrition, particularly stunting and underweight. More than half of the children in these households did not consume fruits and vegetables in the previous 24 hours. Despite this, their consumption of unhealthy foods and sugar-sweetened beverages was lower compared with children from other ethnic groups. Our findings also indicate that Kazakh households had a higher average number of children under five (1.55) compared with the majority Khalkh households (1.35). Previous studies from Asian countries have identified a larger number of young children in the household as a risk factor for undernutrition [25,45]. Nevertheless, further in-depth qualitative research is needed to better understand the contextual and cultural factors contributing to childhood malnutrition in Kazakh households.

This study has several limitations. First, the cross-sectional design precludes establishing causal relationships between identified risk factors and childhood malnutrition. Second, data collection was conducted during the autumn harvest season, which may limit the representativeness of the findings to other seasons characterized by reduced availability of diverse foods in Mongolia. Nevertheless, the study utilizes nationally representative data of households with children under five years of age. Furthermore, the six rounds of the National Nutrition Survey conducted over the past three decades provide important insights into trends in childhood malnutrition and have contributed to the development of key policy documents, including laws, strategies, and ministerial orders.

Conclusion

In conclusion, this study highlights a high prevalence of overweight, the double burden of malnutrition, and suboptimal infant and young child feeding practices in Mongolia. These findings emphasize the urgent need for a comprehensive, multisectoral approach that strengthens the implementation and enforcement of existing nutrition-related laws and policies, while promoting optimal feeding practices across the life course.

Table 1
Association between independent variables and prevalence of malnutrition among children under-five years old

	Total*		Wasting		Stunting		Underweight		Overweight	
	Weight %	n	% (n = 41)	P-value	% (n = 254)	P-value	% (n = 46)	P-value	% (n = 312)	P-value
			1.3		8.4		1.5		11.3	
Area										
Urban	69.7	1480	1.4	0.362	7.7	0.297	1.2	0.554	11.3	0.229
Rural	30.3	1306	1.8		11.2		2.2		12.7	
Age										
0–5 months	6.7	172	3.0	0.025	10.8	0.045	3.9	0.236	20.7	< 0.001
6–11 months	11.0	307	1.0		8.0		2.5		19.6	
12–23 months	20.7	590	2.6		12.4		2.1		16.0	
24–35 months	22.7	656	1.1		8.9		0.6		9.8	
36 + months	38.8	1061	1.1		6.7		0.9		6.6	
Sex										
Male	51.3	1428	1.9	0.622	9.7	0.119	1.3	0.107	12.8	0.248
Female	48.7	1358	1.2		7.9		1.6		10.7	
Mother's education level										
No education/less primary	1.3	54	6.4	0.663	19.0	0.313	2.2	0.080	19.6	0.713
Primary and basic	4.5	147	2.7		15.9		0.9		10.9	
Secondary completed	33.6	1004	2.5		11.0		1.8		11.8	
University/College	60.6	1458	0.9		6.9		1.4		11.6	
Birthweight										

[a]Measured by The Food Insecurity Experience Scale by Food and Agriculture organization of the United Nations

[b]Based on methodology used in the Social Indicator Sample Survey (SISS) – 2023[12]

	Total*		Wasting		Stunting		Underweight		Overweight	
	Weight %	n	% (n = 41)	P-value	% (n = 254)	P-value	% (n = 46)	P-value	% (n = 312)	P-value
			1.3		**8.4**		**1.5**		**11.3**	
Low	3.9	122	11.4	0.335	29.0	< 0.001	3.8	< 0.001	5.7	0.003
Normal	84.3	2282	1.3		8.6		1.5		11.1	
High	11.8	328	0.2		3.7		0.5		18.4	
Household Food Insecurity Scale[a]										
Food secure / mild insecurity	79.7	2180	1.4	0.686	8.1	0.099	1.6	0.314	11.5	0.648
Moderate food insecurity	17.8	486	2.1		10.8		1.0		12.2	
Severe food insecurity	2.5	66	3.7		19.0		1.1		14.9	
Wealth index quintile[b]										
Poorest	19.1	739	2.4	0.499	13.1	0.235	1.3	0.704	12.9	0.850
Second	20.1	634	1.5		10.8		1.9		12.4	
Middle	19.8	589	1.9		8.5		2.4		9.7	
Fourth	20.2	491	1.4		7.7		0.7		12.6	
Richest	20.7	323	0.6		4.2		1.1		11.1	
Ethnicity of the household head										
Khalkh	81.3	2116	1.2	0.130	8.8	0.046	1.3	0.038	11.8	0.852
Kazakh	4.6	183	7.0		16.4		5.6		10.6	
Others	14.1	476	1.6		6.3		1.3		11.5	

[a]Measured by The Food Insecurity Experience Scale by Food and Agriculture organization of the United Nations

[b]Based on methodology used in the Social Indicator Sample Survey (SISS) – 2023[12]

*All values are presented as weighted percentages and unweighted numbers.

Table 2
Adjusted Odds ratios (AOR) and 95% CI of determinants of wasting, stunting, underweight and overweight among children under-five years old

	Wasting		Stunting		Underweight		Overweight	
	AOR	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**
Area								
Rural v. Urban	1.56	0.60, 4.07	1.21	0.85, 1.72	0.79	0.36, 1.72	1.21	0.89, 1.66
Age								
0–5 months v. 36 + months	4.92	1.70, 14.22	1.90	0.91, 3.99	3.67	0.94, 14.31	3.80	2.15, 6.74
6–11 months v. 36 + months	2.91	0.90, 9.49	1.26	0.74, 2.16	0.93	0.14, 6.10	3.55	2.10, 5.99
12–23 months v. 36 + months	2.33	0.72, 7.47	1.93	1.28, 2,90	2.30	0.96, 5.53	2.79	1.73, 4.51
24–36 months v. 36 + months	0.70	0.21, 2.28	1.39	0.90, 2.16	1.16	0.44, 3.04	1.53	0.99, 2.36
Sex								
Male v. Female	0.82	0.36, 1.84	1.32	0.93, 1.86	1.80	0.88, 3.69	1.18	0.89, 1.56
Maternal education								
No education/less primary v. University/College	1.14	0.21, 6.29	1.79	0.68, 4.69	4.44	0.77, 25.62	1.72	0.70, 4.20
Primary and basic v. University/College	0.48	0.10, 6.29	1.58	0.79, 3.16	2.30	0.71, 7.42	0.90	0.44, 1.84
Secondary completed v. University/College	1.24	0.53, 2.90	1.22	0.88, 1.70	2.60	1.07, 6.34	1.03	0.71, 1.48
Birthweight								
Low v. Normal	1.77	0.38, 8.17	4.01	2.38, 6.77	8.37	3.28, 21.41	0.44	0.15, 1.27
High v. Normal	0.35	0.10, 1.29	0.43	0.21, 0.86	0.18	0.02, 1.35	1.78	1.24, 2.57
Household Food Insecurity Scale								
Moderate food insecurity v. Food secure / mild insecurity	0.68	0.24, 1.91	1.23	0.83, 1.83	1.39	0.65, 2.95	1.07	0.70, 1.65
Severe food insecurity v. Food secure / mild insecurity	1.17	0.18, 7.44	2.15	1.03, 4.51	2.48	0.66, 9.31	1.55	0.61, 3.98

	Wasting		Stunting		Underweight		Overweight	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Wealth index quintile								
Poorest v. Richest	0.82	0.17, 3.87	2.33	1.12, 4.88	2.01	0.34, 11.83	1.03	0.57, 1.85
Second v. Richest	1.33	0.32, 5.51	2.09	1.05, 4.16	1.12	0.21, 5.96	1.05	0.61, 1.80
Middle v. Richest	1.56	0.30, 8.19	1.70	0.79, 3.64	2.19	0.39, 12.35	0.82	0.44, 1.53
Fourth v. Richest	0.50	0.11, 2.35	1.72	0.88, 3.37	1.94	0.24, 15.63	1.01	0.60, 1.68
Ethnicity of the household head								
Kazakh v. Khalkh	3.42	0.87, 13.42	1.43	0.87, 2.32	4.07	1.51, 10.98	0.92	0.59, 1.45
Others v. Khalkh	0.97	0.36, 2.62	0.69	0.47, 1.01	1.42	0.42, 4.82	0.93	0.61, 1.42

Table 3
Association between some infant and young child feeding practices and prevalence of malnutrition among children aged 6–23 months old

	Children aged 6–23 months old*		Wasting		Stunting		Underweight		Overweight	
	%	n	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
MMF[c]	49.4	418								
No v. Yes			4.17	0.69, 25.33	1.53	0.77, 3.05	3.15	0.71, 13.91	1.32	0.69, 2.52
MDD[d]	51.9	476								
No v. Yes			0.47	0.12, 1.78	3.55	1.55, 8.13	11.04	0.92, 132.94	1.45	0.65, 3.22
MAD[e]	30.4	262								
No v. Yes			0.68	0.08, 5.54	0.31	0.12, 0.83	0.53	0.02, 15.67	0.62	0.22, 1.76
Age-appropriate breastfeeding	67.9	625								
No v. Yes			0.88	0.17, 4.52	1.89	1.02, 3.49	2.87	0.84, 9.80	1.54	0.94, 2.53
Children who consumed egg and/or flesh food	89.3	821								
No v. Yes			0.10	0.01, 1.11	2.30	0.80, 6.62	10.91	2.13, 55.88	1.14	0.59, 2.19
Children who consumed unhealthy foods	42.2	384								
No v. Yes			2.77	0.79, 9.75	1.14	0.63, 2.05	0.55	0.13, 2.32	0.92	0.59, 1.44

[c]Proportion of children 6–23 months old who received the appropriate number of meals/snacks/milk feeds in the previous 24 hours.

[d]Proportion of children 6–23 months old who consumed food items from at least five food groups in the previous 24 hours: breast milk; grains, roots, and tubers; legumes and nuts; dairy products; flesh foods (meat, fish, poultry, and liver/organ meats); eggs; vitamin-A rich fruits and vegetables; and other fruits and vegetables.

[e]Proportion of children 6–23 months old who received the appropriate number of meals/snacks/milk feeds and consumed food items from at least 4 of the above-mentioned food groups in the previous 24 hours.

The infant and young child feeding practices were adjusted for area, age, sex, maternal education, birthweight, household food insecurity scale, wealth index quintile and ethnicity of the household head.

*All values are presented as weighted percentages and unweighted numbers.

List of abbreviation

BMI Body Mass Index

IYCF Infant and Young Child Feeding

MAD Minimum Acceptable Diet

MDD Minimum Dietary Diversity

MMF Minimum Meal Frequency

SISS Social Indicator Sample Survey

VI NNS Sixth National Nutrition Survey

UNICEF United Nations Children's Fund

WHO World Health Organization

Declarations

Clinical Trial number

Not applicable

Ethics approval and consent to participate:

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving research study participants were approved by the Medical Ethics Committee of the Ministry of Health (reference number: 23/017). Written informed consent was obtained from all participating caregivers or legal guardians prior to data collection.

Consent for publication:

Not applicable.

Competing Interests

D.T. receives financial compensation from the International Life Sciences Institute (ILSI) for being the Editor-in-Chief for Nutrition Reviews. All other authors declare no known competing interests.

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Authorships' contributions:

A.B. conceptualized the study, performed formal analysis and data curation, prepared the visualizations, and wrote the original draft of the manuscript. B.N. contributed to conceptualization and methodology, performed formal analysis and data curation, conducted the investigation, and coordinated the project. B.J. contributed to methodology and supervision. M.L. acquired funding. D.T. reviewed and edited the manuscript and contributed to visualization. Tuul.B. conducted the investigation, performed data curation, and contributed to project administration. O.D., D.D., T.B., G.T., D.M., G.D., and Ts.Z. conducted the investigation and performed data curation. Ts.M. performed formal analysis and prepared the visualizations. G.P. and Kh.D. conducted the investigation. N.Kh. reviewed and edited the manuscript. U.S. supervised the study. Bayasgalan.J. contributed to conceptualization, methodology, funding acquisition, investigation, supervision, project administration, and review and editing of the manuscript. All authors reviewed and approved the final manuscript.

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Author Contribution

A.B. conceptualized the study, performed formal analysis and data curation, prepared the visualizations, and wrote the original draft of the manuscript. B.N. contributed to conceptualization and methodology, performed formal analysis and data curation, conducted the investigation, and coordinated the project. B.J. contributed to methodology and supervision. M.L. acquired funding. D.T. reviewed and edited the manuscript and contributed to visualization. Tuul.B. conducted the investigation, performed data curation, and contributed to project administration. O.D., D.D., T.B., G.T., D.M., G.D., and Ts.Z. conducted the investigation and performed data curation. Ts.M. performed formal analysis and prepared the visualizations. G.P. and Kh.D. conducted the investigation. N.Kh. reviewed and edited the manuscript. U.S. supervised the study. Bayasgalan.J. contributed to conceptualization, methodology, funding acquisition, investigation, supervision, project administration, and review and editing of the manuscript. All authors reviewed and approved the final manuscript.

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Data Availability

Sixth National Nutrition Survey, Mongolia that support the findings of this study are available from National Center for Public Health (NCPH), but restrictions apply to the availability of these data, which were used under licence for the current study and so are not publicly available. The data are, however, available upon request and with the permission of National Center for Public Health (NCPH).

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Figures

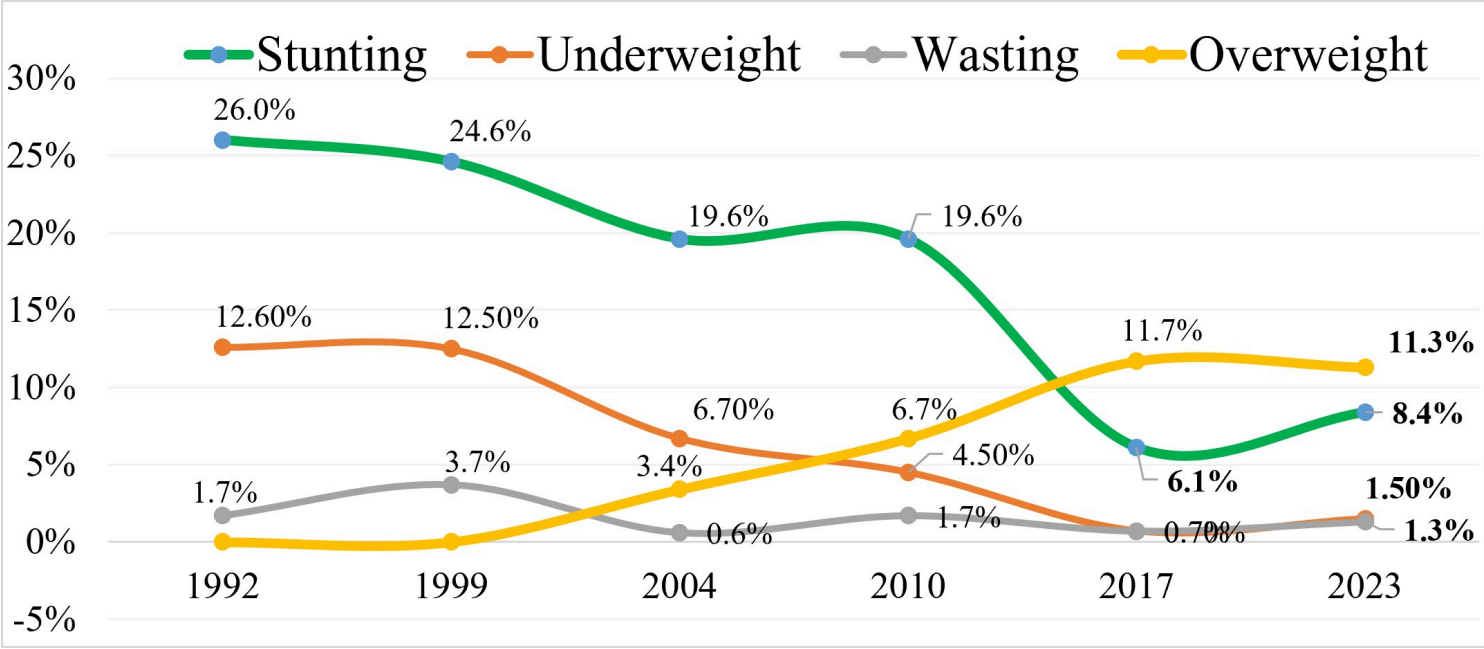


Figure 1

Under-five childhood malnutrition trends in Mongolia between 1992-2023

*The respective prevalence data were obtained from the I–VI National Nutrition Surveys conducted in Mongolia between 1992 and 2023 [(9)].