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Early Lives, Unequal Diets: Examining Nutritional Disparities Among Children in Mizoram

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Abstract

Undernutrition and inadequate dietary diversity are significant concerns in Mizoram, especially in one of the aspirational districts, Mamit. This study tries to capture the nutritional status and dietary practices of children aged 0-6 years in Mamit, focusing on three major tribal communities—Mizo, Bru, and Chakma. 660 children across the three ICDS blocks of Mamit were surveyed, using a cross-sectional design, structured interviews, and nutritional outcomes were calculated. Results show that children under 5 are stunted, underweight and wasted, by 25%, 18% and 13% respectively. with the Chakma community showing the highest malnutrition rates. The dietary diversity was inadequate, as only 26.6% of children aged 6-23 months fulfilled the MMD (Minimum Dietary Diversity) criteria. Only 47.9% of children aged 2-6 years consumed items from four or more dietary categories. Limited access to food, climatic vulnerabilities, and socio-economic factors construct significant obstacles in securing nutritional adequacy. Results highlight the need for focused interventions to improve food diversification and feeding patterns in Mamit. Improving food accessibility, nutrition education, and community-based agriculture activities are essential for tackling undernutrition in this borderland district.

Keywords

Undernutrition, Dietary diversity, Northeast, Borderland, Vulnerability, Mizoram

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Introduction

Undernutrition is a significant concern, particularly among children and pregnant and lactating women, which has long-lasting effects on the mother and her child. A diverse diet is crucial to promote optimal growth, development, and overall health (Arimond & Ruel, 2004). Dietary diversity refers to consuming a variety of food from different food groups to ensure an adequate intake of essential nutrients. It is widely used as a tool to measure dietary quality, micronutrient adequacy, and food access and influences children's health outcomes (Darapheak et al., 2013; World Health Organization (WHO), 2019). Inadequate dietary quality and diversity lead to undernutrition, which includes stunting, being underweight, and wasting (Arimond & Ruel, 2004). In low and middle-income countries, less than one-fourth of children aged 6–23 months meet the minimum acceptable dietary diversity and meal frequency standards (WHO, 2008, 2018). According to the latest National Family Health Survey (NFHS) dataset, 36%, 19%, and 32% of children in India aged below five were stunted, wasted, and underweight (Ashok et al., 2022; IIPS & ICF, 2021). Though significant improvements have been observed in the nutrition indicator over the past decade, it is still far from achieving the target milestones. Hence, understanding the root cause of malnutrition is essential from a program and policy perspective.

The focus of national programs in India and across the globe has been on access to food and not just food availability, especially in border regions and vulnerable areas of the country that become isolated due to natural calamities and difficult terrain.

It is also argued for such a distinction that existing measures of food availability within the country fail to account for the question of adequate access and can be misleading due to the inherent and "inevitable" inequality in terms of access to food (Barrett, 2010; Sen, 1981) particularly in northeastern states of the country. Another concern is the right to adequate food and not just quantity of food. There is widespread consensus that merely meeting standardized calorie norms, as set for example by the Food and Agriculture Organization (FAO), does not translate into adequate food or nutrition. Instead, adequate nutrition involves measuring access to dietary diversity (Deaton & Drèze, 2009).

Mizoram, one of the seven states of northeast India, is the southernmost landlocked state with low population density. Sharing its common international border with Bangladesh and Myanmar (Pachuau, 2009), the state has the highest concentration of tribal population in the country; about 95% of the population is of diverse tribal origins with specific beliefs and practices, specifically around food preparation and consumption. As per the recent NFHS data around 29% children

below five years were stunted in Mizoram in 2019-21 (Ashok et al., 2022; IIPS & ICF, 2021). Though the level of stunting is lower as compared to the national figure, it is evident that dietary diversity is very low among the children in the state. At the national level, 11% of children aged 6-23 months were fed an adequate diet, while it was 13% for Mizoram (Down to Earth, 2023). A study from the National Institute of Nutrition (ICMR-NIN) found that a very small proportion of India's population is fed a recommended level of protein, milk, vegetables, and fruit, which have both short- and long-term implications for health and nutrition (ICMR-NIN, 2020).

The current study is an attempt to explore the dietary patterns, eating habits, feeding practices, and nutritional outcomes of children under six years of age in the most remote and vulnerable regions. The research presented here is part of a larger report to study Diet Diversity and Nutritional outcomes among children and women in the Mamit District of Mizoram which is a border district with extreme climatic conditions and an economy heavily dependent on agriculture (Sati & Vangchhia, 2017). The study findings will help improve Mamit's nutritional indicator, which was carved out from the erstwhile Aizawl District in 1998. The district faces the problem of food availability and accessibility because of its high climatic vulnerability. The study was carried out under the aegis of the Department of Women and Child Development (DoWCD), Government of Mizoram.

Participants and methods

Sample design and setting

A cross- sectional study was conducted in Mamit district, where the tribes within the district are Mizo followed by Chakma and Bru (Registrar General of India, 2011). The nutritional status of Mamit, as per the standard nutrition indicators, is better as compared to that at the state level, however, the number of children aged 6-23 months receiving adequate diet is low (International Food Policy Research Institute [IFPRI], 2021). According to National Family Health Survey 2019-21, about 26%, 7% and 14% children were stunted, wasted, and underweight in Mamit (IIPS, 2021).

Participants

The study was conducted following a two-stage sampling across the three ICDS blocks of the district - Reiek, West Phaileng and Zawlnuam. The Anganwadi centres across these three blocks formed sampling frame, covering various parts and communities of the district, which makes the study representative. Assuming the confidence level of 95%; margin of error: 5%; population Proportion: 50%. The required sample size was 480 children (0-6 years). Considering

the non-response and design implications, total 660 children under six years were taken for the study. The list of beneficiaries was extracted from the AWC register and served as the basis for randomly selecting respondents.

Data collection

Information was collected via structured questionnaires from mothers of children under 6 years of age after securing consent. The questionnaire has multiple sections covering a range of topics, including socio-economic and demographic circumstances, dietary recalls and frequency of consumption of selected foods, and infant and young child feeding practices.

Statistical Analysis

Anthropometric measurement (z-score for weight/age, height/age and weight/height) was calculated and analysed using Emergency Nutrition Assessment (ENA) Standardizing Monitoring and Assessment of Relief and Transition (SMART) 2007 software[7]. The z-scores for children aged 0-5 years have been calculated with reference to WHO standards 2006, while z-scores for the children aged 5-6 years have been calculated with reference to National Centre for Health Statistics (NCHS) reference 1977 as the z scores for children greater than 5 years were not sufficiently obtained using the WHO standards. These measures were also verified using WHO Anthro-software[8] to validate the exact z score [WHO, 2006b;2008].

Diet Diversity among the children aged 6 month-23 months were estimated based on three indicators such as minimum dietary diversity (MDD), minimum meal frequency (MMF) and minimum acceptable diet (MAD) based on the WHO-IYCF guidelines while only MDD is, estimated for the children aged 2-6 years children (WHO 2018).

Univariate analysis was used to estimate the prevalence of various key indicators for Mamit district while bi-variate analysis was used to estimate the prevalence across the key socio-demographic groups.

Ethical Statement

The study was carried out under the aegis of the Department of Women and Child Development, Government of Mizoram.

Results

Characteristics of children

The demographic characteristics of children under six years of age, categorized by different tribal communities, is outlined in Table 1. Among the 660 children, profiled for nutritional assessment, 159 were from the

[7] https://smartmethodology.org/survey-planning-tools/smart-emergency-nutrition-assessment/

[8] https://www.who.int/tools/child-growth-standards/software.

Bru community, 126 from the Chakma community, 340 from the Mizo community and 35 from other communities (Dumka, Taipeng, Meitei, Gorkhali etc).

Table 1. Background characteristics of children under age six years, by tribes in Mamit

Characteristics	Bru	Chakma	Mizo	Total
Age of child (in months)				
0-6	26.4	23.8	18.8	21.2
6-11	14.5	15.9	9.7	13.2
12-17	6.3	10.3	13.8	10.8
18-23	15.0	5.6	12.9	11.8
24-35	12.6	19.8	14.1	15.3
36+	25.2	24.6	30.7	27.7
Sex of child				
Male	53.5	55.6	49.4	51.7
Female	46.5	44.4	50.6	48.3
Mother's age				
15-19	10.1	27.8	4.7	10.5
20-29	59.1	50.8	44.1	48.9
30+	30.8	21.4	51.2	40.6
Mother's education				
No schooling	18.3	35.7	2.4	13.6
1-5 standard	28.9	18.3	7.7	15.5
6-8 standard	35.2	27.8	24.7	28.2
9-10 standard	15.7	15.9	40.6	28.8
11+ standard	1.9	2.3	24.6	13.9
Characteristics	**Bru**	**Chakma**	**Mizo**	**Total**
Mother's occupation				
Farmer/Cultivator	18.8	24.6	8.5	14.2
Wage labour/Labourer	20.8	8.7	13.3	14.7
Salaried job	13.2	7.2	18.5	14.4
Not working/Housewife	47.2	59.5	59.7	56.7
Number	**159**	**126**	**340**	**660**

The age and gender distribution across tribes displayed a uniform pattern, with exceptions noted in the 12-17 months age group among the Bru and the 18-23 months age group among the Chakma community. The predominant age range for mothers in the Bru and Chakma communities was between 20 and 29, whereas in the Mizo community, it skewed towards those above 30 years. Homemaking was the predominant occupation for mothers in all tribes. Regarding education, a distinct trend emerged, revealing a significant proportion of Chakma mothers (36%) lacking formal schooling, followed by Bru mothers (19%). Notably, a substantial number of mothers from these

communities attained a secondary education level (grades 6-8). Mizo tribal women demonstrated higher literacy rates compared to their counterparts in other tribal communities.

Status of Malnutrition among children

Table 2. Nutritional status of children under age five years, by age, and by gender

Age groups (in months)	Number of children	Weight-for-age (%)		Height-for-age (%)		Weight-for-height (%)	
		<-3SD	<-2SD	<-3SD	<-2SD	<-3SD	<-2SD
Total (Male and Female)							
0-5	111	1.8	9.9	2.7	10.8	6.3	14.4
6-11	103	3.8	14.5	8.7	20.3	0.9	12.6
12-23	143	4.9	17.4	8.3	25.8	4.9	12.5
24-35	91	5.4	20.8	5.4	29.6	3.3	13.1
36-47	83	7.2	24.1	8.4	31.3	2.4	12.0
48-60	73	6.8	23.2	5.4	34.2	4.1	12.3
Total (0-60)	**604**	**4.8**	**17.7**	**6.6**	**24.5**	**3.8**	**12.9**
Males							
0-5	53	0.0	11.3	3.7	11.3	7.5	18.8
6-11	56	5.3	17.8	10.7	28.5	1.7	12.5
12-23	69	8.7	21.7	14.4	33.3	7.2	13.0
24-35	49	8.1	22.4	10.2	34.6	6.1	12.2
36-47	40	7.5	22.5	10.0	30.0	2.5	15.0
48-60	45	6.6	20.0	2.2	42.2	4.4	13.3
Total (0-60)	**312**	**6.0**	**19.2**	**8.9**	**29.8**	**5.1**	**14.1**
Females							
0-5	58	3.4	8.6	1.7	10.3	5.1	10.3
6-11	47	2.1	10.6	6.3	10.6	0.0	12.7
12-23	74	1.3	13.5	2.7	18.9	2.7	12.1
24-35	42	2.3	19.0	0.0	23.8	0.0	14.2
36-47	43	6.9	25.5	6.9	32.5	2.3	9.3
48-60	28	7.1	28.5	10.7	21.4	3.5	10.7
Total (0-60)	**292**	**3.4**	**16.1**	**4.1**	**18.8**	**2.4**	**11.6**

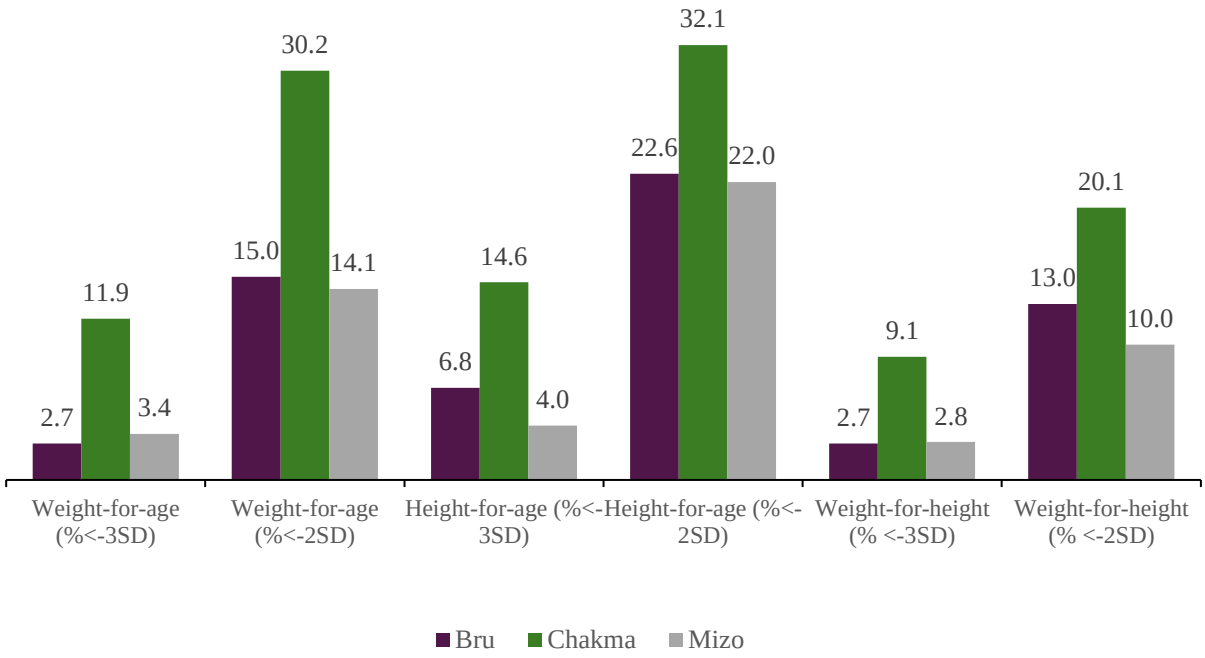
Note: Each of the indices is expressed in standard deviation (SD) units from the median of the WHO Child Growth Standards. Lower and upper SD boundaries set flag limits Table is based on children with valid dates of birth (month and year) and valid measurement of both height and weight.

The percentages represent the prevalence of children falling below certain standard deviations (SD) from the mean, which is often used as a measure of malnutrition is shown in Table 2. In Mamit, 25% of children under age five years were stunted (too short for their age). This is a sign of chronic undernutrition. Eighteen percent of children under age five years were underweight, while 13% of children under age five years were wasted (too thin for their height), which is a sign of acute undernutrition. This trend was positively associated with their age – increasing both stunting and underweight as individuals grew older. A higher prevalence of

stunting is observed among male children in Mamit district, with approximately 30% of them face stunted growth, whereas 19% exhibit the same condition among female children. The prevalence of wasting and underweight was also relatively higher among male children compared to their female counterparts.

The information on the nutritional status of children belong to different tribal communities, as indicated by various indicators: Weight-for-age, Height-for-age, and Weight-for-height is shown in Figure 1. In the Bru community, 3% of children were found severely underweight, with a weight-for-age falling below -3 SD, while 15% were categorized as underweight, registering a weight-for-age below -2 SD. In contrast, within the Chakma community, a higher proportion of children, specifically 12%, face severe underweight conditions, and 30% were classified as underweight using the same criteria. The Mizo community demonstrates a comparatively lower prevalence of underweight conditions, with 3.4% falling below -3 SD and 14.1% below -2 SD, indicating a relatively healthier nutritional status among its children compared to the other communities.

Figure 1. Nutritional status of children under five years, by tribes



The Chakma community exhibits a higher prevalence of severe stunting, recorded at 15%, in contrast to 7% in the Bru community and 4% in the Mizo community. Similarly, the prevalence of stunted children was more pronounced in the Chakma community, accounting 32%, compared to 22% in both the Bru and Mizo communities.

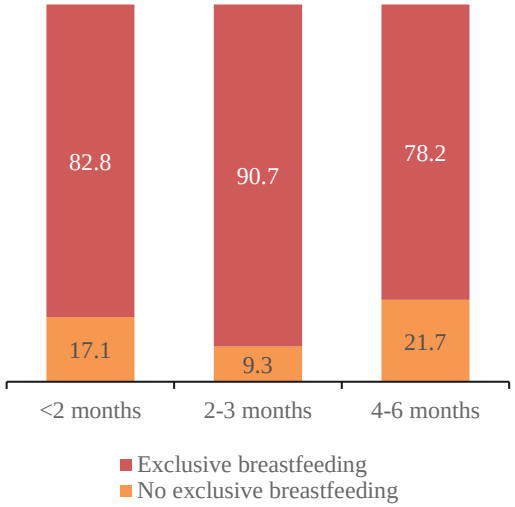
The Chakma community has a higher incidence of severe wasting in children, reaching 9%, surpassing the rates observed in other tribes, which stand at 3% for both the Bru and Mizo communities. Moreover, the overall prevalence of wasting was significantly higher in the Chakma community (20%), than in the Bru community (13%) and the Mizo community (10%). In summary, the Chakma community has higher percentages of children suffering from nutritional problems than the Bru and Mizo communities, particularly with regard to height-for-age and weight-for-age indicators.

Feeding practices among children under two years

Breastfeeding status among children of age 0-6 months

The breastfeeding status in children is calculated for the children aged 0-6 months. Figure 2 shows that exclusive breastfeeding decreases from 0-6 months. It is observed that in children under 6 months, complementary foods have been introduced early on as 17% of children under 2 months were not exclusively breastfeeding, and this is around 21.7% in 4-6 months children.

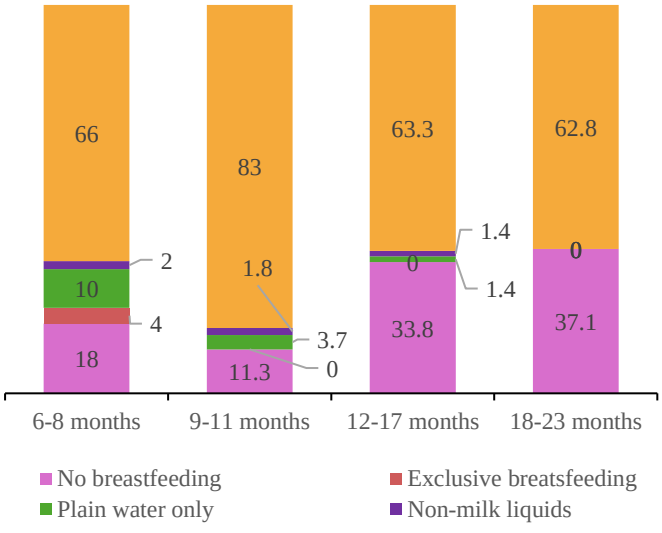
Figure 2. Breastfeeding among children of age 0-6 months



Breastfeeding status among children of age 6-23 months

The feeding practices of children in the age of 6 months to 23 months in Mamit district of Mizoram (Figure 3).

Figure 3. Breastfeeding among children of age 6-23 months



Children in Mamit district consumed grains, roots, and tubers, followed by dairy products. The consumption of flesh foods was the lowest (Figure 4).

Figure 4. Food consumption by children of age 6-23 months

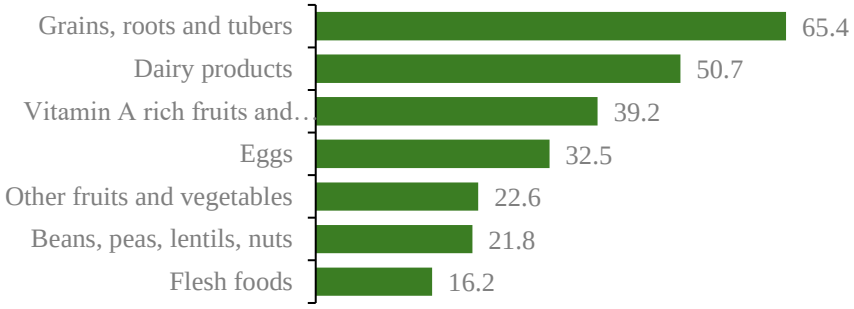


Table 3. IYCF practices (%) with children of age 6-23 months, by tribes

IYCF indicators	Type of children	Bru	Chakma	Mizo	Total
Minimum dietary diversity (MDD)	Breastfed children	26.7	22.2	29.1	25.5
	Non breastfed children	30.8	0.0	34.0	29.4
	All children	27.6	18.2	30.8	26.6
Minimum meal frequency	Breastfed children	55.6	47.2	45.4	50.0
	Non breastfed children	38.5	62.5	42.6	44.1
	All children	51.7	50.0	44.4	48.4
Minimum acceptable diet (MAD)	Breastfed children	17.8	5.6	14.0	12.5
	Non breastfed children	7.7	0.0	12.8	10.3
	All children	15.5	4.6	13.5	11.9

The IYCF indicators for minimum acceptable diet by breastfeeding status among the youngest children aged 6-23 months presented in Table 3. Twenty-seven percent of children had a sufficiently diverse diet incorporating foods from four or more food groups, while 48% were fed the minimum number of times appropriate for their age according to the IYCF recommendations. Only 12% of children aged 6-23 months meet the minimum standards for all IYCF feeding practices and the same percentage received the minimum acceptable diet. The pattern of MDD, minimum meal frequency, and minimum acceptable diet was similar among breastfed and non-breastfed children. In terms of feeding practices within tribal communities, the prevalence of a minimum acceptable diet was higher among Bru community children (16%) compared to those in the Mizo community (14%). Additionally, feeding practice of supplemental food among children belong to Chakma Community was notably poor compared to other tribal groups.

Diet Diversity among Children of age 2-6 years

Diet diversity helps in understanding micronutrient consumption. The

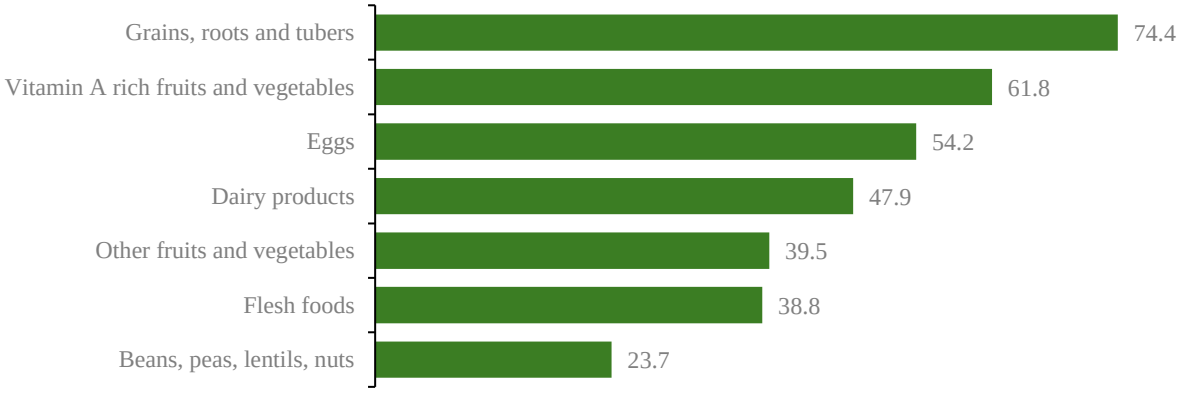
minimum dietary diversity (4+ food groups) among children aged 2-6 years in Mamit district was found to be 47.9% (refer to Table 4). Minimum dietary diversity represents consumption of at least 4 or more food groups on the previous day. Consumption of food from at least 4 food groups means that, in most populations, the child will have a high likelihood of consuming at least one animal source food and at least one fruit or vegetable, in addition to a staple food.

Table 4. Minimum dietary diversity (4+ food groups) among children (2-6 years), by tribes

Gender	Bru (%)	Chakma (%)	Mizo (%)	Total (%)
Male	43.2	29.0	57.1	44.8
Female	33.3	32.0	64.0	51.9
Total children	**39.3**	**30.3**	**60.1**	**47.9**

The percentage of children (2-6 years) consuming 4+ food groups in Bru (39.3), Chakma (30.3), Mizo (60.1), respectively. Among female children (2-6 years), approximately 51.9% consumed four or more food groups, compared to 44.8% among male children.

Figure 5. Food consumption by children of age 2-6 years



Gains, roots and tubers food group was consumed most by the children in Mamit district followed by Vitamin A rich fruits and vegetables. The consumption of beans, peas, lentils and nuts was the lowest followed by flesh foods and other fruits and vegetables (Figure 5).

Table 5. Food consumption by children of age 2-6 years, by tribes

Type of community	Grains, roots and tubers	Beans, peas, lentils or nuts	Dairy products	Flesh foods	Eggs	Vitamin A rich fruits and vegetables	Other fruits and vegetables
Bru	80.3	19.6	34.4	39.3	45.9	57.3	29.5
Chakma	82.1	25.0	19.6	35.7	35.7	60.7	41.0
Mizo	71.2	26.8	66.6	39.8	64.7	65.3	43.7
Total	**74.4**	**23.7**	**47.9**	**38.8**	**54.2**	**61.8**	**39.5**

The consumption of different food groups as per three dominant tribes of Mamit district (Table 5). It was observed that the most prominent food groups consumed in all the tribes were grains, roots and tubers followed by Vitamin A rich fruits and vegetables. The consumption of beans, peas, lentils or nuts were found to be poor in all tribes. The Mizo tribe out of the three tribes have comparatively better consumption of most food groups.

The mean dietary diversity score of children in the age group of 2-6 years (Table 6) surveyed in the Mamit district. Mizo tribe showed the highest mean diet diversity score of 3.7 in children surveyed with a standard deviation of 1.4. Furthermore, the mean diet diversity score of all the tribes falls in the range of 3.0 to 3.7. The maximum diet diversity score registered was seven with zero being the least.

Table 6. Mean dietary diversity score (DDS) of children (2-6 years), by tribes

	Bru	Chakma	Mizo	Total
Mean	3.0	3.0	3.7	3.4
SD	1.5	1.5	1.4	1.5
Number of children	61	56	153	286
Maximum	7	7	7	7
Minimum	0	0	0	0

Discussion

This study presents critical insights into undernutrition and dietary diversity among children under six in Mamit, a geographically remote and climatically vulnerable district of Mizoram. Despite Mizoram's relatively favorable nutrition indicators compared to national averages (IIPS & ICF, 2021), significant disparities in nutritional outcomes persist at the district level, particularly among some vulnerable tribal populations.

Among the surveyed children, 25% were stunted, 18% were underweight, and 13% were wasted—statistics that reflect both chronic and acute forms of undernutrition.

Notably, boys exhibited higher rates of stunting and underweight than girls, a trend consistent with previous research in the region (Purbey et al., 2024; Rao et al., 2005; Sati & Vangchhia, 2017). Nutritional disparities were particularly pronounced in the Chakma community, where the prevalence of stunting and underweight was significantly higher than in the Mizo and Bru communities.

Feeding practices also revealed critical gaps. Only 12% of children aged 6–23 months met the minimum acceptable diet as per WHO standards (WHO, 2018). The prevalence of minimum dietary diversity was only 26.6% among this group, while nearly half (47.9%) of children aged 2–6 failed to meet a basic threshold of four food groups. The consumption of protein-rich foods such as beans, lentils, eggs, and animal-based sources remained alarmingly low across all communities.

These findings align with national concerns regarding the erosion of traditional diets and the shift toward low-nutrient, market-dependent food patterns (Chyne et al., 2017; ICMR-NIN, 2020). However, in Mamit, food insecurity is also exacerbated by geographic and climatic factors. The district, being landslide-prone and subject to erratic rainfall, frequently experiences disruptions in food availability and accessibility (Mandal et al., 2023; Monsang et al., 2021). Heavy rainfall and poor road connectivity hinder market access and contribute to seasonal food shortages, particularly in remote blocks like Zawlnuam and West Phaileng.

The economic and infrastructural disadvantages are compounded by a reliance on subsistence agriculture, with limited crop diversity and vulnerability to climatic shocks (Thong et al., 2022). Mamit's spatial marginalization—away from the state capital Aizawl and bordering Bangladesh—translates into lower administrative visibility and limited programmatic outreach (Singh, 2017).

The study also highlights the limited reach of Infant and Young Child Feeding (IYCF) practices. Early initiation of complementary feeding and a drop in exclusive breastfeeding by two months of age point to critical knowledge and behavior gaps among caregivers. These gaps are likely influenced by maternal education, with a notable proportion of Chakma and Bru mothers reporting low or no schooling.

While the findings provide valuable micro-level evidence, several limitations must be noted. The cross-sectional design restricts causal inferences between dietary patterns and nutritional outcomes. The use of a 24-hour recall method may introduce recall bias and fails to account for seasonal variations in food intake. Furthermore, self-reported responses from mothers and caregivers may be subject to social desirability bias.

Conclusion

This study highlights the persistence of nutritional inequality in Mamit district, despite Mizoram's relatively strong state-level performance. Undernutrition and inadequate dietary diversity disproportionately affect marginalized tribal groups, particularly the Chakma community. The findings emphasize the urgency of adopting a localized, culturally sensitive, and climate-resilient approach to address nutritional deficits. Interventions must go beyond food availability to enhance food accessibility, promote traditional and nutritionally rich food systems, and integrate behavior change communication targeting feeding practices. Community-based programs that couple nutrition education with resilient agricultural strategies are especially warranted in ecologically fragile border districts like Mamit.

The study reiterates the importance of primary data collection in uncovering the lived realities of underrepresented communities. Investments in granular, district-level research are essential to informing targeted policy responses and improving child nutrition outcomes in vulnerable and remote regions of Northeast India.

Declarations

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Consent for publication

Not applicable. No details, images or videos related to individual participants were obtained.

Competing interests

The authors declare no competing interests.

References

Ashok, S., Nguyen, P. H., Singh, S. K., Sarwal, R., Bhatia, N., Johnston, R., ... & Menon, P. (2022). State nutrition profile: Mizoram (Vol. 77). Intl Food Policy Res Inst.

Arimond, M., & Ruel, M. (2004). Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys. Journal of Nutrition, 134(10), 2579–2585. https://doi.org/10.1093/jn/134.10.2579

Barrett, C. B. (2010). Measuring food insecurity. Science, 327(5967), 825–828. https://doi.org/10.1126/science.1182768

Census 2011. (n.d.). Mamit district: Census 2011 data. Retrieved from https://www.census2011.co.in/census/district/386-mamit.html

Chenkual, L. (2016). Vulnerability of the State of Mizoram, India to Various Natural Hazards. International Journal of Innovative Science, Engineering & Technology, 3(1), 438-445.

Chyne, D. A. L., Meshram, I. I., Rajendran, A., Kodali, V., Getti, N., Roy, P., ... & Longvah, T. (2017). Nutritional status, food insecurity, and biodiversity among the Khasi in Meghalaya, North-East India. Maternal & Child Nutrition, 13, e12557.

Darapheak, C., Takano, T., Kizuki, M., et al. (2013). Consumption of animal source foods and dietary diversity reduce stunting in children in Cambodia. International Archives of Medicine, 6, 29. https://doi.org/10.1186/1755-7682-6-29

Deaton, A., & Drèze, J. (2009). Food and nutrition in India: Facts and interpretations. Economic & Political Weekly, 44(7), 42–65.

Down to Earth. (2023). Dietary diversity can help stamp out child malnutrition in India. Retrieved October 23, 2023, from https://www.downtoearth.org.in/blog/health/dietary-diversity-can-help-stamp-out-child-malnutrition-in-india-90180

ICMR-National Institute of Nutrition. (2020). What India eats. Ministry of Health and Family Welfare, Government of India. Retrieved from https://www.millets.res.in/pdf/what_india_eats.pdf

International Food Policy Research Institute (IFPRI). (2021). District nutrition profile, Mamit. Retrieved from https://ebrary.ifpri.org/digital/api/collection/p15738coll2/id/131866/download

International Institute for Population Sciences (IIPS) & ICF. (2021). National Family Health Survey (NFHS-5), 2019-21: India. IIPS.

Mahanta, T. G., Ronghangpi, P., Baruah, M., & Baruah, S. D. (2022). Complimentary feeding practices amongst tribal and non-tribal population of Assam. Journal of Comprehensive Health, 10(1), 4-13.

Mandal, R., Goswami, B., Sarma, M., & Nath, H. K. (2023). Extreme weather events and food insecurity in Northeast India. In Sustainable Development Goals in Northeast India: Challenges and Achievements (pp. 101-126). Singapore: Springer Nature Singapore.

Monsang, N. P., Tripathi, S. K., Singh, N. S., & Upadhyay, K. K. (2021). Climate change and Mizoram: Vulnerability status and future projections. Mizoram: Environment, Development, and Climate Change, 2021, 33-40.

National Centre for Disease Control. (2024). State action plan on climate change and human health: Mizoram. Ministry of Health and Family Welfare, Government of India.

Pachuau, R. (2009). Mizoram: A study in comprehensive geography. Northern Book Centre.

Purbey, A., Zavier, A. F., Mishra, P., Acharya, R., Saggurti, N., & Mondal, S. (2024). NFHS-2024-wl-6438-Assessing the geographical and contextual vulnerability of reproductive, maternal, child and adolescent health in northeast India. Economic & Political Weekly, 59(35).

Rao, G. R., Ladusingh, L., & Pritamjit, R. (2005). Nutritional status of children in north-east India. Asia-Pacific Population Journal, 19(3), 39-56.

Registrar General of India. (2011). Census of India 2011. Retrieved from

https://censusindia.gov.in/census.website/data/census-tables

Sati, V. P., & Vangchhia, L. (2017). Food security status in rural areas of Mizoram, Northeast India. Journal of Mountain Science, 14, 795-805.

Sen, A. (1981). Poverty and famines. Oxford University Press.

Singh, A. K. (2017). Urbanization in Mizoram: Characteristics and correlates. The Geographer, 64(1), 21-31.

Thong, P., Thangjam, U., Sahoo, U. K., & Pebam, R. (2022). Socio-economic vulnerability assessment of shifting cultivators (Jhumias) amidst the changing climate in Mizoram, northeast India. Applied Geography, 147, 102790.

World Health Organization. (2008). Indicators for assessing infant and young child feeding practices: Part 1: Definitions: Conclusions of a consensus meeting held 6–8 (Publication No. WHO/UNICEF/2008). World Health Organization.

World Health Organization. (2018). Infant and young child feeding. World Health Organization.

World Health Organization. (2019). Levels and trends in child malnutrition: UNICEF/WHO/The World Bank Group joint child malnutrition estimates: Key findings of the 2019 edition. World Health Organization.

Supporting Information

1. How Dietary diversity was recorded for this study?

a. Minimum dietary diversity

The study asked the mothers/ caregivers of the children aged 6 months to 6 years about his/her consumption in last 24 hours. These food groups further converted to 7 groups as grain, roots, and tubers, legumes and nuts, dairy products (milk, yogurt, and cheese), foods[9], eggs, vitamin A rich fruits and vegetables, fruits, other fruits and vegetables[10]. Consumption of any amount of food from each food group is sufficient to "count", i.e., there is no minimum quantity. The cut-off of at least 4 of the above 7 food groups above was selected because it is associated with better quality diets. Though the results reported separately for the breastfeed and non-breastfed children, the diversity score is not compared, and breastmilk is also not considered as a food group in this report. This indicator is further segregated to understand the pattern of MDD by various socio-demographic characteristics.

b. Minimum Meal Frequency

Minimum meal frequency among currently breastfeeding children is defined as children who also received solid, semi-solid, or soft foods two times or more daily for children aged 6-8 months and three times or more daily for children aged 9-23 months. For non-breastfeeding children aged 6-23 months it is defined as receiving solid, semi-solid or soft foods, or milk feeds, at least four times. A proportion of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more.

c. Minimum Acceptable Diet

The minimum acceptable diet for breast-feed children aged 6-23 months is defined as receiving the minimum dietary diversity and the minimum meal frequency. For non-breastfed children, achieving the indicator requires at least two milk feedings and furthermore, minimum dietary diversity must be achieved without including milk feeds and the minimum meal frequency must be met.

2. Status of breastfeeding is calculated in the children in the age group 6-23 months, different categories included are:

1. **Currently not breastfeeding:** This includes children in 6-23 months who are currently not breastfeeding.

2. **Exclusive breastfeeding:** This includes children in 6-23 months who are still breastfeeding without consumption of any other liquids or solid food.

3. **Breastfeeding and plain water:** This includes children in the age group 6-23 months who are currently

[9] Includes meat and fish

[10] Any other fruit like oranges, apples, bananas, tangerines, green/ unripe mangoes Any other vegetables like cabbage, eggplants, tomatoes, onions, green pepper, green/ fresh beans, broad beans, cluster beans, okra etc.

breastfeeding as well as consuming plain water.

4. **Breastfeeding and non-milk liquids:** This includes children in the age group 6-23 months who are currently breastfeeding as well as consuming juices/clear broth/any other liquid.

5. **Breastfeeding and other milk:** This includes children in the age group 6-23 months who are currently breastfeeding as well as consuming milk/infant formula.

6. **Breastfeeding and complementary food:** This includes children in the age group 6-23 months who are currently breastfeeding as well as consuming any solid/semi-solid/soft food/commercially fortified baby food.

3. ICYF practice module

WHO recommends continued breastfeeding after six months till two years of age and beyond. After the initial six months, breast milk alone is insufficient to fulfil the nutritional requirements of the infant. Hence, introducing complementary foods becomes crucial for the child's diet. It is essential to diversify the range of foods to ensure the fulfilment of nutrient needs. Daily consumption of fruits and vegetables, particularly those high in vitamin A, is recommended. Incorporating a variety of fruits and vegetables beyond those rich in vitamin A is equally important for a balanced diet. In this study we used infant and young child feeding (IYCF) practices module (WHO and UNICEF, 2021) to calculate the dietary diversity, minimum meal frequency, and minimum acceptable diet of under two-year-old children considering the following food groups:

1. Infant formula, milk other than breast milk, cheese or yogurt or other milk products
2. Foods made from grains or roots, including porridge or gruel, fortified baby food
3. Vitamin A-rich fruits and vegetables
4. Other fruits and vegetables
5. Eggs
6. Meat, poultry, fish, shellfish, or organ meats beans, peas, lentils, or nuts