

# PROVINCIAL INEQUALITIES IN CHILD MALNUTRITION IN VIETNAM: EVIDENCE FROM PANEL DATA, 2020–2024

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## ABSTRACT

*Child malnutrition remains a major public health challenge in many developing countries, including Vietnam, where substantial socioeconomic disparities persist across provinces. This study examines provincial trends and socioeconomic inequalities in child malnutrition in Vietnam during 2020–2024. Panel data from 63 provinces were compiled from official sources, including the Ministry of Health of Vietnam, the General Statistics Office of Vietnam, and provincial socioeconomic reports. Three indicators of malnutrition among children under five years of age were analyzed: stunting, underweight, and wasting. Descriptive statistics, the Gini coefficient, Theil index, and Concentration Index were employed to assess interprovincial disparities and socioeconomic inequality. The findings reveal substantial provincial variation in child malnutrition, with major urban areas showing lower prevalence and faster improvement than mountainous and disadvantaged provinces. Both Gini and Theil index increased over the study period, indicating widening interprovincial inequality. Negative and statistically significant concentration indices suggest that malnutrition remains disproportionately concentrated in poorer provinces. These findings highlight the need for geographically targeted nutrition policies and stronger investments in health and social protection systems in disadvantaged regions.*

**Keyword:** child malnutrition, health inequality, provincial disparities, concentration index, Vietnam.

## 1. INTRODUCTION

Improving child nutrition remains a central priority in global health and sustainable development, particularly in low- and middle-income countries. Despite notable progress in reducing malnutrition over recent decades, millions of children worldwide continue to experience chronic and acute forms of malnutrition. According to joint estimates from UNICEF, World Health Organization, and the World Bank, approximately 148 million children under five years of age were affected by stunting and 45 million by wasting in 2022. These figures indicate that malnutrition remains a persistent challenge, especially in settings where poverty, unequal access to healthcare, and regional development gaps continue to shape child health outcomes.

Existing evidence suggests that child malnutrition is not evenly distributed across populations. Children living in economically disadvantaged households, rural communities, or geographically isolated areas often face a significantly higher risk of poor nutritional outcomes. Socioeconomic

deprivation may limit access to adequate food, maternal healthcare, immunization, sanitation, and other essential determinants of child growth and development. As a result, nutritional inequalities often reflect broader structural disparities in economic opportunities, social protection, and health system capacity.

In Vietnam, substantial improvements in maternal and child health have been achieved during the past two decades through economic growth and expanded public health programs. However, these improvements have not been equally distributed across provinces. Major urban centers and economically dynamic regions tend to report lower rates of child malnutrition, while mountainous provinces, ethnic minority areas, and economically disadvantaged regions continue to experience a relatively high nutritional burden. This suggests that national averages may mask important subnational disparities in child health outcomes.

Although previous studies in Vietnam have explored household-level determinants of child malnutrition, limited evidence is available on

provincial inequality in child malnutrition using recent panel data and inequality measurement approaches. In particular, there remains a lack of evidence on how malnutrition is distributed across provinces and whether it is systematically concentrated in economically disadvantaged areas in the post-COVID-19 period. To address this gap, this study investigates provincial trends in child malnutrition in Vietnam from 2020 to 2024, measures interprovincial inequality, and examines the socioeconomic concentration of child malnutrition across provinces.

## 2. LITERATURE REVIEW

The relationship between socioeconomic inequality and child nutritional outcomes has been widely examined in public health and health economics literature. Among the most commonly used approaches, the Concentration Index (CI) has become a standard measure for assessing income-related inequality in health outcomes. A pioneering study by Wagstaff et al. (2003) analyzed child malnutrition in Vietnam and demonstrated that malnutrition was disproportionately concentrated among children from poorer households. Using decomposition techniques, the authors showed that household income, maternal education, and access to health services were major contributors to nutritional inequality.

Subsequent studies extended the application of the concentration index to cross-country comparisons. Van de Poel et al (2008) examined socioeconomic inequality in child malnutrition across developing countries and found that stunting and underweight were consistently more prevalent among economically disadvantaged populations. Their findings confirmed that nutritional inequality remains strongly associated with poverty and limited access to basic healthcare services.

In China, Chen et al. (2007) used the concentration index (CI) to examine child malnutrition inequality across provinces. The study found that income growth, parental education, and improved transportation infrastructure contributed to reducing nutritional inequality, while regional disparities remained a significant determinant of child health outcomes.

Beyond income-related inequality, several studies have employed the Gini coefficient and Theil index to assess geographic disparities in nutrition and

health outcomes. The Gini coefficient, originally developed to measure income inequality, has increasingly been applied to quantify disparities in health indicators across regions. Similarly, the Theil index offers an advantage in decomposing inequality into within-group and between-group components, making it particularly useful in regional health studies. A recent systematic review of global malnutrition inequality also confirmed that child malnutrition remains disproportionately concentrated among poorer populations, with consistently negative concentration indices observed for stunting and wasting across low- and middle-income countries (R. Alao et al, 2021).

Although previous studies have provided substantial evidence on socioeconomic inequality in child nutrition, most existing research has focused on household-level data or cross-sectional surveys. Limited evidence is available on interprovincial inequality in child malnutrition using panel data and multiple inequality measures simultaneously, particularly in Vietnam during the post-pandemic period. This study addresses this gap by combining the Gini coefficient, Theil index, and concentration index to examine both spatial and socioeconomic inequality in child malnutrition across Vietnamese provinces from 2020 to 2024.

## 3. METHODOLOGY

### 3.1. Data sources

This study uses a balanced panel dataset covering 63 provinces and centrally governed cities in Vietnam over the period 2020–2024. Provincial-level data were compiled from official sources, including the Ministry of Health of Vietnam, the General Statistics Office of Vietnam, and annual provincial socioeconomic reports. These sources provide consistent information on child nutritional outcomes, economic conditions, and healthcare resources across provinces. Due to incomplete reporting in some provinces, the number of observations in 2023 and 2024 is slightly lower than in previous years.

The unit of analysis is the province-year observation. After data cleaning and consistency checks, the final dataset includes information on child nutritional indicators and provincial socioeconomic characteristics across the study period.

### 3.2. Variables

Child malnutrition was measured using three standard indicators for children under five years of age:

- Stunting (%): proportion of children with height-for-age below the WHO growth reference standard, reflecting chronic malnutrition.
- Underweight (%): proportion of children with weight-for-age below the reference standard, reflecting cumulative nutritional deficiency.
- Wasting (%): proportion of children with weight-for-height below the reference standard, reflecting acute malnutrition.

These indicators are widely used in international nutrition surveillance and public health research.

### 3.3. Analytical methods

To examine provincial disparities and socioeconomic inequality in child malnutrition, four analytical approaches were employed.

- Descriptive analysis, including mean, standard deviation, minimum, and maximum values, were used to summarize the distribution and temporal variation of nutritional and socioeconomic indicators across provinces.

- Measurement of interprovincial inequality:

To assess disparities in child malnutrition across provinces, the study employs the Gini coefficient and Theil index.

- + The Gini coefficient is calculated as: where  $y_i$  represents the malnutrition rate of province  $i$ ,  $n$  is the number of provinces, and  $\mu$  is the sample mean.

- + The Theil index is defined as:

$$T = \frac{1}{n} \sum_{i=1}^n \frac{y_i}{\mu} \ln \left( \frac{y_i}{\mu} \right)$$

Higher values of both indices indicate greater inequality in nutritional outcomes across provinces.

- Measurement of socioeconomic inequality:

To examine whether child malnutrition is concentrated among poorer provinces, the study uses the Concentration Index, expressed as: where  $y_i$  denotes the child malnutrition rate in province  $i$ ,  $\mu$  is the sample mean, and  $R_i$  represents the fractional rank of provinces based on GRDP per capita.

A negative concentration index indicates that child malnutrition is disproportionately concentrated among economically disadvantaged provinces, whereas a positive value suggests concentration among wealthier provinces.

### 3.4. Statistical software

All statistical analyses were performed using Stata version 17. Descriptive statistics, inequality indices, and concentration measures were estimated at the provincial level for each year from 2020 to 2024.

## 4. FINDINGS

### 4.1. Descriptive statistics and provincial trends

The descriptive statistics reveal substantial variation in child nutritional outcomes and socioeconomic conditions across provinces in Vietnam during 2020–2024.

**Table 1. Descriptive statistics of variables, 2020-2024**

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
Stunting rate (%)	306	20,52	5,24	2,6	30,8
Wasting rate (%)	305	5,53	1,52	1,5	12,7
Underweight rate (%)	306	11,62	3,98	3,2	24,6
Multidimensional poverty rate (%)	315	6,25	7,48	0	36,7
GRDP per capita (million VND/year)	315	81,94	47,01	29,8	372,1

The average prevalence of stunting among children under five was 20.52%, ranging from 2.6% to 30.8%, indicating considerable interprovincial disparity in chronic malnutrition. Similarly, the average prevalence of wasting and underweight was 5.53% and 11.62%, respectively, with wide variation across provinces. These findings suggest that nutritional outcomes remain unevenly distributed across localities.

Socioeconomic indicators also exhibited significant disparities. The multidimensional poverty rate ranged from 0% to 36.7%, while

GRDP per capita varied substantially across provinces, reflecting large differences in economic development and living standards. These variations provide an important context for understanding nutritional inequality.

#### 4.2. Provincial trends in child malnutrition

Table 2 reveals substantial disparities in child malnutrition across provinces in Vietnam during 2020–2024, highlighting a clear contrast between economically developed urban centers and socioeconomically disadvantaged provinces.

**Table 2. Changes in child malnutrition rates in provinces with the highest and lowest prevalence in Vietnam, 2020–2024**

Province	Underweight (%)		Stunting (%)		Wasting (%)	
	2020	2024	2020	2024	2020	2024
Hanoi	4,9	4,8	12,6	8,8	2,7	4,6
Bac Ninh	9,7	4,6	20,7	10,8	4,8	4,8
Hai Phong	6,8	6,5	17,2	16,3	2,9	3,2
Da Nang	3,5	3,3	12,9	10,4	3,7	3,6
HCM City	4,3	4,5	6,5	5,8	1,5	2,5
Ha Giang	18,6	18,3	19,9	30,2	5,9	5,8
Cao Bang	16,7	16,8	28,5	28	5,3	11,7
Lai Chau	18,3	17,4	28,8	26,7	4,8	6,9
Gia Lai	19,8	24,6	29,7	27,6	5,9	9,2
Dak Lak	18,4	17,6	28,5	27,6	6,2	6,6

Among provinces with relatively low malnutrition prevalence, major urban areas such as Hanoi, Ho Chi Minh City, Da Nang, and Hai Phong maintained comparatively favorable nutritional outcomes throughout the study period. For example, the stunting rate in Hanoi declined from 12.6% in 2020 to 8.8% in 2024, while Bac Ninh recorded a substantial reduction from 20.7% to 10.8%. These improvements may be associated with stronger economic performance, better maternal and child healthcare services, higher urbanization, and more effective implementation of nutrition and vaccination programs. Provinces such as Hanoi and Ho Chi Minh City consistently rank among the highest in GRDP per capita and healthcare resource availability, which may contribute to improved child nutritional outcomes.

In contrast, mountainous and disadvantaged provinces such as Ha Giang, Cao Bang, Lai Chau, Gia Lai, and Dak Lak continued to experience a relatively high nutritional burden. Particularly, Ha Giang saw its stunting rate increase from 19.9% to 30.2%, while wasting in Cao Bang more than

doubled from 5.3% to 11.7%. Similarly, underweight prevalence in Gia Lai increased markedly from 19.8% to 24.6%. These findings reflect persistent nutritional vulnerability in remote and ethnic minority areas, where poverty, difficult geographic conditions, food insecurity, and limited access to healthcare services remain significant challenges.

These provincial patterns are consistent with national evidence showing that child malnutrition in Vietnam remains concentrated in mountainous northern provinces and parts of the Central Highlands, where multidimensional poverty rates remain significantly above the national average. Although Vietnam has made notable progress in reducing national child malnutrition over the past decade, the findings suggest that the benefits of economic growth and public health interventions have not been equally distributed across regions. This highlights the continuing need for geographically targeted nutrition and primary healthcare interventions in vulnerable provinces.

#### 4.3. Interprovincial inequality in child malnutrition

The results of the Gini coefficient and Theil index demonstrate an increasing level of inequality in

child malnutrition across provinces between 2020 and 2024.

**Table 3. Gini coefficient and Theil Index of interprovincial inequality in child malnutrition, 2020–2024**

Malnutrition Indicators	Index	2020	2021	2022	2023	2024
Stunting	Gini	0,1015	0,1055	0,1055	0,1669	0,1898
	Theil	0,0196	0,0209	0,0209	0,0446	0,0599
Underweight	Gini	0,1653	0,1689	0,1689	0,2116	0,2259
	Theil	0,0467	0,0485	0,0485	0,0710	0,0818
Wasting	Gini	0,1209	0,1292	0,1292	0,1514	0,1707
	Theil	0,0255	0,0285	0,0285	0,0392	0,0487

For stunting, the Gini coefficient increased from 0.1015 in 2020 to 0.1898 in 2024, representing an increase of approximately 87%. Similarly, the Theil index rose from 0.0196 to 0.0599, more than tripling over the study period. This indicates that disparities in chronic malnutrition between provinces widened substantially. The sharp increase after 2022 suggests that some provinces improved more rapidly, while others—particularly remote and economically disadvantaged areas—continued to face persistent nutritional challenges.

A similar pattern is observed for underweight, which recorded the highest inequality among the three indicators. The Gini coefficient increased from 0.1653 in 2020 to 0.2259 in 2024, while the Theil index rose from 0.0467 to 0.0818. These results imply that cumulative nutritional deprivation became increasingly concentrated in specific provinces. This finding is consistent with field observations in provinces such as Gia Lai and Ha Giang, where underweight prevalence remained high or even worsened during the study period.

For wasting, although inequality levels were lower than underweight, both indices also increased steadily. The Gini coefficient rose from 0.1209 to 0.1707, while the Theil index nearly doubled from 0.0255 to 0.0487. This suggests that acute malnutrition also became more unevenly distributed across provinces.

From a broader perspective, these findings indicate that while Vietnam has continued to reduce national child malnutrition in recent years, the benefits of economic growth and public health interventions have not been equally shared across regions. Major urban and industrial provinces such as Hanoi, Ho Chi Minh City, and Bac Ninh experienced faster improvements, whereas mountainous provinces in the Northern Midlands and the Central Highlands continued to report relatively poor nutritional outcomes. The increasing Gini and Theil values therefore suggest widening regional inequality in child nutrition, emphasizing the need for geographically targeted nutrition and healthcare policies.

#### 4.4. Socioeconomic inequality in child malnutrition

Table 4 presents the results of the Concentration Index, which measures the extent to which child malnutrition is distributed across provinces with different socioeconomic conditions in Vietnam. The results show that the concentration index remained negative and statistically significant throughout the study period ( $p < 0.001$ ), indicating that child malnutrition was disproportionately concentrated in economically disadvantaged provinces.

**Table 4. Concentration Index of child malnutrition by socioeconomic conditions in Vietnam, 2020–2024**

Year	Observations	Concentration Index (CI)	Standard Error	p-value
2020	63	-0,0689	0,0109	0,000
2021	63	-0,0734	0,0110	0,000
2022	63	-0,0734	0,0110	0,000

2023	58	-0,1182	0,0161	0,000
2024	59	-0,1099	0,0212	0,000

Specifically, the concentration index decreased from  $-0.0689$  in 2020 to  $-0.1099$  in 2024, with the most negative value observed in 2023 ( $-0.1182$ ). The increasing absolute magnitude of the index suggests that socioeconomic inequality in child malnutrition became more pronounced over time. In other words, although Vietnam continued to improve child health outcomes at the national level, the nutritional burden remained increasingly concentrated in poorer provinces.

The results are consistent with provincial patterns observed in northern mountainous provinces such as Ha Giang, Cao Bang, and Lai Chau, as well as Central Highlands provinces such as Gia Lai and Dak Lak, where both poverty rates and child malnutrition prevalence remained relatively high. By contrast, economically developed provinces such as Hanoi, Ho Chi Minh City, and Bac Ninh consistently reported lower malnutrition rates, reflecting the benefits of stronger local economies, better healthcare access, and more developed social infrastructure.

The sharper decline in the concentration index after 2022 may also reflect the unequal recovery from the COVID-19 period, during which poorer provinces faced greater challenges related to household income instability, food insecurity, and disruptions in maternal and child healthcare services. Although the number of observations in 2023 and 2024 was slightly lower due to incomplete provincial reporting to the Ministry of Health of Vietnam, the consistency of statistically significant negative estimates suggests that the overall pattern of socioeconomic inequality remained robust.

Overall, the findings indicate that child malnutrition in Vietnam is not only a public health issue but also a manifestation of broader socioeconomic inequality, emphasizing the importance of targeted nutrition interventions and social protection policies in disadvantaged provinces.

## 5. DISCUSSION

The findings provide strong evidence that child malnutrition in Vietnam remains closely associated with regional socioeconomic

disparities. Provinces with stronger economic performance, better healthcare infrastructure, and higher urbanization levels generally achieved lower malnutrition rates and faster improvements over time. In contrast, provinces characterized by high poverty, limited healthcare access, and geographic isolation continued to experience a higher nutritional burden.

The increasing values of the Gini and Theil indices suggest that economic growth at the national level has not translated into equitable improvements in child nutrition across provinces. This finding is consistent with the work of Van de Poel et al. (2008), who found that malnutrition tends to be concentrated among disadvantaged populations in developing countries. Similarly, the negative concentration indices observed in this study support earlier evidence from Wagstaff et al., which demonstrated that nutritional deprivation is more prevalent among poorer households and communities.

The widening inequality observed after 2022 may also reflect the uneven recovery from the COVID-19 pandemic, during which economically vulnerable provinces may have faced greater disruptions in healthcare access, food security, and maternal-child health services. This suggests that post-pandemic public health recovery has not been equally distributed across regions.

## 6. CONCLUSION

This study provides empirical evidence on provincial disparities and socioeconomic inequality in child malnutrition across Vietnam during the period 2020–2024. Using panel data from 63 provinces and multiple inequality measures, including the Gini coefficient, Theil index, and Concentration Index, the study identifies several important findings.

First, child malnutrition in Vietnam continues to show substantial variation across provinces. Major urban and economically developed areas such as Hanoi and Ho Chi Minh City generally reported lower rates of stunting, underweight, and wasting, while mountainous and socioeconomically disadvantaged provinces such as Ha Giang, Cao Bang, and Gia Lai continued to

experience a relatively high nutritional burden. Second, the increasing values of the Gini coefficient and Theil index indicate that interprovincial inequality in child malnutrition widened during the study period. Third, the consistently negative and statistically significant concentration indices confirm that child malnutrition remains disproportionately concentrated in economically disadvantaged provinces.

These findings suggest that improvements in national nutrition outcomes have not been equally distributed across regions. Persistent disparities in poverty, healthcare access, and local development capacity continue to shape unequal child health outcomes. Therefore, reducing child malnutrition in Vietnam requires not only broad national nutrition programs but also geographically targeted interventions focusing on poor and vulnerable provinces. Strengthening primary healthcare systems, expanding maternal and child nutrition services, and improving social protection coverage in disadvantaged regions should be prioritized to promote more equitable child health outcomes in the future

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