Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.8895

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2022) *10*(2), 57-65

Indian Journal of Pure & Applied Biosciences

Peer-Reviewed, Refereed, Open Access Journal

Research Article

Inequality in Under-Nutrition among Under-Five Children in Lakhimpur District of Assam

Jatin Phukan[1*], Sarat Hazarika[2] and Bipin Gogoi[3]

[1]Ph.D. Scholar, Dept. of Statistics, Dibrugarh University, Assam, India-786004

[2]Registrar, Madhabdev University, Narayanpur, Assam, India-784164

[3]Professor, Dept. of Statistics, Dibrugarh University, Assam, India-786004

*Corresponding Author E-mail: jatinlasi1992@gmail.com

Received: 7.02.2022 | Revised: 26.03.2022 | Accepted: 5.04.2022

ABSTRACT

Children of today are citizens of tomorrow, hence improving nutritional status among children becomes extremely important for all the nations. The raw data collected from the Lakhimpur district reveals that the burden of overall nutritional deficiency among children is still too high; on average, two in every five (37%) children had at least one kind of nutritional deficiency. However, the nutritional status of female children has improved over time compared to the male children, but the overall decline is not satisfactory. We have observed a higher inequality of nutritional deficiency among children in Assam by household wealth status (Gini value= 0.498) compared to the mother's education level (Gini value = 0.067). Therefore, it's an urgent need to expand the scope of the ICDS program to provide mass nutrition and health education by making provisions for home visits and primarily targeting pregnant and lactating mothers.

Keywords: *Nutritional Indicators, Under-five Children, Gini index, Lorenz curve, Assam.*

INTRODUCTION

In India, despite economic progress in the past two decades, one-third of children under five are malnourished, i.e. stunted, wasted, or overweight, and nearly two-thirds of them suffer from hidden hunger because of the poor quality of their diets. Due to the vast geographic preview of the country and the huge variation of food habits and culture, the nutritional status among children varies extensively within the country. However, children's growth is internationally recognized as a key indicator for monitoring a population's nutritional status and health status (de Onis & Blössner, 2003; & Mitsunaga & Yamauchi, 2020). Recently child health has gained global attention and has been included as a target indicator in Sustainable Development Goal (SDG) 2; "zero hunger and end of all forms of malnourishment by 2030".

Cite this article: Phukan, J., Hazarika, S., & Gogoi, B. (2022). Inequality in Under-nutrition among under-five children in Lakhimpur district of Assam, *Ind. J. Pure App. Biosci. 10*(2), 57-65. doi: http://dx.doi.org/10.18782/2582-2845.8895

Also, the World Health Assembly (WHA, 2012) targets reducing the burden of under-nutrition and overweight and increasing exclusive breastfeeding for six-month-old newborns by 2025. The beginning two years of a child's life are recognized as a crucial period for optimal growth and development (Arnold et al., 2009; & Victora et al., 2010). During this period, optimal energy and nutrients are required to meet children's metabolic and physiological demands (Butte, 2005). Hence, a proper diet is necessary from the very early stages of life for systematic growth, development, and overall well-being. However, adequate nutrition has always been a policy priority for achieving maternal and child health targets (Singh, 2020). Children of today are citizens of tomorrow, and hence improving the nutritional status of children becomes extremely important.

The most common and popularly used child nutritional indicators are - Height-for-age Z-score, Weight-for-age Z-score, and Weight-for-height Z-score. These three nutritional indicators are expressed in standard deviation units (Z-scores) from the median of the international reference population (WHO Multicentre Growth Reference Study Group, 2006) and the basic information required for calculating these indicators are - age of children (months), gender of children (male/female), the height of children (cm), and weight of children (kg). Each of the indicators provides different information about the physical growth of the children. The low height-for-age Z-score is an indicator of chronic malnutrition, the result of prolonged food deprivation and disease or illness, Low weight-for-height Z-score is an indicator of acute malnutrition, the result of more recent food deprivation or illness, Low weight-for-age Z-score is used as a composite indicator to measure both acute and chronic malnutrition. A child is defined as malnourished (stunting or wasting, or underweight) if his/her height-for-age Z-score is below -2 SD from the median of the international reference population recommended by the World Health Organization. Other hands, children who are below -3 SD from the median of the international reference population are considered as severely malnourished.

The present study examines the nutritional status of 235 children that are randomly collected from the Anganwadi centres in Lakhmpur district of Assam. Secondly, based on the fourth round of the National Family Health Survey (NFHS-4) data, measuring the inequality of aggregated nutritional deficiency among children by household wealth status and mother's education levels for the state of Assam.

MATERIALS AND METHODS

Data sources and sampling design

The present study was carried out in the Lakhimpur district of Assam in August, 2021. Three Integrated Child Development Service (ICDS) projects were purposively selected, i.e. 30% (Total ICDS projects in Lakhimpur district are ten) as the area of investigation and selected nine Anganwadi centres are proportionally distributed among the three ICDS projects before data collection. Then simple random sampling without replacement (SRSWOR) was applied to collect the sample (children aged under five) from the selected Anganwadi centres (AWC) under each ICDS project.

A detail sampling procedure is given below in the Fig. 1.

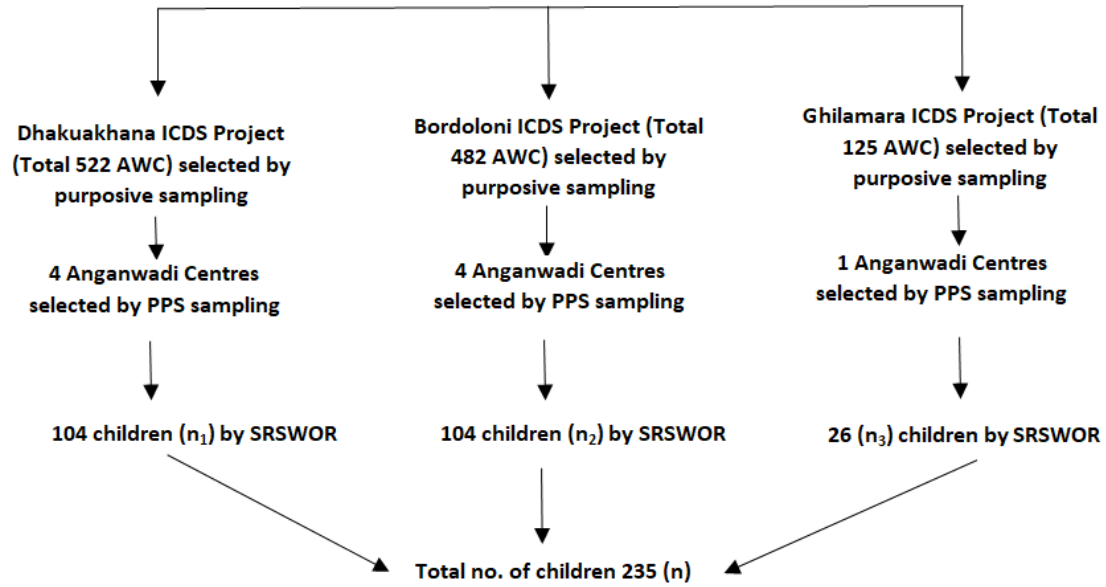

Fig. 1: Distribution of sample size

The present study also used cross-sectional data that was carried out in the fourth round of the National Family Health Survey (NFHS-4) during 2015-16 in Lakhimpur district of Assam. The NFHS provides nationally representative information on health and family welfare and data on emerging issues, including the nutritional status of children at national, state, and district levels. In 2015, the survey collected information from a sample of 328 children from 361 eligible women in Lakhimpur district of Assam. However, children whose height and weight information was found out of plausible limits (2) and flagged cases (4) were excluded from the analysis. So, the final analysis was done based on 322 samples.

Statistical Analysis:

The standard normal distribution, descriptive statistics and Multiple Classification Analysis (MCA) table from bivariate logistic regression were used to fulfill the objectives of this study. Also, Lorenz Curve and Gini Index were also used to measure the inequality of overall nutritional deficiency among children by household wealth status and mother's educational levels based on NFHS-4 data published in 2015-16 by the Govt. of India. All the analyses were performed with the help of the Stata14 version and MS-Excel.

Ethical clearance:

Ethical clearance was obtained prior to data collection from the Student Research Committee of the Institute. Written, as well as verbal consent, was obtained from each respondent, and strict confidentiality of the collected information was assured. Before data collection, the purpose of the study was explained clearly to them.

The key Results:

The present study comprised of 30% sample area (ICDS projects) in Lakhimpur district where the information on children under five was collected. There were no huge gender differences observed as 54% (127) were male child and 46% (108) were female children, with an average age of 31 months at 95% confidence interval (28.5-33.27).

Fig. 2 represents the distribution of Z-scores (i.e. height-for-age, weight-for-age, and weight-for-height) among under-five children and compared it with the World Health Organization standard (n=235). It reveals that all the three nutritional indicators are not properly distributed as compared to the internationally recognized Z-score. Among these three Z-scores, height-for-age (Which provides information on Stunting) Z-score performed better than the other Z-scores (Weight-for-age Z-score and Weight-for-height Z-score).

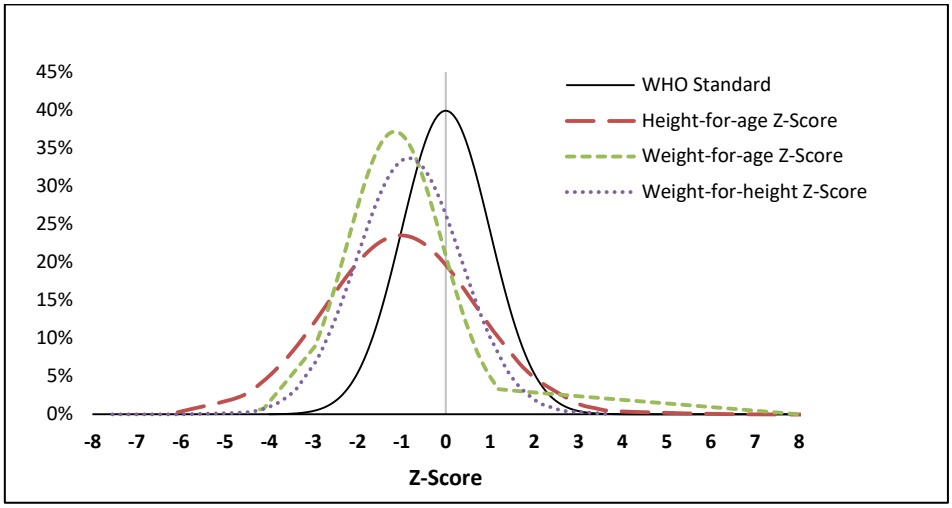

Fig. 2: Distribution of Z-score for height-for-age, weight-for-age and weight-for-height among under-five children and compared with the World Health Organization standard (n=235).

Fig. 3 shows the mean z-scores of all the nutritional indicators by child age in Lakhimpur district of Assam. This indicates that on average, the number of thin children (weight-for-height Z-score) was very high within 5 to 6 months irrespective of gender in Lakhimpur district (in 2021) as compared to other age groups.

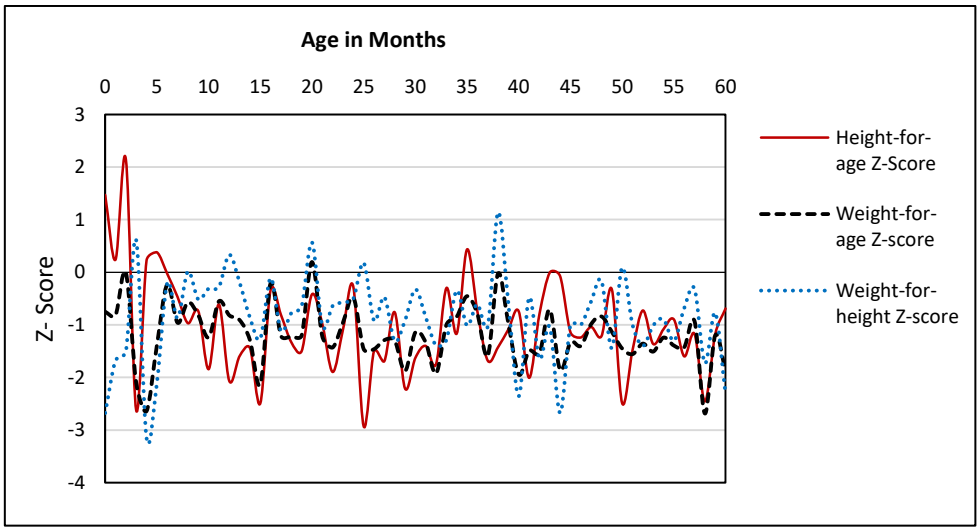

Fig 3: Mean z-scores of nutritional indicators according to age among children under five in Lakhimpur district, Assam (n=235).

The primary data collected from the Lakhimpur district clearly reveal that over the last 5-6 years the Nutritional level of children slightly improved in case of all the three nutritional indicators. The prevalence of stunting children declined by around 5%, underweight children by 9%, and thin children by 1%, respectively (Fig. 4). However, these conventional indicators are insufficient to estimate children's overall nutritional deficiency. Because these nutritional indicators may be overlapped with each other. For example-

a. Children who are stunted will also be underweight and/or be thin
b. Underweight children will also thin and/or be stunted and
c. Children who are thin will also be stunted and/or underweight

Table 1: Classification of children with nutritional deficiency

Group Name	Description	Wasting	Stunting	Underweight
a	**No failure:** Children whose height and weight are above the age-specific norm (i.e. above –2 Z-scores) and do not suffer from any anthropometric failure.	No	No	No
b	**Wasting only:** Children with acceptable weight and height for their age but who have subnormal weight for height	Yes	No	No
c	**Wasting and underweight:** Children with above-norm heights but whose weight for age and weight for height is too low.	Yes	No	Yes
d	**Wasting, stunting, and underweight**: Children who suffer from anthropometric failure on all three measures.	Yes	Yes	Yes
e	**Stunting and underweight:** Children with low weight for age and low height for age but who have acceptable weight for their height.	No	Yes	Yes
f	**Stunting only:** Children with a low height for age but who have acceptable weight, both for their age and for their short height.	No	Yes	No
y	**Underweight only:** Only underweight Children.	No	No	Yes

[w]Another theoretical combination would be "wasted and stunted", but this is not physically possible since a child cannot simultaneously experience stunting and wasting and not be underweight.

To overcome this problem, in the recent past, economist Peter Svedberg (2000) developed a single and more comprehensive model (index) known as the **C**omposite **I**ndex of **A**nthropometric **F**ailure (CIAF) which provides an estimate of overall (or a better-aggregated indicator) nutritional deficiency among children aged under-five years. This model is used in this study to understand the overall burden of nutritional deficiency in children under the age five years in Lakhimpur district of Assam.

The CIAF method can be expressed symbolically as –

$$\mathbf{CIAF = (1 - a)/ (a + b + c + d + e + f + y) = (1 - a)/1}$$

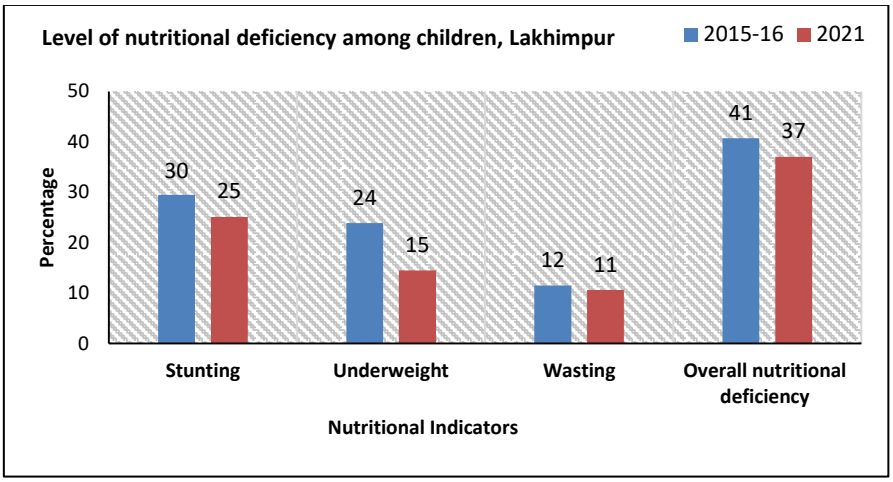

Fig 4: Prevalence of all types of nutritional deficiency among children aged under five in Lakhimpur district, Assam (n=235).

The Fig. 4 clearly shows that, though the nutritional status of children slightly improved during the last 5 years in Lakhimpur district according to the three conventional nutritional indicators i.e. stunting, underweight and wasting, the overall nutritional deficiency is still too high as 37% of the children aged under-five had at least one kind of nutritional deficiency in Lakhimpur district as per survey data (2021). Other hands it was 41% as per the NFHS-4 (2015-16) data.

Fig 5 represents a comparative prevalence of overall nutritional deficiency among children by age group and gender. By age, both the upward trend lines indicate - over the time, the prevalence of overall nutritional deficiency among children was increasing according to age of the children. That means, as compared to younger children, older children are more undernourished in Lakhimpur district of Assam in both the time periods. In case of gender, male children

follow an upward trend and female children follow a downward trend over the time in case of overall nutritional deficiency, which indicates that the nutritional status of female children has improved over time as compared to their counterpart of male children (Fig. 5).

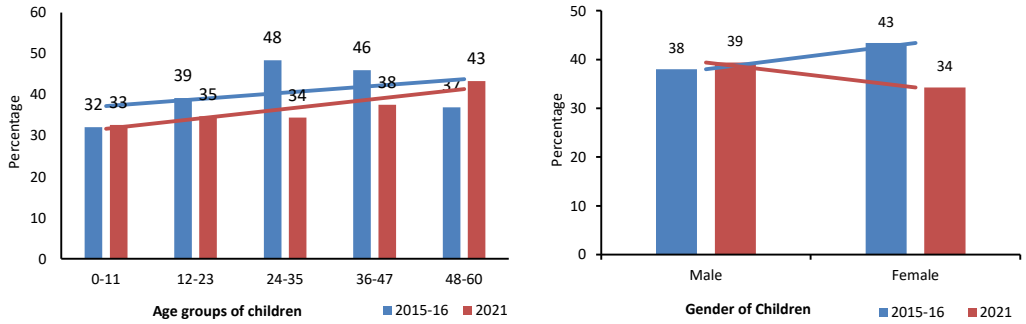

Fig 5: Comparative prevalence of overall nutritional deficiency among children by age groups and gender in Lakhimpur district of Assam (n=235).

Table 2 depicts the Multiple Classification Analysis (MCA) table from the binary logistic regression analysis and considers the child's overall nutritional deficiency as a response variable as it was coded as binary. The most important finding of this table was the probability (in percent) of nutritional deficiency children in each category of predicted (independent) variables as compared to its reference category.

Table 2: Multiple Classification Analysis (MCA) table of overall nutritional deficiency children by age and gender in Lakhimpur district (235 sample, 2021), Assam.

Background characteristics	Co-efficient	Proportion	Coeff. x Proportion	log omega	Exp (log omega)	Probability (%)
Constant	-0.725937					
Age in Months						
< 12 (Reference)	0	19.570	0.000	-0.726	0.484	48
12-23	0.0934	20.850	1.948	-0.633	0.531	53
24-35	0.0793	13.620	1.080	-0.647	0.524	52
36-47	0.2151	20.430	4.395	-0.511	0.600	60
48-60	0.4577	25.530	11.684	-0.268	0.765	76
Gender of child						
Male (Reference)	0	54.04	0.000	-0.432	0.649	65
Female	-0.2200	45.96	-10.110	-0.652	0.521	52

It was found that the probability of nutritional deficiency was very high (i.e. 76%) for those children who were in the age group (48-60) months as compared to children below aged 12 months. In case of gender, the male children have a higher chance (65%) of nutritional deficiency as compared to the female children in Lakhimpur district.

Inequality of overall nutritional deficiency among children by wealth and education:

As we already mention that the present study also measures the inequality of overall nutritional deficiency among children. Hence, we have applied Lorenz Curve and Gini Index as a measure of inequality of overall nutritional deficiency among children by household's wealth status and mother's educational levels based on NFHS-4 data published in 2015-16.

The Lorenz curve is the most popular visualized tool to measure inequality. It is a 45-degree line, running from the bottom left-hand corner to the top right-hand corner, which is known as the line of equality. If the health variable takes higher (lower) values among poor and illiterate people, the Lorenz curve will lie above (below) the line of equality. The farther the curve is above the

line of equality, the more concentrated the health variable among poor and illiterate categories.

The Gini coefficient, which is defined mathematically based on the Lorenz curve. It is calculated as the ratio of the area between the perfect equality line and the Lorenz curve (A) divided by the total area under the perfect equality line (A + B). i.e.

$$\text{Gini coefficient} = \frac{A}{A+B} \quad \text{---------- (i)}$$

A + B = 0.5 (since the axes scale from 0 to 1). In other words, it is double the area between the Lorenz curve and the line of perfect equality. G is the Gini index value, which lies between 0 and 1. The nearer the Gini value to 1, the higher is the inequality and vice versa.

When negative values are included, the Gini coefficient is no longer a concentration index (De Battisti & Francesco, 2019).

The area under the Lorenz curve is calculated as follows:

$$\text{Given, } y_1 \leq y_2 \leq \ldots \leq y_n, \text{ that}$$

$$q_1 = \frac{y_1+y_2\ldots+y_i}{y_1+y_2\ldots+y_n} = \frac{y_1+y_2\ldots+y_i}{y} \rightarrow \text{cumulative proportion of income.}$$

$$P_i = \frac{i}{n} \rightarrow \text{cumulative proportion of population}$$

$$\text{with, } q_0 = p_0 = 0 \text{ and } q_n = p_n = 1$$

$$G = 1 - \sum[(q_i + q_{i-1})(p_i - p_{i-1})]$$

The Gini coefficient 0 corresponds to perfect income equality (i.e. everyone has the same income) and 1 corresponds to perfect income inequality (i.e. one person has all the income out of 100, while everyone else has zero income). Therefore higher the Gini coefficient corresponds to less equality (i.e. more inequality) in the society.

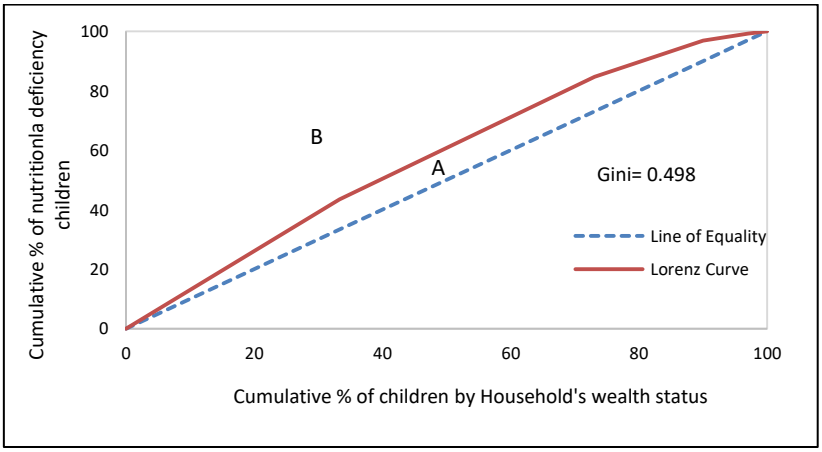

Fig. 6: Lorenz Curve and Gini Index showing Inequality in overall nutritional deficiency among Children by household's wealth status in Assam, 2015-16.

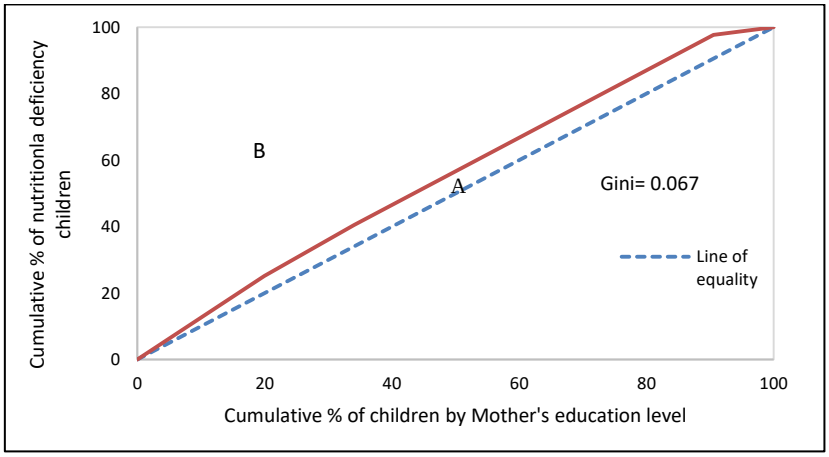

Fig. 7: Lorenz Curve and Gini Index showing Inequality in overall nutritional deficiency among Children by Mother's education level in Assam, 2015-16.

The Fig. 6 and 7 shows the Lorenz curves and Gini indices of overall nutritional deficiency among children in Assam by wealth status and mother's education. We observed in the Lorenz curves that it lies above the equality line, which signifies that undernourished children were concentrated more among poor households and uneducated mothers compared to better-off households and educated mothers. But, we have observed a higher inequality of nutritional deficiency among children in Assam by household wealth status (Gini value= 0.498) as compared to the mother's education level (Gini value = 0.067).

Limitation of the present study:

One of the potential limitations of this study is that –this study does not include or control diet and health care indicators of the concerned children.

CONCLUSION

The majority of the population in Lakhimpur district belongs to rural area with 15.04% of the total population being children (aged 0-6 years) as per the 2011 census, where the burden of nutritional deficiency in children was significantly high in poor households as compared to the children in better-off households. As per primary data, in Lakhimpur district, the burden of overall nutritional deficiency in children is still too high as on average, two in every five (37%) children had at least one kind of nutritional deficiency. However, the nutritional status of female children has improved over time as compared to the male children, but the overall burden of undernourished children were not decline as expected to the Sustainable Development Goal targets. Therefore, all the nutrition-specific and nutrition-sensitive interventions should be prioritized in vulnerable areas, focusing on extremely poor households, which are often clustered in low-income groups. Also, there is a need to expand the scope of the ICDS program to provide mass education regarding nutrition and health education by making provisions for home visits also and primarily targeting the pregnant and lactating mothers.

Acknowledgement

We are very grateful to Asst. Prof. Monimala Neog, Department of Statistics, Dibrugarh University for her constant support and all the help during this research work. We also want to thank Mrs. Bijumani Dutta, Anganwadi worker (Kathalpara Anganwadi Centre under Dhakuakhana ICDS Project, Lakhimpur District), Mrs. Dipa Boruah, Anganwadi worker (Dhenukhana Kulaguti Chuk AWC under Dhakuakhana ICDS Project, Lakhimpur District), Mrs. Dipa Gogoi, Anganwadi worker (Lecham Batamari AWC under Dhakuakhana ICDS Project, Lakhimpur District), Hunmai Chutia, Anganwadi worker (Dhapalial AWC under Bordoloni ICDS Project, Lakhimpur

District) and Pubali Gogoi, Anganwadi worker (Jalbhari No. 2 AWC under Ghilamara ICDS Project, Lakhimpur District) for their support and all the help during data collections in the field. We are very thankful to every person, who helped us in making this research work successful in each and every way.

Funding: Nil

Conflict of interest: The author declares no conflict of interest.

Author Contribution: The present research work is a team work. All the authors are equally involved and make it possible within a short period of time.

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