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NUTRITIONAL INEQUITIES IN GUJARAT: A DISTRICT-LEVEL ANALYSIS OF DISPARITIES IN CHILD AND ADULT NUTRITION

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Abstract

Malnutrition is a global public health issue that impacts millions of children worldwide. Poverty and childhood malnutrition are interlinked with each other by inadequate food, low educational attainment, poor living standards, and lack of access to health facilities. If we look at the nutritional status of Gujarat, it is seen that, except for overweight, the rate of all types of malnutrition in Gujarat is higher than the national average. In this research endeavour, an attempt has been made to create District Nutritional Index (DNI) for children under 5 years of age and adults ageing 15 to 49 years for all the districts of Gujarat using NFHS- 4 (2015-16) and NFHS-5 (2019-21) data. Result shows that the prevalence of malnourished children under 5 years of age, including stunted, wasted, severely wasted, and underweight have been found higher in South and Central Gujarat, specifically in the Dang, Dahod, and Panchmahal districts, while the prevalence of overweight children has been found higher in Saurashtra, specifically in Rajkot district. Moreover, the results related to adults, show that the prevalence rate of Lower Body Mass Index (LBMI) among men and women are found to be lower for Saurashtra region of Gujarat, while the worst situation of LBMI is found for South Gujarat region. In contracts, higher percentage of overweight adults have been found for the Saurashtra region, while a lower percentage of overweight adults have been found in South Gujarat, especially in the Dang district. Overweight population is more in Saurashtra (Rajkot) because of increased urbanization, and growth related to life style related living standards. While for the Dang, Dahod and Panchmahal districts, as they are tribal districts of Gujarat and are comparatively less developed than other districts of Gujarat. Their poor economic status contributes to chronic and acute malnutrition.

Key words – DNI, NFHS, Malnutrition, Lower body mass index, Overweight/Obese

JEL code - I14, I15, I1

Introduction

Malnutrition is a global public health issue that impacts millions of children worldwide (Rana et al., 2019). Malnutrition is defined as a deficiencies, excesses, or imbalances in a person's energy and nutritional intake. Around 45 percent of deaths among children under 5 years of age are linked to undernutrition in low and middle-income countries, whereas at the same time, childhood overweight and obesity is also rising in these countries (WHO, 2021). The

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overall nutritional profile of any country can be inferred from the nutritional status of its children. The health status of children significantly influences the future growth and development of the nation (Viramgami et al., 2014).

The nutritional status of children is somehow dependent on their mother's nutritional status. In the case of malnutrition, it can be found intergenerational transmission of malnutrition from generation to generation. Undernourished girls become undernourished mothers who give birth to the next generation of undernourished children, and these children often face health and developmental challenges throughout their lives (Meyerhoff, 2014) (Suri, 2020). Nearly, 70 percent of girls and women globally suffer from deficiencies of vitamins and other essential nutrients such as iron, zinc, folate and iodine (Buechner & Fox, 2023). Poverty is also one of the reasons for malnutrition. In fact, two way link exists between malnutrition and poverty, creating a vicious cycle with each fuelling the other (Siddiqui et al., 2020). As per the Multidimensional Poverty Index (MDPI) 2023, Globally 18 percent of the total population are acutely multidimensionally poor and live in 110 countries. India still has more than 230 million people as poor (NITI Aayog, 2023).

Global estimates of children under 5 years old for 2023 indicate that 148.1 million children will be stunted, 45 million will be wasted, and 37 million will be overweight or obese (UNICEF et al., 2023). As per the National Family Health Survey (NFHS) – 5 report, among the children under 5 years of age in India, 35.5 percent children are found stunted, 19.3 percent children are wasted, 7.7 percent children are severely wated, 32.1 percent children are underweight, and 4.4 percent children are overweight (Ministry of Health and Family Welfare, 2020). The proportion of overweight children has increased for NFHS-4 to NFHS-5 data. The proportion of overweight children was 2.1 percent in NFHS-4, which has increased to 3.4 percent in NFHS-5. As per NFHS-5 report, 39 percent of children under 5 years of age in Gujarat are stunted, 25.1 percent of children are wasted, 10.6 percent of children are severely wasted, 39.7 percent of children are underweight and 3.9 percent of children are overweight. If we look at the nutritional status of Gujarat, it is observed that, except for overweight, the rate of all types of malnutrition in Gujarat is higher than the national average.

In this research endeavour, an attempt has been made to inquire the nutritional status of children under 5 years of age and adults whose age is between 15 to 49 years in all the districts of Gujarat for NFHS-4 (2015-16) and NFHS-5 (2019-21) data.

Literature review

(Viramgami et al., 2014) They studied the problem of malnutrition in under five age groups in the slum areas of Rajkot and identified various socio demographic factors related with malnutrition. Study was carried out between April – 2011 to March 2012. Using multistage random sampling technique 480 samples were studied. A semi closed questionnaire was used for data collection. World Health Organisation (WHO) growth standard was used for classification of nutritional status of children. Modified Prasad classification was used to classify socio economic status of child. Their results showed that, out of 480 children, 56.5 percent of children were underweight, 20.2 percent were wasted, and 53.9 percent were stunted. Further, it showed that the proportion of underweight, stunted and wasted were

significantly higher among girls than boys. They found a direct association between number of family members with underweight children. Moreover, they concluded that the prevalence of underweight is higher in Muslim children as compared to Hindu children. Maternal education was inversely related to malnutrition, and the proportion of malnourished children was higher among families with low economic status.

(Rana et al., 2019) Researchers have identified potential risk factors for wasting among under 5 children in the Aravalli district of Gujarat. This Study was carried out between January to October 2017. Meghraj and Modasa blocks were selected using purposive sampling, as higher number of children were found in these blocks. Total sample size was 124 out of them, 64 samples were taken as a case (children with WHZ≤ 2SD) and 64 samples were taken as a control (children with WHZ ≥ 2SD). Semi structured questionnaire was used for data collection. They used Chi square test to find out the association between outcome and exposure variables. The results showed that children living in houses with no handwashing and toilet facility had 2.7 times higher odds of being wasted than children living in houses with this facility. They also found an association of acute malnutrition with childhood illness and food insecurity.

(Damor et al., 2013)They have assessed the malnutrition and immunisation status of under five children in urban slums of Jamnagar, Gujarat. Study was conducted from August 2008 to October 2010. Total 450 children were included in the study. Data were collected by interviewing mothers using pre designed and pre tested questionnaires. They used Gomez classification and modified Prasad classification to measure nutritional status and socio – economic status respectively. Their results showed that 54 percent of children were malnourished. Moreover, out of 450 mothers, 57.33 percent of mother were educated, 42.89 percent of the families belonged to the socio-economic class IV, which indicates that these families have per capita income between Rs. 1272 and Rs. 2543. Further, results also showed that 75.11 percent of children were fully immunized, whereas 11.56 percent of children were not immunised. They have observed that the prevalence of malnutrition was higher in female children, mothers with low education, and linked with lower socio- economic class.

Objectives of the study

- To construct District Nutritional Index (DNI) for children and adults and compared their rank for NFHS-4 and NFHS-5 data
- To compare the District Nutritional Index (DNI) rank for children and adults

Methodology of the Study

To inquire and compare the nutritional status of children under five years, and adults ageing 15-49 years across all the districts of Gujarat, a District Nutritional Index (DNI) has been developed. The DNI of children is based on five indicators of malnutrition, namely stunted, wasted, severely wasted, underweight, and overweight, while the DNI of adults is based on two indicators, such as the Lower Body Mass Index (LBMI) and overweight or obese men and women. Data for the indicators of DNI has been compiled from the National Family Health Survey (NFHS) - 4 (2015-16) and NFHS - 5 (2019-21) for all the districts of Gujarat.

To construct the DNI, researchers have been converted all the actual values into the normalised value. The methodology for the calculation of the normalised value is demonstrated in Appendix. After getting the normalised value, for the construction of the DNI, we have used Example 1 and Example 2 for the children and adults, respectively. All the variables included in this study are negative indicators of nutritional status. Equal weightage has been given to all the variables because all the indicators are equally important when we consider nutritional status. In general, index value lies between 0 to 1. The DNI value also lies between 0 to 1. Getting 1 or closer to 1 indicates a better condition, while getting 0 or closer to 0 indicates a worse situation.

Table 1 shows the actual values, normalised values, and DNI values of children and its DNI ranks for 26 districts of Gujarat for NFHS-4, while Table 2 shows the actual, normalised, and DNI values of children and its DNI ranks of 33 districts of Gujarat for NFHS-5. Table 3 shows the comparison of the DNI ranks of children for NFHS-4 and NFHS-5. For the purpose of logical comparison, only 26 districts have been considered, as NFHS-4 consisted 26 districts.

Table 4 shows the actual, normalised, and DNI values of adults and its DNI ranks of 26 districts of Gujarat for NFHS-4 (2015-16), while Table 5 shows the actual, normalised, and DNI values of women and its DNI rank of 33 districts of Gujarat for NFHS-5. Table 6 shows the comparison of DNI ranks of women between NFHS-4 and NFHS-5 because NFHS - 5 does not consist the data for men. Table 7 shows the comparison between DNI ranks of children and women for both NFHS-4 and NFHS-5.

Map -1 shows the graphical presentation of district level disparities in terms of DNI of children. Prevalence of malnutrition status is classified into four parts namely high prevalence of malnutrition (0 to 0.54 DNI value), moderate prevalence of malnutrition (0.55 to 0.69 DNI value), Low prevalence of malnutrition (0.70 to 0.79 DNI value), and very low prevalence of malnutrition status (0.80 to 1 DNI value). These classifications are based on Human Development Index (HDI) classification. Map-2 shows the graphical presentation of district level disparities in terms of DNI of women. As discussed above, nutritional status is classified into four parts, these four parts of nutritional status are coded into four colours namely green, lime green, yellow and red. Green colour indicates very low prevalence of malnutrition (0.80 to1 DNI value), lime green colour indicates low prevalence of malnutrition (0.70 to 0.79 DNI value), yellow colour indicates moderate prevalence of malnutrition (0.55 to 0.69 DNI value) and red colour indicates high prevalence of malnutrition (0 to 0.54 DNI value).

Results of the study

The results of the study are divided into three parts:

(1). Results related to nutritional status of children under 5 years of age

(2). Results related to nutritional status of adults ageing 15-49 years

(3). Comparison between the nutritional status of children and women

Each of the three parts of result are discussed considering NFHS- 4 and NFHS – 5. First two parts of results are further divided into three sub parts. First sub part is related to the prevalence of malnutrition in terms of various indicators of malnutrition for the children and adults. Secondly, interpretation related to DNI of children and adults. Lastly, results related to the comparison of DNI of children and adults.

(1). Results related to nutritional status of children under 5 years of age

In case of NFHS-4, Table 1 shows that the highest percentage of stunted children is found in Sabarkantha (50.6 %), while the lowest percentage of stunting is found in Porbandar (22.6 %). The highest and the lowest percentage of wasted children are found in the Dang (43 %) and Vadodara (16.3 %) districts of Gujarat, respectively. While considering severely wasted children, result shows that the higher prevalence of severely wasted children are found in t

he Dang, while the lowest prevalence of severely wasted children is found in Rajkot district. The highest and the lowest percentage of underweight children are found in the Dang and Junagadh districts, respectively. In the case of NFHS-5, Table 2 shows that the highest prevalence of stunting is found in Dahod district where 55.3 percent of children under 5 years are suffering from stunting, while the lowest prevalence of stunting is found in Porbandar where 18.2 percent of children are suffering from stunting. The highest and the lowest prevalence of wasted children are found in the Dang (40.9 %) and Junagadh (17.3 %) district, respectively. When severely wasted children is considered, result shows that the highest prevalence of severely wasted children is found in the Dang (22.2 %), while the lowest prevalence of severely wasted children is found in Gir Somanath (4.9 %). The highest and the lowest percentage of underweight children are found in the Dang (53.1 %) and Porbandar (25.5 %) districts of Gujarat, respectively. In case of overweight children, it has been traced that the highest percentage of overweight children is found in Rajkot (8.1 %), while Valsad district is having the lowest percentage of overweight children which is 0.3 per cent.

Table 1 shows the result related to DNI of children for NFHS-4 (2015-16). DNI result shows that the Rajkot district has obtained the first rank which indicates the lowest prevalence of malnutrition, while the Dang district has obtained the last rank, which indicates that the highest percentage of malnourished children has been found in the Dang. Table 2 shows the result related to DNI of children for NFHS-5 (2019-21). In NFHS-5, DNI of children shows that Porbandar district has obtained the first rank, while Panchmahal district has obtained the last rank.

Table 3 shows the changes in DNI rank of children between NFHS-4 (2015-16) to NFHS-5 (2019-21). It indicates that only Patan district has remained stable for DNI rank of children for NFHS-4 to NFHS-5. Seventeen districts have improved their DNI ranks of NFHS-5 as compared to NFHS-4, while nine districts including Amreli, Anand, Dahod, Navsari, Rajkot, Sabarkantha, Surat, Tapi, Vadodara have deteriorated their rank from NFHS-4 to NFHS-5 in DNI ranking. Valsad is the district which has shown the highest improvement in its relative rank compared to other districts. It has improved its DNI score by 0.18 points from NFHS-4 to NFHS-5 and has achieved 2rd rank from 17th rank. The highest deterioration in relative rank is found in Rajkot, It has declined its 1st rank to 9th from NFHS-4 to NFHS-5.

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Based on the results, it can be concluded that the prevalence of malnourished children under 5 years of age including stunting, wasting, severely wasted, and underweight are found higher in south and central Gujarat, specifically in the Dang, Dahod and Panchmahal while, Prevalence of overweight children is found more in Saurashtra region, specifically in Rajkot.

2). Results related to nutritional status of adults ageing 15-49 years

Table 4 shows the results related to nutritional status of adults for NFHS- 4. In NFHS- 4, the highest percentage of LBMI women is found in Panchmahal district, while the lowest percentage of women with LBMI is found in Porbandar district. Rajkot and the Dang districts are having the highest and the lowest percentage of overweight women in NFHS-4, respectively. When nutritional status of men has been taken into consideration, it has been found that Dahod is having the highest percentage of men with LBMI, while Jamnagar district is having the lowest percentage of men with LBMI. Ahmadabad district is having the highest percentage of overweight men, while the Dang is having the lowest percentage of overweight men. Table – 5 shows the result related to nutritional status of women for NFHS-5. In NFHS-5, the highest percentage of women with LBMI is found in Dahod (44.1%) district, while the lowest percentage of women with LBMI is found in Porbandar. Junagadh (33.4 %) and Chhota Udaipur (7.6 %) districts are having the highest and the lowest percentage of overweight women in NFHS-5, respectively.

Table 4 also shows the result related to men and women DNI separately for NFHS-4. For DNI of women, Porbandar ranked first, which means Porbandar is having the best nutritional situation of women, while Panchmahal has obtained the last rank which indicates worst nutritional status of women. While the results related to DNI for men indicates that Porbandar district has obtained the first rank while Ahmadabad district has obtained the last rank. Table 5 shows the result related to DNI of women for NFHS-5. DNI of women for NFHS-5 shows that the best nutritional status of women is found in Chhota Udaipur district while, Anand and Bharuch are having worst nutritional situation for women in NFHS -5.

Table -6 shows the comparison of DNI ranks of women between NFHS-4 and NFHS-5. Result shows that Valsad has remained stable in its DNI rank of women from NFHS-4 to NFHS-5. For DNI ranks of women, 10 districts have improved their relative rank from NFHS-4 to NFHS-5, while 16 districts have deteriorated in their rank from NFHS-4 to NFHS-5. The highest relative difference in women DNI between NFHS-4 and NFHS-5 in terms of deterioration has been found for Junagadh district. It has secured 2nd rank in NFHS-4 while it stands at 19th rank in NFHS-5, which means Junagadh has lagged with 17 numbers in its rank in NFHS-5 as compared to NFHS-4. Whereas, the highest relative difference in women DNI between NFHS-4 and NFHS-5 in terms of improvements has been found for Narmada district. It has secured 16th rank in NFHS-4 while it stands at 2nd rank in NFHS-5 which means that the district has improved its rank by 14 numbers.

(3). Comparison between the nutritional status of children and women

Table -7 Shows the comparison between DNI ranks of children and DNI ranks of Women for NFHS-4 and NFHS-5. In NFHS-4, Banaskantha, Bhavnagar, Jamnagar, Junagadh, Kachchh, Mehsana, Narmada, Patan, Porbandar, Sabarkantha, Surendra Nagar, Tapi, the Dang, and

Valsad have improved their women DNI rank as compared to children DNI rank. In NFHS-5, result shows that Narmada, Navsari, Panchmahal, Sabarkantha, Surendra Nagar, the Dang, Tapi have achieved better places in women DNI as compared to their children DNI rank. In NFHS – 5, 19 districts have deteriorated in their rank from children DNI rank to women DNI rank. The highest relative difference between children DNI and women DNI rank in terms of deterioration has been found for Junagadh district. Junagadh has secured 1st rank in children DNI, while it stands at 23rd rank in women DNI rank which means Junagadh has been lagging with 22 numbers in its women DNI rank. The highest relative difference between children DNI and women DNI rank in terms of improvement has been found for the Dang. The Dang has secured 17th rank in children DNI while it stands at 4th rank in women DNI, which means the Dang has improved its rank by 13 number.

Map 1 shows the graphical presentation of districts level disparities in terms of nutritional status. It can be seen that all the districts of South Gujarat except Valsad district have been fallen into the high prevalence of malnutrition. All the districts of Central Gujarat except the two districts, namely, Ahmadabad and Vadodara, all other districts have been fallen into the high prevalence of malnutrition. If we consider Saurashtra region, It can be found that Devbhumi Dwarka and Surendra Nagar districts have been fallen into the high prevalence of malnutrition category. Porbandar and Junagadh districts of Saurashtra region have been categorised in the low prevalence of malnutrition, while Kachchh and all the districts of North Gujarat excluding Sabarkantha and Aravalli have been fallen into the moderate prevalence of malnutrition. Whereas, Sabarkantha and Aravalli districts have been fallen into the high prevalence of malnutrition.

Map 2 shows the women nutritional status as per DNI of women in all the districts of Gujarat. It has been found that quite different situation of women has been seen as compared to children in terms of nutritional status. It has been found that all the districts of South Gujarat have shown moderate and low prevalence of malnutrition. This result is contradicted with children DNI result. As per the above discussion, women DNI includes two variables, namely, LBMI and overweight or obese. South region of Gujarat is fallen into the moderate prevalence of malnutrition rather than the high prevalence of malnutrition as per the women DNI, it could be the result of Overweight or Obese people are found less in South Gujarat. Kachchh district has been fallen into the moderate prevalence of malnutrition. Rajkot, Junagadh and Bhavnagar districts of Saurashtra region have been fallen into the high prevalence of malnutrition. In case of Central Gujarat except Mahisagar and Chhota Udaipur, all the districts of Central Gujarat have been fallen into the high prevalence of malnutrition category. Presence of 'very low prevalence of malnutrition' has neither been found in DNI of children nor in women.

Conclusion:

Based on the results, it can be concluded that the prevalence of malnourished children under 5 years of age, including stunting, wasting, severely wasted, and underweight, is found higher in South and Central regions of Gujarat, specifically in the Dang, Dahod, and Panchmahal. Ishwarjit et al., in 2019 indicated that prevalence of underweight, stunting and wasting was significantly higher among children belonging to Schedule Tribe (ST) community as compared to other community, and the proportion of ST community in South region is 76 percent. Apart from that proportion of households having access to safe drinking water was

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higher in Saurashtra & Kachchh region as compared to South and Central regions. Prevalence of overweight children is higher in the Saurashtra regions. Dietary diversity was more in Saurashtra region this may be the reason that the stunted, wasted and severely wasted children are found less in the Saurashtra. Considering the nutritional status of women, it has been shown that most of the Central and North districts are have worst nutritional status while South region have low level of malnutrition as compared to Central and North regions. Literature shows unfavourable economic condition and low education level negatively affected to the woman's health. The proportion of illiterate mothers was higher in North & Central (37 % and 37.7 %) regions as compared to South region as per the study of Ishwarji et al., in 2019. In short, results show the inter district variabilities. This type of indices might be utilised to prioritise the vulnerable districts in terms of nutritional status and accordingly take some affirmative steps.

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Table 1 Actual values, normalized values, and District Nutritional Index value of children and its rank of 26 district of Gujarat in NFHS-4

Sr. No	Districts	Actual values				Normalized values				DNI value	Rank
		Stunted	Wasted	Severely wasted	Underweight	Stunted	Wasted	Severely wasted	Underweight		
1	Ahmadabad	29.4	27.1	11.5	31	0.76	0.60	0.49	0.88	0.68	6
2	Amreli	37.8	24.6	6.4	31.7	0.46	0.69	0.82	0.86	0.71	3
3	Anand	48.2	21.7	7.4	41.3	0.09	0.80	0.76	0.57	0.55	11
4	Banaskantha	40.7	21.6	8.5	43.1	0.35	0.80	0.68	0.52	0.59	9
5	Bharuch	41.5	29.4	7.6	44.2	0.33	0.51	0.74	0.48	0.51	13
6	Bhavnagar	48.4	26	7.9	44.4	0.08	0.64	0.72	0.48	0.48	15
7	Dahod	44.4	24.9	7.8	50.8	0.22	0.68	0.73	0.28	0.48	15
8	Gandhinagar	36.5	29	10.2	42.7	0.50	0.52	0.57	0.53	0.53	12
9	Jamnagar	27.9	31.3	16.8	29.3	0.81	0.44	0.14	0.94	0.58	10
10	Junagadh	27.9	30.4	17.5	27.2	0.81	0.47	0.09	1	0.59	9
11	Kachchh	40.8	31.4	15.5	39	0.35	0.43	0.22	0.64	0.41	18
12	Kheda	45.5	27.2	7.1	48.1	0.18	0.59	0.78	0.36	0.48	15
13	Mehsana	40.5	25.3	11.6	41.9	0.36	0.66	0.48	0.55	0.51	13
14	Narmada	47.4	35.8	12.7	53.6	0.11	0.27	0.41	0.20	0.25	20
15	Navsari	38.9	26.8	5.7	37.4	0.42	0.61	0.87	0.69	0.65	7
16	Panchmahal	40.4	36.3	14.2	42.3	0.36	0.25	0.31	0.54	0.37	19
17	Patan	37.6	24.5	9.2	38.4	0.46	0.69	0.64	0.66	0.61	8
18	Porbandar	22.6	25.4	10.6	27.7	1	0.66	0.55	0.98	0.80	2
19	Rajkot	30.9	23.4	3.7	31.4	0.70	0.73	1	0.87	0.83	1
20	Sabarkantha	50.6	23.5	7	45.5	0.00	0.73	0.78	0.44	0.49	14

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Sr. No	Districts	Actual values				Normalized values				DNI value	Rank
		Stunted	Wasted	Severely wasted	Underweight	Stunted	Wasted	Severely wasted	Underweight		
21	Surat	30	26.2	8.1	36.1	0.74	0.63	0.71	0.73	0.70	4
22	Surendranagar	45.5	27.7	9.5	45.9	0.18	0.57	0.62	0.43	0.45	16
23	Tapi	35.9	35.8	9.6	42.4	0.53	0.27	0.61	0.54	0.49	14
24	Dang	48.1	43	18.9	60	0.09	0	0	0	0.02	21
25	Vadodara	43.8	16.3	5.8	39.1	0.24	1	0.86	0.64	0.69	5
26	Valsad	43.3	30.3	11.9	41.9	0.26	0.48	0.46	0.55	0.44	17

Source- Computed data from NFHS-4 & Authors own calculation

Table – 2 Actual values, normalized values, and District Nutritional Index value of children and its rank of 33 district of Gujarat in NFHS-5

SR. No	Districts	Actual values					Normalized value					DNI	Rank
		Stunted	Wasted	Severely wasted	Underweight	Overweight	Stunted	Wasted	Severely wasted	Underweight	Overweight		
1	Ahmadabad	35.5	17.5	7.4	34	4.6	0.53	0.99	0.86	0.69	0.45	0.70	3
2	Amreli	35.3	23.7	7.2	30.6	6.8	0.54	0.73	0.87	0.82	0.17	0.62	6
3	Anand	38.4	28.6	10.9	46.6	3.8	0.46	0.52	0.65	0.24	0.55	0.48	13
4	Aravali	47.1	29	9.3	47.2	3.3	0.22	0.50	0.75	0.21	0.62	0.46	15

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SR. No	Districts	Actual values					Normalized value					DNI	Rank
		Stunted	Wasted	Severely wasted	Underweight	Overweight	Stunted	Wasted	Severely wasted	Underweight	Overweight		
5	Banaskantha	39	25.5	8.5	44.1	1.2	0.44	0.65	0.79	0.33	0.88	0.62	6
6	Bharuch	40.9	24.5	8	45.5	4.7	0.39	0.69	0.82	0.28	0.44	0.52	11
7	Bhavnagar	32.6	29.6	6.3	39.5	1.8	0.61	0.48	0.92	0.49	0.81	0.66	5
8	Botad	32.2	26	9.6	32.3	5.8	0.62	0.63	0.73	0.75	0.29	0.61	7
9	Chhota Udaipur	48.6	28.4	13.8	48.1	4.8	0.18	0.53	0.49	0.18	0.42	0.36	17
10	Dahod	55.3	27.6	13.4	53	5.8	0.00	0.56	0.51	0.00	0.29	0.27	19
11	Devbhumi Dwarka	30.2	26.1	17.2	36.2	4.9	0.68	0.63	0.29	0.61	0.41	0.52	11
12	Gandhinagar	38.1	30.6	9.9	44.6	0.5	0.46	0.44	0.71	0.31	0.97	0.58	8
13	Gir Somanath	44.4	18.5	4.9	30.3	5	0.29	0.95	1.00	0.83	0.40	0.69	4
14	Jamnagar	28.4	23.8	12.5	28.9	3.6	0.73	0.72	0.56	0.88	0.58	0.69	4

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SR. No	Districts	Actual values					Normalized value					DNI	Rank
		Stunted	Wasted	Severely wasted	Underweight	Overweight	Stunted	Wasted	Severely wasted	Underweight	Overweight		
15	Junagadh	37.3	17.3	7.1	26.4	4.4	0.49	1.00	0.87	0.97	0.47	0.76	1
16	Kachchh	37.5	20.2	10.6	33.4	2.6	0.48	0.88	0.67	0.71	0.71	0.69	4
17	Kheda	37.3	30.9	12.1	39.5	2.5	0.49	0.42	0.58	0.49	0.72	0.54	10
18	Mehsana	31	28.2	12	41.4	1.5	0.65	0.54	0.59	0.42	0.85	0.61	7
19	Mahisagar	43.4	26.2	12	49	2.6	0.32	0.62	0.59	0.15	0.71	0.48	13
20	Morabi	32.9	25.2	12.5	32.3	4	0.60	0.67	0.56	0.75	0.53	0.62	6
21	Narmada	47.2	23	9.9	52.8	3.1	0.22	0.76	0.71	0.01	0.64	0.47	14
22	Navsari	36.8	29	9.3	43.6	3.4	0.50	0.50	0.75	0.34	0.60	0.54	10
23	Panchmahal	47.1	35.7	19.7	51.9	3.4	0.22	0.22	0.14	0.04	0.60	0.25	20
24	Patan	50.5	20.9	6.5	42.3	3.1	0.13	0.85	0.91	0.39	0.64	0.58	8

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SR. No	Districts	Actual values					Normalized value					DNI	Rank
		Stunted	Wasted	Severely wasted	Underweight	Overweight	Stunted	Wasted	Severely wasted	Underweight	Overweight		
25	Porbandar	18.2	21.8	14.2	25.5	3.9	1.00	0.81	0.46	1.00	0.54	0.76	1
26	Rajkot	38.9	17.6	7.3	37	8.1	0.44	0.99	0.86	0.58	0.00	0.57	9
27	Sabarkantha	37	33.1	16.6	41	4.9	0.49	0.33	0.32	0.44	0.41	0.40	16
28	Surat	36.1	26	14.7	32.5	5.3	0.52	0.63	0.43	0.75	0.36	0.54	10
29	Surendra Nagar	39.2	27.1	8.8	41.8	5.2	0.43	0.58	0.77	0.41	0.37	0.51	12
30	Tapi	41.7	36.6	17.1	51.8	1.9	0.37	0.18	0.29	0.05	0.79	0.34	18
31	Dang	37.6	40.9	22.2	53.1	1.1	0.48	0.00	0.00	0.00	0.90	0.27	19
32	Vadodara	42.3	20.1	5.2	39.9	6.4	0.35	0.88	0.98	0.48	0.22	0.58	8
33	Valsad	37.8	23.2	9.1	34.8	0.3	0.47	0.75	0.76	0.66	1.00	0.73	2

Source – Computed data from NFHS-5 & Authors own calculation

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Table – 3 Comparison of District Nutritional Index rank of children between NFHS-4 and NFHS-5

Sr. No	*States*	*DNI rank*		*Changes*
		NFHS-4	*NFHS-5*	
1	*Ahmadabad*	*6*	*3*	*3*
2	*Amreli*	*3*	*6*	*-3*
3	*Anand*	*11*	*13*	*-2*
4	*Banaskantha*	*9*	*6*	*3*
5	*Bharuch*	*13*	*11*	*2*
6	*Bhavnagar*	*15*	*5*	*10*
7	*Dahod*	*15*	*17*	*-2*
8	*Gandhinagar*	*12*	*8*	*4*
9	*Jamnagar*	*10*	*4*	*6*
10	*Junagadh*	*9*	*1*	*8*
11	*Kachchh*	*18*	*4*	*14*
12	*Kheda*	*15*	*10*	*5*
13	*Mehsana*	*13*	*7*	*6*
14	*Narmada*	*20*	*14*	*6*
15	*Navsari*	*7*	*10*	*-3*
16	*Panchmahal*	*19*	*18*	*1*
17	*Patan*	*8*	*8*	*0*
18	*Porbandar*	*2*	*1*	*1*
19	*Rajkot*	*1*	*9*	*-8*
20	*Sabarkantha*	*14*	*15*	*-1*
21	*Surat*	*4*	*10*	*-6*
22	*Surendra Nagar*	*16*	*12*	*4*
23	*Tapi*	*14*	*16*	*-2*
24	*Dang*	*21*	*17*	*4*
25	*Vadodara*	*5*	*8*	*-3*
26	*Valsad*	*17*	*2*	*15*

Source - Authors own calculation

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Table - 4 Actual values, normalised values and District Nutritional Index value of adults and its rank of 26 district of Gujarat in NFHS-4 (2015-16)

Sr. No	Districts	Actual values				Normalized values				Women DNI value	Men DNI value	Women DNI Rank	Men DNI Rank
		Women LBMI	Men LBMI	Women Overweight	Men Overweight	Women LBMI	Men LBMI	Women-Overweight	Men Overweight				
1	Ahmadabad	21.5	25.9	30.7	26.4	0.77	0.59	0.17	0.00	0.47	0.30	13	18
2	Amreli	17.1	18.1	28.2	23.9	0.91	0.83	0.25	0.12	0.58	0.48	4	10
3	Anand	36	30.3	19.4	17.9	0.33	0.45	0.52	0.40	0.42	0.43	17	14
4	Banaskantha	38.4	28.1	10.6	14	0.26	0.52	0.79	0.58	0.53	0.55	8	6
5	Bharuch	31.3	23.7	23.7	16.5	0.47	0.66	0.39	0.46	0.43	0.56	16	5
6	Bhavnagar	21.5	17.4	28	23.7	0.77	0.86	0.25	0.13	0.51	0.49	10	9
7	Dahod	44.1	44.9	9.8	8.9	0.08	0.00	0.82	0.82	0.45	0.41	15	16
8	Gandhinagar	30.5	27.1	22.1	19.2	0.50	0.55	0.44	0.34	0.47	0.45	13	12
9	Jamnagar	19.5	12.8	29.4	21.1	0.83	1.00	0.21	0.25	0.52	0.62	9	4
10	Junagadh	16.9	16.3	25.5	21.3	0.91	0.89	0.33	0.24	0.62	0.56	2	5
11	Kachchh	23.7	21.1	19.9	20.4	0.70	0.74	0.50	0.28	0.60	0.51	3	8
12	Kheda	38.5	31	18	11.5	0.25	0.43	0.56	0.70	0.41	0.56	18	5
13	Mehsana	26.8	27.6	22.7	17.9	0.61	0.54	0.42	0.40	0.51	0.47	10	11
14	Narmada	44.1	31.5	11.4	16	0.08	0.42	0.77	0.49	0.43	0.45	16	12
15	Navsari	29.5	35.9	23.1	17	0.53	0.28	0.40	0.44	0.47	0.36	13	17
16	Panchmahal	46.8	37.2	10.1	12.8	0.00	0.24	0.81	0.64	0.40	0.44	19	13
17	Patan	30.2	30.6	17	15.3	0.51	0.45	0.60	0.52	0.55	0.48	6	10
18	Porbandar	14	14.9	24.8	15.1	1.00	0.93	0.35	0.53	0.68	0.73	1	1

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Sr. No	Districts	Actual values				Normalized values				Women DNI value	Men DNI value	Women DNI Rank	Men DNI Rank
		Women LBMI	Men LBMI	Women Overweight	Men Overweight	Women LBMI	Men LBMI	Women-Overweight	Men Overweight				
19	Rajkot	17.4	16.1	36.1	22.3	0.90	0.90	0.00	0.19	0.45	0.54	15	7
20	Sabarkantha	37.1	25.6	12.9	18.1	0.30	0.60	0.72	0.39	0.51	0.49	10	9
21	Surat	18.4	22.7	34.5	23.2	0.87	0.69	0.05	0.15	0.46	0.42	14	15
22	Surendra Nagar	25.7	24.3	20.6	18.2	0.64	0.64	0.48	0.38	0.56	0.51	5	8
23	Tapi	43.4	33.5	8.8	7	0.10	0.36	0.85	0.91	0.48	0.63	12	3
24	Dang	44	35	4	5	0.09	0.31	1.00	1.00	0.54	0.65	7	2
25	Vadodara	29.1	25.6	22	20.7	0.54	0.60	0.44	0.27	0.49	0.43	11	14
26	Valsad	22.9	15	24.8	23	0.73	0.93	0.35	0.16	0.54	0.55	7	6

Source – Computed data from NFHS-4 & Authors own calculation

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Table - 5 Actual values, normalized values, and District Nutritional Index value of women and its rank of 33 district of Gujarat in NFHS-5

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Source- Computed data from NFHS-5 & authors own calculationSr. No	Districts	Actual values		Normalized value		Women DNI value	DNI Rank
		Women-LBMI	Women-Overweight/obese	Women-LBMI	Women-Overweight/obese		
1	Ahmadabad	19.4	30.1	0.87	0.13	0.50	19
2	Amreli	17.1	28.2	0.95	0.20	0.58	11
3	Anand	36	19.4	0.29	0.54	0.41	24
4	Aravali	34.4	18.1	0.34	0.59	0.47	21
5	Banaskantha	38.4	10.6	0.20	0.88	0.54	15
6	Bharuch	31.3	23.7	0.45	0.38	0.41	24
7	Bhavnagar	20.8	29.4	0.82	0.16	0.49	20
8	Botad	19.6	27.3	0.87	0.24	0.55	14
9	Chhota Udaipur	30.6	7.6	0.48	1.00	0.74	1
10	Dahod	44.1	9.8	0.00	0.91	0.46	22
11	Devbhumi Dwarka	22.4	24.1	0.77	0.36	0.56	13
12	Gandhinagar	30.5	22.1	0.48	0.44	0.46	22
13	Gir Somnath	24.8	17.3	0.68	0.62	0.65	6
14	Jamnagar	17.3	29.5	0.95	0.15	0.55	14
15	Junagadh	18.7	33.4	0.90	0.00	0.45	23
16	Kachchh	23.7	19.9	0.72	0.52	0.62	7
17	Kheda	32.2	17.8	0.42	0.60	0.51	18
18	Mehsana	26.8	22.7	0.61	0.41	0.51	18
19	Mahisagar	30.7	9.4	0.47	0.93	0.70	2
20	Morabi	21.2	24.6	0.81	0.34	0.58	11
21	Narmada	30.7	11.1	0.47	0.86	0.67	4
22	Navsari	21.8	18.7	0.79	0.57	0.68	3
23	Panchmahal	33.1	16.1	0.39	0.67	0.53	16
24	Patan	29.3	18.3	0.52	0.59	0.55	14
25	Porbandar	15.8	27.8	1.00	0.22	0.61	8
26	Rajkot	19.5	28	0.87	0.21	0.54	15
27	Sabarkantha	26.6	15.5	0.62	0.69	0.66	5
28	Surat	21	25.1	0.82	0.32	0.57	12
29	Surendra Nagar	24.1	20.7	0.71	0.49	0.60	9
30	Tapi	35.4	12.6	0.31	0.81	0.56	13
31	Dang	33.7	8.1	0.37	0.98	0.67	4

32	Vadodara	20.9	27.6	0.82	0.22	0.52	17
33	Valsad	23.8	21.3	0.72	0.47	0.59	10

Table - 6 Comparison of women DNI rank between NFHS-4 and NFHS-5

Sr. No	Districts	NFHS-4	NFHS-5	Change
		Women DNI rank	Women -DNI rank	
1	Ahmadabad	13	16	-3
2	Amreli	4	8	-4
3	Anand	17	20	-3
4	Banaskantha	8	12	-4
5	Bharuch	16	20	-4
6	Bhavnagar	10	17	-7
7	Dahod	15	18	-3
8	Gandhinagar	13	18	-5
9	Jamnagar	9	11	-2
10	Junagadh	2	19	-17
11	Kachchh	3	4	-1
12	Kheda	18	15	3
13	Mehsana	10	15	-5
14	Narmada	16	2	14
15	Navsari	13	1	12
16	Panchmahal	19	13	6
17	Patan	6	11	-5
18	Porbandar	1	5	-4
19	Rajkot	15	12	3
20	Sabarkantha	10	3	7
21	Surat	14	9	5
22	Surendra Nagar	5	6	-1
23	Tapi	12	10	2
24	Dang	7	2	5
25	Vadodara	11	14	-3
26	Valsad	7	7	0

Source: Authors own calculations

Table - 7 Comparison between District Nutritional Index rank of children and women for both the year NFHS-4 & NFHS-5

Sr. No	Districts	NFHS-4			NFHS-5		
		Children DNI rank	Women DNI rank	Change	Children DNI rank	Women DNI rank	Change
1	Ahmadabad	6	13	-7	3	19	-16
2	Amreli	3	4	-1	6	11	-5

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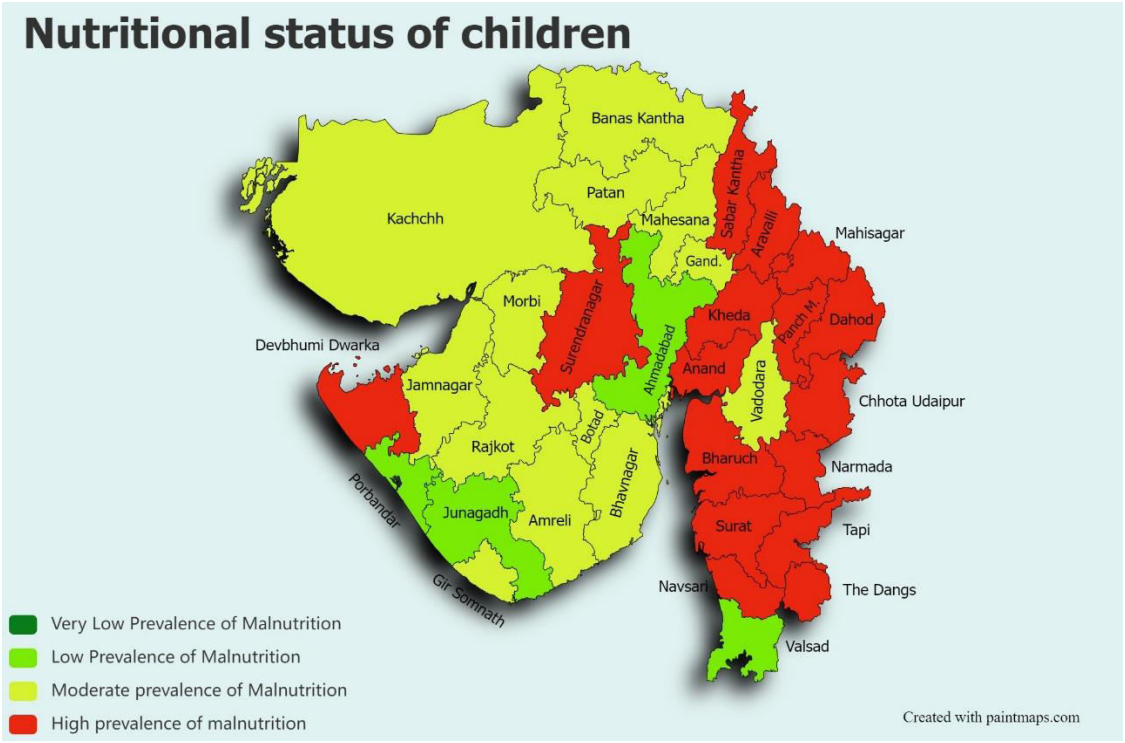
3	Anand	11	17	-6	13	24	-11
4	Banaskantha	9	8	1	6	15	-9
5	Bharuch	13	16	-3	11	24	-13
6	Bhavnagar	15	10	5	5	20	-15
7	Dahod	15	15	0	17	22	-5
8	Gandhinagar	12	13	-1	8	22	-14
9	Jamnagar	10	9	1	4	14	-10
10	Junagadh	9	2	7	1	23	-22
11	Kachchh	18	3	15	4	7	-3
12	Kheda	15	18	-3	10	18	-8
13	Mehsana	13	10	3	7	18	-11
14	Narmada	20	16	4	14	4	10
15	Navsari	7	13	-6	10	3	7
16	Panchmahal	19	19	0	18	16	2
17	Patan	8	6	2	8	14	-6
18	Porbandar	2	1	1	1	8	-7
19	Rajkot	1	15	-14	9	15	-6
20	Sabarkantha	14	10	4	15	5	10
21	Surat	4	14	-10	10	12	-2
22	Surendra Nagar	16	5	11	12	9	3
23	Tapi	14	12	2	16	13	3
24	Dang	21	7	14	17	4	13
25	Vadodara	5	11	-6	8	17	-9
26	Valsad	17	7	4	2	10	-8

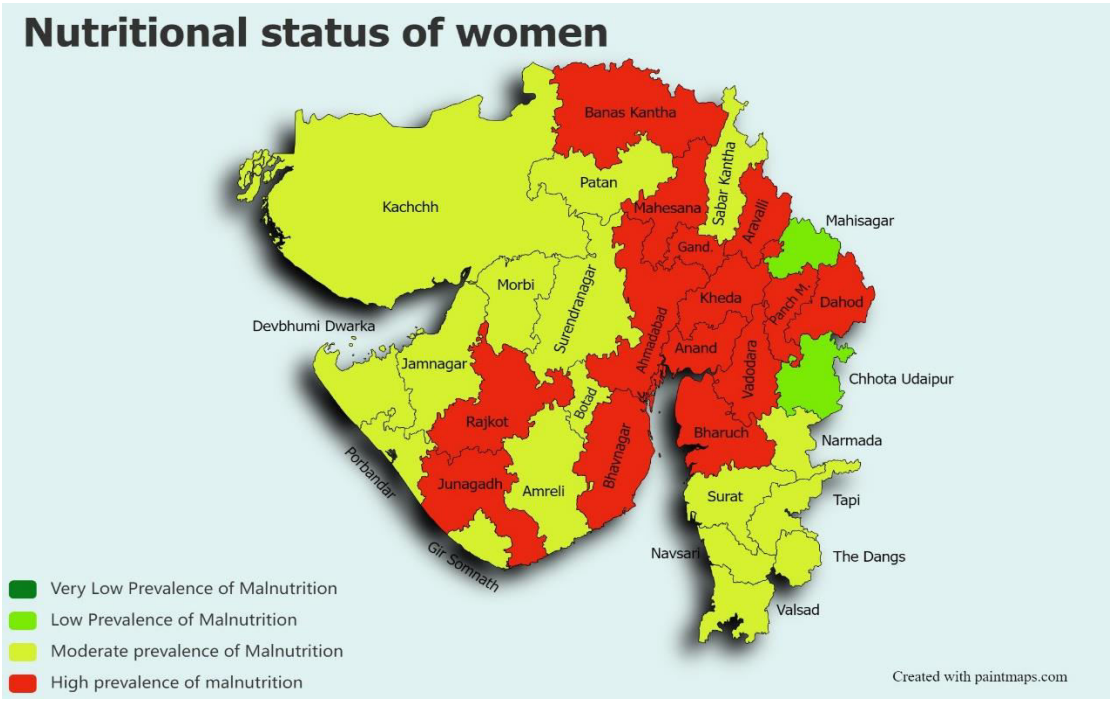
Source- Authors own calculation

Map – 1 Graphical presentation of district level disparities in terms of children DNI for NFHS-5



Source – Authors own calculation

Map-2 Graphical presentation of district level disparities in terms of woman DNI for NFHS-5



Source: Authors own calculations

References

Baheiraei, A., Bakouei, F., Mohammadi, E., Montazeri, A., & Hosseni, M. (2015). The social determinants of health in association with women's health status of reproductive age: A population-based study. *Iranian Journal of Public Health*, *44*(1), 119–129. https://www.researchgate.net/publication/278044620_The_Social_Determinants_of_Health_in_Association_with_Women's_Health_Status_of_Reproductive_Age_A_Population-Based_Study

Buechner, M., & Fox, K. (2023). *Undernourished and Overlooked: New Report Reveals Global Nutrition Crisis for Women and Girls*. UNICEF. https://www.unicefusa.org/stories/undernourished-and-overlooked-new-report-reveals-global-nutrition-crisis-women-and-girls

Damor, R. D., Pithadia, P. P., Lodhiya, K. K., Mehta, J. P., & Yadav, S. B. (2013). A study on assessment of nutritional and immunization status of under-five children in urban slums of Jamnagar city, Gujarat. *Healthline*, *4*(2), 35–39. https://www.researchgate.net/publication/321937108_A_study_on_assessment_of_nutritional_and_immunization_status_of_under_five_children_in_urban_slums_of_Jamnagar_city_Gujarat

Ishwarji, M. I., Rao, K. M., Ramakrishna, K. S., Kumar, R. H., Venkaiah, K., & Laxmaiah, A. (2019). Regional variation in the prevalence of undernutrition and its correlates among under 5 year children in western india. *Indian Journal of Community Health*, *31*(4), 521–531. https://doi.org/10.47203/IJCH.2019.v31i04.016

Meyerhoff, S. (2014). *The Intergenerational Cycle of Malnutrition: How Gender and Social Status Doom Many Mothers and Newborns*. New Security Beat. https://www.newsecuritybeat.org/2014/08/intergenerational-cycle-malnutrition-gender-social-status-doom-mothers-newborns/

Ministry of Health and Family Welfare. (2020). National Family Health Survey-5 (NFHS-5). In *International Institute for Population Sciences.* chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://main.mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf

NITI Aayog. (2023). *INDIA NATIONAL MULTIDIMENSIONAL POVERTY INDEX A PROGRESS REVIEW 2023*. https://niti.gov.in/sites/default/files/2023-08/India-National-Multidimentional-Poverty-Index-2023.pdf

Rana, R., Vaze, G., Christian, P., & Gupta, P. (2019). Determinants of Acute Malnutrition among Under Five Children in Aravalli District of Gujarat, India: A Community-Based Case-Control Study. *International Journal of Health Sciences & Research*, *9*(6), 1–8. https://www.academia.edu/en/66995201/Determinants_of_Acute_Malnutrition_among_Under_Five_Children_in_Aravalli_District_of_Gujarat_India_A_Community_Based_Case_Control_Study

Siddiqui, F., Salam, R. A., Lassi, Z. S., & Das, J. K. (2020). The Intertwined Relationship Between Malnutrition and Poverty. *Frontiers in Public Health*, *8*(453), 1–5. https://doi.org/10.3389/fpubh.2020.00453

Suri, S. (2020). *Malnutrition: India needs to urgently break inter-generational cycle*. Observer Research Foundation. https://www.orfonline.org/research/malnutrition-india-needs-to-urgently-break-inter-generational-cycle/

UNICEF, WHO, & IBRD. (2023). Levels and trends in child malnutrition: UNICEF / WHO / World Bank Group Joint Child Malnutrition Estimates: Key findings of the 2023 edition. In *UNICEF and WHO*. https://doi.org/10.18356/6ef1e09a-en

Viramgami, A. P., Vala, M. C., Sharma, S., Sheth, A., Ninama, R., & Verma, P. B. (2014). Study of socio-demographic profile of malnourished children residing in urban slums of Rajkot city , Gujarat , India. *International Journal of Research in Medical Sciences*, *3*(2), 53–56. https://www.researchgate.net/publication/308029565_Study_of_socio-demographic_profile_of_malnourished_children_residing_in_urban_slums_of_Rajkot_city_Gujarat_India

WHO. (2021). *Malnutrition*. WHO. https://www.who.int/news-room/fact-sheets/detail/malnutrition

Appendix

For negative indicators = $(Max_i – X_i) / (Max_i\text{-}Min_i)$ ……. (1)

When,

Max_i = Maximum value of i indicator

Min_i = Minimum value of i indicator

Xi = Actual value of i indicator

Example (1) (Table 1) (Ahmadabad) for children DNI

= Sum (stunted, wasted, severely wasted, underweight, overweight) *1/5

=Sum (0.76 +0.60+0.49+0.88) *1/4

=0.68

Example (2) (Table 1) (Ahmadabad) for women DNI

= Sum (Lower Body Mass Index, Overweight or Obese) * ½

=Sum (0.77+0.17) * ½

= 0.47