

Composite Indexing for Nutritional Status Evaluation: A Snapshot of Malnutrition across India

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Abstract

Introduction: Data from several sources revealed that huge incongruity persists in nutritional status across the states in India. Thus, this study was undertaken to generate a nutritional index, so that these disparities could be quantified and comparison be done. **Materials and Methods:** A nutritional index for 21 major states of India has been constructed on the basis of eight important nutrition-related indicators. The scaled value of each indicator for all the states was calculated. Each indicator was assigned an arbitrary weight (W_i) on the basis of its impact on nutritional status. On the basis of the scaled value and weight given to the particular indicator, a composite-weighted index was thus calculated. **Results:** States were ranked on their nutritional status as per the final composite score they attained. Out of 21 major states, Kerala took the top position followed by Jammu and Kashmir and Himachal Pradesh on the 2nd and 3rd position, respectively, while Uttar Pradesh got the lowest rank followed by Bihar and Jharkhand on the 2nd and 3rd lowest positions. **Conclusion:** Our study concludes that not taking an account of the burden of malnutrition when disbursing funds leads to ineffective implementation of various nutritional programs. Integrated Child Development Services has already been brought in mission mode under Poshan Abhiyan. Other determinants, i.e., illiteracy, poor sanitation, diseases, and infections, should also be considered and addressed through nutritional programs.

Keywords: Composite score, malnutrition, NITI Aayog, nutrition index, Poshan Abhiyan

INTRODUCTION

Good nutrition is among the basic human needs, also addressed in the second sustainable development goal (end hunger, achieve food security, and improved nutrition).^[1] However, progress to improve nutrition remains inordinately slow.^[2] According to recent estimates by UNICEF, malnutrition is the root cause of virtually half of all deaths occurring globally among children under 5.^[3] Undernutrition not only jeopardizes the healthy survival of children by increasing the susceptibility for common infections but also makes them vulnerable to increased frequency and severity of such infections and thereby leading to delayed recovery.^[4] It is an impenetrable truth that India accommodates largest numbers of malnourished children and every year malnutrition contributes to about half of the 1.3 million deaths occurring in under-five children.^[5] NFHS-4 data disclosed that 35.7% children below 5 years are underweight, 38.4% are stunted, and 21% are wasted in the country.^[6] Furthermore, malnutrition is among one of the foremost causes of anemia. Several studies have identified stunting and low BMI as one of the risk factors of anemia in under-five.^[7] While

continuing to focus on undernourishment, substantial efforts are indispensable for addressing anemia among children. Due to the towering prevalence of malnutrition and anemia in India, Children aged 0-5 years have been granted sizable program attention GOI launched Integrated Child Development Services (ICDS) scheme in 1975, which emerged as one of the premier programs to alleviate malnutrition burden.^[8] Even though four decades have elapsed since the program was set in motion, still malnutrition persists to be a major public health problem.^[9] The ICDS program suffered from several crunches such as inadequate data management, weak accountability, and varying practices across the states. Besides this, in many states, Anganwadi centers (AWCs) were dispensing services to more beneficiaries than they can afford, compromising the

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services, whereas in some states, AWCs failed to achieve 100% registration of children. Thus, the undernourished children remained unspotted. To acknowledge these challenges, a more ambitious program, i.e., Poshan Abhiyan derived by a National Nutritional Strategy, has been launched in 2018 to successfully reach to MALNUTRITION-FREE INDIA by 2022.^[10]

Data from several sources revealed that huge incongruity persists in nutritional status across the states in India.^[11,12] Thus, this study was undertaken to generate a nutritional index, so that these disparities could be quantified and comparisons be done. Second, this study was done to bring about appropriate and cost-effective interventions needed to improve the nutrition of vulnerable children.

MATERIALS AND METHODS

A nutritional index for 21 major states of India has been constructed on the basis of eight important nutrition-related indicators. These eight indicators were grouped into two categories, namely, key input indicators and nutritional outcome indicators. The scaled value of each indicator for all the states was calculated. For positive indicator i.e. % children breastfed within 1 hr of birth (source: NFHS 4)^[13], % children exclusively breastfed under age of 6 months (source: NFHS 4)^[13], and per capita fund released under ICDS for supplementary nutrition (Authors calculation; numerator has been taken from data available from Ministry of Consumer Affairs, Food and Public Distribution^[14] and denominator has been taken from census 2011); scaled value was calculated as follows:^[15]

$$Si = \frac{(Xi - \text{Minimum value}) \times 100}{*(\text{Maximum value} - \text{Minimum value})}$$

where Si = Scaled value for positive indicator and Xi = Data value of the indicator.

Similarly, For negative indicator i.e. % stunted children under 5 years age (source: NFHS 4)^[13], % wasted children under 5 years age (source: NFHS 4)^[13], % anaemic children under 5 years age (source: NFHS 4)^[13] and population covered per AWC (Source: Authors calculation; numerator has been taken from census 2011 and denominator has been taken from data available from Ministry of Women and Child Development)^[16]; scaled value was calculated as follows:^[15]

$$Si = \frac{(\text{Maximum value} - Xi) \times 100}{*(\text{Maximum value} - \text{Minimum value})}$$

where Si = Scaled value for negative indicator and Xi = Data value of the indicator.

*The minimum and maximum value for each of the positive and negative indicator was determined based on the values for that indicator across states. As all the indicators included in the study do not have an equal importance. So, each indicator was assigned an arbitrary weight (Wi) on the basis of its impact on nutritional status. Finally, on the basis of the above-scaled value and weight given to the particular indicator, a composite-weighted index was thus calculated as follows:^[15]

$$\text{Composite - weighted index} = \frac{\sum Wi \times Si}{\sum Wi}$$

Table 1 provides the value of arbitrary weight given to each indicator for calculating the final score and ranking of states. The highest weight, i.e., 100, was given to indicators which are directly linked to health and have maximum impact on nutrition.

RESULTS

A total of four indicators for each state were selected to reflect the key input in alleviation of malnutrition. Table 2 depicts the state-wise list of key input indicators. Only one indicator, i.e., population covered per AWC, was considered as a negative indicator, and the rest three indicators (% children breastfed within 1 h of birth, % children exclusively breastfed under age of 6 months, and per capita fund released under ICDS for supplementary nutrition) were positive. Similarly, four indicators for each state were selected to evaluate the nutritional outcome [Table 3]. All the four nutritional outcome indicators were considered as a negative indicator, e.g., lower the value, better is the performance.

Figure 1 shows ranking of states based on their nutritional status according to the final composite score. Out of 21 major states, Kerala took the top position followed by Jammu and Kashmir and Himachal Pradesh on the 2nd and 3rd position, respectively,

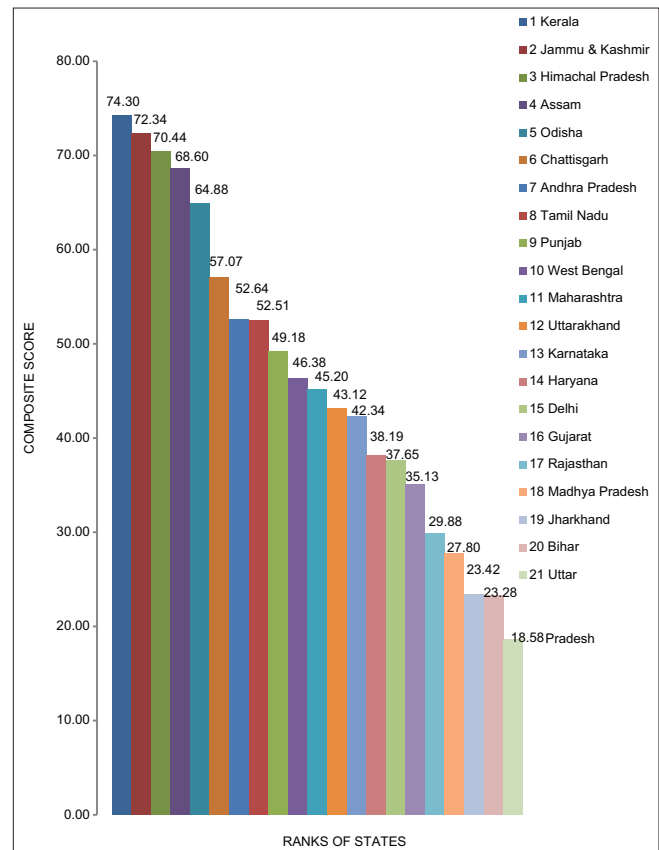


Figure 1: Ranking of states within India from highest to lowest composite score

Table 1: Value of arbitrary weight given to the particular indicator

Key input		Nutritional outcome	
Indicator	Weight	Indicator	Weight
% children breastfed within 1 h of birth*	100	% stunted children (<5 years)	100
% children exclusively breastfed under age of 6 months*	100	% wasted children (<5 years)	75
Per capita fund released under ICDS for supplementary nutrition	25	% underweight children (<5 years)	50
Population covered per AWC (operational)	25	% anemic children (<5 years)	25

ICDS: Integrated Child Development Services, AWC: Anganwadi center

Table 2: State wise list of key input indicators

State	% children breastfed within 1 h of birth*	% children exclusively breastfed under age of 6 months*	Per capita fund released under ICDS for supplementary nutrition (in rupees)**	Population covered per AWC (operational)***
Andhra Pradesh	40	70.2	0.8136	1521.07
Assam	64.4	63.5	2.9793	502.08
Bihar	34.9	53.4	0.9834	1135.50
Chhattisgarh	47.1	77.2	2.0024	506.37
Delhi	28	49.6	0.8205	1540.60
Gujarat	49.9	55.8	1.0620	1139.75
Haryana	42.4	50.3	0.6343	976.48
Himachal Pradesh	41.1	67.2	2.8417	362.73
Jammu and Kashmir	46	65.4	2.1818	423.71
Jharkhand	33.1	64.8	1.4010	858.35
Karnataka	56.3	54.2	1.5778	926.94
Kerala	64.3	53.3	0.8548	1004.87
Madhya Pradesh	34.4	58.2	1.4963	747.71
Maharashtra	57.5	56.6	0.9270	1023.64
Odisha	68.5	65.6	1.5639	578.26
Punjab	30.7	53	0.4934	1027.99
Rajasthan	28.4	58.2	0.7272	1106.08
Tamil Nadu	54.7	48.3	0.8835	1325.28
Uttar Pradesh	25.2	41.6	1.4083	1062.85
Uttaranchal	27.8	51.2	3.5405	502.63
West Bengal	47.4	52.3	0.8706	791.06

■ Maximum value of the Indicator, ■ Minimum value of the indicator. ICDS: Integrated Child Development Services, AWC: Anganwadi center, NFHS: National Family Health Survey

whereas Uttar Pradesh got the lowest rank followed by Bihar and Jharkhand on the 2nd and 3rd lowest position, respectively.

Table 4 shows the categorization of states on the basis of composite score obtained. Good performing states were the ones achieving top one-third scores (score >55.72), moderate performing states were the ones falling in middle one-third (score between 55.72 and 37.15), and poor performing states were the ones falling in the lowest one-third score (score < 37.15).

DISCUSSION

The present study underpins an attempt to compile data on malnutrition from various secondary sources and compares the disparities in the nutritional status of states across India. While stunting and wasting indicate chronic and acute malnutrition, respectively, underweight is a composite indicator and includes both acute (wasting) and chronic (stunting) malnutrition.^[17] Limited reduction in the prevalence of malnutrition has been

achieved by the country from 48% (stunting), 19.8% (wasting), and 42.5% (underweight) in 2006 to 38%, 21%, and 35.8% in 2016.^[18,19] States such as Kerala, Punjab, and Himachal Pradesh who are performing well in most of the health indicators have also sustained their status in nutrition, but at the same time, states such as Bihar, UP, and Jharkhand are still struggling with the wide prevalence of malnutrition. This is in concordance with the UNICEF report, which documented that all the districts in Bihar have prevalence above 30%, while 36 out of 38 districts have 40% and 13 out of 38 districts have unacceptable high prevalence of 50%.^[20] The impressive picture of states like Kerala is attributed to high female literacy and remarkable reach of public distribution system.^[21,22] On the same place, the gloomy picture of states such as Bihar, Jharkhand, and Uttar Pradesh is attributed to poverty, high fertility rate, and low female literacy.^[23] Furthermore, poor and inappropriate infant and young child feeding practices play a significant role in the occurrence of malnutrition, especially in children under 2 years of age.^[24-26] In consonance with this, our study also noted higher prevalence of

Table 3: State wise list of nutritional outcome indicators

State	*% Stunted children (<5 years)	*% wasted children (<5 years)	*% underweight children (<5 years)	*% Anemic children (<5 years)
Andhra Pradesh	31.4	17.2	31.9	58.6
Assam	36.4	17	29.8	35.7
Bihar	48.3	20.8	43.9	63.5
Chhattisgarh	37.6	23.1	37.7	41.6
Delhi	31.9	15.9	27	59.7
Gujarat	38.5	26.4	39.3	62.6
Haryana	34	21.2	29.4	71.7
Himachal Pradesh	26.3	13.7	21.2	53.7
Jammu and Kashmir	27.4	12.1	16.6	54.5
Jharkhand	45.3	29	47.8	69.9
Karnataka	36.2	26.1	35.2	60.9
Kerala	19.7	15.7	16.1	35.7
Madhya Pradesh	42	25.8	42.8	68.9
Maharashtra	34.4	25.6	36	53.8
Odisha	34.1	20.4	34.4	44.6
Punjab	25.7	15.6	21.6	56.6
Rajasthan	39.1	23	36.7	60.3
Tamil Nadu	27.1	19.7	23.8	50.7
Uttar Pradesh	46.3	17.9	39.5	63.2
Uttaranchal	33.5	19.5	26.6	59.8
West Bengal	32.5	20.3	31.6	54.2

■ Minimum value of the indicator, ■ Maximum value of the indicator. NFHS: National Family Health Survey

Table 4: Categorization of states on the basis of composite score

Good performing states	Moderate performing states	Poor performing states
Kerala	Andhra Pradesh	1. Uttarpradesh
Jammu &kashmir	Tamil Nadu	2. Bihar
Himachal Pradesh	Punjab	3. Jharkhand
Assam	West Bengal	4. Madhya Pradesh
Odisha	Maharastra	5. Rajasthan
Chattisgarh	Uttarakhand	6. Gujarat
	Karnataka	
	Haryana	
	Delhi	

The categorization of states is done using the same score cutoffs as the NITI Ayog Healthy states progressive India.

initiation of breastfeeding and exclusive breastfeeding among the top ranking states (Odisha, Assam, etc.). In support of our finding, Masare *et al.*^[26] also concluded in their study in Maharashtra that nonoptimal breastfeeding practices are significant risk factor for underweight infants. Similar finding was recognized by Das and Barua,^[27] Ukarande *et al.*,^[28] and Kumar and Singh.^[29] Statistics of anemia among under 5 age group at national level achieved no exception gain with 69.4% in 2006 to 58.6% in 2016. As per the NFHS-4 data, Haryana emerged as the state with the highest number of anemic children, holding it accountable for standing at rank 14 (moderate performing state) in our list. Kumar *et al.*^[30] also identified in their study in Haryana that most of the anemic patients were suffering from different grades of malnutrition. Another study conducted in Haryana by Narayan and Singh,^[31] revealed that children aged 6 to 24 months belonging to low socioeconomic

group and not receiving breastfeed in first 4–6 months of their life are at significant risk of anemia.

Another matter of concern in our study was pertaining to per capita fund released under ICDS. Allocating the funds equally to both, high performing as well as poor performing states, falls shorts to fix the higher malnutrition status of poor performing states like Bihar, Jharkhand and UP. Thus, indicating the need for higher fund allocation for states with high malnutrition prevalence as compared to states with lower prevalence. It is also observed that states such as Gujarat and Tamil Nadu are spending more than the required amount, but still they are lagging behind as moderate performers, indicating that effective implementation of the ICDS program is a matter of equal concern than just the funding constraint.^[32]

During the current decade, Odisha and Chhattisgarh have emerged as an exemplary state. Despite being a poor state, Odisha has managed to make a worthy improvement in nutrition (Rank-5). Adequate allocation of fund for supplementary nutrition, skilled and motivated Anganwadi worker, and prioritization of disadvantaged population were important contributory factors toward increasing their health coverage.^[9]

It is worth noting in our study finding that in states such as Delhi, Gujarat, Tamil Nadu, and Bihar, AWCs were catering to population higher than the usual ICDS norm, i.e., 1540.60, 1139.75, 1135.5, and 1325.25, respectively, thus overburdening the Anganwadi worker which eventually brings down their efficiency and performance.^[33] Furthermore, the quality of service is adversely hampered where the AWC is reaching out to populations more than the authorized usual norms. Kochar *et al.* mentioned in their study

that providing an additional worker of higher ability to a cluster of AWCs might address this human resource constraint at low cost.^[34]

CONCLUSION

The study brings forth a composite index, an important tool, that brings all the 21 states at one platform and reveals the fair picture to then analyze the status. Our study concludes that not taking an account of the burden of malnutrition when disbursing funds leads to ineffective implementation of various nutritional programs. ICDS has already been brought in mission mode under Poshan Abhiyan, emphasizing on convergence, targeted approach, use of information technology, social audit, and service delivery for the first 1000 days of life. Apart from these, it is desirable that other determinants, i.e., illiteracy, poor sanitation, diseases, and infections should also be considered and addressed through nutritional programs.

Limitation

The current study has some limitations which are required to be marked. First, inclusion of all the states could not be done. Only 21 major states (categorized as per Niti Aayog report for genesis of health index) were included in the study. Second, only limited number of input and output indicators could be used due to nonavailability of data of the others. Thus, the indicators covering diseases and infections contributing to malnutrition could not be incorporated in the study. Third, the weights assigned to each indicator for the calculation of composite index are not standardized and the importance of each indicator to the composite could not be analyzed statistically.

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Conflicts of interest

There are no conflicts of interest.

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