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Research

The performance of Indian States and Union Territories on Global Nutrition Targets: A rank-based analysis using a composite nutrition index

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Background

The increased global discourse on nutrition challenges has underscored the imperative to comprehend and monitor diverse manifestations of malnutrition. The comprehensive monitoring of various forms of malnutrition, including undernutrition, overnutrition, and micronutrient deficiencies, plays a pivotal role in assessing the progress towards the Global Nutrition Targets (GNTs) established by the World Health Assembly (WHA), as well as nutrition-related SDGs (SDGs). To this end, a Composite Index (CI) of six nutrition indicators centred on GNTs has been formulated to gauge and appraise progress across India's various States and Union Territories (UTs).

Methods

To calculate the CI, the authors apply a methodology developed by Webb et al. (2015). Disparities in performance between Indian States and UTs are highlighted. The analysis uses data from two surveys: the National Family Health Survey (NFHS) of 2015-16 and the NFHS of 2019-21. The main analytical tool is a rank-order analysis of the CI scores among states and union territories, with higher scores representing greater progress in achieving the targets for the six indicators.

Results

Based on data from both NFHS-4 and NFHS-5, India's overall estimated CI-WHA score stood at 2.80 and 2.86, respectively. Notably, the CI-WHA exhibited considerable inter-State/UT variation, ranging from 2.16 in Dadra and Nagar Haveli and Daman and Diu to 5.07 in Manipur, as per NFHS-4, and from 2.14 in Gujarat to 5.25 in Manipur, as per NFHS-5. Among the 34 States/UTs for which complete data sets for all six WHA targets were available from NFHS-4, the top five performers according to the developed CI-WHA targets were Manipur (5.07), Mizoram (4.87), Nagaland (4.12), Kerala (4.00), and Telangana (3.80). In contrast, the bottom five States/UTs based on NFHS-4 data were Dadra and Nagar Haveli and Daman and Diu (2.16), Uttar Pradesh (2.31), Meghalaya (2.40), Haryana (2.40) and Madhya Pradesh (2.43). However, based on NFHS-5 data, the top five States/UTs were Manipur (5.25), Mizoram (4.29), Puducherry (UT) (4.15), Goa (3.89), and Kerala (3.87), while the bottom five were Gujarat (2.14), Tripura (2.16), West Bengal (2.20), Bihar (2.31), and Assam (2.46).

Conclusions

Applying the CI to monitor States/UTs' progress in reaching WHA targets. Furthermore, it offers a means to track the progress made on nutrition-related SDGs at the sub-national level. This can help identify States/UTs whose nutrition policies and

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programs require targeted enhancements to comprehensively improve India's performance concerning GNTs. It aims to empower policymakers with the information required to make informed decisions and implement effective measures to enhance overall nutrition outcomes, especially in under-performing States/UTs.

INTRODUCTION

Malnutrition poses a formidable threat to a nation's economic development and prospects. The Sustainable Development Goals (SDGs) include commitments to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture by 2030. Developing countries like India are diligently devising strategies to align with and achieve these noble objectives. However, attaining SDGs necessitates an all-encompassing focus on the entire spectrum of causes of both undernutrition and overnutrition.

In 2012, the World Health Assembly (WHA) ratified six Global Nutrition Targets (GNTs) to enhance maternal infant and young child nutrition by 2025. GNTs established benchmarks for progress in alleviating the burden of malnutrition and the consequent loss of human capital (World Health Organization 2018). The WHA called upon its Member States to formulate and implement strategies to achieve these targets at national and sub-national levels. The Global Nutrition Monitoring Framework was developed to measure the outcomes, processes, and policies to track nations' progress towards these goals (WHO and UNICEF 2017). The six GNTs for 2025 endorsed by the WHA in 2012 are 1) 40% reduction in stunting among children under the age of five, 2) 50% decrease in anaemia among women of reproductive age, 3) 30% reduction in low birth weight (LBW), 4) no increase in childhood overweight, 5) at least 50% exclusive breastfeeding (EBF) in the first six months and 6) reduction and maintenance of childhood wasting to less than 5% (World Health Organization 2018).

India faces the dual challenge of undernutrition and a growing concern over overnutrition, which each have far-reaching implications for individual health and the broader domains of the nation's economy, growth, and development (Sahu et al. 2015; Nguyen et al. 2021). In 2017-18, the Government launched the multi-ministerial convergence mission, the Prime Minister's Overarching Scheme for Holistic Nourishment (POSHAN) Abhiyaan, with the vision of achieving a malnutrition-free India by 2022. Specific policy objectives targeted an annual reduction of 2% in stunting, underweight, and LBW and 3% in anaemia were set up (Ministry of Women and Child Development 2018). These indicators do not perfectly align with the GNTs endorsed by the WHA, as they do not encompass wasting, overweight, and EBF (Ministry of Women and Child Development, 2021).

The ongoing measurement of periodic progress associated with these nutrition indicators and net gain achieved across various dimensions is paramount at the national and sub-national levels. Prioritizing states and union territories (UTs) for targeted interventions necessitates the development of a comprehensive 'Composite Index' (CI). Several 'nutrition indices' have been developed globally to provide a nuanced perspective on progress. These global and Indian indices vary in their focus, with some assessing the prevalence of hunger while others delve into the broader landscape of malnutrition, encompassing performance. Those that have commonly used in India draw attention to the complex and persistent issue of malnutrition, highlighting the need for effective policy actions and interventions to improve nutrition outcomes, reduce hunger, and address inequity, emphasising the need for comprehensive and effective solutions (Grebmer et al. 2021; Rosenbloom, Kaluski, and Berry 2008; Lintelo et al. 2014; Muthayya et al. 2013; Aguayo, Singh, and Badgaiyan 2014; Menon, Deolalikar, and Bhaskar 2009; Agarwal et al. 2020; Luo, Zyba, and Webb 2020; Webb, Luo, and Gentilini 2015; Kanjilal et al. 2010; Swaminathan et al. 2019).

The progress towards GNTs endorsed by the WHA in India hinges upon the collective efforts of its diverse States and UTs. However, the systematic documentation of progress at the sub-national level in India, a country characterized by substantial heterogeneity, has been lacking. To address this, we calculated CIs for each of India's 34 States and UTs for which comprehensive data for all relevant indicators were available through the latest available National Family Health Survey (NFHS) data from NFHS-5, 2019-21, and examined the progress made since the NFHS-4 was conducted in 2015-16 (International Institute for Population Sciences (IIPS) 2016 and 2021).

Another aim was to increase awareness regarding the prevalence of diverse forms of malnutrition and highlight disparities in performance across States/UTs.

METHODS

We adapted the methodology devised by Webb, Luo, and Gentilini (2015) to calculate the CI for India based on WHA indicators. The authors created the Net State of Nutrition Index (NeSNI) using the UNDP's Human Development Index (HDI) indicators because of its simplicity and transparency and because most governments are already familiar with and understand it. The HDI ranks nations according to three dimensions, i.e. life expectancy at birth, achievements in education, and GDP per capita, with maximum and minimum assigned values for each dimension, with maximum and minimum assigned values for each dimension. The HDI values range from 0 (lowest) to 1 (highest) (Webb, Luo, and Gentilini 2015; Alkire, Sabina, and James Foster, 2011). Webb, Luo, and Gentilini (2015) had a similar equation structure, which was simple, and we incorporated the six WHA indicators into it.

In this study, National, State and UT factsheets of both the NFHS-4 (2015-16) and NFHS-5 (2019-21) were used to extract and compile the data on all six indicators of WHA. The first stage involved finding the indicators pertinent to the WHA targets. Next, we ascertained whether both the surveys NFHS - 4 and NFHS - 5 captured all the required

variables for all States and UTs. The description of indicators and the data sources used in calculating our CI, along with minimum and maximum values for each indicator, are shown and explained in detail in **Table I.**

All the indicators (stunting, wasting, anaemia, childhood overweight, and LBW) except EBF are expected to show a negative impact in values dropping. The indicators were combined into a single index despite differences in their scales and expected directions of association with health outcomes.

As a result, the score for Index is calculated as –

1. For Indicators: Stunting, Wasting, Childhood Overweight, Anaemia (Women 15-49 yrs.), LBW.
$$A = \Sigma_{i=1}^{5}(max_i - X_i)/(max_i - min_i)$$
Where, i = aggregate of all five indicators
max= the highest value
min= the lowest value
X= the actual value of the indicator
2. For the Exclusive Breastfeeding (EBF) Indicator
$$B = (X_{EBF} - min_{EBF})/(max_{EBF} - min_{EBF})$$
Where max = the highest value of EBF
min = the lowest value of EBF
X= the actual value of EBF
3. Finally, the CI is calculated by adding the values of A and B of all six indicators together of respective States/UTs, which are ranked based on NFHS-4 and NFHS-5 data.

Each indicator was standardised and transformed using the maximum and minimum values to create the CI and received a score value between 0 and 1, where 0 is the minimum range and 1 is the maximum range. This allowed states and UTs to be ranked.

RESULTS

Overall, the CI-WHA score for India was 2.80 (out of a possible 6) for 2015-16 according to NFHS-4, increasing to 2.86 in 2019-21 (NFHS-5). Among the States and UTs, Manipur (5.07), Mizoram (4.87), Nagaland (4.12), Kerala (4.00), and Telangana (3.80) demonstrated the highest CI-WHA scores in 2015-16, while Dadra and Nagar Haveli and Daman and Diu (UT) (2.16), Uttar Pradesh (2.31), Meghalaya (2.40), Haryana (2.40), and Madhya Pradesh (2.43) exhibited the lowest scores.

In contrast, utilizing the latest NFHS-5 data (2019-21), Manipur (5.25), Mizoram (4.29), Puducherry (UT) (4.15), Goa (3.89), and Kerala (3.87) emerged as the top five States/UTs with the highest CI-WHA scores, while Gujarat (2.14), Tripura (2.16), West Bengal (2.20), Bihar (2.31), and Assam (2.46) ranked as the bottom five.

Figure 1 and Figure 2 show the change in the CI score (arrow) of states and UTs over the two time periods. The first half of the graph, from Tripura to Odisha, saw a decline in the CI from NFHS-4 to NFHS-5, whereas the lower half of the graph, from Arunachal Pradesh to Haryana, showed some improvement.

Detailed information on the specific indicators and scores utilized to construct the CI is presented in **Table I**.

It is important to note that while scores were calculated for all 34 States and UTs, data availability constraints led to the exclusion of Chandigarh and Ladakh. Specifically, EBF rates were unavailable for Chandigarh in both NFHS-4 and NFHS-5, while LBW data were unavailable for Ladakh in NFHS-4.

Analysing the latest NFHS-5 data reveals significant changes in rankings among several States and UTs. For instance, Puducherry has ascended from 19th place in NFHS-4 (2015-16) to the 3rd rank in NFHS-5 (2019-21). Goa improved from the 10th rank in NFHS-4 to the 4th rank in NFHS-5, attributed to declines in wasting (21.9% to 19.1%), childhood overweight (3.7% to 2.8%), LBW 22.3% to 14%), and an increase in EBF rates (60.9% to 61.4%). Uttarakhand also demonstrated substantial progress, rising from the 26th rank to the 7th rank, with significant reductions in stunting (33.5% to 27%), wasting (19.5% to 13.2%), anaemia in women of reproductive age (WRA) (45.2% to 42.6%), LBW (24.7% to 17.7%), and an improved rate of EBF (51.2% to 52.5%) between NFHS-4 and NFHS-5.

Conversely, Telangana, previously among the top five States in NFHS-4, experienced a significant drop to the 21st rank, primarily due to increases in stunting (33.1%), wasting (21.7%), childhood overweight (3.4%), anaemia in WRA (57.6%), and LBW (16.3%). Assam witnessed a noteworthy increase in wasting (21.7%), childhood overweight (4.9%), and anaemia in WRA (65.9%), leading to a decline to the 30th rank in NFHS-5 from the 14th rank in NFHS-4. Similarly, West Bengal's ranking decreased from 20th to 32nd, while Tripura, ranked 7th in NFHS-4, now ranks 33rd in NFHS-5. These States, including Assam, West Bengal, and Tripura, have moved from their original positions in NFHS-4 to the bottom five in NFHS-5.

Mizoram, characterized by the lowest prevalence of LBW (4%) and wasting (9.8%), maintaining its 2nd place ranking in NFHS-5, remains a notable exception. Nevertheless, worrisome trends in other indicators, including stunting, wasting, childhood overweight, and anaemia in WRA, warrant further attention.

A comparative analysis of CI-WHA rankings between NFHS-4 and NFHS-5 data for the 34 States/UTs is presented in **Table II,** along with additional information for a nuanced comparison.

Based on NFHS-4 data, Manipur, Mizoram, Nagaland, Kerala, and Telangana held the top five positions with the highest CI scores. At the same time, Madhya Pradesh, Haryana, Meghalaya, Uttar Pradesh, Dadra and Nagar Haveli and Daman and Diu ranked lowest. However, when considering NFHS-5 data, there has been a shift in CI scores and rankings among Indian States/UTs, with Manipur, Mizoram, Puducherry (UT), Goa and Kerala emerging as the top five performers across most nutritional indicators. Conversely, Gujarat, Tripura, West Bengal, Bihar, and Assam face challenges in improving their nutrition outcomes.

DISCUSSION

The GNTs pertaining to maternal, infant, and young child nutrition, as endorsed by the WHA in 2012, serve as pivotal

Table I. Definition of indicators and National Family Health Surveys used for CI-WHA Indicators

S. No	Indicator	Target group	Definition	Data Source	CI-WHA NFHS-4 (2015-16)		CI-WHA NFHS-5 (2019-21)	
					Maximum Value across States/UTs (%)	Minimum Value across States/UTs (%)	Maximum Value across States/UTs (%)	Minimum Value across States/UTs (%)
1	Stunting	Children Below 5 yrs. of age	Below -2 SD based on WHO Standard	NFHS-4 (2015-16) India and State/UTs Fact Sheet NFHS-5 (2019-21) India and State/UTs Fact Sheet	48.3	19.7	46.5	20
2	Wasting	Children Below 5 yrs. of age	Below -2 SD based on WHO Standard	NFHS-4 (2015-16) India and State/UTs Fact Sheet NFHS-5 (2019-21) India and State/UTs Fact Sheet	29	6.1	25.6	9.8
3	Childhood Overweight	Children Below 5 yrs. of age	Above +2 SD based on WHO Standard	NFHS-4 (2015-16) India and State/UTs Fact Sheet NFHS-5 (2019-21) India and State/UTs Fact Sheet	8.6	0.7	10.5	1.9
4	Anaemia	All women age 15-49 years	Haemoglobin level (< 12.0 g/dl). Prevalence is adjusted for altitude and for smoking status if known	NFHS-4 (2015-16) India and State/UTs Fact Sheet NFHS-5 (2019-21) India and State/UTs Fact Sheet	72.9	24.8	71.4	25.8
5	LBW	New-born	Birth weight < 2500 g	NFHS-4 (2015-16) India Report NFHS-5 (2019-21) India Report	26.6	6	22.4	4
6	EBF	All Children between 0-6 months of age	Based on youngest child living with the mother and whether exclusively breastfed the day before the survey	NFHS-4 (2015-16) India and State/UTs Fact Sheet NFHS-5 (2019-21) India and State/UTs Fact Sheet	77.2	35.8	80.3	28.3

Table II. Comparison of Ranking and Score of States/UTs and other relevant information.

Rank as per NFHS-4 (2015-16)	Indian States and UTs	CI-WHA Score	Rank NFHS-5 (2019-21)	Indian States/ UTs	CI-WHA Score	The time interval between 2 surveys (in months)	Mid-year estimated total population (Ref: Oct. 2020)	(%) Share to India's total population	Launch of POSHAN Abhiyaan	Survey conducted before COVID pandemic
	India	2.80		India	2.86	52	1356978000	100.0	2017-18	
1	Manipur	5.07	1	Manipur	5.25	49	3149000	0.2	2017-18	Yes
2	Mizoram	4.87	2	Mizoram	4.29	37	1210000	0.1	2017-18	Yes
3	Nagaland	4.12	3	Puducherry (UT)	4.15	53	1557000	0.1	2017-18	No
4	Kerala	4.00	4	Goa	3.89	37	1555000	0.1	2017-18	Yes
5	Telangana	3.80	5	Kerala	3.87	55	35413000	2.6	2017-18	Yes
6	Himachal Pradesh	3.79	6	Nagaland	3.76	40	2182000	0.2	2017-18	Yes
7	Tripura	3.75	7	Uttarakhand	3.62	67	11346000	0.8	2017-18	No
8	Lakshadweep	3.72	8	Haryana	3.58	55	29314000	2.2	2017-18	No
9	Jammu and Kashmir	3.66	9	Arunachal Pradesh	3.58	53	1526000	0.1	2017-18	No
10	Goa	3.60	10	Andaman and Nicobar Island (UT)	3.55	58	400000	0.0	2017-18	Yes
11	Andhra Pradesh	3.58	11	Lakshadweep	3.50	53	68000	0.0	2017-18	Yes
12	Chhattisgarh	3.57	12	Andhra Pradesh	3.46	41	52669000	3.9	2017-18	Yes
13	Arunachal Pradesh	3.54	13	Delhi (NCT)	3.44	49	20414000	1.5	2017-18	No
14	Assam	3.49	14	Tamil Nadu	3.43	60	76255000	5.6	2017-18	No
15	Punjab	3.45	15	Rajasthan	3.39	57	78861000	5.8	2017-18	No
16	Sikkim	3.43	16	Punjab	3.33	68	30239000	2.2	2017-18	No
17	Andaman and Nicobar Island (UT)	3.43	17	Himachal Pradesh	3.23	52	7374000	0.5	2017-18	Yes
18	Odisha	3.09	18	Chhattisgarh	3.21	54	29333000	2.2	2017-18	No
19	Puducherry (UT)	3.09	19	Madhya Pradesh	3.16	66	84040000	6.2	2017-18	No
20	West Bengal	2.85	20	Karnataka	3.15	53	66627000	4.9	2017-18	Yes
21	Maharashtra	2.85	21	Telangana	3.11	74	37599000	2.8	2017-18	No

Rank as per NFHS-4 (2015-16)	Indian States and UTs	CI-WHA Score	Rank NFHS-5 (2019-21)	Indian States/ UTs	CI-WHA Score	The time interval between 2 surveys (in months)	Mid-year estimated total population (Ref: Oct. 2020)	(%) Share to India's total population	Launch of POSHAN Abhiyaan	Survey conducted before COVID pandemic
22	Delhi (NCT)	2.80	22	Sikkim	3.10	39	673000	0.0	2017-18	Yes
23	Karnataka	2.79	23	Odisha	3.06	68	45552000	3.4	2019-20	No
24	Tamil Nadu	2.77	24	Meghalaya	2.85	53	3272000	0.2	2017-18	Yes
25	Rajasthan	2.74	25	Uttar Pradesh	2.83	57	229672000	16.9	2017-18	No
26	Uttarakhand	2.62	26	Dadra Nagar Haveli and Daman&Diu (UT)	2.79	52	1053000	0.1	2017-18	Yes
27	Bihar	2.57	27	Jharkhand	2.78	68	38249000	2.8	2017-18	No
28	Gujarat	2.53	28	Jammu and Kashmir	2.67	43	13365000	1.0	2017-18	Yes
29	Jharkhand	2.45	29	Maharashtra	2.50	36	123961000	9.1	2017-18	Yes
30	Madhya Pradesh	2.43	30	Assam	2.46	53	34887000	2.6	2017-18	Yes
31	Haryana	2.40	31	Bihar	2.31	56	122341000	9.0	2017-18	Yes
32	Meghalaya	2.40	32	West Bengal	2.20	50	97871000	7.2	Not Implemented	Yes
33	Uttar Pradesh	2.31	33	Tripura	2.16	38	4051000	0.3	2017-18	Yes
34	Dadar and Nagar Haveli and Daman & Diu (UT)	2.16	34	Gujarat	2.14	41	69402000	5.1	2017-18	Yes

Note: Chandigarh and Ladakh were excluded from the analysis due to unavailable EBF and LBW data in NFHS-4, respectively, affecting CI-Score and Ranking computation. For merged UTs Dadra and Nagar Haveli and Daman and Diu, NFHS-5 data were used, averaging NFHS-4 LBW values. The calculated score, ranging from 0 to 1, evaluates state/UT performance against six WHA targets, underscoring nutrition complexities and guiding solutions.

instruments in identifying priority areas, instilling ambition at the national level, and establishing an accountability framework. The selection of global targets is predicated on considering epidemiological and public health significance and the feasibility of universal attainment (World Health Organization and United Nations Children's Fund 2019). The primary objective of this study was to develop a Composite Index (CI) for assessing and ranking the performance of Indian states and union territories (UTs) for nutrition-related indicators spanning the period from NFHS-4 (2015-16) to NFHS-5 (2019-21). The CI, its associated score, and the resultant rankings help assess the progress made by each state/UT in India while concurrently highlighting areas necessitating intervention for improved nutritional outcomes—an essential facet of overall development and a crucial element embedded within most SDGs. When interpreting these results, it is essential to acknowledge the substantial population disparities among Indian states and UTs, with population shares ranging from 0.01% to 16.9% of the total population (**Table II**). Consequently, the impact and magnitude of the observed effects at the population level are far more varied than the rankings themselves might suggest.

Global efforts are underway to realize the GNTs, necessitating a profound understanding of the multifaceted dimensions of both undernutrition and overnutrition. Such endeavours entail harmonized collaboration between governmental bodies and national and international organizations. The paradigm shifts in dietary habits, lifestyles, food systems, and food security, denoted as the "nutrition transition," has manifested itself globally in recent years, further entrenching micronutrient deficiencies and non-communicable diseases (NCDs) (Popkin, Adair, and Ng 2017). Consequently, to facilitate nations in achieving WHA targets, policymakers must reckon with this nutritional transition, instigate new nutrition policies, revisit existing policies, including agricultural and food policies, and effectuate alterations in the prevailing policies and programmes (Nutrition and Systems 2014).

The CI developed herein draws its theoretical foundation from the research of Webb, Luo, and Gentilini (2015). However, in the context of India, this study incorporates the six global targets endorsed by the WHA, thereby creating a multifaceted approach to the measurement and comparison of Indian states/UTs' performance and progress in combatting nutrition-related issues.

Examining the rankings of Indian states/UTs for global targets, as derived from NFHS-4 versus NFHS-5 data, reveals notable trends. Specifically, among the top five states/UTs according to NFHS-4 data, Nagaland and Telangana have experienced a notable decline in their positions in the most recent NFHS-5 data. In contrast, Puducherry and Goa have improved their rankings, thus emerging as new entrants in the top five list. This observation underscores the complex nature of malnutrition, hinting at the necessity for multidimensional actions. It is apparent that not all states/UTs are making progress across all six indicators; indeed, some lag behind in at least one indicator or have even witnessed a decline in their rankings. This underscores the interdependence of indicators and how changes in the prevalence of any single indicator can exert a cascading effect on the overall score and ranking of states/UTs. Overall, as per the NFHS-5 factsheet, a marginal improvement in EBF is discernible, along with a decrease in stunting and wasting on a nationwide scale. However, there is an increase in anaemia among WRA and in childhood overweight (Bhatia et al. 2023).

These findings underscore how malnutrition, in all its manifestations, can serve as an informative indicator for constructing a multifaceted yet cohesive index and ranking tool, informing government, policymakers and programme managers in their efforts. The CI-WHA Score and ranking offer a holistic representation of a nation's nutritional status, accounting for the myriad factors contributing to malnutrition. The findings, particularly concerning select states in India, serve as a clarion call to the government and policymakers to institute robust nutrition programs centred on "double-duty actions" that address both undernutrition and overweight within the population.

Our findings also prompt reflection on the current POSHAN 2.0, suggesting the potential need for a more comprehensive approach that incorporates indicators related to overnutrition and infant and young child feeding/EBF practices. The Government of India's continued leadership in this endeavour is essential to achieving sustainable improvements in the nutritional well-being of its citizens.

CONCLUSION

The CI-WHA Score offers insights into the nutritional profile of a nation, facilitating the assessment of temporal changes and regional comparisons. This paper demonstrates the utility of such a tool in evaluating the impact of national strategies on various forms of malnutrition, contributing to informed decision-making processes.

A rank-order analysis seems appropriate to measure the disparities in nutrition conditions among states and union territories. It may introduce a competitive element in the sense that policy and program decision-makers compare the nutrition conditions of a particular state to those of other states.

LIMITATIONS

The intertemporal comparison of two rankings in time series does not allow us to reach conclusions about progress in each state/UT towards achieving GNTs for the following reasons:

- Measurement of progress or lack thereof in a particular state, as indicated by a change in rank order, depends on progress or lack thereof in other states.
- Two pivotal events transpired during the interlude between the two National Family Health Surveys conducted in 2015-16 and 2019-21, as delineated in Table II. Firstly, the inauguration of the POSHAN Abhiyaan, a comprehensive nutrition initiative launched in India during 2017-18, aimed at addressing various

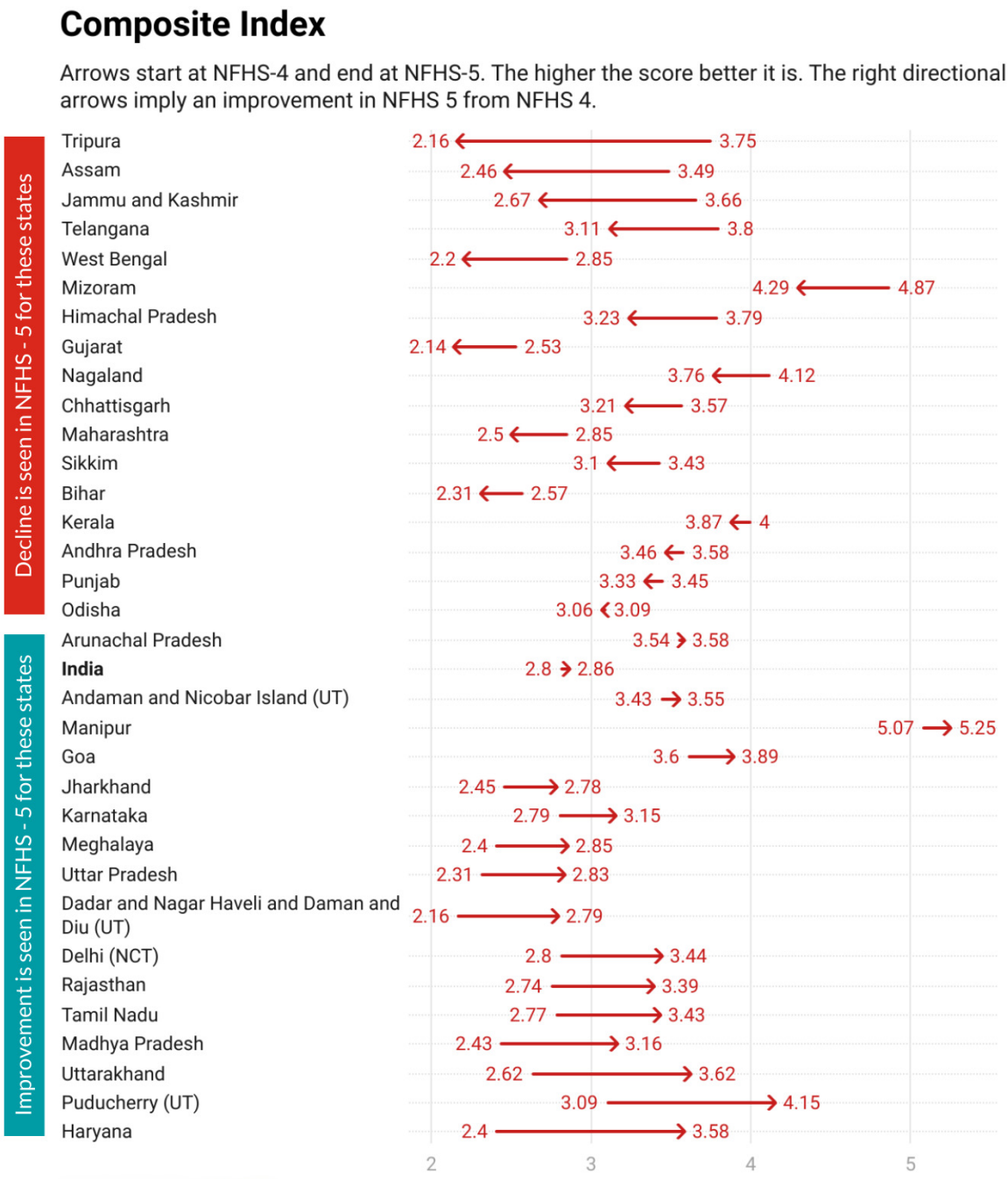

Figure 1. Change in Composite Score for each state/Union Territory based on data from national surveys NFHS-4 (2015-6) and NFHS (2019-21)

facets of undernutrition. It is unavoidable that roll-out took place sooner in some states/UTs than others. Secondly, the advent of the COVID-19 pandemic in 2020 affected states/UTs differently.

- The temporal disparities in the intervals between the NFHS-4 and NFHS-5 surveys across various States/UTs, which spanned from 36 to 74 months, have not been scrutinized in this analysis (refer to Table II). In addition, the analysis did not consider the potential ramifications of the distinct phases of data collection for NFHS-5, which were conducted both prior to and subsequent to the onset of the COVID-19 pandemic.
- The approach does not have a cause-effect study design. Hence, it is not justified to attribute differences in these rankings to any particular causal factors.
- There is an exclusion of certain States and UTs from this analysis due to data unavailability across both the surveys.

AUTHOR CONTRIBUTION

AD and VK conceptualized the research design and analysis plan and RD performed the analysis and wrote the manuscript. KV provided additional insight and reviewed the

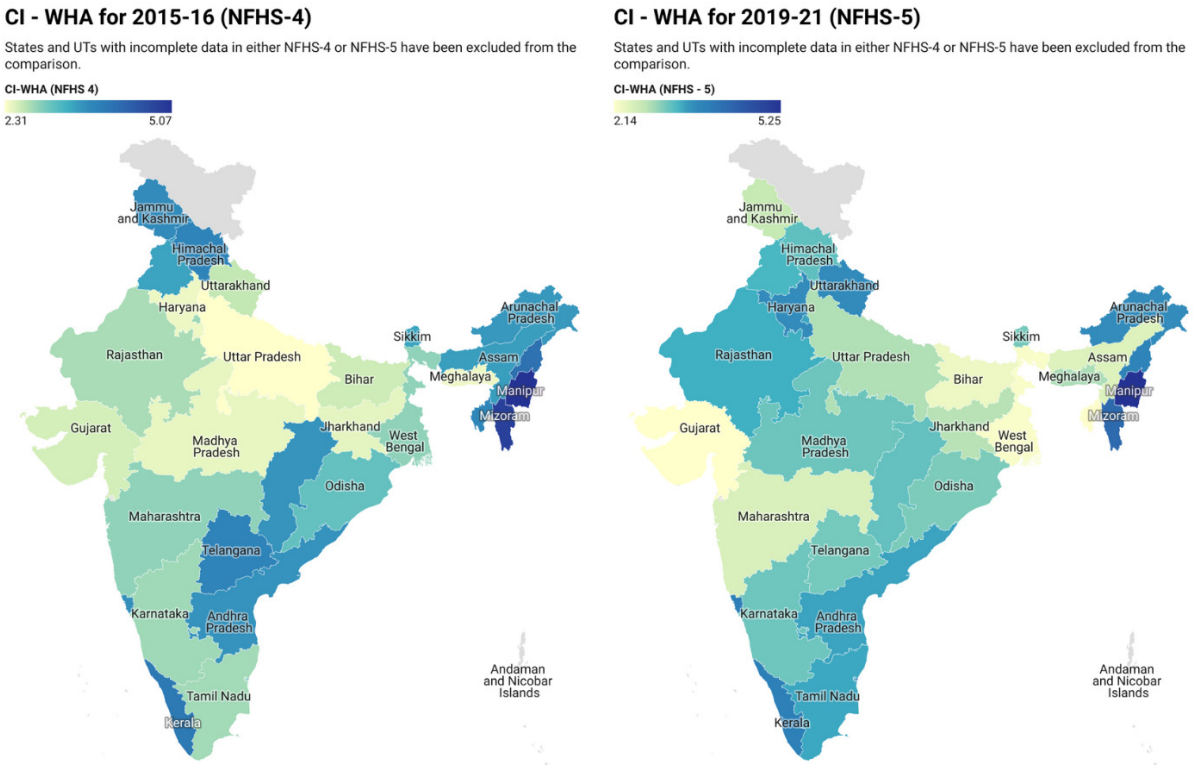

Figure 2. Mapping of States/UTs according to the gradient of Composite Score over two surveys.

draft. All authors approved the final manuscript as submitted.

DECLARATIONS

The views expressed in this manuscript, along with the developed 'index' are solely the authors' and do not necessarily reflect the opinion and beliefs of any organization.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICAL APPROVAL

The research was conducted using secondary data sources; hence, ethical approval was not applicable.

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