

Causative Factors Of Child Malnutrition In Odisha: A Findings From National Family Health Survey, 2019-21

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ABSTRACT

Aim

Children are widely recognized as a vulnerable group in health & mind point of view. Therefore, our present study dealt with precise delineation and clustering of districts of Odisha on the basis of nutritional value and to identify the health status and socioeconomic indicators that influence child malnutrition.

Subject and methods

The micro level data from National Family Health Survey (NFHS), 2019-21 was used for analysis. In this study, nutritional indicators are synthesized through cluster analysis to get better insight of nutritional status of different districts of Odisha. Cluster analysis classified all districts into four main clusters indicating different nutritional indicators. Correlation method is adopted to know the strength and direction of the association between child nutritional status with their respective influenced indicators.

Results

There was a significant reduction in stunted (4.11%), wasted (3.05%), under-weighted (6.32%) and severely wasted (0.07%) category of child is noticeable in recent survey as compared to past survey. The comparative analysis of Odisha all nutritional status was compared with aspirational districts identified by NITI Aayog. There was a reduction in the level of wasted, severely wasted, under weighted children category by 6.4%, 1.1% and 6.16% respectively, while it is limited by 0.95% for stunted child category. Correlation analysis revealed that clean cooking fuel & improved household sanitation, immunization & anaemic child play pivotal role in reducing malnutrition.

Conclusion

Child malnutrition is still a big deal all over Odisha but the situation is very critical in southern districts of the state where a large proportion of tribal population inhabits. Our finding suggests that the many flagship programs and POSHAN Abhiyan should adopt an equity approach for nutritional benefits of children in all districts of Odisha.

Keywords: Anaemic, Household Indicators, Child Malnutrition, NFHS, Social Welfare Scheme

INTRODUCTION

Nutrition is a process of Ingestion, absorption, assimilation, biosynthesis, catabolism and excretion of food material that is supplied for growth of a life. Sometimes, alteration in any of above processes have deleterious impact and leads to sever health hazard to adult as well as child life. However, the term, undernutrition is lack of proper nutrition, caused due to paucity of food materials and basic elementary needs viz., benefit nutrients and vaccination for growth and health. Therefore, good nutrition depends both on quality and quantity of food, child and maternal health care, access to health and a healthy environment. Child malnutrition is an important risk factor for death and disease globally. In Sustainable Development Goals (SDG), Out of 17 targets, twelve targets are directly or indirectly related to malnutrition. Target 2 aims at reducing malnutrition in all forms by 2030 (United nations 2016). Hence under the Goals, there a target to achieve zero hunger, no poverty as well as good health and wellbeing all over the world by 2030. The recent estimates suggest that stunting affected 21 % of children under 5 years of age (144 million), while 7 % of children were found to be wasted (47 million), and 13 % of children were underweight (88 million) across the globe in 2019 (UNICEF 2020). The World Health Assembly (WHA) set six commendable targets for stunting, wasting, overweight, anaemia, low birth weight and exclusive breastfeeding to improve the state of maternal and child health. It recommended that stunting be reduced by 40% from its current level and wasting be reduced by 5% among under-5 children by 2025 (WHO 2017). Globally, three countries India, Nigeria and Pakistan in South East Asia and Africa have the most malnutrition children. Globally, India alone had 47 million stunted children and 26 million wasted children, the highest in the world in 2018 (DIGN 2018). In India, around 38.4, 21.0 & 35.7 percent of children under the age of five years are stunted, wasted and underweight respectively as per fourth round of NFHS in 2015-16 (NFHS 4) but in Odisha the rate was 34.1%, 20.4% & 34.4 %. NFHS-5 reported a significant reduction nationally in stunted (4.11%), wasted (3.05%), underweight (6.32%) category of child is noticeable within 5 years but in Odisha, the decline rate is 3.1%, 2.3% & 4.7%. The first-ever Comprehensive National Nutrition Survey (CNNS) found that 35 % of children under 5 years of age were stunted, and 17 % were wasted, and 33 % were underweight in India in 2016–2018 which is a significant reduction from NFHS 4 (2015-1016) (CNNS 2019) Estimates in data from Partnerships and Opportunities to Strengthen and

Harmonize Actions for Nutrition in India (POSHAN) suggest that 3,09,300 babies die the day they are born, and 8,76,200 babies die during their first month of life, from causes involving low birth weight, underweight, and iron deficiency (POSHAN 2017). Agarwal and Sethi estimated, in the year 2012, 1.6 million children died before reaching age 5.

Odisha is an ideal place for studying child nutrition because of high rate & sluggish development of child undernutrition, economically poor state, where around 32.59 % people are living below poverty line as per Odisha Economic Survey, 2014-15 and female literacy rate is 67.4 % as per NFHS-4 data which is comparatively lower than many states (Bera et al. 2019) The 11 districts of Southern and western Odisha are known as KBK and is made up of the districts of Bolangir, Boudh, Gajapati, Kalahandi, Khandamal, Koraput, Malkangiri, Nabarangpur, Nuapada, Rayagada, and Subarnapur. These are regarded as the most backward regions by the planning commission so here study of child malnutrition is a matter of great concern. Many previous studies show that Maternal characteristics such as underweight, low body mass index, low educational attainment and early age at marriage are consistently associated with a high chance of stunting and wasting of under-5 children (Bhutta et al. 2008; Vollmer et al. 2917). Household poverty, unimproved sanitation and unhygienic practices are the key household correlates of stunting and wasting. A result of this poor nutritional deprivation in early childhood is higher risks of diarrhoeal disease and acute respiratory infection, delayed motor skills, and poor cognitive and social development during childhood; high blood pressure, obesity, diabetes and heart disease during adulthood (Victora et al. 2008; Kar et al. 2008; Alderman et al. 2006) Household structure has been the focus of many studies on child malnutrition (Bronte et al. 2004). Demographic factors that appear to be important in overcoming childhood malnutrition include birth order, breastfeeding practices, and sex differentials (Mishra et al. 2004; Marcoux 2002; Pande 2003) Many previous studies linked socio-economic and demographic factors with childhood undernutrition. The factors include age and sex of child, birth weight, birth order, duration of exclusive breast-feeding, bottle feeding, age of mother, lower maternal education, undernourished mothers, household socio-economic status, presence of toilet facility in the household, poor drinking water quality, poor sanitary conditions and place of residence (Ansuya et al. 2018; Habimana et al. 2019; Budhathoki et al 2020; Dorsey et al. 2018; Mukabutera et al. 2016). A recent study found that a higher burden of stunted and underweight children in the least developed districts in India. Further study shows that maternal education and safe drinking water has drastically reduced its inequality level (Singh et al. 2019). Therefore, The specific objectives of this research article are;

1. To assess the nutrition prosperity and identification causative factors for its development
2. To understand the inter-dependence of nutrition with various indicators implemented by government of India
3. To cluster the districts of equivalent nutritional value.

4. To analyse the nutrition value of aspirational districts and its status in relation to Odisha.

Database and Methodology

The present study used nationally representative data National Family Health Survey (NFHS): NFHS-4 (2015–16) & NFHS-5 (2019-2021). It is a large scale, multi round survey conducted in a representative sample of households throughout India. The survey provides state and national information for India on fertility, infant and child mortality, maternal and child health, reproductive health, nutrition, anaemia, the practice of family planning. Recent survey NFHS-5 which conducted in 2019-2021 includes some new topics, such as preschool education, disability, access to a toilet facility, death registration, bathing practices during menstruation, and methods and reasons for abortion. In this study, *k*-means clustering method is used to partition *n* observations into *k* clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. Correlation method is used to know about the strength and/or direction of the association between nutritional status of children with their indicators.

Results

To understand the nutritional landscape among the fellow citizens of Odisha, basic elementary needs & services provided by state & central government have been critically analysed for its advancement & deterioration. To accurately characterise the nutrition standard of Odisha following data has been synthesized considering data from the 4th and 5th phase of National Family Health Survey.

Essential Nutritional Indicators

Drinking Water

Drinking water and sanitation are two basic elementary requirements for each household for their daily needs. In the era of climate change & fast population growth leads to scarcity of drinking water. Therefore, both the central & state government have taken many initiatives for its augmentation in the state of Odisha. To assess its development during NFHS-5 over the NFHS-4 survey, result depicts 24 districts of Odisha are connected 80-100% clean and uninterrupted drinking water supply followed by 4 districts with 60-80% drinking water and two districts sparsely connected 40-60%. NFHS-5 shows that 26 districts of Odisha are well connected with 80-100% improved drinking water facility followed by 4 districts connected with 60-80% drinking water facility. Maximum change in drinking water facility is observed for the Khurda, Gajapati, Kendujhar districts while minimum change is noticed for Jharsuguda followed by Subarnapur & Bolangir. The minimum change for the above district could be attributed due to attainment of higher percentage of drinking water facility during the fourth phase of family health survey. Besides, development in drinking water facility also analysed on the basis of category of revenue district. Results showed that the mean percentage of change of drinking water facility during NFHS-5 survey for all district is 3.9%, which is low as compared to the central districts (4.2%) and relatively higher

than northern districts (3.3%). Besides, the gradient or range of change in drinking water facility is observed as low for the southern, northern & central sector compared to all districts. The relatively higher value of range in the central district indicates some districts associated with a very lower and higher percentage of achievement of drinking water facility compared to the northern district & southern districts. Comparison analysis among all, indicates southern districts of Odisha are in a good position to bring significant development & prosperity in connecting drinking water facilities to its citizens for their socio-economic development.

Sanitation Facility

Sanitization in rural India is viewed as the cleanliness of a country for development of healthy biodiversity as well as towards creating a better habitable & hygienic space for all. To provide better sanitization, various schemes of government have been implemented to bring a transformation in sanitization. Analysis represents the achievement of sanitization development in Odisha districts during NFHS-4 & 5 survey. Further result depicts 17 districts of Odisha are connected with 20-40% sanitization facility followed by 13 districts with 0-20% during NFHS-4 survey. NFHS-5 shows that 17 districts are provided with 60-80% sanitization facility followed by 12 districts with 40-60% sanitization & only one district connected with 20-40% sanitization which indicates. Odisha has to go a long mile to achieve 100% in terms of sanitization. Maximum change in achieving sanitization facility is observed for Bolangir, Kalahandi & Subarnapur district while minimum change is observed for Jajapur followed by Gajapati and Malkangiri. Besides, it is observed that maximum & minimum sanitization facilities connected to households are observed for Khurda & Koraput respectively. The minimum change for the above district could be attributed due to attainment of a sanitization facility during fourth phase of family health survey.

Besides these, sanitization development is also analysed on the basis of category of revenue districts. Results showed that the mean percentage of change in sanitization facility during NFHS-5 survey for all the districts is 36.9%, which is low compared to the northern districts (40.8%) and higher than the central districts (34.9%) and southern districts (35%). Besides, change in range in sanitization development indicates high value for all districts compared to the southern, northern and central sectors. Relative high value of range in central district indicates some districts associated low & high percentage of achievement in sanitization facility as compared to the northern & southern district. The minimum value of range for northern district is an indication of uniform development among the all districts of northern district. Comparison analysis indicates northern districts of Odisha are good at providing basic needs of sanitization facilities against the other districts for welfare of each household and socio-economic development.

Clean Cooking Fuel

Clean fuel for cooking is considered as modern ways of liberty to women resources of India. More states connected with clean fuel for cooking will lead the state forward in terms of saving time to do more work productivity in all sectors. Therefore, with central sponsored

Soubhagya Yojana and other schemes, each state is moving forward to liberate their women's energy from the daily traditional way of cooking and channelizing them to become more reliant, saving their valuable time through various socio-economic poverty alleviation schemes. Therefore, to assess the prosperity and development of cooking fuel supply and connectivity in the state of Odisha, data collected during NFHS-4 & 5 are analysed and results depict 29 districts of Odisha are connected 0-20% cooking fuels followed by 1 district with 20-40% during NFHS-4 survey. NFHS-5 survey shows a significant transformation in providing the above facility to households. Results showed that more than 50% of the districts are below 40% of cooking fuel connectivity while very few districts achieved higher connectivity to fuel energy. Detail anatomy of results shows 19 districts are provided with 20-40% cooking fuel followed by 6 districts with 40-60% and 3 districts connected with 0-20% cooking fuel indicating Odisha as well as its people have to orient their sentiments in a same direction to achieve 100% of cooking fuel to fulfil the dreams of women as well as country towards targets of net zero emission of carbon by 2030.

Maximum change in supplying cooking fuel facility is observed for Khurda & Ganjam while minimum change is observed for Mayurbhanj & Debagarh district respectively. Besides, maximum & minimum connectivity of cooking fuel is observed for Ganjam & Mayurbhanj respectively. The minimum change in connectivity of cooking fuel could be attributed due to either lack of self-interest of people to take cooking fuel connection or might be due to failure of government mechanism to achieve the targets and dreams of the federal government. Besides, connectivity of cooking fuel was also analysed on basis of category of revenue district. Results showed that the mean percentage of change in connectivity of fuel during the latest survey for all districts is 22.2%, which is low compared to the northern districts (23.5%) & higher than the central districts (21.1%) and southern districts (21.9%). Besides, change in range in connectivity of cooking fuel indicated high value for all districts and low is observed for northern districts. Relative higher range in the central districts indicates some districts associated low and high percentage cooking fuel connectivity as compared to the northern and southern districts. The minimum range value associated with northern districts is an indication of uniform connectivity compared to other districts. Comparison analysis indicates northern districts of Odisha are as good at providing cooking fuel to its household as against the other districts for the welfare and generation of more work hours for socio-economic uplift.

Iodised Salt Usage

Consumption of iodized salt on a daily basis is considered as one of the major requirements for the nutritional benefits & development. The iodized salts also have many health impacts on children, women and animals at large. Therefore, a result of iodized salt consumption was analysed to obtain district wise salt consumption & attitude of people towards their health development. Analysis represents the usage of iodized salt in districts of Odisha during NFHS-4 & 5 survey & it depicts 26 districts of Odisha using 80-100% iodized salts followed by 4 districts with 60-80% usage during NFHS-4 survey. However, an NFHS-5 survey shows that 30 districts are using 80-10% iodized salts. Maximum change in iodised

salt use is observed for Mayurbhanj followed by Rayagada district and minimum change is observed for Puri & Subarnapur.

It is also observed that maximum and minimum iodized salt use is observed for Khurda & Gajapati respectively. The maximum change in iodized salt use for above district could be attributed due to awareness among the peoples for health hazard caused due to iodine deficient and speedy government mechanism for fulfilling demands of peoples towards iodine supply. Besides, use of iodised salt was analysed on revenue districts of Odisha. Results showed that the mean percentage of change in iodized salt use during NFHS-5 for all districts is 5.3%, which is low compared to the southern districts (7.4%) and central districts (6.1%) while it is higher compared to the northern districts (2.5%). Besides, the percentage of change in range for iodized salt usage indicated high value for all districts as compared to northern & central districts. The higher percentage of change in mean and range indicates development and growth of iodine salt use among the people. Comparison analysis indicates central districts of Odisha are in a good condition for developing their attitude towards iodized salt consumption for their health & nutritional prosperity, however other districts have already saturated in terms of use of iodized salts.

Women Literacy

Literacy rate of a society is considered as an important dimension towards ensuring sustainable socio-economic protection at all fronts. With respect to gender, literacy is the best mechanism to combat various types of problems that people face. In particular, as members of the family are supported by women contributions, therefore their empowerment in terms of literacy is very essential for the development of the nation. Result shows that maximum & minimum women literacy is observed for Puri & Nabarangpur districts respectively. The maximum positive change in women literacy for the above district could be attributed to more literate women who participated in the survey program. Further it is observed that women literacy in advanced districts like Cuttack & Jajapur have substantially decreased by 3.3% and 2.9% respectively. Besides, women literacy was analysed on revenue district wise of Odisha. Results showed that the mean percentage change of women literacy during the NFHS-5 for all districts is 4.9%. The mean percentage change of central & northern revenue districts is below the mean change rate of all districts while the women literacy for southern revenue districts has substantially increased compared to the overall women literacy of all Odisha districts. However, the mean percentage change of women literacy is observed as 22.2% for all districts of Odisha. The range of change in women literacy percentage for southern districts (18.8%) is high compared to central districts (9.3%) & northern districts (7.2%). Comparison analysis indicates a combination of high values of mean & range for southern districts could have resulted in a big shift in women literacy compared to central & northern districts.

Consumption of Folic Acid Tablet

Folic acid supplement is a boon to women in abating anaemic & blood deficiency disease in rural & urban landscapes. The analysis of development in folic acid consumption discerned that folic acid consumption has achieved a dramatic shift during the NFHS-5

compared to NFHS-4. During NFHS-4, thirteen districts achieved 40-60% folic acid consumption followed by 16 districts with 20-40% folic acid consumption, while during NFHS-5, sixteen districts have achieved 60-80% followed by 10 districts with 40-60% & three districts with 80-100% in folic acid consumption. It is observed that most districts jumped from 20-40% & 40-60% folic acid consumption during NFHS-4 to 40-60% & 60-80% during NFHS-5. Positive change in Folic acid consumption is observed high for Nabarangpur followed by Gajapati & Ganjam while mere change is observed in Kendujhar & Jajapur. Folic acid consumption was analysed based on revenue districts. Results of analysis showed that the mean percentage change in folic acid consumption during NFHS-5 is 24.5% for all districts, while it is 24.8%, 20.3% and 28.5% for central, northern and southern revenue districts respectively. Southern & central revenue district mean folic acid consumption rate is relatively high compared to mean rate of all districts while northern district achieved low rate (20.3%) as compared to mean rate of all districts. The range of change in folic acid consumption is observed at 42.1% for all districts of Odisha, while it is 32.6%, 29.4% and 39.9% respectively for central, northern & southern districts of Odisha. Comparison analysis indicates high mean rate of folic acid consumption & its range for southern districts has resulted in bringing prosperity in folic acid tablet supply followed by central district of Odisha.

Janani Surakhya Yojana

Socio-economical protection of women resources is considered as respect and prosperity of a state as well as its nation. As most mortality of mother & child was very high in past decades, so to minimise its gap, Janani Surakhya Yojana has been implemented at all districts of Odisha. To assess its development & prosperity, data of family health survey phase 4 & 5 analysed & it is observed that 21 districts have achieved 60-80% followed by 9 districts with 80-100% in ensuring protection for Janani Surakhya Yojana (JSY). However, during NFHS-5 it is observed that all districts of Odisha have been protected with JSY for wellness and welfare of mothers & their Childs.

Most of the districts achieved 100% ensuring its women with JSY while the rest district achieved more than 98% with JSY. Further, it is observed that maximum change in rate of protection with JSY is observed for Cuttack (34.7%) followed by Kalahandi (33%) & Bhadrak (32.8%) respectively. Similarly, minimum change in rate in ensuring JSY is observed low for Malkangiri (9.7%) followed by Kandhamal (11.2%) and Jagatsinghpur (13.6%) respectively. JSY was analysed based on revenue district wise. Results of analysis showed that mean percentage change in JSY during NFHS-5 is 22.6% for all the districts, while it is 25.6%, 22.6% & 19.7% for central, northern & southern revenue districts respectively. Central revenue district mean rate in ensuring JSY is relatively high compared to mean rate of all districts, while northern & southern district progressed at equal (22.6%) & low (19.7%) mean rate compared to all district rate. Comparison analysis indicates high values of mean rate of ensuring JSY and its range for central district has informed great

transformation works has been initiated in protecting its women resources although other revenue districts have not lagged in ensuring JSY.

Adequate Diet Supply to Child

Majority of body & mind development in adolescent child occurs at their juvenile age, therefore, to strengthen adolescent overall integral development, many nutrition schemes like POSHAN (National level) & Mo Chhatua (Odisha State level) has been implemented in state of Odisha. These schemes are considered as an indicator for prosperity in nutrition of country. Therefore, adequate diet supply (ADS) among the child within 6-23 month has been assessed for fourth & fifth phase of National family health survey & presented in Fig. 8. Results of analysis described those 30 districts of Odisha able to deliver 0-20% diet supply during NFHS-4 while as substantial change has been observed during NFHS-5. sixteen districts achieved 20-40% adequate diet supply followed by 14 districts with 0-20% diet supply. Maximum change rate has been observed for the Nuapada followed by Bolangir & Ganjam while minimum change rate is observed for the districts of Sundargarh & Khurda. Distribution of adequate diet is assessed based on revenue districts of Odisha. Results of analysis showed that mean percentage change in ADS during NFHS-5 is 11.5% for all the districts, while it is 11%, 10.9% and 12.7% for central, northern and southern revenue districts respectively. Southern revenue districts mean rate in ADS is relatively high compared to all districts, while central & northern revenue districts progressed at a low mean rate compared to all district rates. Comparison analysis indicates high values of mean rate of ensuring ADS & its range for southern district has informed good progress has done in ensuring ADS among the adolescent though all the district has to go long mile to achieve the dreams of no hunger and malnutrition child in state.

Distribution of Anaemic Diseases

Anaemic is a blood deficiency disease commonly found in females and mainly caused either due to lack of proper nutrition or irregularities in physio-biological processes. A country's human scape becomes more reliant when its female parts will be free from economic and health constraints, among which anaemic scenarios of the country stood as a major setback for growth of the country. The anaemic patient of Odisha was compared between the fourth and fifth phase of national family health survey and results show that the percentage of anaemic women during 4th phase of survey was satisfactory while such percentage has increased drastically at all districts. Positive percentage change in anaemic patient is observed in district of Angul (31.3%) followed by Debagarh (29.4%) while improvement (reduction in anaemic percentage) has been observed in Subarnapur (-10.4%) followed by Koraput (-9.4%) and Sambalpur (-8.9%) and respectively. Further it is observed that 16 districts encountered with 40-60% anaemic patients followed by 11 districts with 60-80% anaemic patients during NFHS-4 survey while during NFHS-5, 22 districts of Odisha prevailed with 60-80% anaemic patients followed by 8 districts with 40-60% anaemic patients. Present survey characterises severity of anaemic conditions among the women resources of Odisha, although there has been substantial improvement in drinking water and

sanitation schemes within the states. Revenue districts wise distribution of anaemic case has been analysed & results show that positive change in anaemic patients for all districts has risen at 10.5% while such trend is higher for central revenue district (22.1%) followed by south revenue districts (8.1%) and northern districts (1.3%). The range of anaemic patient change is very maximum for the north district followed by the southern districts and central districts. Comparison analysis shows that occurrence of lower mean & intermediate values of range of anaemic percentage in southern revenue districts is good scenarios for controlling anaemic diseases, although all districts failed to fulfil the interest of the nation towards abating anaemic scenarios.

Distribution of Child Nutrition

The health status of adolescents was assessed taking the statistics collected during the 4th and 5th phase survey of NFHS for all districts of Odisha. Results of analysis are presented in tabular format for better insight of nutritional level (Table 1& Table 2). Stunted category of child that measures unsatisfactory progress of body weight of child with age is varied from 12.4 to 47.2% with mean percentage of 35.7% during NFHS-4, while distribution of stunted category of child varied from 13.2% to 44.3% with mean value of 31.65% throughout all districts of Odisha during NFHS-5. It is observed that higher stunted category of child was distributed over the Malkangiri, Subarnapur followed by Nabarangpur during NFHS-4 while during NFHS-5 Subarnapur able to reduce the stunted child to a drastic level and achieved 29.6% while other two district retained the same rank as former. The percentage of stunted child is minimum in Cuttack (12.4%) followed by Puri and Jagatsinghpur during NFHS-4, while Jagatsinghpur district able to reduce substantial percentage of stunted child & achieved the (13.2%) followed by Puri (13.8%) & Khurda (17.1%). The district identified as low percentage of stunted children during NFHS-4 has enhanced its level & is not able to maintain first rank for prosperity in stunted children. During the first phase survey, the mean percentage of the stunted category has reduced by approximately 4% with mean deviation varied from 9.14 to 9.38% indicating significant reduction in stunted child.

Table 1: Nutritional status of child under five years (%) in all the district of Odisha

District	NFHS-4				NFHS-5				Change			
	ST N	WS T	SW T	UW T	ST N	WS T	SW T	UW T	ST N	WS T	SW T	UW T
Angul	33.6	21.6	7.9	36.2	28.1	25.1	7.7	30.5	-5.5	3.5	-0.2	-5.7
Bolangir	44.4	28.3	10.2	46.8	32.7	25.5	12.7	37.6	-11.7	-2.8	2.5	-9.2
Baleswar	32.1	18.4	7.2	34	24.4	15	5.4	22.6	-7.7	-3.4	-1.8	11.4
Bargarh	39.8	25.2	8.6	39.8	38.9	18	6	30	-0.9	-7.2	-2.6	-9.8

Boudh	42.8	22.8	7.3	44.4	37	20.1	6.9	38.6	-5.8	-2.7	-0.4	-5.8		
Bhadrak	36.7	16.3	4.1	30.6	32. 3	15.8	7.5	28.9	-4.4	-0.5	3.4	-1.7		
Cuttack	12.4	7.9	2.5	15.5	20. 4	14.2	5.6	18.9	8	6.3	3.1	3.4		
Debagarh	33.2	20.4	5.4	37.8	28. 4	27.3	12.1	34.3	-4.8	6.9	6.7	-3.5		
Dhenkanal	28.7	18.6	3.8	31.2	33. 3	22.7	5.4	30	4.6	4.1	1.6	-1.2		
Gajapati	34	18.9	5.4	33.9	43. 4	16.1	4.3	34.3	9.4	-2.8	-1.1	0.4		
Ganjam	31.2	17.5	5.3	23	23. 9	10.2	1.5	18.9	-7.3	-7.3	-3.8	-4.1		
Jagatsinghpur	19.4	12.6	4	16.8	13. 2	10.7	5.6	11	-6.2	-1.9	1.6	-5.8		
Jajapur	30.1	17.3	6.4	30.1	25. 5	15.9	6.4	21.8	-4.6	-1.4	0	-8.3		
Jharsuguda	42.5	24.2	6.2	40.2	27. 1	16.9	3.5	26.9	-	15.4	-7.3	-2.7	-	13.3
Kalahandi	37.3	25.5	9.3	40.8	33	17.2	6	33.6	-4.3	-8.3	-3.3	-7.2		
Kandhamal	39.5	23.5	8.4	44.3	34. 2	23.3	12.4	35.2	-5.3	-0.2	4	-9.1		
Kendrapara	27.2	12.5	4.5	24.7	28. 6	7.9	1.4	17.9	1.4	-4.6	-3.1	-6.8		
Kendujhar	44.2	18.6	5	42.6	36. 2	23.8	6.2	37.1	-8	5.2	1.2	-5.5		
Khurda	24.8	12.7	2.2	19.8	17. 1	13.2	2.4	16.9	-7.7	0.5	0.2	-2.9		
Koraput	43.7	29.3	8.4	46.3	43. 1	15.9	6.8	33.5	-0.6	-	13.4	-1.6	-	12.8
Malkangiri	47.2	33	8.7	52.5	44. 3	19.3	5.5	41.6	-2.9	-	13.7	-3.2	-	10.9
Mayurbhanj	44.6	17.6	4.9	44.9	36. 7	28.5	10.4	45.9	-7.9	10.9	5.5	1		
Nabarangpur	46.6	36	11.3	51.6	44. 1	25.2	9.7	46.6	-2.5	-	10.8	-1.6	-5	
Nayagarh	27.8	18.2	4	26.4	20	10.5	1.5	20.2	-7.8	-7.7	-2.5	-6.2		
Nuapada	36.4	27	9.8	40	43. 1	18.1	3.7	38	6.7	-8.9	-6.1	-2		

Puri	16.7	11.2	2.8	17.7	13.8	8.9	1.5	11.3	-2.9	-2.3	-1.3	-6.4
Rayagada	46.5	23.3	5.8	44.4	43.6	16.1	3.6	39.8	-2.9	-7.2	-2.2	-4.6
Sambalpur	44.2	30.4	5.3	51.3	40.7	25.5	7.6	36.3	-3.5	-4.9	2.3	-15
Subarnapur	47.1	22.3	5.5	43.4	29.6	26	11.7	34.5	-17.5	3.7	6.2	-8.9
Sundargarh	38.3	34.4	10.3	46	32.9	21.1	7.4	34.7	-5.4	-13.3	-2.9	-11.3
Min	12.40	7.90	2.20	15.50	13.2	7.90	1.40	11.00	-17.50	-13.70	-6.10	-15.00
Max	47.20	36.00	11.30	52.50	44.3	28.50	12.70	46.60	9.40	10.90	6.70	3.40
Mean	35.77	21.52	6.35	36.57	31.6	18.47	6.28	30.25	-4.11	-3.05	-0.07	-6.32
Std. Dev.	9.38	7.00	2.48	10.82	9.14	5.85	3.29	9.61	5.98	6.34	3.20	4.42
Skewness	-0.80	0.24	0.27	-0.53	-0.37	-0.03	0.41	-0.42	0.32	0.22	0.51	0.12

Table 2: Percentage distribution of nutritional indicator(s) and its statistics in revenue districts of Odisha. STN- stunted, WST-wasted, SWT-severely wasted and UWT- Underweight, CD- Central revenue district, ND- Northern revenue district, SD- Southern revenue district

% / No. of District	NFHS-4				NFHS-5			
	SNT	WST	SWT	UWT	SNT	WST	SWT	UWT
0-20	3	14	30	4	4	18	30	6
20-40	16	16	0	12	19	12	0	21
40-60	11	0	0	14	7	0	0	3
60-80	0	0	0	0	0	0	0	0
80-100	0	0	0	0	0	0	0	0
	Mean Change (%)				Range (%)			
All District	-4.1	-3.1	-0.1	-6.3	26.9	24.6	12.8	18.4
CD	-4.0	-0.4	0.5	-4.5	15.9	18.6	8.6	14.8
ND	-6.8	-1.2	1.2	-8.3	22.1	20.2	9.6	13.8
SD	-1.6	-7.5	-1.9	-6.1	16.7	13.5	10.1	13.2

Inter-relationship between Child Nutrition with its Indicators

To get a thorough insight on the nutritional indicator with other attributes that facilitate nutrition prosperity, the Pearson correlation was adopted to assess the degree of resemblance (Table 3). Analysis shows different types of strength of association of nutritional indicators with different attributes. Stunted children under five years are positively associated with the anaemic child & negatively associated with the improved sanitation & zinc supplement against diarrhoea. Percentage of stunted children under five years are decreasing with the increase of improved sanitation and zinc supplement against diarrhoea and also it decreases with decreasing anaemic child conditions. Children under 5 years, who are wasted have low association with given attributes. Similarly, children with underweight scenarios are negatively associated with clean fuel, positively associated with anaemic child and low associated with other attributes.

Table.3: Correlation among child malnutrition variables with household & health indicators

Nutrition Indicator	Children under 5 years who are stunted (%)	Children under 5 years who are wasted (%)	Children under 5 years who are underweight (%)
Improved Sanitization (%)	-0.61	-0.17	-0.48
Clan fuel Use (%)	-0.46	-0.42	-0.51
Janani Suraksha Yojana	0.17	0.20	0.17
BCG	-0.04	0.05	-0.07
Polio Vaccine	0.10	0.13	0.10
DPT Vaccine	0.06	0.09	0.00
MCV	-0.06	0.07	-0.07
Rota vaccine	0.37	0.34	0.42
Hepatitis-B vaccine	0.05	0.15	0.03
Vitamin-A	-0.03	-0.08	-0.03
Diarrhoea prevalence preceding to the survey	-0.42	-0.12	-0.34
ORS supply after Diarrhoea	-0.14	-0.41	-0.41
Zinc supplement against Diarrhoea	0.58	-0.02	0.24
Health Consultation against Diarrhoea	0.01	0.24	0.11
Breastfeeding Child receives adequate diet	-0.10	-0.14	-0.09
Anaemic Child	0.52	0.46	0.59
Anaemic Pregnant Woman	0.06	-0.07	-0.01

Clustering Districts based on Nutritional Value

Nutritional indicators are synthesized through cluster analysis to get better insight of nutritional status of different districts of Odisha. In Table 4 & 5, Cluster analysis classified all districts into four main clusters indicating different nutritional indicators. Results showed that districts falling under cluster-1 & 3 have a relatively low percentage of stunted, wasted, severely wasted and underweight patients as compared to the Cluster 2 & 3. Further it is noticed that district under cluster-4 needs more attention as compared to district falls under other clusters. In connection with elementary needs such as drinking water, districts falling under the cluster-3 achieved higher percentage to access better quality of drinking water followed by districts under cluster-1 and 2, while very less percentage (82%) is achieved for the districts under the cluster-4. In the sanitization point of view, districts under cluster-1

achieved better access followed by districts under Cluster-3 and very less percentage of improved sanitation is achieved by the district under cluster-2. The clean cooking fuel was achieved at a higher percentage for the district coming under cluster-1 followed by cluster-2 & 4 and Cluster-3 respectively. The consumption of iodised salt remained almost the same for all districts falling under all clusters. Iron folic tablet consumption was noticed at a higher rate for the Cluster-1 districts followed by cluster-2 while approximately 50% patients are consuming folic tablets for the district under cluster 3 & 4, which need to be augmented for prosperity of anaemic patients. It is observed that all the districts under four clusters achieve almost 99% in ensuring Janani Suraksha Yojana for welfare of pregnant women to optimize nutrition status of Odisha.

To prevent various communicable and malnutrition diseases, districts under cluster 1-3 achieved approximately 97% BCG vaccination while district under clustre-4 is poor in vaccinating children with BCG, Polio, DPT MCV vaccines. Districts under cluster-2 are in very good condition in achieving the Rotavirus vaccine while districts under cluster-1, 3 & 4 have to make extra effort to connect people for vaccinating the child with Rotavirus vaccine. To remove hepatitis, districts under the cluster 1-3 did spectacular work in achieving the approximately 95 to 97% hepatitis vaccination while cluster-4 districts achieved very less percentage 57% for the same. All cluster districts are in the same phase in providing Vitamin-A supplements while cluster-4 and 3 districts are considered as diarrhoea prevalent districts which could lack an improved drinking water supply. It is observed that cluster 1-4 districts are achieving approximately the same percent (19.1 to 21.3%) in providing adequate food supply to breast feeding children. In anaemic point of view, cluster 2 & 4 districts are prevalent in anaemic children as compared to other cluster districts. Over analysis indicates attention must be needed for cluster 4 districts for achieving nutritional prosperity of Odisha.

Table 4: Resemblance of inter-districts nutritional value by using k-mean cluster analysis.

Nutrition variable	Cluster-1	Cluser-2	Cluster-3	Cluster-4
Stunted	20.4	39.1	27.6	32.1
Wasted	12.3	20.7	15.8	22.9
Severe wasted	2.7	7.6	6.3	7.3
Underweight	18.9	37.5	24.1	33.3
Drinking water	91.1	90.3	97.0	82.7
Improved Sanitization	68.5	54.8	63.7	56.6

Clean fuel Use	48.4	29.5	26.7	27.5
Iodized salt	98.7	96.6	98.2	98.4
Iron folic tab	71.6	67.3	53.4	50.6
JSY	99.8	99.7	99.2	99.2
BCG vaccine	97.7	98.6	98.2	32.1
Polio Vaccine	94.2	95.7	92.8	22.9
DPT vaccine	94.9	96.7	97.4	7.3
MCV vaccine	96.9	97.8	97.0	33.3
Rotavirus Vaccine	88.7	95.0	87.2	82.7
Hepatitis Vaccine	94.9	96.7	96.5	56.6
Vitamin-A	88.0	89.2	86.0	86.0
Diarrhoea Prevalence	9.5	5.5	11.8	12.0
Breastfeeding child received adequate Diet	20.5	21.3	20.6	19.1
Anaemic Child	58.8	68.4	58.2	69.5

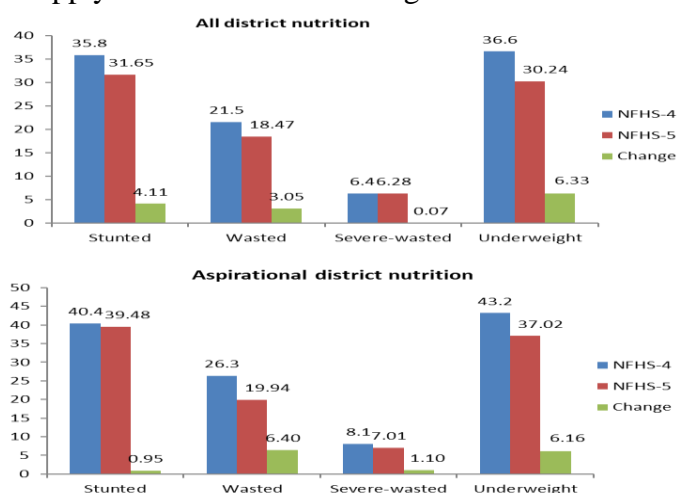
Table 5: Resemblance of inter districts nutritional value by using k-mean clustering

Name of Cluster	District within cluster
Cluster-1	Cuttack, Ganjam, Jharsuguda, Khurda, Nayagarh & Puri
Cluster-2	Bolangir, Boudh, Gajapati, Kalahandi, Koraput, Malkangiri, Nabarangpur, Nuapada, Rayagada, Sambalpur, Subarnapur
Cluster-3	Baleshwar, Bargarh, Bhadrak, Debagarh, Jagatsinghpur, Kandhamal, Kendrapara
Cluster-4	Angul, Dhenkanal, Jaipur, Kendujhar, Mayurbhanj, Sundargarh

Nutritional Assessment in Aspirational Districts

The Government of India has launched the transformation of Aspirational districts initiative in January 2018 with a vision of new India by 2022 where the focus is to improve

India's ranking under human development index, rising living standards of its citizens and ensuring inclusive growth of all and achieving no hunger. In 2022, A total of 117 aspirational districts from across 28 states of the country have been identified by NITI Aayog based upon composite indicators from health & nutrition, education, agriculture & water resources, financial inclusion and skill development and basic infrastructure which have direct bearing on the quality of life and economic productivity of the citizens. In Fig. 1, a comparison analysis is made among the aspirational districts with all districts. Analysis shows that nutritional status of Odisha depicts significant reduction in under-weighted children followed by stunted category children while no significant change is noticed for severely wasted children. Nutritional status of Aspirational District of Odisha shows significant decline in wasted and under-weight category children compared to Stunted category Child. Decline rate of under-weight child between the aspirational district and all district are advancing in a uniform rate. Aspirational districts able to reduce significant % of severe wasted child compared to all district, which might due to increased coverage of Janani Surakhya Yojana and adequate supply of diet to breast feeding child.



DISCUSSION AND CONCLUSION

Children have been widely recognized as a vulnerable group from a health point of view. They need adequate food and protein for proper nourishment of bodies and minds. Over the last five years, Odisha has managed to make improvements in most health and nutrition outcomes. This was possible mostly by the expansion of nutrition specific interventions & many flagship programs. We identify several areas of challenge for nutrition as Odisha looks forward: Sanitation, Clean fuel, Vaccination, Women education, Anaemia etc. Between 2015 & 2019, Odisha has shown a marginal decline in the stunted, wasted & underweight in the rate 3%, 2.4% & 4.7% respectively which are influenced by availability of household with water (89.1 to 91.1), electricity (86.6 to 97.0), clean fuel for cooking (19.2 to 34.7). Odisha achieved significant reduction in nutritional status due to the flagship program National nutrition mission (NNM) through which many targets will strive to reduce the level

of stunting, anaemia & low birth weight babies. Similarly, the Integrated child development services (ICDS) scheme is also being implemented with the aim of aggregate development of children & to meet nutritional needs of pregnant women and lactating mothers.

In our present study, Malnutrition is still a big deal all over Odisha but the situation is very critical in southern districts of the state where a large proportion of tribal population inhabits. Though child nutritional status has ameliorated over time, the current level is considerably high so this is known to be socio-economically backward due to high prevalence of child malnutrition as compared to North-western districts of the states. Our finding suggests that the POSHAN Abhiyan should adopt an equity approach for nutritional benefits of children in all districts of Odisha. Our findings show that districts with improved sanitation and clean fuel have a low rate of undernutrition so the Govt should focus on the economic conditions of households in the state. Similarly, districts with low rates of vaccination & women education have high levels of child undernutrition. It is examined that household conditions, education status & women health factors influenced the nutritional status of the children in the state. In our findings many aspirational districts programmes have witnessed holistic development in stunting, wasting & underweight by curbing the multi-dimensional issues raised from antenatal care, postnatal care, health & new born, growth of children, contagious diseases & health infrastructure through various mitigation measures to remove regional disparities across the progressing Odisha. The meticulous initiatives taken by the state administration at all fronts of health infrastructure is a way forward message to other states of equivalent socio-economics conditions & natural disaster prone to higher uncertainties.

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Declarations

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