

## ORIGINAL ARTICLE

**Development of composite index and ranking the districts using nutrition survey data in Madhya Pradesh, India**

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**Abstract**

**Introduction**: Level of development in health and nutrition at district level is useful for planning intervention in less developed districts. **Aims & Objectives**: To develop composite index based on 12 variables to compare development within districts in the state of Madhya Pradesh. **Material & Methods**: Data collected by National Institute of Nutrition, Hyderabad during 2010-11 on nutritional status of rural children at district level in Madhya Pradesh was used. A total of 22,895 children (Boys: 12379, Girls: 10516), were covered. **Results**: It was observed that Indore district rank 1st as per composite index and Singrauli rank last in the district ranking. Three categories of districts were done based on percentile of composite index i.e less developed, developing and developed districts. It was observed that there was significant ( $p < 0.01$ ) trend in the prevalence of undernutrition among three set of districts. Similarly, significant ( $p < 0.01$ ) trend was observed in proportion of children participating regularly in ICDS supplementary feeding programme, use of sanitary latrine and iodized cooking salt among three sets of districts. **Conclusions**: Widespread disparity in health and nutrition was observed among the districts. It is quite important to examine the extent of improvements needed in different developmental indicators for enhancing the level of development of low developed districts. This will help the planners and administrators to readjust the resources for bringing about uniform development in the state.

**Key Words**

Composite index; ranking of districts; nutritional status; Madhya Pradesh

**Introduction**

In recent years, international organizations, think-tanks, and academicians in the quantitative social sciences have been bringing out many composite indices designed to assess broad social science concepts in concise manner (1). The composite indices have the ability to summarize complex or multi-dimensional issues in a simple manner, making it possible for policymakers to get a perceptible and representative sense of the situation in a given geographical area, which enable to compare

countries with other areas where it stands in comparison with others. Per Capita Gross Domestic Product (GDP) is a measure which provides a more intuitive understanding of the state's economy, than a table of the output of different industries and sectors and it provides a single estimate. Composite indices have substantial ease of interpretation over the use of multiple indicators benchmarks, while quantification of a concept makes it possible to monitor progress over a period and to highlight cases where intervention may be needed (2).

The Human Development Index (HDI) is a composite measure of health, education and income. This index was first introduced in Human development Report in 1990 as an alternative to GDP to assess National progress in a specified period (3-5).

HDI is a summary measure of average achievement in key dimensions of human development; i.e. a long and healthy life, being knowledgeable and have a decent standard of living. The standard of living is measured by gross per capita national income. The HDI does not reflect about inequalities, poverty, human security and empowerment. etc. (3-5).

United Nations annually ranks all the member countries on the basis of health, education and income. The human development index reveals the relative rank of a country's achievement in a concise manner. This helps to identify the countries of immediate concerns as well as prioritize the relevant policy areas. National level figure of the HDI has its own limitations in the policy formulation, especially, for a large country like India where socio-cultural, demographic and socio-economic status is diverse.

To minimize such limitations, it needs to adopt a measure that can capture the said disparities in aspects of human wellbeing where appropriate policy actions can be focused at the level of the smallest possible administrative unit. The 73rd and 74th amendments (6) of the constitution emphasized the need of decentralization and the focus for planning and programme implementation at district level.

Composite index techniques were also used to classify districts based on agriculture development in different states (7-8).

In backdrop of this, the assessment of the current status of development at district level is essential, as the districts vary considerably in the achievement of socio-demographic, health, social status and development of infrastructure. Therefore, ranking and mapping of the districts on the basis of the selected developmental indicators will help to identify the districts with their relative performance and also to know the districts performing well and which are lagging behind in the State, so that appropriate strategies can be developed and implemented in focussed way in the resource constraint set up in country like India.

### Aims & Objectives

To rank the districts on the basis of selected developmental indicators in the State of Madhya

Pradesh by using various health and nutrition indicators and to compare with the ranks given to the districts by IIPS in 2006 for Madhya Pradesh (9).

### Material and Methods

The data on health and nutrition carried out during 2010-11 in Madhya Pradesh was utilized, which was collected by National Institute of Nutrition (NIN), Hyderabad during 2010 in all the districts Madhya Pradesh [10] and secondary data from Census 2011 [11] and Annual health survey 2011-12 for Madhya Pradesh were utilized [12].

The study was approved by Institutional Ethical Review Board and consent was obtained from the mothers of children involved in the study.

**Selection of Indicators:** An selection of appropriate indicators /variables itself is first important step for ranking and categorizing the districts to decide the relative rank of district with regard to development in terms of health and nutrition as compared to other districts in the state. The following 12 indicators were identified and used for calculating the composite Index. Methodology adopted earlier in 2006 by Indian Institute of Population Studies (IIPS), Mumbai for relative measurement of districts in Madhya Pradesh state was used in this presentation (9).

The following variables were selected to compute the relative ranking for each district.

1. Female Literacy Rate (%) – Respondent is the mother of index child.
2. Children (12-24 months) fully immunized (%)
3. Household access to safe drinking water (%)
4. Household having toilet facility and in use (%)
5. Household with Electricity (%)
6. Pregnant women received 2 doses of TT injections during pregnancy (%) – Respondent is the mother of index child.
7. Pregnant women who had  $\geq 3$  or more ANC's (%) – Respondent is the mother of index child.
8. Children with birth order  $\geq 3$  (%)
9. A woman with maternal age  $< 18$  years (%) at the time of marriage– Respondent is the mother of index child.
10. Prevalence (%) of underweight among  $< 5$  years children.
11. Population  $< 5$  years (%) - Census 2011.
12. Under 5 mortality rate (%) - Annual health survey 2011-12

Statistical analysis: The procedure adopted by lyengar and Sudarshan (1982) [13] to classify regions

using multivariate data to measure development in India, and is widely used to provide a composite index for spatial differentiation in the level of development. Present analysis was also carried out in similar way to calculate the index value for a given development indicator and the composite index value for each district, as follows;

Let  $X_i$  represent the value of the  $i$ -th variable and is positively associated with development of district, then

$$\text{Index Value } (X_i) = \frac{(X_i) - \text{Min } (X_i)}{\text{Max } (X_i) - \text{Min } (X_i)} \quad \text{I}$$

For e.g. the higher the female literacy rate, better is the district.

If  $X_i$  is negatively associated with development of district, then

$$\text{Index Value } (X_i) = \frac{\text{Max } (X_i) - (X_i)}{\text{Max } (X_i) - \text{Min } (X_i)} \quad \text{II}$$

For e.g., Percentage of non-immunized & partially immunized children are low, better is the district.

The composite index is the simple average of all the indices. It may possible that among the selected indicators, one is more important than the other, and therefore, for the composite index, there is a need to give appropriate weights to each of the Indicator. However, we have opted for a simple average to construct the composite index.

$$\text{Composite Index } (CI) = \frac{(X_1+X_2+X_3+\dots\dots\dots +X_{12})}{12} \quad \text{III}$$

After the calculations, the values were arranged in ascending order accordingly. Higher the value, better the rank, second highest will be second rank, similarly, the last value will get the last rank. The Percentiles was calculated and used to classify the districts. The index values up to 25th Percentile has been considered in the category of least developed districts. The districts having the composite index value between 25th and 75th percentile are considered as developing districts. Finally, districts with composite index value above 75th percentile are grouped under more developed districts.

**Advantages of composite index**

- It can summarize complex or multi-dimensional issues.
- It is easier to interpret.

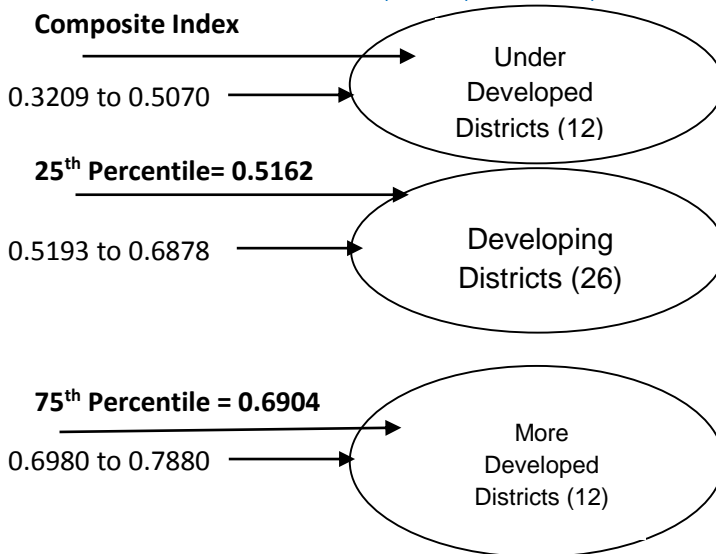
- It facilitates the task of ranking states/districts/regions etc. on complex issues.
  - It can assess the progress of different regions over time.
  - It reduces the size of a set of indicators or includes more information within the existing size limit.
  - It places performance and progress of different regions at the centre of policy arena.
  - It facilitates communication with general public (citizen, media etc.) and promotes accountability
- Disadvantages**
- It may send misleading policy messages if it is poorly constructed.
  - It may invite simplistic policy conclusions which may not be possible for adoption.
  - It may be misused.
  - The selection of indicators and weights for aggregating the composite index can change the final conclusions.
  - It may lead to inappropriate conclusions if indicators that are difficult to measure, are ignored
- The back-ground characteristics of the districts were tabulated and tested for the significant difference between groups using Chi-square statistic

**Results**

The descriptive statistics (minimum, maximum and average percentage) of various parameters included in the analysis are presented in Table-I. About a third of children interviewed, the birth order was three and above. A maximum of 100% of the children in a district were fully immunized with an average of 84.5%.

The average female literacy is about 48% with a minimum of 13% and maximum of 79%. Majority of HHs (81.04%) were using safe drinking water (bore well and tap), while, the usage of toilet facility was poor (12.12%). About three fourth of the HHs surveyed had the electricity facility. Health parameters such as ANC visits and TT injections were satisfactory. The prevalence of underweight ranged from a minimum of 35% to maximum of 67% in the state ([Table 1](#)).

The Composite Index was developed and values were divided on the basis of percentiles as presented below. Composite index value and the relative rank of the district are presented in table 2a, 2b &2c. Indore district has the highest relative ranking of 1 as compared to other districts and district Singrauli is the lowest in rankings.



12 districts were observed to be below 25th percentile Score of 0.5162, 26 districts were between 25th to 75th percentile score between 0.5193 to 0.904 and only 12 districts were above 75th percentile score of 0.6904. Indore district ranked 1st while, Singrauli ranked last (50th), in the list of districts in Madhya Pradesh.

When background characteristics were compared to study the trend within three sets of districts i.e underdeveloped with developing and developing with developed districts, it was observed that there was significant ( $p < 0.01$ ) trend in the prevalence of undernutrition among three set of districts. Similarly, significant ( $p < 0.01$ ) trend was observed in proportion of children participating regularly in ICDS, sanitary latrine use and use of iodized salt for cooking among three set of districts. Significant ( $p < 0.05$ ) trend was observed in proportion of children belonging to SC/ST population and mother's occupation as laborers among least developed and developing districts (Table 3).

When comparison was made between the present findings with IIPS 2006 ranking of districts, it was observed that out of 12 districts classified as less developed, 3 districts have gone in developing districts, and remaining 9 as under developed districts. Out of 26 developing districts in IIPS, 3 districts each moved towards less developed and developed districts, while 20 districts remains in same category, while 9 districts from developed retains the same category and 3 districts moved towards developing districts (Figure 1).

## Discussion

An attempt was made to construct composite index using the primary data carried out by the Institute. This cumulative index helps to categorize the districts in different levels of development.

The analyses showed that 12 districts were less developed, 26 were developing and remaining 12 were developed as per composite index values. Nearly 80% of the districts, the ranks given by the two surveys are similar. The improvement in ranking of districts from 2006 IIPS survey might be the time interval of 5-6 years duration during which many nutritional interventional programmes took place in Madhya Pradesh. The districts which are still in under developed category mostly belong to tribal region where intensification of intervention strategies is needed to improve the health and nutritional status. The findings of the present study are similar to the study by IIPS in ranking of districts in Madhya Pradesh [9].

Cholakkal (2013) in his study in Kerala also used similar method to classify districts according to development in health and education (14).

Narain *et al* (2002) (8) report on socioeconomic development in Madhya Pradesh reported that 10 districts were high level of development, 27 in middle level of development and 8 districts in low level of development which is in accordance with our results (15).

It is quite useful and important to examine the extent of improvements needed in different developmental indicators for enhancing the level of development of low developed districts. This will help the planners and administrators to readjust the resources for bringing about uniform regional development.

Indore is known as a commercial capital of Madhya Pradesh, and is one of the richest cities in central India and also known as "Mini Mumbai. Average literacy rate was 82% in Indore district in 2011 with 87.2% and 74.0% among male and female respectively, while in Singrauli, literacy rate was 73.7% and 49.8% among men & women respectively. Infant mortality was 74 per 1000 live birth in rural areas of Singrauli, while it was 34 per 1000 in rural areas of Indore (16), sanitary latrine was available in 67% in rural areas of Indore, while it was 2.3% in Singrauli (17).

The strength of the study is that the 10 variables included in composite index were from the primary data carried out by NIN in Madhya Pradesh, and the data collection was done by the qualified investigators trained by NIN scientists and

supervision was carried out in regular intervals by the scientist from NIN to ensure quality of data collected by the investigators

### Conclusion

It was observed that Indore ranks 1st and Singrali rank last in the set of districts. The study will help the policy makers to divert the limited resources to the least developed districts.

### Recommendation

There is a need to intensify interventions in the under-developed districts, as top priority districts (in terms of undernutrition), and strengthening the existing nutritional programmes in other districts as the prevalence of undernutrition is still high in other districts.

### Limitation of the study (If any)

Data was used only on nutritional parameters and per capita GDP of districts was not considered in the present analysis.

### Relevance of the study

The study helps in ranking of districts based on some developmental indicators in nutrition, so that more attention should be given to less developed districts and appropriate intervention strategies could be adopted to prevent and control undernutrition in the state.

### Authors Contribution

All the authors were involved in design, concept and planning of the study. Author 1 & 3 carried out analyses, author 1& 2 was involved in drafting the article, while others were involved in critically reviewing the article.

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17. District Profile of Singrauli, Taken from <http://singrauli.nic.in/teacher/profile.pdf>.

**Tables**

**TABLE 1 DESCRIPTIVE STATISTICS OF SELECTED INDICATORS**

| S. No | Indicator (%)                                    | Mean (%) | Min (%) | Max (%) |
|-------|--|----------|---------|---------|
| 1     | Birth order three and above                      | 35.5     | 21.0    | 51.0    |
| 2     | Maternal age at the time of marriage (<18 years) | 0.98     | 0.0     | 4.1     |
| 3     | Fully immunized                                  | 84.5     | 32.1    | 100.0   |
| 4     | Female literacy rate                             | 48.43    | 13.0    | 78.8    |
| 5     | Safe drinking water                              | 81.04    | 41.4    | 99.2    |
| 6     | Toilet facility                                  | 12.12    | 0.8     | 41.2    |
| 7     | Electricity                                      | 74.69    | 18.0    | 97.7    |
| 8     | Women received >=3 ANC visits                    | 36.91    | 7.9     | 100.0   |
| 9     | Women received 2 TT injections                   | 86.33    | 55.3    | 100.0   |
| 10    | % of Population 0-5 years                        | 14.8     | 11.7    | 20.3    |
| 11    | Under 5 Mortality / 1000                         | 90.8     | 51      | 140     |
| 12    | Prev. of Underweight                             | 51.8     | 34.7    | 67.1    |

**TABLE 2 RANKING OF DISTRICTS ACCORDING TO COMPOSITE INDEX VALUE**

| District     | CI     | Rank |
|--------------|--------|------|
| Indore       | 0.7881 | 1    |
| Balaghat     | 0.7841 | 2    |
| Narasimhapur | 0.7817 | 3    |
| Jabalpur     | 0.7785 | 4    |
| Betul        | 0.751  | 5    |
| Hoshangabad  | 0.7468 | 6    |
| Bhopal       | 0.7442 | 7    |
| Harda        | 0.7263 | 8    |
| Neemuch      | 0.712  | 9    |
| Ujjain       | 0.7104 | 10   |
| Raisen       | 0.6985 | 11   |
| Seoni        | 0.698  | 12   |
| Dewas        | 0.6878 | 13   |
| Chindwara    | 0.6795 | 14   |
| Anuppur      | 0.6623 | 15   |
| Mandsaur     | 0.658  | 16   |
| Ratlam       | 0.6575 | 17   |
| Sehore       | 0.6558 | 18   |
| Burhanpur    | 0.6498 | 19   |
| Bhind        | 0.6359 | 20   |
| Shajapur     | 0.627  | 21   |
| Khandwa      | 0.6179 | 22   |
| Gwalior      | 0.6163 | 23   |
| Morena       | 0.6099 | 24   |
| Vidisha      | 0.6091 | 25   |
| Sagar        | 0.6088 | 26   |
| Katni        | 0.6085 | 27   |
| Khargone     | 0.5889 | 28   |
| Dhar         | 0.5693 | 29   |
| Dindori      | 0.5669 | 30   |

**TABLE 2 CONTINUE RANKING OF DISTRICTS ACCORDING TO COMPOSITE INDEX VALUE**

| District | CI | Rank |
|----------|----|------|
|----------|----|------|

|            |        |    |
|------------|--------|----|
| Datia      | 0.5564 | 31 |
| Chhatarpur | 0.5509 | 32 |
| Mandla     | 0.5503 | 33 |
| Rajgarh    | 0.5454 | 34 |
| Sheopur    | 0.5396 | 35 |
| Guna       | 0.5239 | 36 |
| Shivpuri   | 0.5209 | 37 |
| Damoh      | 0.5193 | 38 |
| Ashokngar  | 0.507  | 39 |
| Rewa       | 0.4892 | 40 |
| Jhabua     | 0.4868 | 41 |
| Sidhi      | 0.4741 | 42 |
| Panna      | 0.4673 | 43 |
| Tikamgarh  | 0.4666 | 44 |
| Shahdol    | 0.4524 | 45 |
| Alirajpur  | 0.4107 | 46 |
| Sathna     | 0.4014 | 47 |
| Barwani    | 0.3927 | 48 |
| Umria      | 0.3716 | 49 |
| Singrauli  | 0.321  | 50 |

**TABLE 3 DIFFERENCE IN NUTRITIONAL STATUS AND BACKGROUND CHARACTERISTICS OF HHS IN THREE DIFFERENT CATEGORIES OF DEVELOPMENT**

| Parameter                            | Under Developed | Developing | Developed |
|--------------------------------------|-----------------|------------|-----------|
| Stunting                             | 54.7a           | 49.8b      | 40.8c     |
| Wasting                              | 28.2a           | 25.9 b     | 23.4c     |
| % of SC/ST Population                | 58.1a           | 43.9 b     | 43.3      |
| Occupation of mother as labourer     | 35.5a           | 26.4 b     | 26.3      |
| Regular participation in ICDS        | 33.8a           | 50.1b      | 58.6c     |
| Sanitary latrine presence and in use | 5.5a            | 10.3 b     | 22.3 c    |
| Using Iodized salt ( $\geq 15$ ppm)  | 34.2a           | 41.2 b     | 73.2c     |