ORIGINAL ARTICLE

Ranking of districts in Andhra Pradesh using women and children nutrition and health indicators by topsis method

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Citation

Article Cycle

Abstract

Background: Wide variation exists in the nutritional status of under 5 years children among districts/states and more focus is needed on less developed districts in order to allocate resources. Ranking of districts provide baseline information for allocating resources to poor ranking districts and can be considered for comparison of progress in future studies. **Aims & Objectives**: To rank the districts of Andhra Pradesh state using a multi-criteria decision making method based on the major nutritional and health indicators. **Materials and Methods**: Data provided by NFHS-4 on nutrition and health indicators of women and children in the state was used to rank the districts in the state. A multi-criteria decision making technique called TOPSIS is used for ranking of the districts in the state based on the selected health indicators. **Results:** It is observed that Krishna district ranked first and Vizianagaram holds the last rank. The better performing districts include Krishna, Chittoor, East Godavari, Visakhapatnam and Guntur, whereas poor performing districts include Vizianagaram, Kurnool, Srikakulam and Prakasham. Indicators such as per capita income, urbanization, sanitation, use of clean fuel and maternal education were observed high, while infant and maternal mortality was low in in good performing districts. **Conclusion:** It is concluded that the district with poor nutrition and health indicator ranked last while those with good indicators ranked first. The priority should be given for the development of poor performing districts to improve the above indicators by allocating more resources.

Keywords

Multi-criteria decision methods; TOPSIS; NFHS-4

Introduction

In recent years, research organizations, scholars, and academicians in the social sciences have been bringing out many composite indices designed to assess the social development concepts in a concise manner to compare the countries or states within a country (1,2). 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 counties and within the countries, different states and within the state, different districts can be compared for overall development in terms of health and nutrition.

The use of the multi-criteria decision making (MCDM) methods, increasing in the health and nutritional studies (3,4,5,6,7,8). The MCDM approaches are major parts of the decision theory and analysis. These methods seek to take explicit account of more than one criterion in supporting the decision process (9,10). There are several methods for solving MCDM problems (11,12,13,14). One of them is a Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) developed by Hwang & Yoon (15). This method is designed in a way that the decision maker can interfere kind of indicators based on having a positive or negative impact on decision making goal. The analysis method of TOPSIS is a multi-indicator decision making method, by grading and choosing the best option (16,17,18). The TOPSIS method is superior to the conventional composite indices, as this method provides a solution which is relatively closer to the best solution and far from the inferior solution (19). Simplicity, rationality, comprehensibility, better computational efficiency and ability to measure the relative performance for each alternative in a simple mathematical form are the major advantages of the TOPSIS method (20).

Undernutrition is an important public health problem in India in-spite of several nutrition intervention programs are in operation to improve nutritional status of children and women. Undernutrition varies from state to state and among the state, variation exist among the districts. In order to know the better performing districts in nutritional status and also factors associated for poor performance in the district need to be identified so that focus can be given to those districts and also to improve the factors associated with undernutrition. For this, ranking of districts based on certain nutritional and health variables is needed.

The erstwhile Andhra Pradesh, divided into two states, Telangana and Andhra Pradesh on June 2, 2014. The newly separated Andhra Pradesh state consists of 13 districts namely, Anantapur, Chittoor, East Godavari, Guntur, YSR Kadapa, Krishna, Kurnool, Prakasam, SPSR Nellore, Srikakulam, Visakhapatnam, Vizianagaram and West Godavari. Andhra Pradesh is the eighth largest state in India in terms of the geographical area and tenth largest state in the country, in terms of population (21). The state government is running 46 homes for children and 21 institutions for women to take care of health and nutrition of the children and women in the state.

Presently, more than 34.5 lakh beneficiaries were covered under a supplementary nutrition program (21). However, the degree of government programs varies across the districts. District-wise planning and program implementation is very important, as many of the governments and institutions consider it as a base level administrative unit in the state (2). With the recent separation, Andhra Pradesh state has a few challenges with regard to development. One of the challenges is to improve health of women and child in the state. With a view to assess the health situation of women and children, the districts are ranked based on the major health indicators. The comparative ranking can be used as a tool to assess the development of the district with respect to the women and child health indicators in the state.

Aims & Objectives

1. To assess nutritional and health status of mother and children in Andhra Pradesh
2. To rank the districts in the state for area-specific planning and program interventions.

Material & Methods

The data on maternal and child health indicators is obtained from the district-wise fact sheets of National Family Health Survey-4 (NFHS-4) which was conducted during 6 May, 2015 to 4 August, 2015. This survey provides district-level estimates for many important indicators on population, health and nutrition for India and its states. Major health indicators on women and child in Andhra Pradesh were taken from the NFHS-4 and some of the variable were taken from Commissioner Health and Family Welfare, Andhra Pradesh (23) and are presented in Table 1. These variables were used for ranking of the districts in the state using the TOPSIS method. Some of these indicators are falling in line with the WHO recommendations (24,25). The coverage and prevalence of these indicators are given in Table 2.

The TOPSIS method produces a solution that contains the best alternative nearest to the positive ideal (optimum) solution and farthest from the anti-ideal (inferior/negative) solution. The positive ideal solution is composed of all the good values attainable from the indicators, while the anti-ideal solution consists of all the poor values attainable from the indicators. The computational procedure is given below (15).

Let us assume that, there are m districts and n health indicators observed in each district, then denotes

the response value of the jth indicator (j=1, 2, ..., n) in ith district (i=1, 2, ..., m) and the matrix represents the decision matrix for further evaluations. The TOPSIS method consists the following steps:

Step-1: Calculate the normalized decision matrix. The normalized value is computed as

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \text{ for i=1, 2, ..., m and j=1, 2, ..., n.}$$

Step-2: Let are weights associated with the n indicators and . Then the weighted normalized values are given by for i=1, 2,..., m and j=1, 2,..., n. The weights can be introduced by a decision maker.

Step-3: Determine the ideal and anti-ideal solutions. Let the positive ideal solution is

= for i=1, 2, ..., m.

And the negative ideal solution is given by

= = for i=1, 2, ..., m.

Where O={j=1, 2,..., n/ j associated with the benefit criteria, for example, the indicators of coverage, which are desirable to have higher values} and I={j=1, 2,..., n/ j associated with the cost criteria, for example, the indicators of prevalence, which are desirable to have lower values}.

Step-4: Calculate the separation measures. The separation between each district can be measured by the n-dimensional Euclidian distance. The separation of each district from the ideal solution is given by

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} \text{ , i=1, 2,..., m.}$$

Similarly, the separation from the anti-ideal solution is given as

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \text{ , i=1, 2, ..., m.}$$

Step-5: Calculate the relative closeness to the ideal solution. The relative closeness of the ith district with respect to the ideal solution is given as

$$C_i = \frac{S_i^-}{(S_i^+ + S_i^-)} \text{ for i=1, 2, ..., m and } 0 \le C_i \le 1$$

.

The higher the value of for an ith district, the closest district is to the ideal solution and farthest from the anti-ideal solution.

Step-6: Rank the preference order. The districts are ranked on the basis of their values in descending order and the district with the highest value of is best ranked.

Step-7: The health status of women and children in the state is categorized on the basis of the tertiles of values. The status is poor is given for, average is given for and good is assigned when, where and are 33th and 66th percentiles of respectively.

The above procedure is used for ranking of the districts in the Andhra Pradesh state.

Results

It was observed that the full ante-natal care (ANC) coverage was higher (60.7%) in Krishna district and low in West Godavari district (31.3%). Proportion of Institutional births were more in Guntur district (97.5%) and low in Kurnool district (75.5%). Initiation of breastfeeding within one hour of birth was high in Visakhapatnam (58.8%) and low in Srikakulam (27.5%). The prevalence of stunting and underweight was high in Kurnool district (44% & 37.5% respectively) and low in Krishna & Guntur districts (22-23% & 27-28% respectively). The prevalence of chronic energy deficiency (CED) among 15-45 year women was observed high in vizianagaram (25.8%) and low in Guntur (11%) district. The prevalence of Anemia among women was high in Srikakulam & Vizianagaram (71.8% & 75.5% respectively) and low in Chittoor (48.8%) district. Infant mortality observed high in Srikakulam (47/1000 live birth) and a low in Krishna district (25/1000 live birth), whereas, the maternal mortality was observed high in Visakhapatnam (115/lakh live birth) and low in East Godavari (74/lakh live birth) district (Table 2).

Ranking of districts based on TOPSIS is given in table 3. The districts are categorized into three categories for representing the nutrition and health status of the women and children in the state. The districts with relative closeness index below 0.5319 are classified as the districts with "poor" health status, index between 0.5319 and 0.5497 are classified as "average" status and the index value more than 0.5497, are classified as "good" health status districts. Accordingly, Krishna district ranked first, whereas Vizianagaram ranked last with respect to the women and children nutrition and health status indicators in Andhra Pradesh. There are five districts namely, Krishna, Chittoor, East Godavari, Visakhapatnam and Guntur having a 'Good status', four districts namely, Vizianagaram, Kurnool, Srikakulam and Prakasham having 'poor status' while remaining 4 districts namely West Godavari, YSR

Kadapa, SPSR Nellore and Anantapur falls under 'Average status' (Table 3, Figure 1).

Background characteristics of the three groups of districts: When background characteristic such as full ante-natal care, institutional deliveries, breastfeeding practices, nutritional status were analysed against the three groups of districts, it was observed that developmental indicators such as annual per capita income, mother literacy, sanitation facilities, use of clean fuel such as LPG was more in good performing districts as compared to poor performing districts. Infant mortality and maternal mortality which are considered to be important indicators of development was high in poor performing districts (43/1000 live births and 100/lakh live births) as compared to good districts where IMR was 33/1000 and MMR was 87/lakh live births (Table 4).

It was also observed that the proportion of women availing full ANC care was more in good performing districts (45.5%) compared to poor performing districts (40%), the proportion of institutional deliveries well more in good performing districts (94%) compared to low performing districts (87.2%), initiation of breast feeding within one hour was 46% in good districts while it was 33% in poor performing districts.

The prevalence of underweight and stunting was high in poor performing districts (32.7% & 34.2%) as compared to good districts (29.8% & 26.7%). The prevalence of anemia among women and children was high in poor performing districts (65% each) compared to good districts (59-60%) (Table 5).

Discussion

An attempt was made to rank the districts in Andhra Pradesh based on nutritional and health indicators using TOPSIS method for the first time. Three group of district were analysed based on nutrition and health indicators. It was observed that out of 13 districts, 5 ranked in good category, 4 districts each in medium and poor category.

It was observed that the districts which were ranked good had good developmental indicators such as high annual per capita income, more urbanization, high proportion of maternal literacy, high proportion of ICDS projects, good sanitation facilities, use of clean fuel for cooking at household level and low rates of infant and maternal mortality. These indicators are directly associated with the development.

It was also observed that coverage for antenatal care practices was good in good performing districts and prevalence of undernutrition was low. This shows that the health seeking behaviour and access to health care is good in this areas as compared to low performing areas.

Recent Five Year Plans especially focused on health care that includes the reduction in mortality rates, prevalence of anemia and prevalence of malnutrition in addition to improvements in the facilities of sanitation, clean drinking water, personal hygiene, nutritious food and good feeding practices for children below the age of three years in order to improve nutritional and health status of children (26,27). There indicators are of importance in reducing morbidity and mortality, improving nutritional status of population and thus development of districts, states and thus country. According to WHO cut off values for public health significance (28), anaemia in children and women is a serious public health problem in the state. Ananthapur and Kurnool have a very high prevalence of stunting, 12 out of 13 districts in the state showing a critical situation of wasting among under five year old children. There are eight districts out of 13 districts in the state showing a very high prevalence of underweight among under five year old children. The present levels of the undernutrition shows an alarming situation in the state and demands a better policy and program implementation to reduce these high levels of undernutrition in the state.

Conclusion

It is concluded that Krishna district which ranked 1st in TOPSIS has the better nutritional and health indicators, while Vizianagarum rank last indicating poor health and nutritional indicators.

Recommendation

There is a need to give more attention on improving ante-natal care, delivery practices, reduction in anemia levels and immunization of children in less developed districts. Also there is a need to improve women health care and delivery access and strengthening the existing nutritional programmes in other districts as the prevalence of undernutrition is still high in low performing districts.

Relevance of the study

With our best of knowledge, this paper uses first time NFHS-4 district wise data for ranking of the districts after re-organization of the Andhra Pradesh

state. The results can be used as a baseline data for the state for prioritizing district to improve health and nutritional status of population.

Authors Contribution

IIM: Manuscript writing; NKB: Data compilation and analysis; KV: Designing the work, Analysis and critical review of the paper.

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Tables

TABLE 1 DATA DEFINITIONS AND FUNCTION USED IN THE INDEX

Indicator	Description	Optimization	Source
X1	Full antenatal care: i.e. at least four antenatal visits, at least one tetanus toxoid (TT) injection and iron folic acid tablets or syrup taken for 100 or more days. (%)	Max	NFHS-4
X2	Institutional births (%)	Max	NFHS-4
X3	Children age 12-23 months fully immunized (BCG, measles, and 3 doses each of polio and DPT) (%)	Max	NFHS-4
X4	Children under age 3 years breastfed within one hour of birth (%)	Max	NFHS-4
X5	Children under 5 years who are stunted (height-for-age) (%)	Min	NFHS-4
X6	Children under 5 years who are wasted (weight-for-height) (%)	Min	NFHS-4
X7	Children under 5 years who are underweight (weight-for-age) (%)	Min	NFHS-4
X8	Women whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2) (%)	Min	NFHS-4
X9	Women who are overweight or obese (BMI ≥ 25.0 kg/m2) (%)	Min	NFHS-4
X10	Children age 6-59 months who are anaemic (<11.0 g/dl) (%)	Min	NFHS-4
X11	All women age 15-49 years who are anaemic (%)	Min	NFHS-4
X12	Infant Mortality Rate	Min	CHFW
X13	Maternal Mortality Ratio	Min	CHFW

TABLE 2: WOMEN AND CHILD HEALTH INDICATORS IN ANDHRA PRADESH (COMPILED FROM NFHS-4 DISTRICT-WISE FACT SHEETS AND COMMISSIONER HEALTH AND FAMILY WELFARE, ANDHRA PRADESH).

District	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13
Anantapur	47.0	89.9	76.3	51.3	40.3	15.2	39.3	20.2	26.5	53.0	52.7	45	98
Chittoor	45.3	94.0	67.7	45.6	31.4	18.1	32.4	21.0	28.5	46.6	48.8	35	86
East Godavari	44.1	96.9	60.3	42.9	27.7	15.3	27.1	15.9	36.4	63.1	64.6	34	74
Guntur	32.6	97.5	61.7	44.3	22.1	17.9	29.1	11.3	45.1	68.1	57.9	31	83
Krishna	60.7	96.4	74.1	37.7	22.6	20.7	27.7	13.5	45.5	58.1	59.4	25	79
Kurnool	37.3	75.5	66.1	32.0	44.1	18.8	37.5	21.6	24.9	54.5	54.5	43	108
Prakasam	38.2	91.4	64	30.9	28.2	15.3	30.3	16.9	32.5	56.3	57.7	37	87
SPSR Nellore	55.7	96.0	47.7	29.3	29.4	16.9	28.7	17.0	35.0	50.4	59.1	35	77
Srikakulam	42.1	91.2	59.2	27.5	28.0	15.6	28.7	20.5	24.4	70.6	71.8	47	98
Visakhapatnam	44.8	85.5	66.0	58.8	30.1	17.2	33.1	18.9	28.8	64.5	66.4	39	115
Vizianagaram	42.5	90.7	49.3	40.2	36.8	18.8	34.4	25.8	22.4	78.7	75.5	45	107
West Godavari	31.3	97.2	77.7	34.2	28.5	14.7	30.1	14.5	40.0	55.1	59.9	28	80
YSR Kadapa	51.5	93.7	65.3	39.3	36.3	17.9	34.4	18.7	27.0	55.8	57.7	38	85

X1-full ANC care, X2-Institutional birth, X3-fully immunized 12-23 month children, X4-Initiationof breast feeding within 1 hr of birth, X5-prevalence of stunting, X6-prevalence of wasting, x7-prevalence of underweight among 0-5 year children, x8-prevalence of CED among women, X9-prevalence of overweight (BMI>=25) among women, x10- prevalence of anemia among 6-59 mont children, X11-Anemia among 15-49 year women, X12-infant mortalty rate, X13- maternal mortality rate

TABLE 3 RANKING OF THE DISTRICTS IN ANDHRA PRADESH STATE USING TOPSIS METHOD

District	Index	Rank	Status
Krishna	0.612	1	Good
Chittoor	0.592	2	Good
East Godavari	0.581	3	Good
Visakhapatnam	0.555	4	Good
Guntur	0.550	5	Good

West Godavari	0.545	6	Average
YSR Kadapa	0.545	7	Average
SPSR Nellore	0.540	8	Average
Anantapur	0.533	9	Average
Prakasam	0.515	10	Poor
Srikakulam	0.437	11	Poor
Kurnool	0.388	12	Poor
Vizianagaram	0.363	13	Poor

TABLE 4 : SOCIO-DEMOGRAPHIC CHARACTERISTICS OF DIFFERENT GROUP OF DISTRICTS

Variable	Good	Average	Poor
Per Capita Annual Income (Rs.)	88298	76601	65732
Urban area (%)	35.28	27.81	21.25
No. of ICDS projects	23.60	16.75	18.00
Sanitation (%)	55.62	57.28	42.90
Clean fuel (%)	63.74	64.35	53.93
Iodized Salt (%)	85.90	79.58	75.05
Women literature (%)	67.22	62.83	55.08
Infant Mortality Rate	32.80	36.50	43.00
Maternal Mortality Ratio	87.40	85.00	100.00

TABLE 5 ANTENATAL CARE AND NUTRITIONAL STATUS IN DIFFERENT GROUP OF DISTRICTS

Variable	Good	Average	Poor
Full antenatal care (%)	45.50	46.38	40.03
Institutional births (%)	94.06	94.20	87.20
Children age 12-23 months fully immunized (%)	65.96	66.75	59.65
Children under age 3 years breastfed within one hour of birth (%)	45.86	38.53	32.65
Children under 5 years who are stunted (height-for-age) (%)	26.78	33.63	34.28
Children under 5 years who are wasted (weight-for-height) (%)	17.84	16.18	17.13
Children under 5 years who are underweight (weight-for-age) (%)	29.88	33.13	32.73
Women whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2) (%)	16.12	17.60	21.20
Women who are overweight or obese (BMI ≥ 25.0 kg/m2) (%)	36.86	32.13	26.05
Children age 6-59 months who are anaemic (<11.0 g/dl) (%)	60.08	53.58	65.03
All women age 15-49 years who are anaemic (%)	59.42	57.35	64.88

Figures

FIGURE 1 HEALTH STATUS OF WOMEN AND CHILD IN ANDHRA PRADESH STATE