Construction of Health Infrastructure Index in Haryana: An Econometric Approach

M. M. Goel

R G N I Y D, Govt. of India, Sriperumbudur (Tamil Nadu)

Ishu Garg

Department of Economics, Kurukshetra University, Kurukshetra (Haryana)

Abstract

The provision of health infrastructure is one of the major areas of concern in Indian economy including Haryana. Health infrastructure which comprises all the resources necessary to provide health services, is proved to be essential to create health human capital. Thus, being a merit good, establishment of health infrastructure is the prime duty of the State. With this backdrop, the present study is attempted to construct health infrastructure index for the State of Haryana. On the basis of the available data taken from various issues of Statistical Abstract of Haryana, fourteen indicators of health infrastructure are considered for the period of twenty one years from 1991-92 to 2011-12. First of all, the collected data is analyzed by computing descriptive statistics which reveal that seven indicators of health infrastructure possess positive compound annual growth rate (CAGR) while seven others have negative CAGR and certain indicators have experienced high variations in their number over the years. Next, normalization of data is done and then by applying principal component analysis (PCA), composite index for health infrastructure is constructed in various steps including correlation matrix, KMO measure and Bartlett's test; eigenvalues of components; component loading matrix; calculation of weights for variables (indicators of health infrastructure) and finally health infrastructure index. As per index scores, ranks are given to the State for its health infrastructure for all twenty one years. It is found that health infrastructure in Haryana for the year 2004-05 have attained rank 1st with index score 1.000, followed by 2011-12 with score 0.837 and the year 2003-04 having the value of 0.764. Between 1991-92 and 2011-12, up and downs in index scores as well as in ranks are seen. Besides, score of health infrastructure index remain up to 0.5 for eleven years while above 0.5 for ten years. However, the year 2009-10 can be considered quite embarrassing for which score of health infrastructure index is zero indicating availability of health infrastructure was at lowest level in this year. Fortunately, the year 2011-12 having 2nd rank in health infrastructure index arises a ray of hope for the further promotion in the availability of health infrastructural facilities in coming years in State of Haryana. However, negative growth rates of certain indicators and low scores of health infrastructure index calls for immediate attention of Government with sufficient investments towards health infrastructure in Haryana.

Key words: *Composite index, Principal component analysis, indicators of health infrastructure.*

INTRODUCTION

In the age of globalization, health is one of the human rights everywhere including Haryana - a prosperous State of Indian economy. Health which refers to the state of complete physical, mental, social and spiritual wellbeing and not merely an absence of disease; received prominent place in the construction of human development index since 1990. In this context, World

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Health Organization pointed out the dependency of health on the availability of better health infrastructure in terms of health institutions, medical staff, beds in medical institutions, and doctor – patient ratio, doctor – nurse ratio et cetera (Saikia and Bhattacharjee, 2011). Therefore, provision of health infrastructure, health services and related health issues are one of the prime areas of concern. Besides, role of health infrastructure in the improvement of health indicators namely life expectancy, crude birth and death rates, infant mortality rate, maternal mortality rate and eradication of all diseases, is recognized all over the world (Subba Lakshmi and Sahoo, 2013; Anand, 2014). Thus, policy makers consider the health infrastructural facilities as one of the most decisive dimension for the attainment of the social goal of 'Health for all' by the year 2020. Moreover, the health related targets of Millennium Development Goals (MDGs: 2000 – 2015) as well as of Sustainable Development Goals (SDGs: 2015 – 2030) makes the States careful towards the attainment of equity, efficiency and sufficiency in health infrastructure which can be possible by significant investments (Goel, 2011; Goel and Garg, 2016). An adequate health care infrastructure has many components such as physical facilities; laboratory, training, and other support facilities; reliable supplies of pharmaceuticals and other materials; trained staff and professional training systems; by which preventive, diagnostic, and curative care is provided (Kumar and Gupta, 2012; IZUMI Foundation, 2013).

Thus, there may be a number of indicators which form health infrastructure, and from practical stand point, it becomes difficult to identify common trends across separate indicators. For the same, economists realize on composite indices (CI) which prove helpful in analyzing those concepts which encompass multiple indicators. With the help of composite indices, the indicators defining a particular phenomenon are merged into a single score value so that clear, relevant and reliable messages can be obtained (OECD, 2008). Keeping the same in mind, the present paper is primarily concerned with constructing a composite index for health infrastructure in the State of Haryana. Specifically following objectives are worked upon:

(1) To describe health infrastructure in Haryana on its individual indicators across selected years.
(2) To construct composite index for health infrastructure, and discuss its overall methodology.
(3) To examine health infrastructure according to overall ranking based on index scores.

REVIEW OF LITERATURE

Analyzing health infrastructure, health services and health outcomes through construction of composite indices is very popular among economists and

researchers all over the world. Therefore, there is no dearth of literature and out of which some are reviewed as follows:

Kumari and Raman (2011) developed composite indices of education and health attainment during 1990-91 and 2007-08 for Uttar Pradesh by using Principal Component Analysis. They considered eight and thirteen indicators for the health and educational attainment respectively. They found the existence of wide disparity among Districts with respect to education and health. However, Districts having good educational attainment are found to be poor in health attainment while the Districts with well performance in health remained poor in education.

Saikia (2012) used Data Envelopment analysis (DEA) and Principal Component analysis (PCA) to analyze the regional disparity with regard to social sector in India including all States and one Union Tertiary as Delhi. On the basis of two techniques the various ranks are given to the States which explore the presence of regional inequalities in social sector development in India. However, no significant difference exists between the rankings given by DEA and PCA since the rank correlation coefficient between them is strong.

Subba Lakshmi and Sahoo (2013) constructed the health infrastructure index for the period 1980-2010 considering health inputs like number of hospitals and dispensaries, number of beds and number of doctors in government hospitals for the State of Andhra Pradesh by applying principal component analysis. Utilizing health infrastructure index, elasticity coefficients of health indicators with respect to health infrastructure were computed by using double log simple regression model. In order to calculate elasticity coefficients, they. The results revealed that the elasticity coefficients of health indicators like crude birth rate, crude death rate, infant mortality rate and life expectancy at birth with respect to health infrastructure are -37.966, -27.816, -30.598 and 10.282 respectively. Thus, public health facilities are crucial for meeting the basic health requirements of masses in the state.

Anand (2014) by using Principal Component Analysis computed the composite indices of health status and health services for two Indian States namely Uttar Pradesh and Bihar. The study found the existence of wide interdistrict and interregion health disparity in both States with lower disparity in Uttar Pradesh as compared to Bihar in terms of health status and relatively high disparity in health infrastructure.

Lyngdoh (2015) made an attempt to form a healthcare infrastructure index for the north eastern States for the years 2001 and 2011 with the help of Principal Component Analysis. With this health infrastructure index, the States were ranked. The study explored that Tripura attained first rank and Mizoram got second rank in health infrastructure index during 2001 as well as 2011;

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the index score of Arunachal Pradesh have improved in 2011 over 2001. But States of Assam and Meghalaya were found to be the poorest performers.

Motivating from this literature, the present research work is conducted to examine health infrastructure in Haryana through estimation of its composite index.

METHODOLOGY

This section highlights the collection of data, selection of time period and variables, model for composite index and statistical techniques as follows:

1). Data Collection, Time Period and Selection of Variables

For the present study, data on health infrastructure is collected from various issues of Statistical Abstract of Haryana published by Government of Haryana each year. According to the data availability, fourteen major indicators of health infrastructure are selected (table 1) with data for a period of 1991-92 to 2011-12 (table 2). These indicators are the variables for present research.

Table 1: Health Infrastructure Indicators

Infrastructure	Broad Ingredients	Indicators	Abbreviations used in Analysis
Allopathic Institutions	Medical Institutions	1. Hospitals 2. Primary Health Centers 3. Dispensaries 4. Community Health Centers 5. Sub Centers	1. Hos 2. PHCs 3. Dis 4. CHCs 5. SCs
	Medical Staff	6. Doctors 7. Nurses 8. Other Staff	6. Doc 7. Nur 8. OS
	Others	9. Beds	9. Beds
AYUSH Institutions	Medical Institutions	10. Ayurvedic Institutions 11. Unani Institutions 12. Homeopathic Institutions	10. AIs 11. UIs 12. HIs
	Medical Staff	13. Vaidyas/ Hakims 14. Dispensers/Compounders	13. Va/Ha 14. Dis/Com

Source: Researchers' Compilation

There may be other variables also which define health infrastructure, but because of unavailability of reliable data on other indicators, these are not considered in the paper. According to the latest Statistical Abstract of Haryana, health infrastructure in Haryana is a combination of infrastructure allopathic

institutions as well as AYUSH (ayurvedic, unani, siddha, and homoeopathic) institutions which are operative in the State and providing their services to people. The variables can be noted from table 1.

2). Composite Index and Statistical Technique

Composite index is the aggregation of selected variables into one score. There are a number of techniques for aggregation with or without weights. But, mostly, aggregations are done by using weights. Mathematically, Composite Index $= \sum_{i=1}^{N} w_i v_i / \sigma_i$
Where, w_i = weight of respective variable; v_i = variable; σ_i = standard deviation of variable (v_i) and N = number of variables.

In order to make the variable with unit variance, this variable is divided by its standard deviation (Fernando et al. 2012). However, from the point of view of index construction, the selection of measurement units and estimation of weights is much cumbersome.

In the present research work, Principal Component Analysis (PCA) is the foremost econometric technique used to arrive at the weights. IBM SPSS Statistics (Version 20) is utilized to apply the technique. Other major calculations are completed manually as well as by using Microsoft Excel (2013). A number of studies have applied Principal Component Analysis (PCA) for the computation of weights in index construction. In this context, OECD (2008), Nicoletti et al. (2000), Sharpe and Andrews (2012), Fernando et al. (2012), Singh and Gupta (2013), Anand (2014), Daka and Fandamu (2016) are few to mention. The procedures described by these researchers is the basis of statistical methods applied in the present paper.

ANALYSES AND INTERPRETATIONS

This section is mainly divided into three sub-sections and describes the analysis of data completed with suitable statistical techniques to arrive at the objectives.

1). Health Infrastructure in Haryana across Individual Indicators

In order to achieve the first objective table 2 provides a snapshot of collected data and descriptive statistics. It is found that since 1991-92, some of the indicators including numbers of PHCs, CHCs, SCs, doctors, ayurvedic and homoeopathic institutions and their dispensers/compounders have increased as they possess positive compound annual growth rate (CAGR). While the indicators including hospitals, dispensaries, nurses, other staff, beds, unani institutions and vaidyas/hakims has faced negative CAGR in their number.

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Table 2: Indicators of Health Infrastructure in Haryana during 1991-92 to 2011-12

(all figures are in numbers)

| Years | Infrastructure in Allopathic Institutions | | | | | | | | | Infrastructure in AYUSH Institutions | | | | |
| | Medical Institutions | | | | | Medical Staff | | | | Medical Institutions | | | Medical Staff | |
	Hospi-tals (Hos)	PHCs	Dispen saries (Dis)	CHCs	SCs	Doctors (Doc)	Nurses (Nur)	Other Staff (OS)	Beds	Ayur--vedic (AIs)	Unani (UIs)	Ho-moeo-pathic (HIs)	Vaidy-as/ Hakims (Va/Ha)	Dispens-ers/ Com-pounders (Dis/ Com)
1991-92	79	395	232	51	2293	1381	4045	7729	10681	393	20	20	451	426
1992-93	78	395	232	59	2299	1399	4013	7941	11182	404	19	20	455	427
1993-94	79	395	232	59	2299	1492	4032	8369	11382	404	19	20	455	427
1994-95	79	398	234	60	2299	1541	3962	8510	11308	406	21	20	451	412
1995-96	79	398	232	63	2299	1519	3551	8650	11328	407	21	20	418	398
1996-97	79	398	234	63	2299	1500	3748	8272	11328	411	21	20	443	371
1997-98	80	401	231	64	2299	1586	3639	9138	11416	413	21	20	386	387
1998-99	80	401	231	64	2299	1595	3847	9334	11440	421	21	20	371	385
1999-00	78	402	231	64	2299	1415	3649	8224	10878	423	21	20	384	379
2000-01	78	402	229	64	2299	1610	3746	8803	10878	433	21	20	416	365
2001-02	79	402	229	64	2299	1605	3582	8548	10944	434	20	20	404	370
2002-03	79	403	229	64	2299	1770	3724	8595	11044	446	20	20	442	360
2003-04	79	408	228	65	2299	1837	3966	8714	11082	468	20	20	414	355
2004-05	79	408	228	72	2433	1828	3719	8389	11082	470	20	20	461	410
2005-06	60	409	193	81	2433	1839	3403	8242	9584	483	19	20	454	379
2006-07	61	409	193	84	2433	1548	3998	8590	9614	477	19	20	419	482
2007-08	67	416	193	82	2433	1441	4088	7449	9866	477	19	21	450	457
2008-09	68	420	193	84	2433	1554	3806	8154	9986	481	19	22	434	411
2009-10	69	429	193	85	2465	1205	3138	5504	10006	437	20	20	427	406
2010-11	69	429	193	86	2465	1538	3991	7408	10006	462	17	20	402	459
2011-12	69	431	193	86	2465	1593	4078	7514	10028	468	17	23	440	452
Min.	60	395	193	51	2293	1205	3138	5504	9584	393	17	20	371	355
Max.	80	431	234	86	2465	1839	4088	9334	11440	483	21	23	461	482
Range	20	36	41	35	172	634	950	3830	1856	90	4	3	90	127
Mean	75	407	218	70	2354	1562	3796	8194	10717	439	20	20	428	406
S.D.	6.560	11.493	18.357	11.041	73.548	159.382	247.282	800.432	651.474	30.490	1.221	0.784	26.536	35.987
CV (%)	8.747	2.824	8.421	15.773	3.124	10.204	6.514	9.769	6.079	6.945	6.105	3.920	6.200	8.864
CGR(%)	-1.094	0.401	-1.193	2.429	0.401	0.300	-0.200	-0.797	-0.797	1.005	-0.598	0.300	-0.049	0.401

Source: Data is collected from Statistical Abstracts of Haryana (Various Issues); Descriptive statistics is computed by researchers.

However, CHCs have experienced highest CAGR of 2.429 per cent in their number but this indicator also have largest coefficient of variation (CV) of

15.773 per cent thereby revealing high dispersions in the CHCs' number in the State during 1991-92 to 2011-12. Moreover, number of nurses has increased from 4045 in 1991-92 to 4078 in 2011-12 yet their CAGR is -0.200 per cent. Meanwhile, the number of PHCs have just 0.401 per cent CAGR but they possess least variations (CV= 2.824%) over the years.

Also, it is a serious cause of concern that among seven indicators having negative CAGR, hospitals, dispensaries, other staff, beds and unani instituions are found to be lesser in number during the year 2011-12 than their average. Another point worthy to be mentioned is that indicators including PHCs, CHCs, SCs, and homoeopathic institutions are found to attain maximum number in 2011-12 among twenty one year period whereas dispensaries and unani institutions stood at their minimum number for the same year.

However, in case of medical institutions sub centers are found highest in number ($\overline{X}$=2354) with followed by ayurvedic institutions ($\overline{X}$ =439) and PHCs ($\overline{X}$=407). Similarly, with regard to medical staff, the average number of doctors, nurses and other staff are observed as 1562, 3796 and 8194 while for vaidyas/hakims and dispensers/compounders average number is 428 and 406 respectively. In totality, number of allopathic medical institutions and their staff are much higher than ayurvedic, unani and homoeopathic institutions and their medical staff.

Next, this data is put into further analysis in order to attain second objective of getting a composite index score by combining all these indicators or variables. Thus, the data as revealed in table 2 is an input for further analysis in next section.

2). Composite Index Construction for Health Infrastructure

In order to prepare composite index of health infrastructure, step by step procedure is described in following sub-sections:

2.1). Normalization of Indicators of Health Infrastructure

As a preliminary step of constructing an index, normalization is required when the data is obtained in different measurement units to convert it into identical measures. Present data on indicators of health infrastructure have the same unit of measurement, as the entries in all the cells (table 2) denote the numbers. But, then also to convert that data into a specified range [here a range of 0 to 1], the given data is normalized by using a 'Linear Scaling Technique' also called 'Min-Max Normalization' (OECD, 2008; Sharpe and Andrews, 2012). Under this technique, minimum value of a variable in its data series is subtracted from the particular value for which normalization is undertaken and the resultant is divided by the range (difference between maximum and minimum value of this particular variable) of its data series. In this way, the normalized data comes up within a limit of 0 to 1.

Mathematically, Normalized Value = $\dfrac{Indicator\ value - Minimum\ value}{Maximum\ value - Minimum\ value}$

To elaborate fully, suppose, indicator or variable 'Hos' (Hospitals) is to be normalized for the year 1991-92 when they were 79. In table 2, in data series of 'Hos', minimum value is 60 and the maximum value is 80. Now, for normalization, subtract minimum value (60) from indicator value (79) and obtain resultant 19, which has to be divided by the subtraction of maximum (80) and minimum value (60) that is 20. The normalized value is 0.950 for an indicator value of 79. The same process is applied to all the values for all indicators or variables and results are shown in table 3 which are used as an input for Principal Component Analysis.

Table 3: Normalized Indicators of Health Infrastructure

| Years | Infrastructure in Allopathic Institutions | | | | | | | | | Infrastructure in AYUSH Institutions | | | | |
| | Medical Institutions | | | | | Medical Staff | | | | Medical Institutions | | | Medical Staff | |
	Hos (Nm)	PHCs (Nm)	Dis (Nm)	CHCs (Nm)	SCs (Nm)	Doc (Nm)	Nur (Nm)	OS (Nm)	Beds (Nm)	AIs (Nm)	UIs (Nm)	HIs (Nm)	Va/ Ha (Nm)	Dis/ Com (Nm)
1991-92	0.950	0.000	0.951	0.000	0.000	0.278	0.955	0.581	0.591	0.000	0.750	0.000	0.889	0.559
1992-93	0.900	0.000	0.951	0.229	0.035	0.306	0.921	0.636	0.861	0.122	0.500	0.000	0.933	0.567
1993-94	0.950	0.000	0.951	0.229	0.035	0.453	0.941	0.748	0.969	0.122	0.500	0.000	0.933	0.567
1994-95	0.950	0.083	1.000	0.257	0.035	0.530	0.867	0.785	0.929	0.144	1.000	0.000	0.889	0.449
1995-96	0.950	0.083	0.951	0.343	0.035	0.495	0.435	0.821	0.940	0.156	1.000	0.000	0.522	0.339
1996-97	0.950	0.083	1.000	0.343	0.035	0.465	0.642	0.723	0.940	0.200	1.000	0.000	0.800	0.126
1997-98	1.000	0.167	0.927	0.371	0.035	0.601	0.527	0.949	0.987	0.222	1.000	0.000	0.167	0.252
1998-99	1.000	0.167	0.927	0.371	0.035	0.615	0.746	1.000	1.000	0.311	1.000	0.000	0.000	0.236
1999-00	0.900	0.194	0.927	0.371	0.035	0.331	0.538	0.710	0.697	0.333	1.000	0.000	0.144	0.189
2000-01	0.900	0.194	0.878	0.371	0.035	0.639	0.640	0.861	0.697	0.444	1.000	0.000	0.500	0.079
2001-02	0.950	0.194	0.878	0.371	0.035	0.631	0.467	0.795	0.733	0.456	0.750	0.000	0.367	0.118
2002-03	0.950	0.222	0.878	0.371	0.035	0.891	0.617	0.807	0.787	0.589	0.750	0.000	0.789	0.039
2003-04	0.950	0.361	0.854	0.400	0.035	0.997	0.872	0.838	0.807	0.833	0.750	0.000	0.478	0.000
2004-05	0.950	0.361	0.854	0.600	0.814	0.983	0.612	0.753	0.807	0.856	0.750	0.000	1.000	0.433
2005-06	0.000	0.389	0.000	0.857	0.814	1.000	0.279	0.715	0.000	1.000	0.500	0.000	0.922	0.189
2006-07	0.050	0.389	0.000	0.943	0.814	0.541	0.905	0.806	0.016	0.933	0.500	0.000	0.533	1.000
2007-08	0.350	0.583	0.000	0.886	0.814	0.372	1.000	0.508	0.152	0.933	0.500	0.333	0.878	0.803
2008-09	0.400	0.694	0.000	0.943	0.814	0.550	0.703	0.692	0.217	0.978	0.500	0.667	0.700	0.441
2009-10	0.450	0.944	0.000	0.971	1.000	0.000	0.000	0.000	0.227	0.489	0.750	0.000	0.622	0.402
2010-11	0.450	0.944	0.000	1.000	1.000	0.525	0.898	0.497	0.227	0.767	0.000	0.000	0.344	0.819
2011-12	0.450	1.000	0.000	1.000	1.000	0.612	0.989	0.525	0.239	0.833	0.000	1.000	0.767	0.764
Mean	0.733	0.336	0.616	0.535	0.357	0.563	0.693	0.702	0.611	0.511	0.690	0.095	0.628	0.399
S.D.	0.328	0.319	0.448	0.315	0.428	0.251	0.260	0.209	0.351	0.339	0.305	0.261	0.295	0.283

Source: Researchers' Calculations of Normalization

Note: 'Nm' symbolizes that the shown variables have now been normalized

2.2). Principal Component Analysis for Composite Index

Principal component analysis of the normalized data is performed with the help of SPSS (version 20) and resultant output is shown under following headings:

- *Correlation Matrix, Kaiser-Meyer-Olkin (KMO) Measure and Bartlett's Test*

To start the analysis, it is necessary to test that whether present data is adequate for principal component analysis (PCA). In this regard, Correlation matrix (showing scores of correlation among variables), Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity are computed by SPSS system (Constantin, 2014).

Since, the PCA method depends on the correlations between sets of variables. Therefore, it becomes imperative to examine the correlation among variables undertaken. More clearly, the correlation scores clarify that whether the PCA will be meaningful or not. The correlations between individual variables has to be higher than 0.30 for the analysis to provide significant results. However, low scores of some of the correlations do not create problem. But if, most of the correlations score near about zero, then method lose its usefulness (Mooi and Sarstedt, 2011; Hoque, 2014). The correlation matrix which is one of the output of PCA, are presented in table 4.

Table 4: Correlation Matrix, KMO and Bartlett's Test

Correlation Matrix														
Health Indicators	Hos	PHCs	Dis	CHCs	SCs	Doc	Nur	OS	Beds	AIs	UIs	HIs	Va/Ha	Dis/Com
Hos	1.000													
PHCs	-.654*	1.000												
Dis	.938*	-.859*	1.000											
CHCs	-.859*	.905*	-.951*	1.000										
SCs	-.827*	.880*	-.921*	.945*	1.000									
Doc	.016^{ns}	-.070^{ns}	.089^{ns}	.025^{ns}	-.013^{ns}	1.000								
Nur	.060^{ns}	-.092^{ns}	.044^{ns}	-.126^{ns}	-.076^{ns}	.031^{ns}	1.000							
OS	.424**	-.644*	.569*	-.495**	-.600*	.595*	.232^{ns}	1.000						
Beds	.952*	-.740*	.949*	-.852*	-.849*	.081^{ns}	.039^{ns}	.546*	1.000					
AIs	-.732*	.695*	-.766*	.825*	.769*	.477**	.008^{ns}	-.154^{ns}	-.744*	1.000				
UIs	.620*	-.672*	.712*	-.647*	-.699*	-.023^{ns}	-.401**	.429**	.657*	-.547*	1.000			
HIs	-.370**	.591*	-.526*	.518*	.493**	-.017^{ns}	.298***	-.228^{ns}	-.429**	.438**	-.552*	1.000		
Va/Ha	-.181^{ns}	-.035^{ns}	-.114^{ns}	.017^{ns}	.216^{ns}	.052^{ns}	.205^{ns}	-.306***	-.170^{ns}	.097^{ns}	-.288^{ns}	.176^{ns}	1.000	
Dis/Com	-.538*	.409**	-.568*	.483**	.593*	-.383**	.524*	-.386*	-.531*	.232^{ns}	-.672*	.357***	.260^{ns}	1.000
KMO and Bartlett's Test														
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		KMO Measure					0.460							
Bartlett's Test of Sphericity		Approx. Chi-Square					399.705							
		df					91							
		Sig.					0.000							

Source: Researchers' Calculations
Note: *1 per cent significance; **5 per cent significance; ***10 per cent significance; ^{ns} not significant

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The correlation matrix is a rectangular arrangement of numbers showing the correlation coefficients between one variable and every other variables. It is evident from table 4 that the all elements on principal diagonal are 1 since correlation coefficient between a variable with itself is always unity. Below this principal diagonal, the some correlation coefficients are positive and some are negative thereby implying that some of the variables move in same direction with other variables, some varies oppositely with others. Further, correlations between indicator variables are found to be of high, moderate and low degree which are significant either at 1 per cent, or 5 per cent, or 10 per cent level of significance. However, some indicator variables show insignificant correlation with other variables, for example, doctors, nurses and vaidyas/hakims have insignificant correlation with most of the variables. This pattern suggests some variables may flow together and some others may go differently. Thus, possibly certain components or latent variables or factors can be obtained for these variables.

Next output, Kaiser-Meyer-Olkin (KMO) statistic, a measure of the strength of relationship among variables, indicates whether the correlations between variables can be explained by other variables in the dataset. Its value varies between 0 and 1. The data is considered suitable for PCA if KMO statistic is equal or higher than 0.50. In the present context, the value of KMO (0.460) is approximately equal to 0.5 therefore; data is suitable for the application of PCA.

Moreover, the Bartlett's test is another indicator of judging that whether original variables are sufficiently correlated. It is used to test the null hypothesis that the correlation matrix is an identity matrix that is, in which diagonal elements are 1 and others are 0. This implies that all variables are perfectly correlated with themselves but uncorrelated with others. Alternatively, correlation matrix is not identity matrix thereby implying that there are some degree of correlation between variables. To test the null hypothesis that all correlation coefficients are zero or not significant, chi-square statistic is computed under Bartlett test. The value of approximate chi-square statistic is found to be 399.705 with 91 degrees of freedom, which is significant at 0.000 level of significance which is under the accepted range of level of significance (p-value) 0.05. On this basis, null hypothesis that is variables are uncorrelated or correlation matrix is an identity matrix is rejected and alternative hypothesis is accepted which means original variables are correlated which is compulsory for the adequacy of PCA.

Thus, significant scores of correlation coefficients and results of KMO and Bartlett's test show that principal component analysis is preferable.

▪ *Decision for Number of Components*

After passing the above tests, next step is to identify the number of factors or principal components or latent variables that can represent all originally undertaken variables. For the same, eigenvalue-one criterion (Kaiser's criterion or latent root criterion), scree plot and total amount of variance extracted are the methods that can be used. But, present study adopts eigenvalue-one criterion according to the standard practice of decision as mentioned by OECD (2008) and Sharpe and Andrews (2012). Under, eigenvalue-one criterion, those factors or principal components or latent variables are selected which possess eigenvalues larger than 1, individual variance explained more than 10 per cent; and cumulative contribution to overall variance more than 60 per cent. In table 5, initial and rotated eigenvalues are presented as another output of PCA.

Table 5: Eigenvalues (Initial and Rotated) and Components

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.610	54.359	54.359	7.610	54.359	54.359	7.047	50.334	50.334
2	1.889	13.496	67.855	1.889	13.496	67.855	2.254	16.099	66.433
3	1.752	12.515	80.370	1.752	12.515	80.370	1.951	13.937	80.370
4	.998	7.129	87.499						
5	.758	5.415	92.914						
6	.418	2.983	95.897						
7	.247	1.768	97.665						
8	.192	1.375	99.040						
9	.054	.386	99.427						
10	.045	.324	99.751						
11	.015	.108	99.859						
12	.012	.083	99.941						
13	.007	.052	99.994						
14	.001	.006	100.000						

Source: Researchers' Calculations

It is cleared from initial eigenvalues in the table that the number of components is equal to number of variables selected in the study and every component has an eigenvalue showing the variance extracted by itself. But, only first three components are possessing the eigenvalue greater than 1 (7.610, 1.889 and 1.752) and thus, fourteen indicators are reduced to these three set of components as shown in table under column extraction sums of squared loadings. For further clarification about retained components, rotation has been applied. It is found that there exist three components with eigenvalues

7.047, 2.254 and 1.951 which are some different from initial eigenvalues but their summation is same with initial eigenvalues of first three components. After rotation, these components individually explain 50.334 per cent, 16.099 per cent and 13.937 per cent of variance (well above suggested 10 per cent) but cumulatively explain 80.370 per cent of variance which are notably above the suggested criterion of 60 per cent. With this analysis, three components are retained which are able to represent fourteen variables selected for study.

- *Component Matrix and Loadings*

Table 6 is a triad for component loadings, squared component loadings and squared loadings scaled to unity sum. Component loadings are the correlations between variables and the latent components. These are used to examine which component is formed with which of the variables. This information is provided by PCA in its output named initial or un-rotated component loading matrix.

Table 6: Rotated Component Loadings Matrices

Indicator Variables	Component Loadings			Squared Component Loadings			Squared Scaled to Unity Sum (Domain Weight)		
	Component			Component			Component		
	1	2	3	1	2	3	1	2	3
Hos	-.888	-.136	.079	**0.788**	0.018	0.006	**0.112**	0.008	0.003
PHCs	.891	.055	-.174	**0.795**	0.003	0.030	**0.113**	0.001	0.016
Dis	-.959	-.155	.161	**0.920**	0.024	0.026	**0.131**	0.011	0.013
CHCs	.975	.045	-.052	**0.951**	0.002	0.003	**0.135**	0.001	0.001
SCs	.937	.164	-.145	**0.878**	0.027	0.021	**0.125**	0.012	0.011
Doc	.106	-.081	**.945**	0.011	0.007	**0.893**	0.002	0.003	**0.458**
Nur	-.177	**.900**	.188	0.031	**0.810**	0.036	0.004	**0.359**	0.018
OS	-.504	-.027	**.768**	0.254	0.001	**0.591**	0.036	0.000	**0.303**
Beds	-.907	-.147	.154	**0.822**	0.022	0.024	**0.117**	0.010	0.012
AIs	.869	.063	.418	**0.755**	0.004	0.175	**0.107**	0.002	0.090
UIs	-.654	-.608	.045	**0.428**	0.370	0.002	**0.061**	0.164	0.001
HIs	.499	.463	.049	**0.249**	0.214	0.002	**0.035**	0.095	0.001
Va/Ha	.065	.490	-.092	0.004	**0.240**	0.008	0.001	**0.106**	0.004
Dis/Com	.400	.716	-.367	0.160	**0.513**	0.135	0.023	**0.228**	0.069
Explained Variance				7.047	2.254	1.951	1.000	1.000	1.000
Total Variance					11.252				
Explained Variance/Total Variance (Component Weight)				0.626	0.200	0.173			

Source: Researchers' Calculations
Note: Columns under 'Component Loadings' is the output of PCA.

In this matrix, sometimes, it becomes difficult to recognize that which variable should be included in which component because various variables load moderately on each component. To overcome this problem, varimax rotation has been applied; as a result of which each original variable tends to be associated with one (or a small number) of retained components, and each component represents only a small number of variables (Abdi and Williams, 2010). However for the sake of simplicity, the rotated component loading matrix is shown in table 6In order to check which indicator variable load on which component, a criterion of component loadings greater than 0.5 is employed (Hair et al., 2010). It can be seen from the left side of table that first component is formed by Hos (hospitals), PHCs, Dis (dispensaries), CHCs, SCs, Beds and AIs (ayurvedic institutions), UIs (unani institutions) and HIs (homoeopathic institutions) since the component loadings of these variables are high on the first component among three components. Component two is a formation of variables Nur (nurses), Va/Ha (vaidyas/hakims) and Dis/Com (dispensers/compounders). On the same notions, component three is a conglomerate of variable namely Doc (doctors) and OS (other staff).

Now, at the middle of table there are squared component loadings (obtained by squaring the component loadings) which explain the amount of variation of the indicator variables that the latent components explain. Below the matrix of 'squared component loadings' explained variance of three components are displayed. This is attained by adding the square component loadings of components one, two and three respectively. Actually, these are the three eigenvalues, obtained after rotation. Now, total variance is the addition of three values of explained variance [7.047+2.254+1.951]. Explained variance when divided by total variance gives 'component weight'.

Table 7: Weighted Scores for Variables

Indicators	Domain Weight (I)	Component Weight (II)	Weight Score (I*II) III Total=0.856	Resulting Weight III/0.856
Hos	0.112	0.626	0.070	0.082
PHCs	0.113	0.626	0.071	0.083
Dis	0.131	0.626	0.082	0.096
CHCs	0.135	0.626	0.085	0.099
SCs	0.125	0.626	0.078	0.091
Doc	0.458	0.173	0.079	0.093
Nur	0.359	0.200	0.072	0.084

Indicators	Domain Weight (I)	Component Weight (II)	Weight Score (I*II) III Total=0.856	Resulting Weight III/0.856
OtSt	**0.303**	0.173	0.052	0.061
Beds	**0.117**	0.626	0.073	0.086
AyHos	**0.107**	0.626	0.067	0.078
UnHos	**0.061**	0.626	0.038	0.045
HoHos	**0.035**	0.626	0.022	0.026
Va/Ha	**0.106**	0.200	0.021	0.025
Dis/Com	**0.228**	0.200	0.046	0.053

Source: Researchers' Calculations

Third part of table 'squared loadings scaled to unity sum' is attained by dividing squared loadings in each component by the explained variance of respective component, and the values obtained are entitled as 'domain weight' for all original variables rests under various components. Now, the 'component weight' and 'domain weight' are used in table 7 to arrive at the final weights.

In above table 7, column 'domain weight' shows the weight of the original variable in the component in which it falls and is obtained by squared loadings scaled to unity sum shown in third part of table 6. Similarly, each variable has that component weight in which this variable lies and on this basis column of 'component weight' is prepared. For example, variable 'Hos' fell under first component whose weight is 0.626 as calculated in table 6.

Table 8: Weighted Variables or Weighted Indicators of Health Infrastructure

Years	Infrastructure in Allopathic Institutions									Infrastructure in AYUSH Institutions				
	Medical Institutions					Medical Staff				Medical Institutions			Medical Staff	
	Hos	PHCs	Dis	CHCs	SCs	Doc	Nur	OtSt	Beds	AyHos	UnHos	HoHos	Va/Ha	Dis/Com
1991-92	0.238	0.000	0.204	0.000	0.000	0.101	0.309	0.170	0.145	0.000	0.111	0.000	0.075	0.105
1992-93	0.225	0.000	0.204	0.072	0.007	0.111	0.298	0.186	0.211	0.028	0.074	0.000	0.079	0.106
1993-94	0.238	0.000	0.204	0.072	0.007	0.164	0.304	0.218	0.237	0.028	0.074	0.000	0.079	0.106
1994-95	0.238	0.022	0.214	0.081	0.007	0.192	0.280	0.229	0.228	0.033	0.148	0.000	0.075	0.084
1995-96	0.238	0.022	0.204	0.107	0.007	0.179	0.141	0.240	0.230	0.036	0.148	0.000	0.044	0.063
1996-97	0.238	0.022	0.214	0.107	0.007	0.169	0.207	0.211	0.230	0.046	0.148	0.000	0.068	0.024
1997-98	0.250	0.043	0.199	0.116	0.007	0.218	0.170	0.277	0.242	0.051	0.148	0.000	0.014	0.047

1998-99	0.250	0.043	0.199	0.116	0.007	0.223	0.241	0.292	0.245	0.072	0.148	0.000	0.000	0.044
1999-00	0.225	0.050	0.199	0.116	0.007	0.120	0.174	0.207	0.171	0.077	0.148	0.000	0.012	0.035
2000-01	0.225	0.050	0.188	0.116	0.007	0.232	0.207	0.251	0.171	0.102	0.148	0.000	0.042	0.015
2001-02	0.238	0.050	0.188	0.116	0.007	0.229	0.151	0.232	0.180	0.105	0.111	0.000	0.031	0.022
2002-03	0.238	0.058	0.188	0.116	0.007	0.323	0.199	0.236	0.193	0.136	0.111	0.000	0.067	0.007
2003-04	0.238	0.094	0.183	0.125	0.007	0.361	0.282	0.245	0.198	0.192	0.111	0.000	0.041	0.000
2004-05	0.238	0.094	0.183	0.188	0.173	0.356	0.198	0.220	0.198	0.197	0.111	0.000	0.085	0.081
2005-06	0.000	0.101	0.000	0.268	0.173	0.363	0.090	0.209	0.000	0.230	0.074	0.000	0.078	0.035
2006-07	0.013	0.101	0.000	0.295	0.173	0.196	0.292	0.235	0.004	0.215	0.074	0.000	0.045	0.187
2007-08	0.088	0.152	0.000	0.278	0.173	0.135	0.323	0.148	0.037	0.215	0.074	0.033	0.074	0.150
2008-09	0.100	0.181	0.000	0.295	0.173	0.199	0.227	0.202	0.053	0.225	0.074	0.066	0.059	0.083
2009-10	0.113	0.246	0.000	0.304	0.213	0.000	0.000	0.000	0.056	0.113	0.111	0.000	0.053	0.075
2010-11	0.113	0.246	0.000	0.313	0.213	0.190	0.290	0.145	0.056	0.176	0.000	0.000	0.029	0.153
2011-12	0.113	0.260	0.000	0.313	0.213	0.222	0.320	0.153	0.059	0.192	0.000	0.100	0.065	0.143

Source: Authors Calculations
Note: Weighted variables are computed by multiplying each indicator by its respective weight and then divide by indicator's Standard deviation.

Likewise, all variables have domain weight as well as component weight. As a next step, the 'domain weight' and 'component weight' is multiplied (as shown under column 'Weight Score' in table 7) and the resultant is divided by summation of multiplication values to arrive at weight scores. In this way, final weights of each variable are obtained and displayed in the last column under the heading 'Resulting Weight'. The summation of weights in this column is definitely come out to be 1, and now these weights are ready to be used for a weighed aggregation of variables for getting a composite index.

▪ *Composite Index*

To prepare composite index, firstly, each indicator or variable (normalized) for various years is multiplied by its weight (computed in table 7) and is divided by its standard deviation (obtained from normalized data). In this way all variables will be credited with weighted scores for various years which has to be summated to obtain composite index for every year.

Table 9: Composite Index of Health Infrastructure

Years	Composite Index (Aggregation of Weighted Indicators)	Normalized Composite Index	Ranking
1991-92	1.458	0.168	19th
1992-93	1.601	0.305	17th
1993-94	1.731	0.431	12th
1994-95	1.831	0.527	8th
1995-96	1.659	0.361	15th
1996-97	1.691	0.392	13th
1997-98	1.782	0.480	10th
1998-99	1.880	0.574	6th
1999-00	1.541	0.248	18th
2000-01	1.754	0.453	11th
2001-02	1.660	0.362	14th
2002-03	1.879	0.573	7th
2003-04	2.077	0.764	3rd
2004-05	2.322	1.000	1st
2005-06	1.621	0.325	16th
2006-07	1.830	0.526	9th
2007-08	1.880	0.574	6th
2008-09	1.937	0.629	4th
2009-10	1.284	0.000	20th
2010-11	1.924	0.617	5th
2011-12	2.153	0.837	2nd

Source: Researchers' Calculations based on previous table 8

To keep the scores of composite index ranging between 0 and 1, it is necessary to normalize the composite index by subtracting minimum value in the series from each value and then divide the resultant by the difference of maximum and minimum value. In this way, composite index of health infrastructure is constructed and presented in table 9.

3) Ranking of Health Infrastructure in Haryana

To achieve the third objective, ranks are given to the State of Haryana for health infra\structure in various years as per the calculated index scores. It is cleared from the table 9 that score of health infrastructure index have improved from

0.168 in the year 1991-92 to 0.527 in 1994-95 and consequently, the rank is also upgraded from 19th to 8th for the same period. But, in the next year the value of index is declined to 0.361 which attain 15th rank. But, in subsequent three years (1996-97, 1997-98 and 1998-99) the rank of health infrastructure become better to 13th , 10th and 6th with index values 0.392, 0.480 and 0.574 respectively.

Unfortunately, in 1999-00, the index value once again falls and reaches to 0.251 with 18th ranking. But, this situation changes in 2002-03 when index score climbs to 0.573 with rank 7th which is second best over previous years. However, this trend is found to continue in 2003-04 with index score 0.764 attaining 3rd rank and in 2004-05 with 1.000 index score receiving 1st rank. Thus, in 2004-05, health infrastructure in the State of Haryana is at best status in comparison with other years. Meanwhile, the situation deviated once again when index score drops to 0.325 in 2005-06 and thus, in one year the rank slips to 16th from 1st. In the next three years the index score increases to 0.526, 0.574 and 0.629 respectively and consequently ranks also hiked. It is noteworthy that the years 1998-99 and 2007-08 have same index score (0.574) and rank (6th) for health infrastructure status in the State.

However, the worst condition is seen in the year 2009-10, when the value of index become zero. It does not implies the nil availability of health infrastructure in 2009-10; actually, the index score for this year shows least availability of health infrastructural facilities in comparison with other years. It can also be identified from first column of 'Composite index' in table 9 highlighting 1.284 score (without normalization) which is lowest for the year 2009-10. In the next two years, index score is increased to 0.617 with 5th rank in 2010-11 and 0.837 in 2011-12 with rank 2nd. Thus, from the point of view of health infrastructure beginning year 1991-92 was not so encouraging because of 19th rank; but then conditions seemed to be improving in between with certain fluctuations and up-downs. On the whole, health infrastructure index score is found to stood between 0 and 0.5 for eleven years; between 0.5 and 0.6 for two years; 0.6 and above for eight years.

Now, the findings are summarized with certain policy implications and future research directions in the next section.

CONCLUSION AND POLICY IMPLICATIONS

In nut shell, the present study is a humble attempt to examine the status of health infrastructure via constructing its index for State of Haryana. For which, firstly, the relevant indicators of health infrastructure are analyzed individually by their raw data as well as by computing descriptive statistics. The analysis reveals that health infrastructure' indicators namely numbers of PHCs, CHCs, SCs, doctors, ayurvedic and homoeopathic

institutions and their dispensers/compounders have increased as their CAGR is positive. While, numbers of hospitals, dispensaries, nurses, other staff, beds, unani institutions and vaidyas/hakims have experienced negative CAGR. Besides, CHCs have achieved highest rate of growth in their number but also possess much dispersions. Meanwhile, numbers of PHCs, CHCs, SCs, and homoeopathic institutions are at their maximum number in 2011-12 (latest year of data) whereas dispensaries and unani institutions are found to experience their minimum number for the same year.

Next, summated index of all indicators of health infrastructure is prepared by applying principal component analysis (PCA) in various steps while explaining its detailed methodology. First of all, available data is normalized on which PCA is applied; consequently correlation matrix, KMO measure and Bartlett's test result are attempted which are found to favor the application of PCA. Secondly, three principal or latent components capable of representing all original variables are identified on the basis of their eigenvalues produced by PCA. Next, final output of PCA in terms of matrix of component loadings is attained to compute final weights for all variables (indicators of health infrastructure). By utilizing these weights, composite index of health infrastructure is constructed.

The scores of health infrastructure index reveal that 2004-05 is the best year for Haryana's health infrastructural status due to first rank. This rank is achieved in thirteenth year from 1991-92. Between 1991-92 and 2011-12, up and downs in index scores as well as in ranks are felt and thus continuous yearly improvement in ranks are not seen. On the whole, in health infrastructure index, Haryana State have experienced average and above score (0.6 and above) for eight years while for eleven years the score remained 0.5 and lesser, among time period of twenty one years. However, a very embarrassing situation is found during 2009-10 with lowest rank for which health infrastructure index scores zero implying the least availability of health infrastructural facilities for that year in comparison with other years. Thus, one cannot deny the fact that variations exist in the availability of overall health facilities over the years in the State of Haryana. Since, the State have attained second rank in health infrastructure index during the year 2011-12, therefore, there is a hope for further promotion of the status of health infrastructural facilities in coming years.

The present research implicated that the status of health infrastructure needs to be improved in the State of Haryana. The negative growth rate

of certain indicators of health infrastructure is a serious cause of concern which require immediate attention from Government. Moreover, less than average score of health infrastructure index for many years also highlights the poor status of health infrastructure in the State. It may be due to lack of adequate investments in health infrastructure. Thus, there is emergence for sufficient amounts of public expenditure that must be incurred on health infrastructure. Besides, growing demand for healthcare services calls for enhancement in budgetary allocations on health sector every year. However, economically backward sections of society prominently depend on the public sector health care facilities; therefore, it becomes the primary duty of the State to ensure accessibility and affordability of health services to all citizens in general and vulnerable sections in particular. Last but not least, to develop health sector according to modern world, the corrupt practices among health service providers and financial leakages by Government officials must also be checked via adopting good governance at all levels.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Generally, researchers face certain problems while conducting their research which are called the limitations of their study. In the present context, first limitation is that some important indicators of health infrastructure including number of ambulances, blood banks, and stock of medicines, are not undertaken due to the unavailability of their data. Secondly, health infrastructure index is constructed by employing an econometric technique namely Principal Component Analysis which itself has certain shortcomings including requirement of large number of variables or indicators, adequate sample size and variables must be correlated (at least moderately) with each other.

With regard to future research directions, the present study will be directive for future researches as it explains construction of health infrastructure index in step by step procedure. Besides, the present research can be extended by including data for more years and more indicators. Furthermore, the index for health outcomes by taking data on its indicators can also be constructed for the state of Haryana.

REFERENCES

Abdi, H., & Williams, L. J. (2010). Principal component analysis. *WIREs Computational Statistics*, 2(4), 433-459.

Anand, M. (2014). Health status and health care services in Uttar Pradesh and Bihar: A comparative study. *Indian Journal of Public Health*, 58(3), 174-179.

Constantin, C. (2014). Principal component analysis - A powerful tool in computing marketing information. *Bulletin of the Transilvania University of Braşov*, 7 (56), 25-30.

Goel, M. M. Garg, I.	Daka, L., & Fandamu, H. (2016). Evaluating poverty determinants in Zambia with principle component analysis and logistic regression. *International Journal of Multidisciplinary Research and Development,* 3(2), 320-327.

Debapriya, A., & Mohanty, M. K. (2008). Inter-District disparity in the levels of development in education and health care facilities - A case of Orissa. *Indian Journal of Regional Science*, 40(1), 118-123.

Fernando, M.A.C.S.S., Samita, S., & Abeynayake, R. (2012). Modified factor analysis to construct composite indices: Illustration on urbanization index. *Tropical Agricultural Research*, 23(4), 327-337.

Goel, M.M. (2011). *Economics of human resource development in India*. New Delhi: VK Global Publications.

Goel, M.M., & Garg, I. (2016). Public expenditure on health and its impact on health infrastructure and health status in Haryana. *Voice of Research*, 5(2), 9-18.

Hair, Jr Joseph F., Anderson, R. E., Tatham, Ronald L., & Black, William C. (2006). *Multivariate data analysis* (5th ed.). New Delhi: Dorling Kindersley (India) Pvt. Ltd, Pearson Education, Inc.

Hoque, Sonia Ferdous (2014). Asset-based poverty analysis in rural Bangladesh: A comparison of principal component analysis and fuzzy set theory (Working Paper No. 59). Retrieved from Sustainability Research Institute (SRI), University of Leeds, United Kingdom website:

https://www.see.leeds.ac.uk/fileadmin/Documents/research/sri/workingpapers/SRIPs-59.pdf

IZUMI Foundation (2013). Health care infrastructure. Retrieved from http://izumi.org/about/how-we-work/health-care-infrastructure/

Kumar, A., & Gupta, S. (2012). Health infrastructure in India: Critical analysis of policy gaps in the Indian healthcare delivery. Retrieved from Vivekananda International Foundation website: http://www.vifindia.org/sites/default/files/health-infrastructure-in-india-critical-analysis-of-policy-gaps-in-the-indian-healthcare-delivery.pdf

Kumari, R., & Raman, R. (2011). Inter-District disparity in health care facility and education: A case of Uttar Pradesh. *Journal of Education and Practice*, 2(1), 38-56.

Lyngdoh, Lasara M. (2015). Inter-State variations in rural healthcare infrastructure in North-East India. *The NEHU Journal*, 13(2), 31-48.

Mooi, E., & Sarstedt, M. (2011). *A concise guide to market research: The process, data, and methods using IBM SPSS statistics*. Heidelberg: Springer.

Nicoletti, G., Scarpetta, S., & Boylaud, O. (2000). Summary indicators of product market regulation with and extension to employment protection legislation (Working Paper No. 226). Retrieved from OECD, Economics Department website: https://www.oecd.org/eco/outlook/1880867.pdf]

OECD (2008). Handbook on constructing composite indicators: Methodology and user guide. Retrieved from https://www.oecd.org/std/42495745.pdf

Saikia, H. (2012). Regional inequality of social sector development in India. *Romanian Journal of Social Science*, 6(2), 73-90.

Saikia, H., & Bhattacharjee, D. (2011). Quantifying basic health care facilities in Assam: where do the districts stand? *Elixir Soc. Sci.*, 36(2011), 3476-3482.

Singh, N., & Gupta, K. (2013). Environmental attitude and ecological behaviour of Indian consumers. *Social Responsibility Journal*, 9(1), 4-18.

Subba Lakshmi, T., & Sahoo, Dukhabandhu (2013). Health infrastructure and health indicators: The case of Andhra Pradesh, India. *IOSR Journal of Humanities and Social Science*, 6(6), 22-29.

Samanta, Rajeeb (2015). Block level disparity in social development: A case study of Paschim Medinipur, West Bengal, India. *International Journal of Scientific Engineering and Research*, 3(4), 92-95.

Sepehrdoust, Hamid (2009). Health care analysis and regional disparities in different provinces of Iran. *Iranian Economic Review*, 14(24), 113-134.

Sharpe, A., & Andrews, B. (2012). An assessment of weighting methodologies for composite indicators: The case of the index of economic well-being (CSLS Research Report No. 2012-10). Retrieved from CSLS, Ontario website: http://www.csls.ca/reports/csls2012-10.pdf

Singh, A.K., & Kumra, V.K. (2016). Analysis of micro level disparities in healthcare infrastructure in Allahabad District, Uttar Pradesh, India. *The Journal of Bengal Geographe*r, 5(4), 37-50.

Economic and Statistical Advisor, Planning Department, Government of Haryana. (1997). Statistical abstract Haryana: 1995-96.

(1999) Statistical abstract Haryana: 1997-98.

(2002) Statistical abstract Haryana: 2000-01.

(2004) Statistical abstract Haryana: 2002-03.

(2007) Statistical abstract Haryana: 2005-06.

Department of Economic and Statistical Analysis, Haryana. (2009) Statistical abstract Haryana: 2007-08.

(2012) Statistical abstract Haryana: 2010-11.

(2014) Statistical abstract Haryana: 2012-13.

(2015) Statistical abstract Haryana: 2013-14.

(2016) Statistical abstract of Haryana: 2014-15.