1. J. A. Golandaj, RI and H. R. Channakki, FI attended the training programme on 'Capacity Building Workshop' on 'Research Proposal Development' during 5 -9 February, 2018 at IIPS, Mumbai organized by MoHFW, New Delhi.
2. On the eve of 50th year of Pattabhisheka of Pujya Dr. D. Veerendra Heggade as Dharmadhikari of Shrikshetra Dharmasthala, institute has organized felicitation to Dr. Rathnamala Desai, Prof. & Head, Department of Gynecology and Obstetrics, SDM Medical College and Hospital, Dharwad on 17-2-2018
3. Dr. Shriprasad H., Jt. Director, presented a paper 'An Assessment of hygiene knowledge imparting approach and Basic sanitation conditions at Government schools- A Study in Yadgiri District' at National conference organized by Department of Sociology, Karnatak University, Dharwad on 24.03.2018.
4. Javeed A. Golandaj, RI, attended and presented a paper on 'Home Deliveries in Karnataka: A District-level Analysis' by Jyoti S. Hallad, J. A. Golandaj and H. R. Channakki, in a workshop 'Health and Health Care Programmes in India: An Introspection' organized by CMDR, Dharwad on 26.03.2018.
5. Dr. Jyoti S. Hallad, Director and Dr. Shriprasad H. Jt. Director, attended and presented the work completed under AWP for the year 2017-18 and proposed studies for the year 2018-19 in the AWP meeting organized by the Ministry of Health & Family Welfare, Govt. of India, at New Delhi during 27 – 28 March, 2018.
6. A Compendium of studies conducted by PRCs during 2016-17 entitled "Emerging Issues in Maternal, Neonatal and Child Health in India", coordinated and compiled by our Centre was released by Mrs. Rajanesh Jain, Dy. Director General, MoHFW, GoI on 28.03.2018 at New Delhi. Following three research papers from our centre were published in the Compendium:
   - Neonatal Morbidities and treatment seeking behavior in rural North Karnataka – Javeed A. Golandaj, Mallikarjun S. Kampli and Jyoti S. Hallad
   - Rent Seeking Behaviour while getting maternal health care services in Bidar district, Karnataka – Jyoti S. Hallad, S. R. Vatavati, B. I. Pundappanavar and J. A. Golandaj
   - Childhood morbidity, treatment patterns and cost of treatment: A study in Hubli-Dharwad Slums, Karnataka – Rajarama K.E.T. and C. N. Noolvi
7. Prepared and submitted the proposal for 5th round of National Family Health Survey for Karnataka and Goa states. Dr. Jyoti S. Hallad, Director and Mr. B. I. Pundappanavar, RI presented Operational Plan and Technical proposal at IIPS, Mumbai on 21.06.2018
8. Dr. Jyoti S. Hallad as a Co-author published a paper 'They had to Go': Indian Older Adults' Experience of Rationalizing and Compensating the Absence of Migrant Children, in an International Journal 'Sustainability' – 11.06.2018.

Published by

Padma Vibhushana Dr. D. Veerendra Heggade Chair for Studies on Health & Demography

JSS INSTITUTE OF ECONOMIC RESEARCH

VIDYAGIRI, DHARWAD-580 004, KARNATAKA, INDIA

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A Special issue on the eve of Golden Jubilee celebration year of Pattabhisheka of Pujya Dr. D. Veerendra Heggade, Dharmadhikari, Shrikshetra Dharmasthala

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Foreword

I am extremely happy to release the special issue of IER Journal of Health and Demography, on the eve of Golden Jubilee Celebrations of Pattabhisheka of Pujya Dr. D. Veerendra Heggade as Dharmadhikari of Shri Kshetra Dharmasthala. The Journal is coming out regularly from JSS Institute of Economic Research (IER), since last four years with the blessings of Pujya Dr. D. Veerendra Heggade. The Journal has many useful information for the social science researchers. I wish that the Journal will continue its tempo in future years to come.

I congratulate the Editorial Board and pray Lord Manjunath Swamy to bless one and all.

Secretary
Janata Shikshana Samiti,
Vidyagiri, Dharwad
Karnataka

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ARTICLES

Understanding the structural changes in causes of death and age pattern of mortality in urban population of Tamil Nadu

B. K. Gulati*

Abstract

Cause of death information is very important for priority setting in public health. In India, only a few studies had been carried out to understand the dynamics of causes of death. Mortality trends by different causes of death for urban population of Tamil Nadu were estimated by using medical certification of cause of death (MCCD) data for 1990-2014 by calculating percentage of leading causes of death to total deaths by age and sex. Results showed that there had been structural changes in causes of death and age pattern of mortality indicating that epidemiological transition in urban population of Tamil Nadu is higher than India. The state must orient the health system towards prevention, screening, early intervention and new treatment modalities with the aim to reduce the disease burden.

Keywords: Cause of death, MCCD, mortality trend, proportion of leading causes of death, epidemiological transition

Introduction

Cause of death information is very important for priority setting in public health. To identify and monitor the rapidly changing disease and mortality pattern and achieve the health system needs, studying and reporting updated information on causes of death is essential. It reflects better picture of mortality and help in ascertaining whether current disease control efforts are adequate or not. The reliable cause specific death rate estimates are an essential input for planning, managing and monitoring the performance of health sector in all countries. Generating national estimates of causes of death by age, sex, and year requires a strategy and methodology to deal with this diverse set of data issues.

India does not have good quality data on health situation of its population particularly the rural population where three-fourth of its total population lives. Though MCCD is an important scheme for obtaining authentic and scientific information on causes of death, but this is limited to urban population only.

In India, only a few studies had been carried out to understand the dynamics of causes of death. Most of the studies are based on hospital records restricted to the urban areas and focused on causes of maternal and child deaths. Therefore, the present study was done to estimate the trends in mortality by different causes of death for the period from 1990 to 2014 and their relative contributions among different age groups by sex for urban population of Tamil Nadu.

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Tamil Nadu is the focus of this study for several reasons. As per the Census of India 2011, the population of Tamil Nadu is 7,21,38,958 comprising of 3,61,58,871 males and 3,59,80,087 females and it constitutes 5.96% of the India's total population. It ranks 7 among the States/UTs. The decadal growth has gone up from 11.70% in 1991-2001 to 15.60% in 2001-2011. The sex ratio has increased from 987 in 2001 to 995 in 2011. Population in the age group 0-6 has decreased from 72,35,160 (11.59%) in 2001 to 68,94,821 (9.56%) in 2011 (RGI, 2011).

Fertility is falling as the Total Fertility Rate (TFR) dropped from 3.9 in 1971 to 1.6 in 2016. Crude Birth Rate (CBR) has declined from 31.4 in 1971 to 15 in 2016. Crude Death Rate (CDR) has declined from 14.4 in 1971 to 6.4 in 2016. Infant mortality rate has declined from 113 in 1971 to 17 in 2016. During the period from 1971 to 2016 the percentage decline in IMR is the highest (85%) compared to CDR (56%) and CBR (52%) (RGI, 2009, 2016).

Life expectancies have risen from a low of 52.5/51.9 years (male/female) in 1971 to a high of 68.2/72.3 years (male/female) in 2009, indicating that the prevailing health and development conditions have supported the human survival. The increase in the average life of a male (15.7 years) was, however, slower than that of a female (20.4 years) (TN, 2016). As per recent data, life expectancy is 68.9 years of males and 73.5 years of females in 2016 (ICMR, PHFI and IHME, 2017).

Data and Methods

Medical Certification of Cause of Death (MCCD) reports for the years 1990 to 2014 is the main data source used in the study (RGI, 1990-2014). The MCCD under Civil Registration System was implemented in the states/union territories to provide data on the cause of death under the provisions of Registration of Births and Deaths (RBD) Act, 1969. However, it has only been implemented in certain hospitals, generally in urban areas which are selected by the Chief Registrar of Births and Deaths. Thus, the scheme covers mostly those deaths, which occur in medical institutions located in urban areas. Some of the states have notified only teaching and specialised hospitals under it, whereas in others, only district hospitals and Primary Health Centres are under its ambit. Under the scheme, the Office of the Registrar General, India (ORGI) obtains data on medically certified deaths as collected, compiled and tabulated by the Offices of the Chief Registrars of Births and Deaths of the States/UTs. It has been operational in the country, but with varying levels of efficiency across the States/Union Territories. The percentage of medically certified deaths to total registered deaths during 2014 was 20.5% for India.

Data derived from MCCD is tabulated in conformity with the International Classification of Diseases (ICD) - Tenth Revision (1993) (WHO, 1993). It has been adopted in the Office of the Registrar

General, India (ORGI) for classification of causes of death since MCCD 1999 report. The statistics on medically certified causes of deaths is being tabulated as per the National List (ICD –10, modified according to Indian conditions). The underlying cause of death is taken into account while tabulating the cause-specific mortality (RGI, 1995). The MCCD data is collected according to ICD-9 classification from 1990 to 1998 and ICD-10 classification from 1999 to 2014. Detailed information is available elsewhere (Gulati, 2015).

In Tamil Nadu, the scheme was introduced in 7 selected Municipalities and Chennai Corporation during 1969 and later it was extended to all Municipalities and Corporations from 1980. To improve Medical Certification of Cause of Death, regular trainings are given to doctors every year. According to MCCD report, 2014, Tamil Nadu retained the 15th rank, among 33 states on the basis of percentage of medically certified deaths to total registered deaths. Out of the 5,47,579 registered deaths during 2014, about 1,84,875 were medically certified (33.8%).

MCCD data contain a large number of deaths about which age is not stated, In order to evenly distribute the effect of these deaths, age not stated deaths were distributed in all stated age groups in proportion to total deaths in those age groups. This was done for all the years for all causes of deaths by age and sex. MCCD data by age and sex were clubbed into the age groups – 0-1 year, 1-4 years, 5-14 years, 15-24 years, 25-64 years, 65 years and above.

Percentage of each cause of death group to total deaths by age and sex was calculated. Eight leading causes of death groups were taken in order of percentages and remaining causes of death groups were clubbed into 'others' group for the years 1990-2014.

Results

Percentage contribution of leading cause of death in different age groups in urban population of Tamil Nadu have been calculated and presented in tables 1 to 6. Tables 1 and 2 present the leading causes of infant and child deaths during the period from 1990 to 2014.

The results reveal that “certain conditions originating in the perinatal period” contributed to 69.7% share of total male infant deaths in 1990 and this share rose to 88.8% in 2014. The second leading cause of deaths was “certain infectious and parasitic diseases” which contributed to 11.6% share in 1990 and this share declined to 1.4% in 2014. The third leading cause of death was “diseases of the respiratory system” with a contribution of 3.5% in 1990 and this share declined to 0.5% in 2014.

In case of female infants, “certain conditions originating in the perinatal period” contributed to 73.9% share in 1990, rose to 84.5% in 2014. The second leading cause of death was “certain infectious and parasitic diseases” which contributed to 9.6% share in 1990, declined to 1.7% in 2014. The third

leading cause of death was "diseases of the respiratory system" with a contribution of 2.8% in 1990, declined to 1.3% in 2014 (Table 1).

Table 1: Percentage contribution of leading causes of death among infants in the age group 0-1 year in urban Tamil Nadu, 1990-2014

Causes of death	Male							Female						
	1990	1994	1998	2002	2006	2010	2014	1990	1994	1998	2002	2006	2010	2014
Certain conditions originating in the perinatal period	69.7	69.8	69.6	76.0	75.5	85.5	88.8	73.9	74.4	67.7	76.7	72.7	84.0	84.5
Certain infectious and parasitic diseases	11.6	11.1	7.4	6.8	4.4	3.4	1.4	9.6	9.1	8.2	7.3	4.8	2.9	1.7
Diseases of the respiratory system	3.5	3.5	3.8	4.4	5.6	3.5	0.5	2.8	2.9	3.9	5.1	5.7	4.6	1.3
Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified	3.3	3.3	6.6	7.3	9.0	3.0	4.2	3.1	3.2	7.0	5.3	9.8	3.7	4.6
Congenital malformations, deformations and chromosomal abnormalities	3.2	3.2	4.1	0.5	0.2	0.2	0.1	3.3	3.1	4.4	0.8	0.4	0.5	0.1
Diseases of the nervous system	2.8	2.8	1.8	1.5	1.2	0.8	0.3	2.1	2.1	1.5	1.5	1.2	0.8	0.7
Diseases of the circulatory system	2.0	2.1	3.7	0.3	2.3	1.3	3.5	1.7	1.5	3.7	0.3	3.7	1.8	5.2
Endocrine, nutritional and metabolic diseases	1.9	2.5	1.2	0.6	0.3	0.3	0.1	1.8	2.3	1.3	0.9	0.3	0.3	0.2
Others	2.0	1.7	1.8	2.6	1.5	2.0	1.1	1.7	1.4	2.3	2.1	1.4	1.4	1.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(Source: RGI, 1990-2014)

Table 2: Percentage contribution of leading causes of death among children in the age group 1-4 years in urban Tamil Nadu, 1990-2014

Causes of death	Male							Female						
	1990	1994	1998	2002	2006	2010	2014	1990	1994	1998	2002	2006	2010	2014
Certain infectious and parasitic diseases	28.7	30.7	24.7	20.3	13.9	13.1	18.0	30.4	31.1	23.4	24.0	12.8	13.4	25.4
Endocrine, nutritional and metabolic diseases	15.8	12.8	6.1	2.8	0.5	3.0	0.2	18.9	15.4	6.2	0.9	0.7	1.2	0.1
Diseases of the nervous system	12.5	11.0	7.4	12.4	9.3	9.6	1.7	13.2	11.2	10.7	12.7	11.0	6.7	1.7
Diseases of the circulatory system	8.8	9.2	15.3	0.4	18.8	11.2	27.6	7.3	8.8	10.5	0.9	14.5	20.3	32.5
Injury, poisoning and certain other consequences of external causes	7.0	8.5	12.8	19.5	7.8	10.8	4.0	8.8	9.4	11.4	15.7	11.0	9.5	3.3
Diseases of the respiratory system	6.9	5.8	9.4	15.5	15.9	17.6	4.4	8.9	7.9	10.9	15.7	18.3	20.8	4.1

Injury, poisoning and certain other consequences of external causes	7.0	8.5	12.8	19.5	7.8	10.8	4.0	8.8	9.4	11.4	15.7	11.0	9.5	3.3
Diseases of the respiratory system	6.9	5.8	9.4	15.5	15.9	17.6	4.4	8.9	7.9	10.9	15.7	18.3	20.8	4.1
Congenital malformations, deformations and chromosomal abnormalities	6.0	5.9	1.7	1.2	0.2	0.7	0.3	4.0	5.2	1.5	2.2	0.0	0.7	0.0
Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified	5.4	6.1	15.0	17.5	28.6	23.0	41.8	3.4	4.7	19.3	20.1	23.4	21.2	30.6
Others	8.9	10.0	7.6	10.4	5.0	11.0	2.0	5.1	6.3	6.1	7.8	8.3	6.2	2.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(Source: RGI, 1990-2014)

In case of male children in 1-4 years age group, "certain infectious and parasitic diseases" contributed to 28.7% share in 1990, rose to 18% in 2014. The second leading cause of death was "endocrine, nutritional and metabolic diseases" which contributed to 15.8% share in 1990, declined to 0.2% in 2014. "Diseases of the nervous system" was the third leading cause of death with a share of 12.5% in 1990, declined to 1.7% in 2014.

In case of female children, "certain infectious and parasitic diseases" was the leading cause of death which contributed to 30.4% share in 1990, declined to 25.4% in 2014. The second leading cause of death was "endocrine, nutritional and metabolic diseases" which contributed to 18.9% share in 1990, declined to 0.1% in 2014. "Diseases of the nervous system" was the third leading cause of death with a share of 13.2% in 1990, declined to 1.7% in 2014.

In the year 2014, "diseases of the circulatory system" was the leading cause of death of both male and female children with share of 27.6% and 32.5% respectively (Table 2).

Table 3: Percentage contribution of leading causes of death among children in the age group 5-14 years in urban Tamil Nadu, 1990-2014

Causes of death	Male							Female						
	1990	1994	1998	2002	2006	2010	2014	1990	1994	1998	2002	2006	2010	2014
Certain infectious and parasitic diseases	33.7	23.8	15.6	14.6	14.2	14.4	13.6	18.9	21.4	15.0	15.0	12.9	11.4	15.7
Injury, poisoning and certain other consequences of external causes	17.8	21.2	24.3	33.7	13.8	26.0	10.6	26.2	23.8	30.5	33.3	19.5	25.8	8.3
Diseases of the nervous system	14.8	13.1	5.7	10.3	10.0	7.0	3.8	13.6	12.4	5.4	9.5	9.7	5.7	2.5
Diseases of the circulatory system	13.2	14.0	21.2	3.0	22.6	9.9	30.7	15.1	16.3	19.7	2.9	14.7	13.8	36.1

Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified	6.2	7.2	13.5	12.2	18.7	20.4	25.4	6.4	6.9	13.2	11.6	22.2	20.8	25.5
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	2.6	3.2	0.9	2.3	0.8	2.1	0.7	5.5	4.9	1.5	2.0	0.6	1.7	0.6
Diseases of the respiratory system	2.6	3.0	9.4	9.7	10.2	11.4	4.5	4.7	3.8	7.8	15.0	10.8	11.2	3.5
Neoplasms	2.5	3.7	2.7	5.5	2.0	2.3	3.7	3.0	1.4	0.7	3.6	3.2	2.4	2.1
Others	6.6	10.8	6.7	8.7	7.7	6.5	7.0	6.6	9.1	6.2	7.1	6.4	7.2	5.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(Source: RGI, 1990-2014)

Table 3 shows the percentage contribution of the leading cause of death in children in 5-14 years age group. In male children, the leading cause of death was "certain infectious and parasitic diseases" which contributed to 33.7% share in 1990, declined to 13.6% in 2014. "Injury, poisoning and certain other consequences of external causes" contributed to 17.8% share in 1990, declined to 10.6% in 2014. The third leading cause of death was "diseases of the nervous system" which contributed 14.8% share in 1990, declined to 3.8% in 2014.

In case of female children, "injury, poisoning and certain other consequences of external causes" was the leading cause of death with contribution of 26.2% share in 1990, declined to 8.3% in 2014. The second leading cause of death was "certain infectious and parasitic diseases" which contributed to 18.9% share in 1990, declined to 15.7% in 2014. The third leading cause of death was "diseases of the circulatory system" which contributed to 15.1% share in 1990, rose to 36.1% in 2014.

In the year 2014, "diseases of the circulatory system" was the leading cause of death of both male and female children with share of 30.7% and 36.1% respectively (Table 3).

Table 4: Percentage contribution of leading causes of death among youth in the age group 15-24 years in urban Tamil Nadu, 1990-2014

Causes of death	Male							Female						
	1990	1994	1998	2002	2006	2010	2014	1990	1994	1998	2002	2006	2010	2014
Injury, poisoning and certain other consequences of external causes	60.3	59.3	44.3	44.6	32.3	32.0	29.5	50.9	46.6	52.9	46.7	31.6	33.6	25.7
Certain infectious and parasitic diseases	8.5	8.6	9.4	9.7	8.3	9.8	4.7	10.4	7.6	8.0	9.7	12.6	12.2	5.0
Diseases of the circulatory system	8.2	9.9	20.2	16.3	15.4	16.7	29.2	12.4	20.0	14.0	14.6	14.2	11.0	31.5
Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified	7.0	6.4	12.2	9.8	23.8	23.7	23.3	7.9	8.1	9.5	11.6	25.7	23.2	20.5

Diseases of the digestive system	4.1	3.9	2.3	2.4	2.2	2.1	1.8	1.9	2.3	1.6	2.1	1.7	1.7	2.2
Diseases of the nervous system	3.5	3.3	2.1	3.5	4.6	2.6	2.1	2.7	2.4	1.8	2.6	2.6	2.6	1.6
Diseases of the respiratory system	2.3	2.1	4.5	7.2	7.3	7.4	2.4	2.4	2.7	3.3	5.0	4.1	6.2	3.8
Neoplasms	1.9	1.7	2.0	2.8	1.6	1.3	2.9	1.4	1.2	1.4	1.3	1.6	2.4	2.9
Others	4.2	4.8	3.0	3.7	4.5	4.4	4.1	10.0	9.1	7.5	6.4	5.9	7.1	6.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(Source: RGI, 1990-2014)

Table 4 shows the percentage contribution of leading cause of death in youth population of 15-24 years age group. In male youth, the leading cause of death was "injury, poisoning and certain other consequences of external causes" which contributed to 60.3% share in 1990, declined to 29.5% in 2014. The second leading cause of death was "certain infectious and parasitic diseases" which contributed to 8.5% deaths in 1990, declined to 4.7% in 2014. The third leading cause of death was "diseases of the circulatory system" which contributed to 8.2% deaths in 1990, rose to 29.2% in 2014.

In female youth, "injury, poisoning and certain other consequences of external causes" contributed to 50.9% share in 1990, declined to 25.7% in 2014. The second leading cause of death was "diseases of the circulatory system" which contributed to 12.4% share in 1990, rose to 31.5% in 2014. The third leading cause of death was "certain infectious and parasitic diseases" which contributed to 10.4% deaths in 1990, declined to 5.0% in 2014.

In the year 2014, "injury, poisoning and certain other consequences of external causes" was the leading cause of death of male with a share of 29.5% whereas in case of female, it was "diseases of the circulatory system" with a share of 31.5% (Table 4).

Table 5: Percentage contribution of leading causes of death among adults in the age group 25-64 years in urban Tamil Nadu, 1990-2014.

Causes of death	Male							Female						
	1990	1994	1998	2002	2006	2010	2014	1990	1994	1998	2002	2006	2010	2014
Diseases of the circulatory system	38.2	36.8	41.2	39.2	41.2	42.4	52.4	33.1	24.8	34.6	37.1	38.8	41.2	51.6
Injury, poisoning and certain other consequences of external causes	21.1	22.3	16.9	16.5	9.3	8.2	9.3	26.5	29.5	20.1	16.5	8.2	7.5	7.0
Certain infectious and parasitic diseases	11.2	11.3	9.9	8.5	7.9	8.0	5.1	8.6	9.3	9.1	7.7	7.8	7.0	5.9
Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified	7.7	7.6	12.3	10.4	17.8	18.1	17.0	6.9	7.6	12.6	9.2	17.4	17.0	14.9
Diseases of the digestive system	4.8	5.1	3.9	4.6	3.5	3.4	3.1	3.0	4.1	2.5	2.3	2.0	1.7	1.5
Neoplasms	3.7	3.5	4.4	4.2	3.7	3.1	2.6	4.1	4.3	6.6	7.5	7.1	6.6	5.0
Diseases of the respiratory system	3.2	3.1	4.4	5.9	6.7	7.9	3.0	2.9	3.3	4.5	5.4	6.3	7.5	3.1
Endocrine, nutritional and metabolic diseases	3.1	2.9	2.3	4.3	4.0	3.8	3.3	4.1	4.0	3.0	5.2	4.9	5.1	4.6
Others	7.0	7.4	4.7	6.4	5.9	5.1	4.2	10.8	13.1	7.0	9.1	7.5	6.4	6.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(Source: RGI, 1990-2014)

Table 5 illustrates the leading causes of death in adults in 25-64 years age group. "Diseases of the circulatory system" contributed to 38.2% share of adult male deaths in 1990, rose to 52.4% in 2014. The second leading cause of death was "injury, poisoning and certain other consequences of external causes" with a share of 21.1% in 1990, declined to 9.3% in 2014. The third leading cause of death was "certain infectious and parasitic diseases" which contributed to 11.2% deaths in 1990, declined to 5.1% in 2014.

"Diseases of the circulatory system" contributed to 33.1% share of adult female deaths in 1990, rose to 51.6% in 2014. The second leading cause of death was "injury, poisoning and certain other consequences of external causes" with a share of 26.5% in 1990, declined to 7.0% in 2014. The third leading cause of death was "certain infectious and parasitic diseases" which contributed to 8.6% deaths in 1990, declined to 5.9% in 2014.

In the year 2014, "diseases of the circulatory system" was the leading cause of death of both male and female adults with share of 52.4% and 51.6% respectively (Table 5).

Table 6: Percentage contribution of leading causes of death among elderly in the age group 65 years and above in urban Tamil Nadu, 1990-2014

Causes of death	Male							Female						
	1990	1994	1998	2002	2006	2010	2014	1990	1994	1998	2002	2006	2010	2014
Diseases of the circulatory system	37.4	33.9	49.2	50.7	46.5	49.3	53.3	32.7	31.2	48.6	52.3	48.0	51.8	52.2
Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified	33.1	36.3	20.8	14.6	23.2	21.5	26.5	41.7	36.5	22.8	15.7	24.5	21.9	29.0
Injury, poisoning and certain other consequences of external causes	4.8	5.0	3.7	3.7	2.5	2.9	2.7	5.4	5.8	3.2	3.0	1.9	2.2	2.0
Certain infectious and parasitic diseases	4.7	4.8	5.9	4.2	4.7	4.2	4.8	2.9	4.2	5.2	3.2	4.1	3.2	4.5
Diseases of the respiratory system	4.3	3.9	6.0	7.9	7.7	8.5	2.8	3.0	3.5	5.7	6.9	6.7	7.8	2.6
Endocrine, nutritional and metabolic diseases	3.3	3.4	2.8	6.2	4.7	4.8	3.3	3.9	3.9	3.1	6.4	5.1	5.0	3.6
Neoplasms	3.1	3.4	4.1	3.9	3.0	2.8	1.9	2.4	4.5	4.5	4.2	3.3	2.6	1.8
Diseases of the digestive system	3.0	3.0	2.2	2.0	1.7	1.4	1.0	2.3	2.8	1.4	1.5	1.2	0.9	0.7
Others	6.3	6.3	5.3	6.8	6.0	4.6	3.7	5.7	7.6	5.5	6.8	5.2	4.6	3.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(Source: RGI, 1990-2014)

Table 6 provides data on leading cause of death in elderly population in 65 years and above age group. "Diseases of the circulatory system" contributed to 37.4% share of elderly male deaths in 1990,

rose to 53.3% in 2014. The second leading cause of death was "injury, poisoning and certain other consequences of external causes" which contributed to 4.8% share in 1990, declined to 2.7% in 2014. The third leading cause of death was "certain infectious and parasitic diseases" which contributed to 4.7% deaths in 1990, rose to 4.8% in 2014.

"Diseases of the circulatory system" contributed to 32.7% share of elderly female deaths in 1990, rose to 52.2% in 2014. The second leading cause of death was "injury, poisoning and certain other consequences of external causes" which contributed to 5.4% share in 1990, declined to 2.0% in 2014. The third leading cause of death was "certain infectious and parasitic diseases" which contributed to 2.9% deaths in 1990, rose to 4.5% in 2014.

In the year 2014, "diseases of the circulatory system" was the leading cause of death of both male and female elderly with share of 53.3% and 52.2% respectively (Table 6).

Age Pattern of Mortality

Progression of mortality transition and its consequence on epidemiological transition is better understood by examining the changes in age pattern of mortality over time in terms of distribution of age at death. Table 7 shows the share of deaths as per broad age groups in the total population of Tamil Nadu. The percentage share of death in the below 14 years age group was 22.3% in 1991, stood at 5.2% in the year 2014. The death share of middle-age category (15–59 years) decreased from 35.7% in 1991 to 31% in 2014. The share of death for the age group 60 years and above was 42.0% in 1991, increased substantially to 63.8% in the year 2014 (RGI, 1991-2014).

Table 7: Percentage share of deaths by broad age groups in Tamil Nadu (1991-2014)

Age (in years)	Year						
	1991	1994	1998	2002	2006	2010	2014
0-1	13.5	14.2	12.0	10.7	8.0	5.0	4.2
1-4	4.5	3.5	2.0	1.5	1.5	0.9	0.3
5-14	4.3	3.2	1.5	1.8	1.5	1.0	0.7
15-59	35.7	34.0	34.6	34.5	33.7	32.4	31.0
60 & above	42.0	45.1	50.0	51.0	55.3	60.7	63.8
Total	100.0	100.0	100.1	99.9	100.0	100.0	100.0

(Source: RGI, 1991-2014)

A further break-up of the below 14 years age group shows that the share of infant deaths reduced from 13.5% in 1991 to 4.2% in the year 2014. The share of child death fell from 4.5% to 0.3% and share of 5–14 years category fell from 4.3% to 0.7% in that period. The overall reduction in below

14 years mortality during the period was 76.7%, with the fall being 93.3% in the age group 1–4 years, 68.8% in those below 1 year and 83.7% in children between 5-14 years. For the same period, there was 13.2% decrease in mortality in the adult population of 15–59 years age group. Mortality in the oldest age group of 60 years and above increased by 52% (RGI, 1991-2014).

Discussion

This study examined the structural changes in the causes of death and the age pattern of mortality in urban population of Tamil Nadu.

"Certain conditions originating in the perinatal period" were the leading cause of death of both male and female infants during 1990-2014. "Certain infectious and parasitic diseases" were the leading cause of death of male and female children of 1-4 years age group during 1990-2002. "Diseases of the circulatory system" were the leading cause of death of male children in 2006. "Diseases of the respiratory system" were the leading cause of death of female children in 2006. "Diseases of the respiratory system" were the leading cause of death of both male and female children in 2010. "Diseases of the circulatory system" were the leading cause of death of both male and female children in 2014. "Certain infectious and parasitic diseases" were the leading cause of death of male children of 5-14 years age group in 1990 and 1994. "Injury, poisoning and certain other consequences of external causes" were the leading cause of death during 1998-2010; and "diseases of the circulatory system" in 2006. "Injury, poisoning and certain other consequences of external causes" were the leading cause of death of female children of 5-14 years age group in 1990-2010; and "diseases of the circulatory system" in 2014. "Injury, poisoning and certain other consequences of external causes" were the leading cause of death of male youth of 15-24 years age group during the entire period i.e. 1990-2014. These were also the leading cause of death of female youth of 15-24 years age group during 1990-2010; and "diseases of the circulatory system" in 2014. "Diseases of the circulatory system" were the leading cause of death of male adults of 25-64 years age group during 1990-2014. These were also the leading cause of death of female adults of 25-64 years age group in 1990, during 1998-2014; and "injury, poisoning and certain other consequences of external causes" in 1994. In the elderly population in 65 years and above age group, "diseases of the circulatory system" were the leading causes of death of both male and female during the entire period i.e., 1990-2014.

Analysis of all age urban population of Tamil Nadu shows that there has been shift in the structure of mortality by cause. Diseases of the circulatory system which contributed to 25.9% share of overall mortality in 1990, contributed to 48.8% share in 2014 and become the first leading cause of mortality. Injury, poisoning and certain other consequences of external causes which was the next important cause of mortality in 1990 and contributed 18.4% share in overall mortality remained the

second leading cause of mortality with contribution of 6% in 2014. The share of endocrine, nutritional and metabolic diseases to overall mortality increased from 3.2% in 1990 to 3.3% in 2014; share of diseases of the genitourinary system from 2.2% to 2.3%; and symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified from 11.2% to 21.1%. The share of certain infectious and parasitic diseases to overall mortality decreased from 10.4% in 1990 to 5.1% in 2014; neoplasms from 2.7% to 2.5%; diseases of blood and blood forming organs and certain disorders involving the immune mechanism from 1.2% to 0.4%; mental disorders from 0.3% to 0.1%; diseases of the nervous system from 2.7% to 1.0%; diseases of the respiratory system from 3.3% to 2.8%; diseases of the digestive system from 3.1% to 1.7%; pregnancy, childbirth and the puerperium from 1.1% to 0.1%; certain conditions originating in the perinatal period from 13.6% to 4.6% (RGI, 1990-2014).

It appears that "certain infectious and parasitic disease", "diseases of the circulatory system", "diseases of the respiratory system", "diseases of the digestive system", "diseases of the nervous system", "endocrine, nutritional and metabolic diseases" and "injury, poisoning and certain other consequences of external causes" were the most contributory causes of death groups in overall mortality of urban population of Tamil Nadu. Except for respiratory diseases and certain infectious diseases, these groups belong to non-communicable diseases. "Diseases of the respiratory system" includes both communicable and non-communicable diseases. "Certain infectious and parasitic diseases" mostly includes communicable diseases. "Injury, poisoning and certain other consequences of external causes" is often called an external cause of mortality.

There has been reduction of child share in total mortality and increase in elderly share indicating that Tamil Nadu's epidemiological transition has been marked by major changes in the age structure of mortality. As a consequence, the age pattern of mortality had been transforming from U-shape to J-shape during the last two decades. Such mortality transition shows further reflection in disease pattern of deaths. As mortality tilts towards higher age groups, diseases of adults and elderly population emerge as the largest contributors of overall mortality and diseases of younger population take lower position.

The percentage of medically certified deaths to total registered deaths in urban Tamil Nadu was 13.1% in 2014. In the absence of quality cause of death data these results can become inputs for predicting current and future health care needs and possible changes in national health policy agenda and strengthening existing health system.

The classification of medically certified registered deaths by the causes of death indicates that the diseases of circulatory system were the leading causes of death accounting for 48.8% share which was above the national average of 31.6%. The proportion of deaths due to injury, poisoning and certain other consequences of external causes and certain conditions originating in the perinatal period appears

to be low in the state (6% and 4.6%) compared to the national average (7.1% and 7.2%). Similarly, the proportion of deaths due to certain infectious and parasitic diseases and diseases of the respiratory system are very low in the state (5.1% and 2.8% respectively) as compared to the national average (11.9% and 7.8% respectively) which showed that epidemiological transition in urban population of Tamil Nadu is higher than India. Mortality due to communicable diseases has declined substantially and non-communicable diseases and injuries are increasing contributing to overall disease burden. Tamil Nadu's health system therefore faces a dual challenge.

Several studies in the past have revealed that noncommunicable diseases account for a substantial proportion of disease burden in India (Sharma 2013; Upadhyay 2012; WHO, 2014). Recent data also suggests that communicable, maternal, neonatal and nutritional diseases account for 32.7%; non-communicable diseases 55.4% and injuries 11.9% of total disease burden in India in 2016. Whereas in Tamil Nadu, communicable, maternal, neonatal and nutritional diseases account for 20.4%; non-communicable diseases 65.3% and injuries 14.3% of total disease burden in 2016 (ICMR, PHFI and IHME, 2017). The results also align with the findings of studies undertaken in developing countries (Borkar, 2015; Gulati 2016; Gulliford, 2003; Huynen et al., 2005; Karar et al., 2009; Lozano et al., 2012).

Conclusion

In Tamil Nadu, double burden of disease poses challenges in improving the overall health status of the population. There is a need for better health information system management to improve the accuracy of estimates. The State must orient the health system towards prevention, screening, early intervention and new treatment modalities with the aim to reduce the disease burden. Surveillance of NCDs and their risk factors should also become an integral function of health systems.

Limitations of the study

The missing deaths or deaths that physicians were unable to code are classified under the cause of death group "symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified" in MCCD reports. Tamil Nadu reported a good percentage of deaths in this group in both male and female in all age groups during the reported period. Thus, individual errors in medical certification cannot be ignored completely. The cause of death profile of a population is dependent on changes in the health system, socio-economic and cultural factors, and political commitments which are not addressed in this study.

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PREVALENCE AND PATTERN OF CONSANGUINEOUS MARRIAGES IN KARNATAKA: NFHS-4 DATA

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INTRODUCTION:

Marriage is one of the important vital event and entry in to reproductive life in India. Prevalence and pattern of marriage varies across the states, regions and according to their religion and caste. Hindus of Northern India prohibit marriages between biological kin for approximately seven generations on male side and five generations on the female side (Kapadia 1958), where as South Indian Hindu families, particularly in the states of Andhra Pradesh, Karnataka and Tamil Nadu, strongly favour marriage between first cousins that is mother's brother's daughter and in Muslim families strongly favour first cousin father's side (Bittles, 2001, Rao, 1983, Rao et al; 1971). In Karnataka state, by analyzing 600 tribal households, Mutharayappa (1993) revealed that 77.3 percent of Jenukuruba tribe and 22.3 percent of Kadukruba tribe have consanguineous marriages and cross cousin marriages are preferred between both tribes. Consanguineous marriages are preferred in South Indian families because it is believed that consanguinity strengthens family ties and enforces family solidarity and provide better opportunities for the transmission of cultural values and cultural continuity (Sandridge et al 2010),further wife's parents prefer to have their daughter living near them and to enjoy the presence of their grand children and wealthy landlords may prefer to keep their property within the family (Bittles 2001; Hamamy and Bittles 2008).

Consanguineous comes from a Latin word meaning "of the same blood". A marriage is said to be Consanguineous when the union between two persons, genetically related, by descent, from a common ancestor (Centerwall and Chakravarti (1977), Bittles et al., 1985). The marriage relationship between husband and wife is either Uncle-Nice or Cross-Cousin/Parallel Cousin relation classified as consanguineous marriages.

The National Family Health Survey (NFHS-4) shows consanguineous marriages in India from Father Side and Mother Side 4.30, 4.31 percent respectively. Among the Indian States, from Father Side and Mother Side the percentage of consanguineous marriages are high in Andhra Pradesh (11.6%, 12.1%), Telangana (12.7%, 8.2%), Karnataka (9.1%, 13.1%) and Tamil Nadu (10.5%, 13.2%). Also second cousin marriages are high in Karnataka (1.2%) apart from Tamil Nadu (2.2%) (IIPS & CIF 2017) . By analyzing NFHS-1 data Bittles (2002) reveals that 29.7 percentages consanguineous marriages in Karnataka with mean coefficient of inbreeding (α) 0.0180 and it was 0.0212 in Andhra Pradesh.

Apart from large studies, micro study conducted by Mohin, M.S. et al,(2016) in Kalaburgi, Karnataka, with a small sample of 130 married couple revealed that prevalence of consanguineous marriages were

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more in Muslim families (54.05%) than Hindus (25%).Another study conducted by Bhagya Bhaskar et al, (2012) in Mangalore revealed that prevalence of Consanguineous marriages were more in Muslims (13.56 %) than Hindus (5.04%) with mean coefficient of inbreeding by religion was 0.0339 and it was highest in Christians (0.0625) and lower in Hindus (0.0357) and Muslims (0.0310).Recent study by Shrikant Kuntla et al., (2013) by using Indian Human Development survey (IHDS) 2005 data showed that prevalence of consanguineous marriages is more predominant in southern India and among socioeconomically disadvantageous groups. There are very few studies which focus on prevalence and pattern of consanguineous marriages by using large survey data (NFHS-4) which covers 20667 samples currently married women in Karnataka.

This study aims to find out a) Prevalence of consanguineous marriage by social determinants, b) Pattern of consanguineous marriage by religion and c) Consanguineous marriage on child survival in Karnataka.

Methods and Materials:

Data were collected from National Family Health Survey -4 (2015-16) for Karnataka state consisting of currently married women 20667.Detailed information has been collected from currently married women during survey about the relationship of husband before marriage as: first cousin on father's side, first cousin on mother's side, second cousin, uncle, other blood relatives, brother-in-law and other non blood relatives. As the frequency of first cousin and second cousin marriages are high, other relations grouped as "other" category for the present analysis. Prevalence of consanguineous marriages studied across social determinants and χ^2 test was used for establishing association. Patterns have been examined through religion and caste by calculating mean coefficient of inbreeding (α).The coefficient of inbreeding was calculated by formula $\alpha = \sum P_i F_i$ where P_i is the proportion of a certain type of consanguineous marriage and F_i is the coefficient of inbreeding of the type of consanguineous marriage. Coefficient of inbreeding for first cousin 0.625, second cousin 0.15625 was used and for "other" relation very low inbreeding coefficient .0038845 was used. (Bittles, 1994, 2001, Bhagya Bhaskar et al, 2012).

By analyzing children ever born (CEB) and children surviving (CS) data, child loss among consanguineous and non consanguineous marital relation has been calculated. Logit regression has been applied to find out child loss by marital relation with other social determinants.

Results:

The prevalence of consanguineous marriage among currently married women in Karnataka was 26.4 %. Percentage distribution of currently married women according to social determinants by marital

relationship is given in Table 1. Percentage of consanguineous marriage found to be high (37.6 %and 30.8%) among younger group, 15-24 years than other ages but the association between consanguineous and non consanguineous marriage among current age of women is not significant. Other social determinants such as Religion of head of household (χ^2=59.05, P<.001), education level of respondent women (χ^2 =64.76, P<.001), Place of residence (Education level of husband (χ^2 =27.22, P<.001) and wealth index (χ^2 =87.85, P<.001), shows signification with type of marital relation. Prevalence of consanguineous marriage is high among Hindus (27.4%) than Muslims (21.0%), and Christian (20.4%) in Karnataka. Further prevalence of consanguineous marriage is high among Rural women (27.5%) and among families with Poor, Poorest wealth index.

Consanguineous marriage relation among all currently married women in Karnataka (Table 2) found to be high with first cousin on mother's side (51.8%) and First cousin on father's side (37.0%). Small percentage of consanguineous marriages occurred with 'other blood relatives (6.1%)', and with 'second cousin (3.1%). Religion wise Muslim population (39.2%) had marriage relation first cousin on father's side more than Hindu (36.9%), and Christian (30.4%) where as first cousin on mother's side found to be around 50% among Hindu, Muslim and Christian women. Consanguineous marriage with other relations viz: second cousin, other blood relative, Uncle, brother-in-law found to be very less in Hindu, Muslim and Christian women.

Table 1: Background characteristics of currently married women by marriage relationship in Karnataka, NFHS-4 data

Background Characteristics	Marital relationship: Consanguinity			
	No	Yes	Total	
	n= 15209 (73.6)	n=5458 (26.4)	n=20667	Chi-square
Current Age of Women				
15-19	374(62.4)	225(37.6)	225 (4.1)	
20-24	1942(69.2)	865(30.8)	865(15.8)	
25-29	2891(72.3)	1105(27.7)	1105(20.2)	
30-34	2768(74.5)	945(25.5)	945(17.3)	
35-39	2735(75.3)	899(24.7)	899(16.5)	
40-44	2412(76.5)	743(23.5)	743(13.6)	
45-49	2087(75.5)	676(24.5)	676(12.4)	
Religion of Head of Household				
Hindu	12765(72.6)	4815(27.4)	17580(85.1)	
Muslim	2161 (79.0)	574(21.0)	2735(13.2)	
Christian	234 (79.6)	60(20.4)	294(1.4)	
Others	49(84.5)	9 (15.5)	58(0.3)	χ^2 =59.05**

Caste group				
Schedule Caste	12808(73.4)	4649 (26.6)	17457 (84.5)	
Schedule Tribe	832(74.4)	286 (5.2)	1118 (5.4)	
Others	4569(75.0)	523 (25.0)	2092 (10.1)	χ^2 =2.97 NS
Education level of respondent women				
Illiterate	4797(72.4)	1831(27.6)	6628(32.1)	
Primary	1989(72.2)	764(27.8)	2753(13.3)	
Secondary	7159(73.5)	2587(26.5)	9746(47.2)	
Higher	1264 (82.3)	276(17.9)	1540(7.5)	χ^2 =64.76**
Education level of Husband				
Illiterate	629(71.0)	257(29.0)	886(26.0)	
Primary Completed	355(69.5)	156(30.5)	511(15.0)	
Secondary Completed	1184(72.5)	449(27.5)	1633(47.9)	
Higher Sec. Completed	280(73.74)	100(26.3)	380(11.1)	χ^2 =10.33*
Place of Residence				
Urban	5161(75.9)	1641(24.1)	6802(32.9)	
Rural	10048(72.5)	3817(27.5)	13865(67.1)	χ^2 =27.22**
Wealth Index				
Poorest	989 (70.1)	422 (29.9)	1411 (6.8)	
Poor	3318(70.0)	1420(30.0)	4738(22.9)	
Middle	4672(73.0)	1724 (27.0)	6396(30.9)	
Richer	4115(75.8)	1312(24.2)	5427(26.3)	
Richest	2115(78.5)	580(21.5)	2695(13.0)	χ^2 =87.85**
NS=Not significant, *=p<.05 ** p<.001,				

Table: 2: Percent and number of **currently married women** with Consanguineous marriage relation by religion in Karnataka: NFHS-4 data

Marriage relation	Religion group			Total
	Hindu	Muslim	Christian	
First cousin on father's side	1776 (36.9)	225 (39.2)	21 (30.4)	2022(37.0)
First cousin on Mother's side	2497(51.9)	293(51.0)	35(50.8)	2825(51.8)
Second cousin	151(3.1)	16(2.8)	2(2.9)	169(3.1)
Other blood relative	292(6.1)	31(5.4)	8(11.7)	331(6.1)
Uncle	25(0.5)	6(1.0)	1(1.4)	32(0.6)
Brother in-law	41(0.9)	2(0.3)	1(1.4)	44(0.8)
Other non-blood relative	33(0.7)	1(0.2)	1(1.4)	35(0.6)
Total	4815(100.0)	574(100.0)	69(100.0)	5458(100.0)

To know the consanguineous marriage pattern, inbreeding coefficient was computed (Table 3). The mean coefficient of inbreeding was 0.0661. It was found highest in Christians (0.0771) and lower in Hindus (0.0661) and Muslims (0.0655).

Table :3: Coefficient of Inbreeding by religion in Karnataka:NFHS-4 data

Religion	First Cousin*	Second Cousin	Others**	Total	F
Hindu	4283(88.767)	151(3.130)	391(8.104)	4825(100.0)	0.0661
Muslim	518(90.244)	16(2.787)	40(6.969)	574(100.0)	0.0655
Christian	56(81.159)	2(2.899)	11(15.942)	69(100.0)	0.0711
Total	4857(88.826)	169(3.091)	442(8.083)	5468(100.0)	0.0661

*Includes First cousin on father's side or mother side, **Includes other blood relatives, Uncle, Brother-in-law and other non-blood relative

Research studies shows pregnancy outcome and child survival affected by consanguineous marriages and may affect child health with genetic deformities (Asha Bai et al., 1981; Bittles AH et al., 1987, Centerwall and Centerwall 1966, Devi, R.R.A et al, 1981, 1987). To understand child loss among consanguineous marriages, children ever born (CEB) and children surviving (CS) data has been analysed. Child loss (CL) has been calculated by taking difference between CEB and CS for currently married women who have delivered at least once in their reproductive life. This difference is '0" considered as women did not have child loss and other wise women experiences child loss. Table 4 shows 9.3 % of women with consanguineous marriage and 7.9% of non consanguineous women experienced at least one child loss during their reproductive life. More than 7% of women with consanguineous marriage lost one child and 1.6% with two and 0.6 % more than three children. Child loss is significantly higher among women with consanguineous relation than non consanguineous relation (χ^2=28.6063, P<.001).

Table:4: Child loss among currently married women with consanguineous relation in Karnataka, NFHS-4 data

Child Loss (CSE-CS)	Marriage relation: Consanguinity		Total
	No	Yes	
No	12579(93.1)	4391(90.7)	16970(92.5)
Yes	934 (7.9)	449(9.3)	1383(7.5)
28.6063, P<.001			

No loss	12579(93.1)	4391(90.7)	16970(92.5)
One child	772(5.7)	344(7.1)	1116(6.1)
Two children	117(0.9)	79(1.6)	196(1.1)
Three+	45 (0.3)	26 (0.6)	71 (0.3)
Total	13513(100.0)	4840(100.0)	18353(100.0)

To understand influence of social determinants and child loss, Logit regression has been used. The significant variables which are influencing marital relationship given in table 1 have been used as independent variables along with child loss (yes/no). The set of variables considered for regression analysis are: Education level of respondent women (EDU), Religion of Head of household (RHH), Wealth Index (WI), Place of residence (UR) and Child loss (CL). With these set of independent variables logit regression analysis has been carried out by considering consanguineous marriage (yes/no) as dependent variables with "yes" as reference category. The results of logit regression analysis are given in table 5. In the Logit regression, selection of variables and order of entry is important in determining the dependent variables. Hence forward method of entry of variables in to regression has been adopted in this research paper. Out of five selected variables, except Place of residence (UR), remaining four variables showed significant relation with consanguineous marriage and hence EDU,RHH, WI and CL variable used for entry in to regression equation. In the first step wealth index (WI), in the second step Religion of Head of household (RHH), in the third step Education level of women (EDU) and in the fourth step child loss (CL) has been added. Women with less education, belongs to Hindu religion, belongs to Poor and Poorest family, experienced consanguineous marital relation than their counter part. Women with consanguineous marriage were experiencing child loss 1.307 times more than women with non consanguineous marriage relationship (Table 5).

Table 5: Factors influencing Consanguineous marriage in Karnataka: Results of Logit regression analysis

Variables	Categories	B	S.E.	Exp(B)	95% C.I. for EXP(B)	
					Lower	Upper
Education level of respondent women (EDU)	No education			1.000		
	Primary	.061	.051	1.063	.961	1.175
	Secondary	.060	.039	1.061	.984	1.145
	Higher	-.365	.079	0.694**	.594	.811

Religion of Head of Household (RHH)	Hindu			1.000		
	Muslim	-.314	.051	0.731**	.662	.807
	Christian	-.339	.136	0.712	.545	.930
Wealth Index (WI)	Poorest			1.000		
	Poorer	.006	.067	1.006	.883	1.146
	Middle	-.129	.066	0.879	.772	1.000
	Richer	-.229	.069	0.795	.694	.911
	Richest	-.290	.081	0.748**	.639	.876
Child Loss (CL)	No loss			1.000		
	Yes loss	.268	.060	1.307**	1.162	1.471
Constant		-.880	.060	.415		
-2log likelihood=23675.226, Cox& Snell R^2=.009, β= -1.025, p<.0001						

Discussion:

In this study is based on data derived from a cross sectional survey (NFHS-4) focusing on health and family planning of women and marriage pattern in Indian states along with child health. The results in this study revealed that the prevalence of consanguineous marriages in Karnataka found to be 26.4%, which is high when compare to other states apart from Andhra Pradesh and Tamil Nadu. Studied carried out in India and Pakistan, by using national wide data (Bittles, A.H. et al., 1993, Husain and Bittles 2000), and other small sample study in Karnataka (Mohin M.S. et al., 2016, Nath et al., 2004) showed that pattern and prevalence of consanguinity is high among Muslims than Hindus.

In this study it was observed that prevalence of consanguineous marriages significantly high among Hindus followed by Muslims and Christians. Similar results are reported in Pondicherry (Verma et al, 1992) that high consanguinity among Hindus than Muslims. Observing marriage pattern by Religion, Muslim population had marriage relation first cousin on father's side more than Hindu and Christian in Karnataka. Analysis of NFHS-3 by Krishnamoorthy and Audinarayana (2001) also revealed that high proportion of Hindu women marrying first cousin from their mother's side than from their father side and parallel-cousin marriage is only among Muslims. The research carried out by Rao and Inbaraj (1977), Reddy (1992), showed that rate of consanguinity ranges from 20% to 60% with F=0.0267 to 0.0493. In this study in the coefficient of inbreeding by religion found to be 0.0661 which is high because of percentage of consanguineous marriages are high with First cousin and Second cousin relations. In Karnataka, the child loss found to be 1.37 times higher among consanguineous marriages than non consanguinity. It is evident that from the cross-sectional survey where the information collected about marriage relation by asking limited questions may not capture the influence of socio

economic determinants influencing consanguineous marriages. Hence it is very much essential to conduct special studies focusing on causes and consequences of consanguineous marriage in southern states.

One of the specific patterns of marriage in Karnataka state observed by NFHS data was high proportion of girls marrying their mother's brother's son than those marrying their father's sister's son. This pattern is changing with the current generation. Child loss due to consanguineous marriages found to be more than non consanguineous women, still parents perceive to celebrate their children's marriage with near relatives with a reasons: to avoid dowry and for economic reasons, job security (family profession).Necessary marriage counseling centers to be established to impart the knowledge about marriage relation and genetic deformities to younger generation.

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Persistent Intersectional Inequalities in the Prevalence of Childhood Stunting in India: Evidence from NFHS2005-06 and 2015-16

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Abstract

Social and economic identities have critical influence on placement, utilization and effectiveness of nutrition programmes in India. However, there is limited direct evidence to understand the magnitude and distributional incongruities in child anthropometric failure when these groups are cross-classified by their social and economic identities. Against this backdrop, this paper uses the National Family Health Survey (NFHS 2005-06 and 2015-16) data and adopts an intersectional perspective to examine inequalities in childhood stunting across mutually exclusive groups cross-classified by place of residence, social group affiliation and poverty status. Inequality measurement based on a group-analogue of Gini coefficient reveals that, despite reductions in stunting prevalence during 2005-06 and 2015-16, there is an increase in the magnitude of intersectional inequalities. In particular, intersectional groups involving SCST children display the worst prevalence levels. Multilevel logistic regressions also discern only very small attenuation effects in the odds of stunting for the deprived subgroups during 2005-06 and 2015-16.Overall, the results call for improving village level policy implementation with specific geo-targeting of communities with high proportion of SCST population.

1. Introduction

The intrinsic and instrumental relevance of nutritional well-being is widely acknowledgedboth from an individual "micro" and economic "macro" perspective (NITI Aayog, 2017; Grantham-McGregor et al, 2013; Black et al, 2013; Black et al, 2003). The National Nutrition Strategy of India emphasises onnutritional well-being as '*one of the most effective entry points for human development, poverty reduction and economic development, with high economic returns*' (NITI Aayog, 2017, p.6). Given the relevance, it is disconcerting to observe that every second child in India suffers from some form of anthropometric failure (stunting, wasting and/or underweight). In fact, the magnitude of the problem increases manifold because of a huge child population (121 million in 2015) that accounts for 18% share in the global under-five population (United Nations, 2017).

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Since 1970s, the Government of India has launched several policies and programmes,including the massive Integrated Child Development Services (ICDS) scheme,to achieve rapid improvements in nutrition outcomes. But, despite increasing efforts, reductions in anthropometric failure have been rather slow; one that has also failed to respond to the recent episodes of high economic growth of the country (Joe et al, 2016;Subramanyam et al, 2011). Persistent level of anthropometric failure is partly attributable to developmental disparities across individuals, households and communities and, in part is associated with poor coordination andeffectiveness of multi-sectoral policy efforts (Smith and Haddad, 2015;Bryce et al, 2008). These long-standing concerns have received a renewed emphasis under the recently launched Prime Minister's Overarching Scheme for Holistic Nourishment (*POSHAN Abhiyaan*). The POSHAN Abhiyaan calls for a broad-based implementation strategy based on multi-sectoral convergence and has set up ambitious policy targets that includes, among others, achieving reduction in stunting by at least 2 percentage points per annum such that it is reduced from 38% in 2016 (IIPS & ICF, 2017) to 25% by 2022.

The key to success in target achievement is in arriving at solutions to the historical challenges of socioeconomic marginalization that delimit effectiveness of policies and programmes (Mamgain& Diwakar, 2012;Thorat&Sadana, 2009). While policymaking takes cognizance of marginalized groups, particularly the poor and the backward communities (such as scheduled castes and tribes, SCST), but it is critical to adopt an intersectional perspective to understand the intricacies and barriers. It is observed that the interlocking nature of these group identities have significant implications as an interacting process whereby multiple axes of deprivation getcombined to aggravate the problem and intensify distributional inequalities (Joe et al, 2013;Majumdar & Subramanian, 2001).Against this backdrop, this paper uses the National Family Health Survey (NFHS) 2005-06 and 2015-16 data and adopts both index-based as well as econometric approaches to unravel the magnitude and direction of intersectional inequalities in stunting prevalence in India.

2. Data and Methods

The study is based on the data from two consecutive rounds of NFHS 2005-06 and 2015-16 (IIPS & ICF, 2017;IIPS & Macro International, 2007). NFHS 2005-06 and 2015-16 provides data for 51,555 and 259,627 children (under five years), respectively. After excluding dead children and missing information on child's age and anthropometric measures a final analytical sample of 48,084 (2005-06) and 236,446 (2015-16) children is used for the analysis. It is worth mentioning that for the first time, NFHS 2015-16 provides district level information and therefore sample size is substantially higher than NFHS 2005-06. However, in both the rounds, the coverage and sample size is state and nationally representative and therefore, shall not affect statistical inferences and comparisons. We follow the World Health Organization (WHO) child growth reference standards to categorize children as stunted

or severely stunted (WHO 2006).At household level, wealth index is taken as the proxy indicator for household's income. Further, households are categorised into scheduled castes (SC), scheduled tribes (ST), other backward classes (OBC) and others. Religious background is categorized as Hindu, Muslim and Others. Information on access to safe drinking water and improved sanitation facilities are also considered.Maternal covariates include, education, height, and body mass index (BMI). Maternal education was categorized in five levels: no schooling, primary, secondary, higher secondary, and college education. Maternal height is categorized as <145, 145-149.9, 150-154.9, 155-159.9, and 160+ cm. Maternal BMI is categorized as <18.5, 18.5-24.9, and 25+ kg/m^2.

For analysing intersectional inequalities we engage with important identities of poverty status (households in the lowest two wealth quintiles), social group affiliation and place of residence and cross-classify the population in eight mutually exclusive population sub-groups as follows: Rural-Poor-SCST (RPSCST), Rural-Non-Poor-SCST (RNPSCST), Rural-Poor-Others (RPO), Rural-Non-Poor-Others (RNPO), Urban-Poor-SCST (UPSCST), Urban-Non-Poor-SCST (UNPSCST), Urban-Poor-Others (UPO), Urban-Non-Poor-Others (UNPO).Information on stunting prevalence across intersectional groups is estimated and used for computation of intersectional inequalities.

A group analogue of Gini coefficient, G(s), is applied here to discern the magnitude of intersecting inequalities in stunting prevalence (Subramanian 2009).This method accords importance to population subgroups as per their population share. For a given set of intersectional groups j:(j= 1, …, K), G(s) could be computed as follows (Joe, 2014;Subramanian, 2009; Erreygers, 2009);

$$G(s) = \frac{2}{n^2 \mu_s} \sum_{j=1}^{k} n_j w_j \mu_{sj}; \text{ where, } w_j = \frac{n+1}{2} - \rho_j$$

where, n is the total population and n_j:(i=1, 2, . . . ,n_j) represents a given population in the j^{th} subgroup. μ_{sj}, denotesstunting prevalence in j^{th} subgroup and is represented by the vector $\mu^* = (\mu_{s1}, \mu_{s2} \ldots \mu_{sk})$. The subgroups j:(j= 1, …, K) are arranged in a non-increasing order of stunting prevalence ($\mu_{hj} \leq \mu_{hj+1}$, j = 1, …, K – 1) following whichw_j is obtained using the subgroup rank ρ_j as follows;2)

$$\rho_j = n_j + \frac{(n_{j+1} - n_j)}{2}$$

The index G(s) ranges between zero and one with a higher value denoting greater inequality in the distribution of stunting prevalence across intersectional groups. This indicator defines equality as a case when stunting prevalence of each intersectional group matches with the overall stunting prevalence thus yielding a value of G(s) = 0. We also present the group stunting profile (GSP) and group stunting Lorenz profile (GSLP) to provide visual representation of intersectional inequalities. When all the subgroups have stunting prevalence matching the overall national prevalence then GSP would be the straight line connecting the points 0 and the mean national prevalence. However, due to inequalities in stunting prevalence across intersectional groups the actual GSP may deviate from this line of equality. The GSLP can be interpreted along the lines of the Lorenz curve implying that the

farther the GSLP from the diagonal, greater is the magnitude of intersectional inequality. In analogous terms, G(ss) denotes group-analogue of Gini coefficient for severe stunting, group severe stunting profile (GSSP), GSSLP represents group severe stunting Lorenz profile.

Finally, to understand the independent and multivariate associations between the anthropometric failures and socioeconomic groups, we ran three-level (state, district and village) logistic regression models adjusting for state and cluster level random effects. To further the understanding, we also present regression estimates after adjusting the model for several demographic and socioeconomic correlates. For the regression model, child stunting (and underweight) is taken as the outcome variable, whereas intersectional groups, age, sex, wealth quintiles, social categories, religion and place of residence were explanatory variables.

3. Results

Stunting prevalence among children below 5 years in India was 48% in 2005-06 and 38.5% in 2015-16 thus displaying a reduction of about 1 percentage point per annum (Table 1). The burden of severe stunting reduced at a slower rate of about 0.7 percentage point per annum from 24% in 2005-06 to 16% to 2015-16. Significant disparities are evident across disadvantaged groups when cross-classified by place of residence, social group affiliations and poverty status. In 2015-16, rural areas have 1.3 times (1.5 times) higher prevalence of stunting (severe stunting) than urban areas. Similar ratio differentials are observed for SCST group where prevalence of stunting (severe stunting) is 1.2 times (1.3 times) higher than other social groups (non-SCST). Highest differentials are observed among poor and non-poor where the prevalence stunting and severe stunting among the disadvantaged group is 1.7 times (2.1 times) higher.

Table 1: Prevalence of stunting and severe stunting among Children (below 5 years) across intersectional groups, India 2006 and 2016

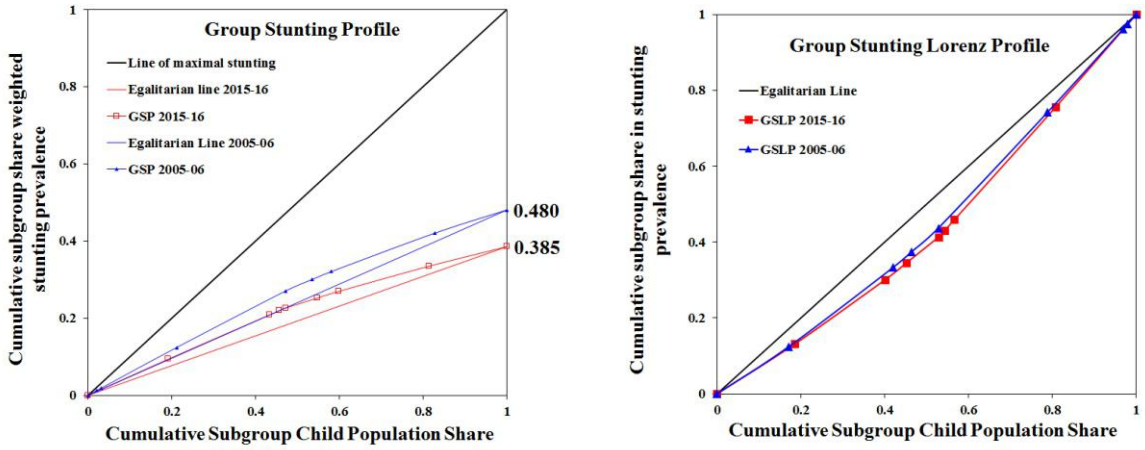
Unidimensional Groups	Stunting		Severe Stunting	
	2006	2016	2006	2016
Rural	50.7	41.2	25.7	17.9
Urban	39.9	31.0	17.7	11.9
SCST	54.0	43.1	28.2	19.2
Non-SCST	45.5	36.2	21.8	14.9
Poor	54.8	44.4	28.9	19.6
Non-Poor	34.2	26.1	12.9	9.3

Intersectional Groups				
RPSCST	58.4	49.0	32.3	23.3
RPO	47.0	34.3	22.4	12.7
RNPSCST	56.3	47.4	30.6	22.0
RNPO	40.3	30.3	16.6	10.7
UPSCST	59.2	45.6	35.8	20.8
UPO	45.1	33.6	17.8	12.9
UNPSCST	59.3	46.8	31.7	20.4
UNPO	34.9	27.3	14.9	10.0
All	**48.0**	**38.5**	**23.7**	**16.4**

Note: Rural-Poor-SCST (RPSCST), Rural-Non-Poor-SCST (RNPSCST), Rural-Poor-Others (RPO), Rural-Non-Poor-Others (RNPO), Urban-Poor-SCST (UPSCST), Urban-Non-Poor-SCST (UNPSCST), Urban-Poor-Others (UPO), Urban-Non-Poor-Others (UNPO)

Thegroup intersections reveal stark disparities in anthropometric well-being in India. In 2015-16, RPSCST group displays the highest prevalence of stunting (49%) which is 1.8 times higher than that of the most advantaged UNPO group (27%). With a ratio differential of 2.3, the disparities between RPSCST and UNPO is much worse in case of severe stunting. Irrespective of place of residence and poverty status, every second children in the intersectional groups involving SCST individuals is stunted and every fifth children is severely stunted.

Figure1: Group stunting profile, group Odds ratio of child stunting and severe stunting across intersectional groups, India 2006 and 2016



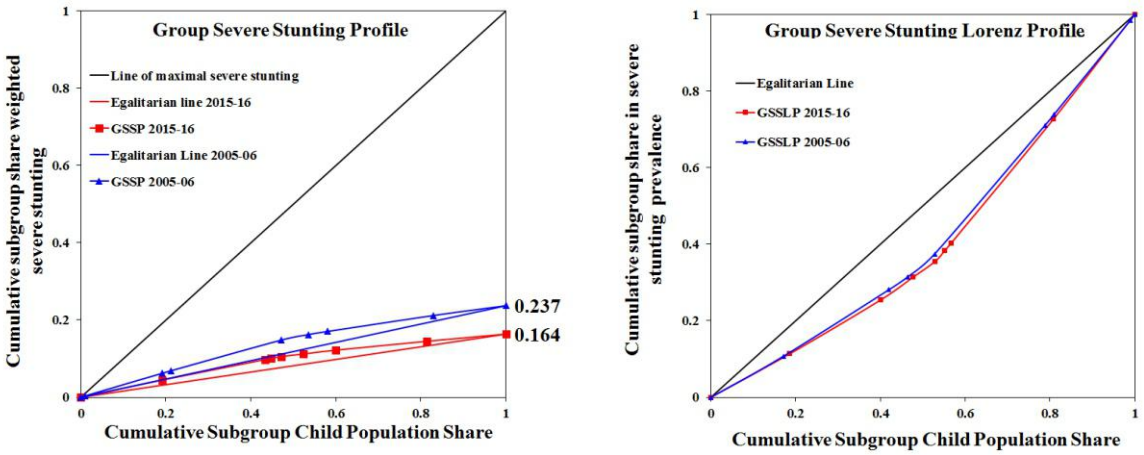


Figure 1 graphically displays the intersectional inequalities in the prevalence of stunting and severe stunting in India for 2005-06 and 2015-16. The diagonal of the GSP and the GSSP represents the line of maximal stunting and maximal severe stunting, respectively; i.e., the worst-case scenario of 100% prevalence across all intersectional groups. The national prevalence is, however, lower for both stunting and severe stunting. In both GSP and GSSP, zero intersectional inequality can be defined as a situation where all the intersectional groups have prevalence levels that is equal to the national prevalence. In such case, the line connecting the axis-origin and the national prevalence is the line of zero intersectional inequality. However, we find that the GSP and GSSP both are found above the line of zero inequality and indicate inequalities in prevalence of stunting and severe stunting across intersectional groups.

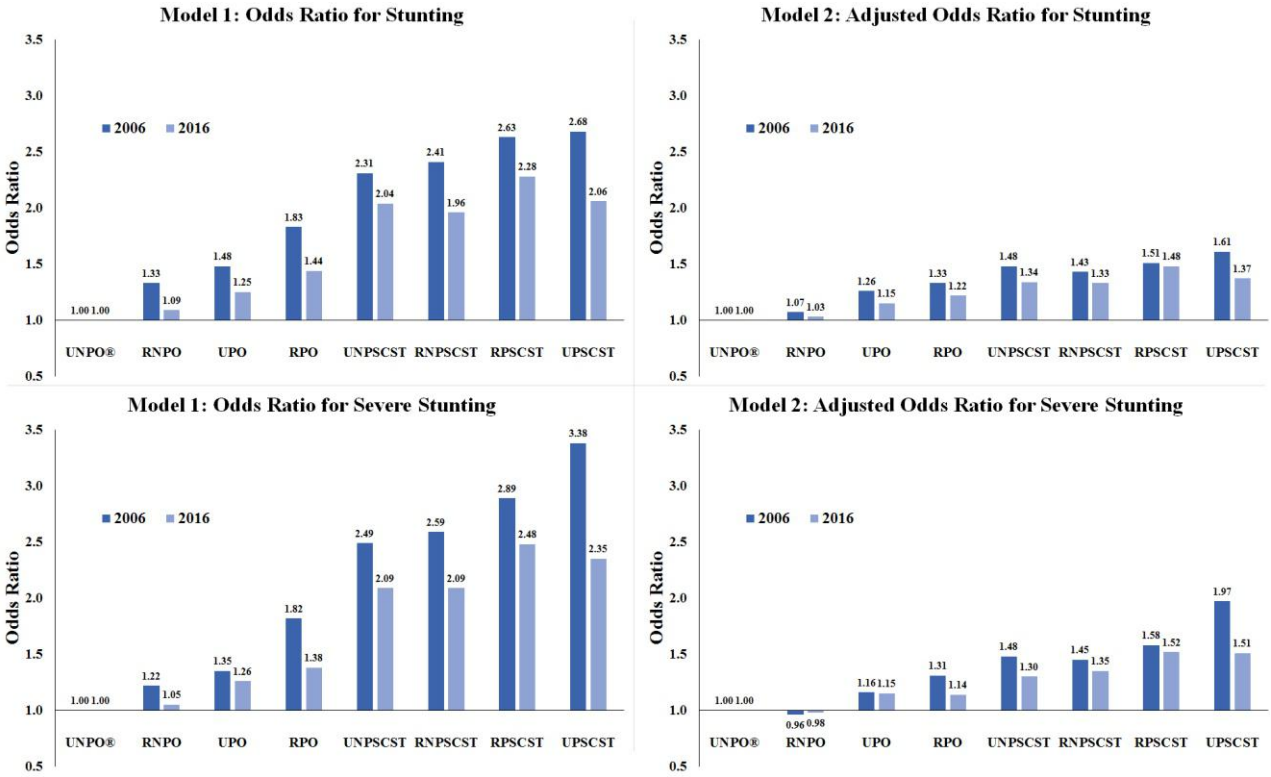
Table 2: Group-analogue of Gini coefficient values for child stunting and severe stunting across intersectional groups, India 2006 and 2016

Indicator	2006	2016
Stunting, G(s) value	0.105	0.122
95% CI	[0.100; 0.111]	[0.119; 0.125]
Severe Stunting, G(ss) value	0.171	0.183
95% CI	[0.161; 0.181]	[0.177; 0.188]

The group stunting Lorenz profile (GSLP) and group severe stunting Lorenz profile (GSSLP) reveal the magnitude of these intersectional inequalities. These are essentially a rescaled version of the GSP and GSSP, respectively. The outward shifts in both the GSLP and GSSLP in 2015-16 indicates that the

overall distributional inequalities in stunting and severe stunting has worsened since 2005-06. Table 2 presents the GSLP and GSSLP based group-analogue of Gini coefficients. In case of stunting the Gini coefficient, G(s), has increased from 0.105 (95% CI: 0.100; 0.111) to 0.122 (95% CI: 0.119; 0.125). Similarly, the Gini coefficient for severe stunting, G(ss), has increased from 0.171 (95% CI: 0.161; 0.181) to 0.183 (95% CI: 0.177; 0.188).

Figure2: Odds ratio of stunting and severe stunting across intersectional groups, India 2006 and 2016



Given the intersectional inequalities, it is critical to understand two issues: first, when compared with the best performer, whether the risk of stunting and severe stunting have reduced for other groups and; second, to what extent the risks are attenuated because of variations in demographic and socioeconomic factors across groups. For this purpose, multilevel logistic regression-based odds ratio is obtained from separate analysis for the years 2005-06 and 2015-16. Figure 2 presents the odds ratios of stunting and severe stunting for the intersectional groups during the two time periods and for both unadjusted (Model 1 with no other covariates) and adjusted models (Model 2 with demographic and socioeconomic covariates). It is apparent that intersectional groups involving children from SCST households are having the highest odds of anthropometric failure compared to the best performing

group of Urban-Non-Poor-Non-SCST (UNPO) children. The unadjusted model shows that RPSCST children are 2.28 times (95% CI: 2.20; 2.37) more likely to be stunted and 2.48 times (95% CI: 2.35; 2.62) more likely to be severely stunted than the UNPO group. Apparently, in 2005-06 the UPSCST group experienced the highest odds of both stunting and severe stunting.

The adjusted models also show that in 2015-16 the RPSCST children have the highest odds of stunting (OR 1.48, 95% CI: 1.42; 1.55) and severe stunting (OR 1.52, 95% CI: 1.43; 1.62) when compared to the advantaged group, UNPO. The odds of stunting and severe stunting among both RPSCST and UPSCST children is similar and indicates that place of residence *per se* has limited leveraging effect in terms of stunting outcomes across these intersectional groups. Overall, the unadjusted models reveal that there has been some attenuation in the odds of stunting between 2005-06 and 2015-16 but when adjusted for potential demographic and socioeconomic correlates the attenuation effects are rather trivial.

Finally, we report odds ratio for the various demographic and socioeconomic correlates included in the analysis (Table 3 and 4). The salient findings are as follows. Age of the child is a critical factor as the odds of stunting and severe stunting is considerably higher for those aged 2 years and above. Sex of the child displays no particular disadvantage in case of stunting but in case of severe stunting females are relatively advantaged. The odds of anthropometric failure show systematic disadvantage for children belonging to higher birth order. Muslim households are also more likely to experience both these adverse anthropometric outcomes. Access to safe sanitation facilities significantly reduces the risk of anthropometric failure. Most importantly, disadvantages in maternal height and education, are critical factors that elevate the risks of both stunting and severe stunting.

Table 3: Multilevel logistic regression-based odds ratio of child stunting prevalence across demographic and socioeconomic correlates, India 2006 and 2016

Characteristics	2006		2016	
	OR	95% CI	OR	95% CI
Group				
UNPO®	1.00	-	1.00	-
RPSCST	1.51***	[1.37;1.66]	1.48***	[1.42;1.55]
RPO	1.33***	[1.20;1.47]	1.22***	[1.16;1.28]
RNPSCST	1.43***	[1.31;1.56]	1.33***	[1.28;1.39]
RNPO	1.07	[1.00;1.16]	1.03	[0.99;1.07]
UPSCST	1.61***	[1.33;1.96]	1.37***	[1.26;1.49]
UPO	1.26***	[1.15;1.39]	1.15***	[1.09;1.21]
UNPSCST	1.48***	[1.27;1.73]	1.34***	[1.25;1.44]

Age Group				
0-5 months®	1.00	-	1.00	-
6-23 months	3.46***	[3.15;3.79]	2.49***	[2.39;2.59]
24 months and above	4.99***	[4.56;5.45]	3.18***	[3.06;3.31]
Sex				
Male®	1.00	-	1.00	-
Female	0.96	[0.92;1.00]	0.92	[0.90;0.94]
Religion				
Hindu®	1.00	-	1.00	-
Muslim	1.15***	[1.07;1.23]	1.16***	[1.12;1.20]
Others	0.99	[0.90;1.09]	0.96	[0.91;1.01]
Birth Order				
First®	1.00	-	1.00	-
Second	1.26***	[1.20;1.33]	1.12***	[1.09;1.14]
Third and above	1.37***	[1.27;1.47]	1.29***	[1.25;1.34]
Improved Sanitation Facility				
No®	1.00	-	1.00	-
Yes	0.82***	[0.77;0.87]	0.88***	[0.86;0.90]
Access to Safe Drinking Water				
No®	1.00	-	1.00	-
Yes	1.07***	[1.01;1.13]	1.08***	[1.05;1.11]
Mother's Height (in Cm.)				
160+®	1.00	-	1.00	-
155-159.9	1.45***	[1.31;1.60]	1.40***	[1.34;1.47]
150-154.9	2.04***	[1.86;2.24]	1.94***	[1.85;2.03]
145-149.9	2.80***	[2.55;3.08]	2.71***	[2.59;2.83]
> 145	4.04***	[3.62;4.50]	4.10***	[3.90;4.32]
Mother's BMI				
< 18.5®	1.00	-	1.00	-
18.5-25	0.81***	[0.78;0.85]	0.80***	[0.78;0.82]
> 25	0.64***	[0.59;0.70]	0.61***	[0.59;0.63]
Mother's Education				
Illiterate®	1.00	-	1.00	-
Primary	0.89***	[0.84;0.96]	0.92***	[0.89;0.95]
Secondary	0.76***	[0.71;0.80]	0.79***	[0.77;0.82]
Higher	0.57***	[0.51;0.63]	0.68***	[0.65;0.71]
College	0.42***	[0.37;0.47]	0.57***	[0.54;0.59]
Mother's Age				
15-20®	1.00	-	1.00	-
21-30	0.76***	[0.70;0.82]	0.93***	[0.89;0.97]
31-40	0.69***	[0.62;0.76]	0.84***	[0.80;0.88]
40 and above	0.80***	[0.66;0.97]	0.83***	[0.76;0.90]

Note: ® denotes the reference category. The three-level logistic random effects model adjusts for clustering at individual, primary sampling unit (PSU) and state level.

Table 4: Multilevel logistic regression-based odds ratio of severe stunting prevalence among children (below 5 years) across demographic and socioeconomic correlates, India 2006 and 2016

Characteristics	2006		2016	
	OR	95% CI	OR	95% CI
Group				
UNPO®				
RPSCST	1.58***	[1.41;1.77]	1.52***	[1.43;1.62]
RPO	1.31***	[1.15;1.48]	1.14***	[1.06;1.22]
RNPSCST	1.45***	[1.30;1.61]	1.35***	[1.27;1.43]
RNPO	0.96	[0.87;1.06]	0.98	[0.93;1.04]
UPSCST	1.97***	[1.60;2.43]	1.51***	[1.35;1.68]
UPO	1.16***	[1.03;1.31]	1.15***	[1.06;1.24]
UNPSCST	1.48***	[1.24;1.75]	1.30***	[1.19;1.43]
Age Group				
0-5 months®				
6-23 months	2.95***	[2.60;3.35]	2.01***	[1.91;2.13]
24 months and above	3.93***	[3.48;4.44]	2.07***	[1.97;2.18]
Sex				
Male®				
Female	0.93***	[0.88;0.97]	0.87***	[0.85;0.89]
Religion				
Hindu®				
Muslim	1.26***	[1.16;1.37]	1.17***	[1.12;1.22]
Others	1.02	[0.91;1.15]	1.00	[0.93;1.07]
Birth Order				
First®				
Second	1.30***	[1.21;1.39]	1.14***	[1.11;1.18]
Third and above	1.58***	[1.45;1.73]	1.35***	[1.29;1.41]
Improved Sanitation Facility				
No®				
Yes	0.82***	[0.76;0.88]	0.86***	[0.83;0.89]
Access to Safe Drinking Water				
No®				
Yes	0.97***	[0.91;1.04]	1.06***	[1.02;1.10]
Mother's Height (in Cm.)				
160+®				
155-159.9	1.44***	[1.25;1.65]	1.27***	[1.19;1.37]
150-154.9	1.89***	[1.66;2.15]	1.71***	[1.60;1.83]
145-149.9	2.56***	[2.24;2.91]	2.33***	[2.18;2.50]
> 145	3.61***	[3.14;4.16]	3.59***	[3.34;3.85]
Mother's BMI				
< 18.5®				
18.5-25	0.86***	[0.81;0.90]	0.83***	[0.81;0.86]
> 25	0.65***	[0.58;0.73]	0.60***	[0.57;0.63]

Mother's Education				
Illiterate®				
Primary	0.87***	[0.81;0.94]	0.85***	[0.82;0.89]
Secondary	0.68***	[0.63;0.73]	0.72***	[0.70;0.75]
Higher	0.52***	[0.45;0.60]	0.64***	[0.60;0.67]
College	0.33***	[0.28;0.40]	0.55***	[0.51;0.59]
Mother's Age				
15-20®				
21-30	0.70***	[0.63;0.76]	0.89***	[0.84;0.94]
31-40	0.62***	[0.55;0.69]	0.82***	[0.76;0.87]
40 and above	0.65***	[0.53;0.81]	0.78***	[0.70;0.87]

Note: ® denotes the reference category. The three-level logistic random effects model adjusts for clustering at individual, primary sampling unit (PSU) and state level.

4. Discussion and Conclusion

The three salient findings of our analysis are as follows. First, the national prevalence in stunting and severe stunting masksstrikingheterogeneity across intersectional groups identified along the dimension of social affiliations, poverty status and place of residence. In particular, the RPSCST and UPSCST children suffer the highest burden of chronic anthropometric failures. Second, although the prevalence of stunting and severe stunting has declined between 2005-06 and 2015-16 but we find an intensification of inequalities across these intersectional groups. This necessitates attention toward efforts to reach out to such marginalized groups forenhancing nutritional well-being. Finally, we observe that despite adjusting for demographic and socioeconomic correlates, there are only small attenuation effects in the likelihood of stunting among the intersectional groups, particularly the RPSCST group.

It is observed that intersectional groups involving SCST population have the highest prevalence as well as highest odds of stunting and severe stunting. This offers an important insight for geographical targeting of nutrition policies and programmes. Recently the Government of India has launched the Aspirational Districts Programme under which 115 districts are identified for focused human development initiatives (NITI Aayog, 2018). However, district officials and programme managers often lack sub-district level information for geo-targeting within districts, particularly across villages. In this regard, our findings suggest that prioritization of villages and wards with higher concentration of SCST population is an effective indicator for programmatic outreach.

To round up the discussion, the key policy implication of the study deserves a mention. Rapid improvements in childhood stunting requires concerted engagements with health and nutrition interventions in areas with high proportion of SCST population. In this regard, strengthening the

Integrated Child Development Services (ICDS) can becritical for accelerating the pace of nutritional improvements across such urban and rural communities. However, the performance of ICDS scheme has been found lacking on several fronts and it fails to demonstrate a definitive impact on child nutritional well-being (Jain, 2015;Kandpal, 2011;Lokshin et al, 2005).Furthermore, dismantling age-old social barriers and discriminatory social outlook in utilization of services under this universal programme can bring about the much-needed acceleration in reducing stunting prevalence (Mamgain& Diwakar, 2012;Thorat&Sadana,2009).Finally, policymaking should recognize the increasing health and nutrition requirements of the marginalized sections in urban areas.

In concluding, it is worthwhile to list the key limitations. First, the findings are based on two repeated cross-sectional household surveys hence it may be difficult to establish a causal relationship. Second, the categorization of poverty status is based on the asset-based wealth quintiles provided by NFHS and the results can be sensitive to the adopted strategy to define the poor household. Finally, the spatial density of SCST population varies considerably in India but this study does not attempt to explore these patterns across different states and union territories of India. However, none of these limitations are likely to alter the main conclusions of the study.

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Childhood Morbidity and Household Expenditure among Slum Dwellers: Reflections from twin city survey

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Introduction

Increase in the cost of health care service in India has been drawing the attention of the policy framers in recent years as nearly 80 percent of the health care service expenditure is borne by the patients. There is a sharp increase in the share of out of pocket spending to the household expenditure from 4 to 7 percent in the past two decades (Hoonda 2015a, 2017). On the other hand the share of health care spending of the poorest households is to the tune of 20 percent of the total expenditure of the households and a half of poor households spend more than 10 percent of the total household expenditure (Chowdari ,S. 2011). Further, per capita spending for availing the health care services is also speedily increased, it was around ten rupees per person in 2000 and increased to 75 rupees in 2012. This kind of high increase in health expenditure leading to catastrophic on part of the poor households in the context of poor enrolment of households under health insurance schemes as documented in some studies. This situation is forcing many households to reduce consumption of food and non food items and become poorer. Besides, overall, monthly average consumption level per individual reduced to 7.4 rupees as a result of high out of pocket expenditure. It is more in the case of BPL families compared to the non BPL families (Rs, 27.8 against Rs. 2.86)(Hoonda 2017). According to an estimation millions of Indians embrace poverty every year because of high spending on health (Balarajan et al 2011). Such people are more than 100 million when we considered the entire world (Tavashi S M, 2014).The reason for high OOPS is the Indian health system which is moving more towards privatization of health services. The last two health policies encouraged privatization of health services (MoHFW, 2017 & 2005). As a result, there is a rapid increase in the private health care providers in the past 20 years .The private health establishments are ten times more than the public health institutions in the country (10.67 lakh as against 1.96 lakh). Although government health institutions are increasing every year, existing hospitals are inadequate to meet the health demands of the growing population. In spite of good infrastructure, drugs, diagnostics and equipment are ensured in most of the government hospitals in order to cut down the OOPS as aimed by the National Health Mission (NHM) and to made easy access of the public health care facilities to the general public, almost all institutions are understaffed. Therefore, majority of patients both in-patient and out-patients and rural and urban health seekers are relied on private health care institutions (Hoonda, 2015a, MoHFW, 2017, RGI, 2011) in spite of the government hospitals are cost effective.

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Status of Child Health

Generally, the child health status is assessed by the level of neonatal, infant and child mortality, morbidity and nutrition level. Recent surveys and estimates have shown that under 5 mortality rate in India has been decreased from 118 deaths per 1000 live birth in 1990 to 47 deaths per 1000 live birth in 2013. According to NFHS-4, IMR and under five mortality rates in Karnataka are 28 and 32 respectively (MOHFW, 2015). Every year more than 2 million children die in India. Out of this, the share of neonate and infant deaths are high. Major causes of neonatal mortality in the country are: low birth weight, asphyxia, infection and hypothermia; whereas among infants and children infection like pneumonia, diarrhoea, measles, malaria and nutrition diseases and malnutrition are the predominant causes (Venkatachalam J, 2014). Diarrhoea and Acute Respiratory Infection (ARI) are the major causes of infant and child death in the country. The prevalence of such diseases is very much under control in Karnataka and in Dharwad district according to recent round of the National Family Health Survey.

Another important health issue of children in the country is malnutrition. Malnutrition and childhood morbidity are closely linked as malnutrition facilitates to get infection and infection contributes to increase malnutrition. Children who suffer from diarrhoea and ARI are nearly two times more malnourished than that of children without diarrhoea (Agarwal, 2014). India has the highest number of protein deficient malnourished children in the world which is visible in the form of decreased weight for age or height for age or weight for height. Global prevalence of Stunting and underweight in children below five years is 30 per cent and 17.8 per cent respectively. In India, 38 per cent of children below 5 years are stunted, 36 per cent are underweight and 21 percent are wasted. The corresponding rates in Karnataka are: stunted 36.2 percent wasted 26.1 percent and underweight 35.2 percent. Prevalence of anaemia among children is 60.9 percent in the state (MoHFW, 2015-16, NFHS) -4).The burden of death of children due poor diet related illness in Indian subcontinent is 3000 children per day (http: India food hungry). Malnutrition during first 3 years of life and low birth weight has immediate and far reaching effect on the life of the victims. It not only stunts children's physical growth, but also retards cognitive development, reduces immunity to fight against infection, hinders the proper eye development, increase the risk of heart disease, diabetes, obesity and high blood pressure when the child grows up. Study conducted in Karnataka established that physical and cognitive performance of well-nourished children is better than performance of their undernourished counterpart (Kumar, 2014).

Rationale of the study

The decennial Census data of 2011 indicates that the slum population in India has increased by 25 percent during 2001-11. Five percent population of Karnataka lives in slums and the child population

constitute 12.7 per cent of the total slum population. The increase in the slum population has mounted pressure on access to basic amenities like water, sanitation, drainage, garbage disposal, etc. This led to degrading state of public health and hygiene in the slums. Because of poor personal and environmental hygiene and poverty, the slum children are more vulnerable to verities of communicable diseases such as; diarrhoea, pneumonia, malaria etc. which are considered as a major factor behind the mortality of under 5 children. Besides, chronic illness like juvenile tuberculosis, asthma, jaundice etc. and developmental delays are contributing to increase the burden of childhood morbidity of slum children. The macro level studies provide state and national level scenario while micro level studies help the policy makers and programme managers to have in-depth knowledge on various dimensions of the subject under study. In this back drop, the current work has been taken up on the most vulnerable population of the community the slum children. It is important to know different types of morbid conditions among young children and various dimensions of cost of treatment.

Objectives:

1. To assess the prevalence of various childhood morbidity;
2. To know the cost of treatment of different diseases among below 5 years children.

Methodology:

The study was conducted in the slums of Hubli-Dharwad city. The city was selected deliberately. Fourteen out of 72 notified slums were selected using probability proportional to size (PPS) sampling method. The slums which have households above 300, if selected, was segmented into a number of smaller segments of about 100 – 120 households and for the survey purpose and 2 segments were randomly selected. Listing of all households was done in the selected segments and in the non-segmented selected slums. From the list, 36 households which had children below 5 years of age were selected using the systematic random method. One child was selected randomly from each selected household if the selected households had more than one child. Mother of the selected child was contacted for collecting the information. In all, 438 children's mothers were contacted and interviewed of the total selected 500 households. The number of children found below 5 years age in the interviewed households was 674. The fieldwork was carried out during August –December 2016.The semi-structured pre-tested schedule was constructed to collect information from the mothers or care giver of the child. The data was analyzed using Statistical Package for Social Sciences (SPSS) version 19. The present study attempted to give a comparative and aggregate picture of childhood morbidities in terms of prevalence, cost of treatment and man days lost for each categories of illness. The terms which we used in the text is defined below for the better understanding of the readers.

Profile of the surveyed slums

It is well recognized that health and housing and environments are closely related. Better the living and sanitation condition, better the health condition of the dwelling population. Almost all visited slums are either situated in the main residential area or adjacent to the city. Of the total 14 slums, 13 slums' inside roads are cemented or tarred. With respect to drainage, majority of slums have drainage facility, but the cleaning of drainages are not regular by the municipality workers. The waste things are thrown on the road side or in the drainage. Therefore these drainages are turned in to breeding grounds of mosquitos which facilitate the spread of water borne diseases. Community toilets are found less common but majority of the households have toilets. With respect to public transport, the slums which are away from the city have a frequent public transport facility. Invariably Anganwadi centres are found in all the study areas and availability of primary school is also fairly good. No health facility either government or private clinics do not exist in 6 slums. People have to travel 2-4 KMs to avail medical treatment in such slums. It is reported that ANM visits the slums only on immunization day whereas, ASHA's visit is regular. The common health problem in these regions are fever, malaria, tuberculosis, HIV/AIDS etc.

Socioeconomic Profiles of the Surveyed Households

The prevalence of morbidity, treatment patterns, and health behavior of people vary according to their socio-economic characteristics of households and individuals. The household characteristics are therefore of vital importance and it helps to increase our understanding of the subject under study in a more comprehensive manner.

Table 1 presents socioeconomic characteristics of the surveyed households. A vast majority of interviewed household belonged to Hindus (71 percent) and more than three-fourths belonged to unprivileged groups (SC/ST/OBC). The proportion of nuclear family is slightly higher when compared to the joint family in the study area. It is a common notion among the general public that people who live in slums have limited economic resources. Contrary to the general notion, the survey data show that average monthly income of the interviewed households is Rs. 18777.57 and more than 50 percent of households' monthly income is more than Rs. 10000. In contrast to the moderate monthly household income, 70 percent of the households are possessing the below poverty line card (BPL) and enjoy all its entitlements(annual household income of BPL families should not exceed Rs. 17000/-). Fifty-six percent of households do not have debts.

Table 1: Socio-economic characteristics of household

Religion	Percent	Family covered under health insurance	
Hindu	70.8	Yes	26.48
Muslim/Christian	29.2	No	69.63
Caste		DK	3.88
SC & ST	44.5	**Household possessions**	
OBC	33.1	Fan	89.04
General	22.4	Mixer/grinder	84.47
Type of family		Refrigerator	27.40
Nuclear family	39.7	Watch/clock	90.18
Joint family	38.4	Water filter	10.73
Other	21.9	Mobile/telephone	94.29
Monthly household income		Television	89.50
< Rs. 5000	10.27	Computer	5.48
Rs. 5000 - 9999	34.70	Sewing machine	31.05
Rs. 10000 -19000	35.39	Washing machine	8.22
Rs. 20000 Plus	18.72	Bicycle	12.56
Mean monthly income(Rs.)	18777.57	Motorcycle	53.20
Outstanding loan amount		Car	4.57
No loan	55.94	Cultivable land	10.50
< Rs. 50000	20.32	**Ownership of current house**	
> Rs. 50000	18.72	Own house	61.6
DK	5.02	Rented/rent free house	38.4

It is noticed that majority of the households possess modern gadgets like electric fan (89 percent), mixer grinder (84 percent), clock/watch (90 percent), mobile or telephone (94 per cent), Television (90 percent), motor cycle (53 percent). Little more than three-fifths of the households ownthe currently staying house.

Housing characteristics

Household amenities such as proper housing, electricity connection, safe drinking water, sanitation, and clean cooking fuel are not only important measures of the socio-economic status of the household, but is also essential to the health of the child as well as other members of the household. The pucca and semi-pucca structures together constitute 91 percent of the total dwelling units. With respect to the number of rooms in the houses, 37 percent of houses possess 2 rooms including kitchen

Table 2 Housing characteristics

Type of house	Percent	Source of lighting	Percent
Pucca	45.7	Electricity	96.8
Semi Pucca	45.7	Other	38.4
Kaccha	8.7	**Main fuel for cooking**	
No. of rooms		LPG	75.1
No exclusive/ 1 room	8.5	Other	24.9
2	37.0	**Use of toilet for defecation**	
3	29.2	Toilet	90.9
4+	24.8	Open space	9.1

Eighty-four percent of households have own tap either inside the house or in the yard. The households having electricity connection to their housing units are 97 percent. Majority of households are using clean fuel for cooking (liquefied petroleum gas/electricity/bio-gas) and using toilets (Table 2).

Demographic and social characteristics of index children

Table 3 presents demographic and social characteristics of surveyed children. The table indicates that male children are slightly more represented than their female counterparts (53 percent against 47 percent) in the survey. Age composition of the children tells that majority of children belonged 24 to 59 months age brackets. With regard to birth weight of the index children, 77 percent of children's birth weight was more than 2500 grams. Of the total, 270 eligible children for attending Anganwadi, 73 percent of them are attending.

Table 3: Demographic & health characteristics of index children

Age (in months)	Percent
0-11	15.10
12-23	23.10
24-59	61.90
Sex	
Male	52.70
Female	47.30
Birth Weight (in grams)	
< 2499	18.30
>2500	77.20
DK	4.60

Anganwadi attending status (>2 years children)	
Yes	73.33
No	26.67
N=270	

Childhood morbidity

The child morbidities are grouped in to three categories on the basis of duration of illness, type of infection and disability as communicable, non-communicable and developmental delay. The prevalence rate of morbidity of communicable diseases refers to a child of 0-4 years age fall sick in the past 30 days of the survey period per 100 children. Diarrhoea, fever and cold, vomiting, skin infection, worm infestation, measles and dental infections are reported under communicable illness in the survey. Similarly, prevalence of non-communicable illness refers to children who suffered from a disease more than 30 days during the past one year per 100 children. Jaundice, urinary tract infection, asthma, hernia, skin infection, tuberculosis, heart disease, ear discharge etc. are reported under chronic diseases. On the other hand the prevalence of developmental delay refers to the children who are showing slow performance in motor development, cognitive development, psychological or mental development corresponding to its age per 100 children. The lay report of the child's mother or care giver is the base for considering morbid condition of the index children.

Prevalence of childhood morbidity and socio-economic characteristics of household

Socio-economic characteristic of households is important as some diseases are more common among certain population sub groups and treatment pattern also varies according to the socio-economic characteristics of the household and population. Table 4 illustrates socio-economic differentials in childhood morbidity. Overall, 40.6 children for every 100 children suffered from one or the other illness in the study area. Sickness is found more among the children belonged to low monthly income households than their counterparts in better income households (Rs. 10000 or more). With regard to prevalence of morbidity among different social groups, it is more common among children belonged to general category. Sick children found relatively less among SC and ST and OBC households. It may be because the economic condition of these communities has improved especially in urban areas and in tern it might have affected on the health conditions of the groups. Regarding prevalence of child sickness between APL and BPL families, no significant difference is noticed.

The general morbidity pattern is that communicable diseases are more common among young

population because of the low immunity, poor hygiene practice and low nutritional level. The Table revels that 36.2 children for every 100 children in the studied area fell sick with one or the other episode of communicable disease during past 30 days. Non-communicable illness is defined as the diseases which are not generally infectious and duration of illness is more than 30 days during last one year prior to the survey. Compared to the prevalence of infectious illness rate, non-communicable disease rate is considerably low (5.9 per 100 children). Fever/cold/cough and epilepsy are the most frequently reported communicable and non-communicable illness respectively among the study subjects (Table not given).

With respect to socio-economic differentials of morbidity, both communicable and non-communicable diseases were found high among the children belonged to the low income households. The prevalence with respect to social groups, communicable illness are more common among children of OBC families whereas, non-communicable diseases is found high among the children of both SC & ST and OBC groups.

Table 4 Prevalence of morbidity and developmental delay among children by HH characteristics

Monthly household Income	Communicable	Non-communicable	Developmental delay	Total morbidity
Rs. less than 5000	43.42	10.53	5.26	51.32
Rs. 5000-9999	36.82	16.10	4.24	49.75
Rs. 10000-19999	35.41	7.39	2.27	40.86
Rs. 20000+	35.11	5.26	5.26	41.22
Social group				
SC & ST	34.98	7.16	1.86	41.80
OBC	41.40	6.51	3.26	43.26
General	32.35	4.41	2.94	52.21
BPL status				
BPL	35.66	7.38	1.84	44.67
Non-BPL	38.71	4.84	4.30	43.55
Total	**36.20**	**5.93**	**3.56**	**40.65**

The developmental delays (DD) are caused by various factors like genetics, care during pregnancy, during delivery and post-delivery. The growth of children during the first three years is important and

it should be monitored in order to identify mal developments for taking the appropriate action to arrest further deterioration and to improve the existing condition. Overall prevalence of DD is 3.6 for every 100 children. The significant differences in the prevalence of DD among the children of different income groups is not observed. Further, it is high among children belong to OBC group and non-BPL household. The emerging point from the table is that all the three types of illness found relatively high among children of OBC community.

Cost of treatment

Understanding the different dimension of cost of treatment is important in the context of rapid increase in the cost of medical treatment in recent years because it is resulting in increase in economic burden of the families. Due to increased economic burden many poor families either postpone the treatment or remain without treatment. Mainly two types of cost involved in the medical care namely, direct cost and indirect cost. Direct cost is the expenditure incurred by the patient or patient's family for the treatment of illness. It includes cost of medicine, consultation, diagnostics, transportation and food etc. On the other hand indirect cost of treatment includes wages lost by the father, mother, care giver and patient on account of ill health. The total cost of treatment in the study is nothing but the additions of direct and indirect costs incurred for treating the index child. We have considered only direct cost incurred on communicable and non-communicable diseases of the surveyed children by the households in Table 5. Overall, 25 percent of families sought treatment either at free of cost or managed the ailing child without providing medicine. This kind of behaviour found high among the high income bracket households (28%). Almost one-third of families have spent Rs. 201-500 for treating the child. The proportion of households spending Rs. 1000 or more is 9 percent; high spending families found more in high income group (14 percent).

With respect to the treatment cost borne by the households for communicable and non-communicable illness of the index children, households spent zero amount found more among children of suffered from non-communicable illness (55 percent) than their counterparts in communicable diseases (20 percent). Further, it is noticed that such behaviour is found more among the middle income group (Rs. 5000-9999) households for non-communicable diseases and found high among high income families for communicable diseases. Majority of families spent Rs. 201-500 for treatment of ailing children. It holds true both for communicable (35 percent) and non-communicable (16 percent) diseases. High spending (Rs 1000 or more) is noticed among high income families irrespective of type of illness. The emerging point from the Table is that parents spent money for children's health up to 1000 rupees

irrespective of their household income, if the cost of treatment is crossed 1000 rupees, majority of high income households only availed such services.

Table : 5 Treatment cost of diseases by monthly household income

Monthly household income	Amount spent on treatment					Total	N
	Free/not taken treatment	Rs. 200 or below	Rs. 201-500	Rs. 501-999	Rs. 1000+		
Communicable disease							
< 5000	9.09	21.21	48.48	15.15	6.06	100.00	33
5000-9999	16.67	34.72	25.00	11.11	12.50	100.00	72
10000-19000	23.08	15.38	42.86	10.99	7.69	100.00	91
20000+	26.09	19.57	26.09	15.22	13.04	100.00	46
Total	19.83	22.73	35.12	12.40	9.92	100.00	242
Non-communicable disease							
< 5000	37.50	12.50	25.00	25.00	0.00	100.00	8
5000-9999	63.16	15.79	5.26	10.53	5.26	100.00	19
10000-19000	53.85	7.69	23.08	7.69	7.69	100.00	13
20000+	50.00	0.00	25.00	0.00	25.00	100.00	4
Total	**54.55**	**11.36**	**15.91**	**11.36**	**6.82**	**100.00**	**44**
Total Expenditure of all disease							
< 5000	14.63	19.51	43.90	17.08	4.88	100.00	41
5000-9999	26.37	30.77	20.88	10.99	10.99	100.00	91
10000-19000	26.92	14.43	40.38	10.58	7.69	100.00	104
20000+	28.00	18.00	26.00	14.00	14.00	100.00	50
Total	**25.17**	**20.98**	**32.17**	**12.24**	**9.44**	**100.00**	**286**

Percentage Share of health expenditure of sick children to the monthly household income by monthly household income

It is important to know the extent of cost of burden of treatment of childhood morbidity on the households. We considered only medical expenditure incurred (direct cost) by the family on communicable and non-communicable diseases of the surveyed children. Table 6 presents data on Percentage share of health expenditure of children of 0-4 years of age to the household monthly income. Overall, 13 percent of households spent 10 or more percent of household income for the treatment of the index children. Majority of households spent 2 to 4.9 percent of household income on children's ill health. Almost similar pattern is observed for communicable and non-communicable

sickness. It is important to note that nearly 50 percent of households which come under low income bracket (Rs, 9999 or less) have spent 10 or more percent of their monthly income towards the child's treatment. It holds true irrespective of type of illness. It indicates that household health spending is high but not catastrophic (the threshold percentage to treat catastrophic spending is more than 30 percent of household income). The pattern of spending with respect to communicable illness, first two income group households spent more compared to the rest of the groups. However, no such pattern is noticed regarding non-communicable illness.

Table 6: Percentage share of total health expenditure of sick children below 5 years to the total monthly income by household income group

Monthly household income	No treatment/ free	Less than 2 percent	2 - 4.9 percent	5 - 9.9 percent	10 or more percent	Total
Communicable						
< 5000	9.09	0.00	27.27	30.30	33.33	33
5000-9999	16.67	13.89	40.28	12.50	16.67	72
10000-19000	23.08	24.18	39.56	7.69	5.49	91
20000+	26.09	32.61	23.91	6.52	10.87	46
Total	19.83	19.42	35.12	11.98	13.64	**242**
Non-communicable						
< 5000	37.50	0.00	25.00	0.00	37.50	8
5000-9999	63.12	5.26	15.79	5.26	10.53	19
10000-19000	53.85	15.38	15.38	7.69	7.69	13
20000+	50.00	0.00	50.00	0.00	0.00	4
Total	**54.55**	**6.82**	**20.45**	**4.55**	**13.64**	**44**
Combined						
< 5000	14.63	0.00	26.83	24.39	34.15	41
5000-9999	26.37	13.19	34.07	10.99	15.38	91
10000-19000	26.92	23.08	36.54	7.69	5.77	104
20000+	28.17	32.00	28.00	4.00	8.00	50
Total	**25.17**	**19.23**	**31.82**	**10.49**	**13.29**	**286**

Per capita child health expenditure

Per capita expenditure is a treatment cost per child among the children who are exposed to risk of morbidity. It includes direct as well as indirect cost incurred by the child's family on each child. It reflects economic burden of health of each child on the family. Per capita expenditure is computed by

adding all cost (direct and indirect) and the sum was divided by the total 0-4 year children in the surveyed households. The per capita expenditure by types of diseases is given in Table 7. The overall morbidity cost on each child is Rs. 1,484. The per capita direct cost (Rs. 1370.86) is much higher than the per capita indirect cost (Rs. 113.54). Considering the cost of treatment on each child by type of ailments shows that per capita expenditure made by the household on treatment of communicable diseases is the highest Rs. 802.43. The corresponding cost for non-communicable and developmental delays is almost same - Rs 333.43 and Rs. 348.53 respectively.

Table 7: Per capita child health expenditure

	Communicable	Non-communicable	Developmental Delay	Total
Percapita direct cost	755.93	294.41	320.52	1370.86
Percapita indirect cost	46.51	39.02	28.01	113.54
Per capita total cost	1370.859	113.54	1484.399	1484.4

Mean cost of treatment by socio-economic characteristics

Mean cost of treatment including direct and indirect cost for communicable, non-communicable and developmental delays are worked out separately and presented in Table 8. Overall mean cost of child treatment is Rs. 2071.44 in the studied slums. With respect to different social and economic groups are concerned, mean health expenditure of SC and ST groups is higher than the rest of the social groups. Among the different income groups, households belonged to monthly income Rs. 10000-19000 emerged as a highest spending group on treatment of children (Rs. 2824.75).

Coming to the disease wise mean cost, the highest expenditure is done for treating the developmental delays (Rs. 16779.29) and it is followed by non-communicable illness (Rs. 4161.70). This is because duration of illness these two types of illness is much more than the communicable diseases. Regarding overall mean cost of treatment among economic and social groups for different diseases - the highest mean expenditure is made by the households of general category for communicable illness. However, much difference is not observed among the different social groups, but large difference is noticed in the mean expenditure of communicable disease among the household income groups, it ranges between418 rupees to 1016 rupees.

Aggregate mean cost of non-communicable illness is Rs 4161.70. Large differentials with respect to social groups and household income group is observed in the mean expenditure of non-communicable illness. The least expenditure is incurred by general groups and households fall under high monthly

income household. It may be because of low prevalence of non-communicable illness in these communities. On the other hand the highest mean expenditure incurred by the OBC community and households which come under the monthly income group of Rs. Is 5000-9999.

Total mean cost of developmental delay is exorbitant Rs. 16779.29. Although prevalence of DD is only 3 percent the medical expenditure is very high this is because one child is having multiple disability and the family spent lakhs of rupees on treatment. If not considered this high expenditure while computing mean, mean cost of DD is minimum. Socio-economic differentials in mean cost is not high barring the highest expenditure of one group.

The direct mean cost of communicable, non-communicable and DD are Rs. 781.79, 4960 and 24003.33 respectively. With respect to differential of mean expenditure, all the three social groups spent more or less same amount for communicable illness whereas, expenditure pattern among different income groups is rather high. As far as the mean expenditure pattern for non-communicable diseases is concerned, wide differences are observed among the different socio-economic groups. The highest expenditure on direct cost is incurred by the high income households and the households belong to OBC group. Mean differential expenditure on direct cost is also noticed for DDs. Further it is noticed that low income households spent the lowest amount for treatment for all types of diseases among all the economic groups.

Table 8: Mean cost of childhood morbidity by socio-economic characteristics of households

Characteristics	Mean direct cost			Mean indirect cost			Mean total cost			Total
Monthly Household income	*Communicable*	*Noncommunicable*	*Developmental delay*	*Communicable*	*Noncommunicable*	*Developmental delay*	*Communicable*	*Noncommunicable*	*Developmental delay*	
< 5000	386.50	1582.50	550.00	537.50	1500.00	0.00	418.29	1555.00	550.00	685.57
5000-9999	1075.53	6531.59	1166.67	827.84	2000.00	600.00	1015.96	5349.43	1025.00	1956.58
10000-19000	586.31	1746.00	105000.00	565.85	400.00	8190.00	581.77	1623.64	56595.00	2824.75
20000+	912.31	14268.75	715.00	0.00	3200.00	950.00	912.31	10579.17	832.50	2194.13
Social group										
SC & ST	758.07	4798.76	42686.00	815.81	2081.25	4320.00	769.30	4049.10	25634.44	2953.55
OBC	742.49	7019.85	700.00	497.10	1812.50	1600.00	688.81	5794.59	925.00	1438.75
General	929.15	1066.67	500.00	755.00	1200.00	0.00	906.82	1100.00	500.00	930.54
BPL status										
APL	749.03	5619.10	35655.00	748.09	1869.23	4570.00	748.85	4511.18	23221.00	2468.67
APL	863.68	2693.33	700.00	475.64	2000.00	600.00	786.07	2624.00	675.00	999.58
Total	**781.79**	**4960.80**	**24003.33**	**666.94**	**1878.57**	**3776.00**	**759.57**	**4161.70**	**16779.29**	**207.44**

The average indirect cost for communicable illness is the lowest (Rs. 1878.57) and it is the highest for DD (Rs. 3776/-). It indicates that parents absent from economic activity for caring the sick child is less

in case of children suffered from communicable diseases. Usually communicable diseases present in the victims for a few days and subsides for timely medication. Therefore, care giver absent for economic activity is less. On the other hand, duration of illness of non-communicable diseases and DDs are much longer compared to communicable diseases, the victims suffer months and years together and sometimes lifelong.Therefore, parents had to be absent frequently from the economic activity for the child care and treatment. Differential in-direct cost found high among the different socio-economic groups.

Man-day lost

Man day lost refers to father, mother or care giver of the child who is economically active and could not engage 'n' number of days in earing activity due to ill health of index child. Table 9 illustrate the man day and mean man days lost by the care taker of the reference child due to various childhood illnesses. Overall, 74 persons lost 351 work days due to sickness of their child. Among the three categories of morbidity, majority of work days of the care giver of the sick child is lost due to communicable illness (219 day). The least man days lost is due to developmental delays (12 days) because parents might have not considered slow motor and cognitive development among their children seriously and hence many parents not taken them for treatment. Further, the Table reveals that little more than half of the total workdays lost are due to morbid condition relating to two diseases fever/cold/cough (135 days) and vomiting/diarrhoea/fever (51 days). Quite a good number of work days lost during 30 days period due to communicable diseases are a matter of serious concern as it has implications on household as well as national economy. Moreover this illness can be controlled by taking appropriate personal, household and community level hygiene and sanitation. From the point of view of good health of children and development the economy child hood diseases should be prevented by taking suitable measure.

Table 9: Man-day lost during child illness by parents

Communicable	**Total Man day lost**	**Mean man day lost**	**N**
Vomiting, Diarrhoea/fever	51	3.0	17
Cold & cough	19	2.4	8
Fever, cold & cough	135	6.4	21
Boils on skin	2	1.0	2
Measles	2	2.0	1
Typhoid	10	10.0	1
Total	**219**	**4.4**	**50**

Non-communicable			
Jaundice	23	7.7	3
Urinary problem	23	7.7	3
Fits	24	8.0	3
Hole in the heart	35	17.5	2
Ear discharge	7	7.0	1
Injury/fracture/burn	8	4.0	2
Total	**120**	**8.6**	**14**
Developmental delay			
Hearing impairment (>1 yr child)	1	1.0	1
Speech impairment (2-3 yrs)	4	1.3	3
Motor impairment (2 yrs)	3	1.5	2
Vision impairment	0	0.0	0
Mental retorted	2	1.0	2
Language delay	1	1.0	1
Learning delay	1	1.0	1
Total	**12**	**1.2**	**10**
Grand Total	**351**	**4.7**	**74**

Summary and Conclusion

The aim of the study was to understand the morbidity pattern and various dimensions of cost of treatment of slum children. The morbidity details of 438 children below 5 years were collected from mothers' of the selected children in 14 notified slums of Hubli-Dharwad city. Communicable illness found more common than the non-communicable sickness and developmental delays. Both communicable and non-communicable diseases were found high among the children belonged to the low income households.The prevalence with respect to social groups, communicable illness are more frequent among children of OBC families whereas, non-communicable diseases is found high among the children of both SC & ST and OBC groups. Overall, 25 percent of families sought treatment either at free of cost or managed the ailing child without providing medicine. Not availing treatment is more frequent for non-communicable illness. Majority of families have spent Rs. 201-500 for treating the child. It holds truth both for communicable and non-communicable diseases. Majority of households spent 2 to 4.9 percent of household income on children's ill health. Almost similar pattern is observed for infectious and non-infectious sickness. The study reveals that household health spending is high but not catastrophic. Overall per capita child treatment expenditure is 1,484 rupees. The per capita direct cost is much higher than the per capita indirect cost. Overall mean cost of child treatment is Rs. 2071.44

in the studied slums. Coming to the disease wise cost, the highest mean expenditure is made for treating the developmental delays and it is followed by non-communicable illness. Both direct and indirect mean cost also much higher for developmental delays. Overall, 74 persons lost 351 work days due to sickness of their child. Majority of work days of the care giver is lost due to communicable illness (219 day).

Morbidity is more frequent among children of socio-economically backward households. To reduce incidence of diseases, the environmental sanitation can be improved by placing sufficient quantity of garbage bins in the slums and ensuing regular disposal of garbage collected in the bins. The education on personal hygiene has to be given to the mothers in the community meetings. Although communicable diseases are much more common among young slum children, the cost of treatment for developmental delays and non-communicable diseases is many times high. To reduce such cost burden, government should open some treatment points at slums. Quite a good number of work days lost due to childhood illness is a matter of serious concern as it has implications on household as well as national economy. From the point of view of good health of children and development the economy childhood diseases should be prevented by taking suitable measure. It is noticed that many sick children were deprived of treatment. This kind of behaviour of parents should be addressed appropriately to check the further deterioration in the health condition of children.

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HEALTH INFRASTRUCTURE AND HEALTH ECONOMICS – A STUDY

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Abstract :*A study on health infrastructure and health economics is made in this paper. The term health infrastructure has risen to fame slowly but strongly in the economic literature during the last decade. Many consider this as a by-product of the growth of health economics as a discipline. Health economics itself is a relatively new subset of economics – about 30 years old – although its content and context is not confined to mainstream economics. Issues of health, including its economic dimension are being discussed and researched upon not only by economists but also by sociologist, anthropologists, biomedical scientists, nutritionists and others. Healthy discussions, affect/guide policy-making. We must acknowledge that quality healthcare is a fundamental right and not a privilege. This paper discusses health services both fromtheoretical and practical viewpoints. From the findings of the study we can infer that that is close relationship between economic development and health infrastructure and services.*

Keywords: Economics, health, infrastructure, gender, Shri Dharmasthala Manjunatheshwara

Introduction

While health is a state of mind, holistic and sustainable health in an individual and a community require strong institutional health. It is in this context that a study of structural and functional development of health infrastructure and services assumes significance.

Contemporary society considers not just income-earning but also spending (end-use) as a major determinant of the standard of living and happiness of the people. Spending on health as a necessary good is to be studied in depth, not just for personal gain but also for societal welfare and country's progress.

Health and ill-health is a problem being studied not just in biological sciences but also in social sciences. Low health status of a person is one of the most neglected forms of human deprivation and cause of socio-economic backwardness of individuals and communities, worldwide. Besides individuals considering health status and promotion as a basic need, even authorities such as governments, policy-makers, politicians, international agencies, service organisation consider health as a human right and index of a nation's development. Moreover, health has no geographical boundaries. Good health like good governance has to be present everywhere in the form of good food and nutrition, health and best practices, value orientation towards human dignity, child protection, and women empowerment, included. Thus, health is an inclusive problem for study and action.

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Research Problem

It is more than 30 years since the member states of the World Health Organisation made an ambitious commitment to a global strategy of "Health for All by 2000 A.D" (i.e. HFA Goal); health as a basic right, and to the principles of primary health care. In the background of the HFA goal, it is necessary to study the role played by the health services – its structure, system and delivery mechanism and impact – in India in the accomplishment of the tasks before us.

India no doubt produced the National Health Policy (NHP), 1983 followed by a number of health and health-related policies, programmes, institutions and organisations, personnel and programmes, but patients and other people are large in number, the demand for health services is ever-increasing. Imbalances in both curative and promotive health services are a bane in India in general and rural India in particular. Distributional aberrations between rural and urban areas, problems of access and equity are striking. Mismatch between personnel and patients, between medicines and cases referred for treatment is evident.

Surely all is not well. What perhaps is needed is a sharp focus on rural health services developed with a participatory approach, and quality monitoring. Social responsibility must be its base. Convergence of health and health services and products such as social security, population education, resource management etc., has to take place without delay. An alternative model of establishing linkages between health promoting-activities and income-generating activities is what we suggest here. This is the origin of the research problem here.

Interdisciplinary Relevance

Healthcare transcends the sphere of medicine per se to sociology, to economics and to political science. The failure of health services – development and delivery – in a country affects the physical quality of life of the people, their productivity, work efficiency, environment and livelihood as also the overall economic status of the individual and the community as a whole.

We cannot also overlook the correlation between health and factors such as nutritional levels, environmental conditions, social structures and situations etc. Societal culture – values and attitudes included – influence the choice of medicines or treatment predominantly in rural areas. Similar is the case with community support, e.g. rehabilitative health in case of HIV patients.

Medical and Para-medical health services have much to do with intellectual, legal and commercial (business) environment too. For instance, telemedicine makes us discuss e-marketing and hence technology in healthcare. So is the case with the laws pertaining to intellectual property rights (IPRs) and agreements for trade, e.g. General Agreements on Trade in Services (GATS). Another discipline that enables health promotion and development across regions and people is Statistics – the science of

numerical data. Data and information system and management go a long way in ensuring quick responses to needs of health in a recurring manner too.

Even in the developed countries like the USA, despite widespread acceptance of the competitive market model, the debate continues regarding the optimal form of competition. In a recent article in the Harvard Business Review, Michael Porter and Elizabeth Teisberg blamed "the wrong kinds of competition" for "making a mess of the American health care system" but remained hopeful that "the right kinds of competition can straighten it out. According to them, the problem is competition at the wrong level –

for example, among "health plans, networks, and hospital groups." The right kind of

competition is competition over the "prevention, diagnosis and treatment of specific diseases or combinations of conditions." If one set of providers offers superior care for acute myocardial infarction, then they should be rewarded with more business of that type, but there should be no presumption that other providers in the same organisation who read mammograms also are excellent. Porter and Teisberg's proposal is a clear rejection of the managed care model, in which a health plan serves as the consumer's agent to help address consumers' problems in the market for health care. Instead, their proposal finds common ground with advocates of high-deductible, consumer-driven health plans.

In several countries, health care services are provided by public and/or private subjects, and they are reimbursed by the government, on the basis of regulated prices (in most countries, diagnosis-related group). Providers take prices as given and compete on quality to attract patients. In some countries, regulated prices differ across regions. This paper focuses on the interdependence between regional regulators within a country: It studies how price setters of different regions interact, in a simple but realistic framework. Specifically, we model a circular city as divided in two administrative regions. Each region has two providers and one regulator, who sets the local price. Patients are mobile and make their choice on the basis of provider location and service quality. Interregional mobility occurs in the presence of asymmetries in providers' cost efficiency, regulated prices, and service quality.

Health Services

Like any other economic service, health service also has to be studies in terms of its market characteristics. Studies and policy action with regards to health – dealing with pricing patterns, cost, demand and supply, consumption preference and impact on human welfare etc. – possess international, national and local status or standing.

Health and human development in the changing global scenario have been linked vitally to evolving economic concepts of growth and development such as welfare, sustainable and human development,

marginalisation, inclusive growth, capability poverty, human poverty and so on. These permeate into rural health services as well. R. Feldman and B. Dowd found in their study (1991) that the magnitude of welfare gain from health insurance of $176 per family is dwarfed by a welfare loss that reacts, under one set of assumptions, as much as $795 per family. Empirical studies by Birdsell and Chuhan (1986), Musgrove (1983) and others also show that the demand for health services is more income-elastic in poorer developing countries (say, close to unity), than in the richer, industrial countries (say, between 0.1 and 0.3).

While in the international space, we need efforts to bridge the gap in services between the developed and least developed or developing countries, within the developing countries like India, the gap to be attended is that of rural-urban divide. Knowing and addressing the rural-urban divide or disparities needs more and more information and relevant research. A well-organised health services structure in the nation can hardly be over-emphasised. We also take note of inequality in the attainment of desired health status across gender. Gender inequality is a moral and social hazard in India. Apart from available evidences in India regarding poor reproductive health status among the women, we also observe increasing violence against women. Even disproportionate burden of hardship on women is a case of gender bias in health.

Health Economics

Economists have taken note of trade-offs between health and other goals. Most people want healthcare, only some don't care. They express their willingness to pay for the commodity healthcare. If health is wealth, healthcare is welfare. Attaining welfare is an economic end but the resources for it are relatively scarce with alternative uses and growth perspective – new ideas and innovations, in pharmaceutical sector for instance. Thus, health economics takes shape.

Health Economics for some is a 'branch' of economics. Health economics is a branch of economics concerned with issues related to efficiency, effectiveness, value and behaviour in the production and consumption of health and healthcare. . In 1958 Selma Mushkin defined health economics as the appraisal of the efficiency of the organisation of health services and the suggesting of ways of improving this organisation. Culyer who criticised this as 'narrow' definition defined health economics as “the discipline economics applied to the topic health”. He also warned that not all techniques of economic analysis are applicable to health. According to Lee and Mills, health economics is “the application of theories, concepts and techniques of economics to the health sector… concerned with the allocation of resources between health-promoting activities…the organisation and funding of health service institutions; the efficiency…and effects…on individuals and societies”. This is indeed a broad definition of health economics.

Health Economics is an applied field of study that allows for the systematic and rigorous examination of the problems faced in promoting health for all. By applying economic theories of consumer, producer and social choice, health economics aims to understand the behaviour of individuals, health care providers, public and private organisations, and governments in decision-making. Health economics is used to promote healthy lifestyles and positive health outcomes through the study of health care providers, hospitals and clinics, managed care and public health promotion activities.

While it is easy to say that health economics is application of economic principles to health, we must also know that (i) health and health care get redefined with every advancement in health science and engineering, and (ii) there are peculiarities of health goods/sector. The peculiarities (features of health economics as well) are as follows.

1. There is malfunctioning of market mechanism to achieve optimal allocation of resources.
2. Health sector is plagued by uncertainty (since illness/death is unpredictable) for both consumers and providers.
3. There is asymmetric information (knowledge gap) between patient and the physician. In Kannada there is an old saying, “Hosavaidhyaniginta hale rogiyemelu” (old patient is better than a new doctor).
4. There are externalities or spill-over effects (both favourable and unfavourable) involved in health goods.
5. In the provisioning of healthcare facilities, one may observe some sort of altruistic behaviour – behaviour that benefits others at some cost or risk – to oneself as opposed to Smith's notion of self-love of every economic agent.
6. Health is a multidimensional concept and practice. It includes consumption, investment, production, public, private, emotions, ethics, current utility, future utility (happiness?) etc.

The significance of the economic approach to health is as follows.

1. It enables the analysis and measurement of health and health related variables on the basis of different criteria.
2. Economics and econometrics make the concept of health to be 'objective', lending for valuation.
3. Being positive as well as a normative it offers useful guidance to health policy makers – need and outcomes of medicare (e.g. health insurance).
4. It inevitably graduates from health economics to health management – performance, systems, delivery and governance – demand managerial choices, strategies and decisions (e.g. Public-Private Partnership in healthcare financing, as in Sri Lanka, National Rural health Mission in India etc.).

Health economics not only generates new knowledge, it also guides action and monitors progress. The scope of health economics is wide. There are not one but many areas in health economics. One reason for that being the development of health at various levels. Doctor therefore, should not be impatient while studying the 'case' of a patient.

Health economics is overwhelmingly inductive in its methodology. Research in health and health related issues ought to be dealt with not only analytical tools of a behavioural science but with hands on experiences (exercises?) – therapy, medication, surgery, add-on services like tourism etc.

Policy (Practical) Issues:

If optimisation is an economic issue, immunisation is a practical issue. There are many such practical issues in health economics. Some of them are –

- Healthy Living in a Consumerist Society
- Public Health as a (still?) important element of basic precautionary measure
- The never complete health pyramid in countries like India (the bottom: PHCs reaching rock bottom in terms of efficiency)
- Invisible health services (health personnel?)
- Poor health funding/spending
- Traditional vs. Modern health care (neglect of indigenous = tribal) knowledge
- Challenges from HIV, new lifestyle diseases etc.
- Low Human Development in Vast majority of communities (low life expectancy, high CBR, IMR etc.)

Recent Trends:

- Supply-induced demand
- Increasing presence of media
- Revival of Indian System of Medicine -Yoga, Ayurveda, Homeopathy
- Religion and Health – a rejuvenation
- Medical Tourism, Telemedicine
- Hi-tech Hospitals and hospice

Areas for Research:

- Healthcare Market (e.g. incompatibility between users' wants and providers' services
- Evaluation of Health Programmes (e.g. cultural gaps between users and providers).
- Health Costs – a Comparative Study of Healthcare – preventive, curative etc. across regions – based on 'elasticities'
- Medicine Manufacture (Economics of the Pharama)
- Hospitals Competition

- Interrelationship of Perceptions of Health Consumers and Characteristics of Healthcare Services
- Agriculture, Food Security and Health (e.g. Health Status of APL/BPL families)
- Nutrition and Health – A Scrutiny of Influencing Factors; Case Studies, of Impact Factors, Household Studies on Health and Livelihood Security (e.g. focussing on accessibility, quality and affordability)
- Women and Child Health – age-specific and problem specific studies (e.g. Divergence of CBR and CDR, Health and Family Welfare, Health and Domestic Workers, Health and Child Labour etc. – policy-oriented research)
- Economics of Labour and Labour Productivity (new areas like Corporate Jobs and Human Health, Impact of Leisure on Health, Home-makers vis-à-vis Working Women's Health, Health of People in Knowledge Centres, Education and Health Health-housing, Political Philosophies and Health etc.)
- Investment Management and Health – Cross Section Analysis, Study of Performance Indicators and so on

Health Infrastructure and Services in India

The country suffers from inadequate health infrastructure. In spite of the three-tier system of rural health infrastructure the condition of rural health infrastructure has been deplorable. A Review of Rural Health Care Infrastructure Development by the Central Council of Health and Family Welfare revealed poor condition not only in the establishment but also in the amount of man power required (see Table 1). Even developed states have this agony (see Table 2).The failure of health services – development and delivery – in a country affects the physical quality of life of the people, their productivity, work efficiency, environment and livelihood as also the overall economic status of the individual and the community as a whole.

The Indian health system has a poor global ranking. A new perspective on health system and planning and development is required to improve the situation and build a system responsive to the needs of the country.

Table 1: Health Manpower

Service (per population)	Existing	Required
Primary Health Centres 1 per 20,000-30,000	22,842	**24,717**
Sub Centres 1 Per 3,000-5,000	137,311	**148,303**
Community Health Centres 1 Per 100,000	**3,043**	**7,415**

Source: Srinivasan, Sandhya (2005).

Table2: Health Infrastructure of Karnataka

Particulars	Required	In position	Shortfall
Sub-centre	9063	8871	192
Primary Health Centre	1445	2310	*
Community Health Centre	361	180	181
Health Worker (Female)/ANM at Sub Centres & PHCs	11181	11434	*
Health Worker (Male) at Sub Centres	8871	3148	5723
Health Assistant (Female)/LHV at PHCs	2310	1036	1274
Health Assistant (Male) at PHCs	2310	823	1487
Doctor at PHCs	2310	2089	221
Obstetricians & Gynaecologists at CHCs	180	175	5
Paediatricians at CHCs	180	95	85
Total specialists at CHCs	720	495	225
Radiographers at CHCs	180	172	8
Pharmacist at PHCs & CHCs	2490	2417	73
Laboratory Technicians at PHCs & CHCs	2490	1058	1432
Nursing Staff at PHCs & CHCs	3570	4978	*

Source: RHS Bulletin, March 2012, Ministry of Health and Family Welfare, GOI.

Two reasons are attributed to the return of many epidemics to Kerala, a state that had achieved developed-country status in all the major human development indices: erosion of the grassroots-level public healthcare system that once thrived on government support, and dysfunctional municipal systems that do not deal effectively with waste-disposal. It is not by accident that the most violent clashes in Kerala in recent times have been the Muthangaadivasi struggle in Wayanad and the communal flare-ups in coastal Maradu. Kerala's famed model of development left the tribal-dominated hills and the coastal fisher communities socially, politically and economically marginalised, leaving the coast clear for communal forces to enter.

Two years ago, UNICEF's vitamin A campaign in Assam caused the death of 30 children and sent over 1,000 to hospital with vitamin A toxicity. The larger question is whether such mass campaigns to combat malnutrition-related deficiencies in India are still required. Or do we need a more sustainable approach?

Orissa has the highest infant mortality rate in the country at 97 per 1,000 live births. Approximately 86,000 infants die in the state each year. Poor healthcare facilities for mother and child, malnutrition, malaria and lack of awareness are major contributing factors.

Do we have 2 million or 20 million HIV-positive in India? Or is there a plateauing of the epidemic? Speculative and alarmist figures about the number of Indians affected by HIV/AIDS have added to public confusion and affected the programme's credibility.

There are lakhs of people without sanitation. The problem, as the success of recent total-sanitation community projects have demonstrated, is not a lack of funds but a lack of conviction amongst people that they need sanitation, and that they can meet those needs themselves.

With only 407 doctors, inadequate sanitation and poor development indicators, Nagaland's people have limited access to quality healthcare.Forty thousand women die every year of childbirth and related complications in Uttar Pradesh, which has the highest maternal mortality rate in the world. Now, a tussle over where to buy dai kits has stalled their distribution to village midwives, putting more lives at risk. 'What services can a doctor provide without basic resources?'At the Rowmari state health dispensary in Bodoland, which caters to villages within an 8 km radius, there is no electricity, no anti-malarial drugs, no paper and pens even for birth and death certificates. The health facilities here are indicative of the state of all Bodo areas, which show shockingly high maternal and infant mortality rates. The country also needs to address the issue of doubtful drug trials.

The story of tuberculosis in India is the story of people with no right to food, employment, shelter or healthcare. No wonder the figures for TB haven't changed all that much in the last few years.

A review of various works on PHCs reveals that the services provided by PHCs are too weak.Further there is a serious lack of infrastructure. India has than one doctor per 1000 population (see Table 3); Medical Officers found to be mostly absent from their duties and when they are present, they merely involve in providing clinical services to the Patients. They lack managerial skills. Equipment is inadequate and often out of order, supply of drugs is irregular. Training is poor and lacks skill development, team building and motivational components. There is only 1 ambulance per 55000 people in India (see Table 4).

Table 3: Density of physicians (total number per 1000 population) in India, 1991-2016

Year	Physicians density (per 1000 population)
2016	0.758
2015	NA
2014	0.725
2013	NA
2012	0.699

2011	0.739
2010	0.663
2009	0.624
2008	0.615
2007	0.6
2006	0.587
2005	0.577
2004	0.573
2003	0.564
2002	0.557
2001	0.538
2000	0.527
1991	1.225

*NA Data Not Available, Source: WHO, 2018.

Table 4:Ambulances Operational under National Health Mission (NHM) [(as on Sept 2017) during 2017-18]

Sl. No.	State/UTs	Dial 108	Dial 102/104	Other patients transport vehicle (empaneled)	Total Ambulance under NHM
1	Bihar	10	799	44	853
2	Chhattisgarh	239	363	0	602
3	Himachal Pradesh	198	126	0	324
4	Jammu & Kashmir	0	331	0	331
5	Jharkhand	0	0	2581	2581
6	Madhya Pradesh	606	739	0	1345
7	Orissa	420	487	0	907
8	Rajasthan	713	586	0	1299
9	Uttar Pradesh	1488	2270	150	3908
10	Uttarakhand	139	109	0	248
11	Arunachal Pradesh	0	123	0	123
12	Assam	380	316	235	931
13	Manipur	0	43	0	43
14	Meghalaya	43	0	0	43
15	Mizoram	0	60	0	60
16	Nagaland	0	80	0	80
17	Sikkim	0	0	0	0
18	Tripura	0	0	0	0

19	Andhra Pradesh	439	0	0	439
20	Goa	37	0	4	41
21	Gujarat	585	0	0	585
22	Haryana	360	0	0	360
23	Karnataka	711	0	200	911
24	Kerala	43	0	0	43
25	Maharashtra	937	2674	0	3611
26	Punjab	242	0	0	242
27	Tamil Nadu	829	0	0	829
28	Telangana	316	0	0	316
29	West Bengal	0	0	2635	2635
30	A&N Island	0	1	0	1
31	Chandigarh	6	9	0	15
32	D&N Haveli	0	0	0	0
33	Daman & Diu	3	4	0	7
34	Delhi	0	265	0	265
35	Lakshadweep	0	0	0	0
36	Puducherry	11	0	0	11
	All India	**8755**	**9385**	**5849**	**23989**

Source: M/O H & FW, India, 2017

In Karnataka – where the present study was conducted – despite being a progressive state, rural health centres (including veterinary hospitals) – even though locally available – lack adequate medicines, equipment and manpower. Visits by health guides are also not regular in many of the villages. This has largely affected health service in general and preventive aspect of health in particular. National Mission for Health should be a catalyst of change.

In a study in all but one taluks of DK district of Karnataka by Dr Shriprasad H. respondents were asked to rate the cleanliness of their PHCs as 'Very good', 'Good' and 'Bad'. Only 20% of the respondents in the District replied that the quality of cleanliness as 'Very good', 61% of the respondents as 'Good' and more than 51 % of the respondents as 'Bad'. One of the most important constraints in the successful treatment at village level PHC is lack of proper follow-up by the patients. About 67% of the doctors interviewed told that Patients were not following the instructions properly and they do not follow-up the treatment.

Waves of Change

The issue of contaminated soft drinks seems to have been pushed on to the backburner with the Pesticide Residues Sub-Committee deciding to set up yet another committee to monitor soft drinks for a year before any attempts are made to decide standards for pesticide contamination. With a Rs 6,750-crore fast food industry growing at 35% annually, non-communicable diseases such as diabetes and cardiovascular disorders are rising sharply. How is this slow-motion health disaster to be tackled?

The draft National Pharmaceuticals Pricing Policy 2011 brings 348 essential drugs under price control, but what about non-essential drugs, which are the bulk of those sold and which can be priced several times?

Promoting something as simple as breastfeeding can reduce infant mortality by 11.6%. But though India has among the worst infant and child mortality figures in the world, 75% of the nation's children are not breastfed from birth and over 50% are not exclusively breastfed.India offers just one hospital bed nationally per 15,400 mentally ill patients.With smoking in offices and private establishments banned from October 2, India is finally recognising that tobacco consumption is a major public health problem. But the ban by itself will not work. We need to reduce accessibility to all tobacco products, including gutkha, by taxing them out of reach and banning their sale in public places.Over 4,000 people live in the Delhi leprosy complex. Though leprosy has been eliminated – not eradicated – in India, the stigma and discrimination that leprosy patients and their children face is far from eliminated.

The country needs a "Health Revolution" including promotive health in a big way. Already there are signs of change. A communications initiative that has spread awareness of healthcare needs and entitlements in hundreds of villages across Gujarat and Rajasthan has had a huge impact.

By providing antenatal care information to rural women through voice messages on their mobile phones, mMitra wants to change their beliefs and practices during pregnancy and post-partum. Scores of women living in inaccessible island villages across West Bengal's South 24 Parganas district are finally able to access ante- and postnatal healthcare, and have institutional deliveries at community delivery centres and hospitals. Cervical cancer affects millions in India. It can be effectively treated if diagnosed early. Now, the VIA/VILI kit, which costs only Rs 5 and can be used by any healthcare professional, is being introduced across Tamil Nadu, offering women the possibility of early detection and treatment.

A drop-in sexual-health centre in New Delhi and an adolescence sex education programme for class 10 students in rural and urban Haryana clearly demonstrate the benefits of sexuality education and counselling for youth.

A unique home-based palliative and chronic care movement is sweeping through Kerala. Thousands of trained citizens are volunteering two hours a week to take care of the chronically ill in villages and cities. Funding for this community-based scheme that has won WHO recognition comes in cash and kind from citizens, including schoolchildren, bus drivers, labourers and others.

In 1995, the Foundation for Research in Community Health began training semi-literate village women to diagnose and treat common health disorders. Today, Parinche'stais are not just barefoot healthworkers. They're also scripting an ecological, cultural and educational revolution in their villages.

Karnataka's community health insurance scheme makes a difference. Three years after a community health insurance scheme was implemented by the government of Karnataka and Karuna Trust, around 200,000 poor people have benefited, paying annual premiums of just Rs 30 per year for insurance cover of Rs 50 per day of hospitalisation.

Not the just the central and state governments but many NGOs are also very active in the health sector. In Karnataka, for instance, the Shri(Kshetra)Dharmastala Manjunatheshwara (SDM) organisationhas been a pioneer – whether in community health centres or in mobile hospitals, in nature cure or fighting the drink evil (See Box 1). They work beyond speciality hospitals. They have encouraged health decision. The collaborative process between a clinician and patient to arrive at a healthcare decision together is known as Shared Decision Making (SDM).

SDM enables clinicians and patients to explore the benefits and harms of medical options, when the "best" option is not clear. The best healthcare decisions combine the patient's preferences with the clinician's expertise.Healthcare decisions can be incredibly challenging: for patients, the medical terminology may be difficult to understand, the math of risk can be complicated, and the implications of available options may be hard to fully comprehend. HealthDecision does the "heavy lifting" associated with decision support for clinicians, combining patient-specific medical data with the latest medical guidelines and calculators, and presents a patient's personalised risk analysis. Visual presentation of outcomes, cited as a favourite feature of the tools by clinicians and patients alike, is educational, easy-to-understand, and facilitates the discussion of the benefits and harms to arrive at mutual agreement on a treatment plan.

BOX 1: Healthcare by Shri KshetraDharmasthala

- SDM Trust contri buted 50% of the cost for building the Dharmasthala Government Hospital. It also provides medicines every year.
- The Shree Kshetra Dharmasthala Manjunatheshwara Block covering 44000 sq.ft at the Kidwai Memorial Institute of Oncology at Bangalore provides re lief to poor cancer patients. This block has facilities like outpatient ward (separate facilities for men and women), consultation rooms for doctors, rooms for nurses, minor operation theatres, store room, toilets, ramp and waiting hall.
- It has built an ai r-conditioned Shri Dharmasthala Manjunatha Swamy Neonatal Intensive Care Unit at the Indira Gandhi Institute of Child Health at a cost of Rs.53 lakhs. This unit has been dedicated to provide specialised health care for high -risk newborn infants belonging t o the poor sections of the society.
- Dharamshalas have been constructed at the Wenlock District Hospital and the Government Lady Goschen Hospital in Mangalore; accommodation to the family members of patients admitted to these hospitals is provided at no charges.
- Annual contribution of Rs.15 lakhs to Shri Jayadeva Institute of Cardiology to help needy patients.
- A block for treatment of Pet animals at Karuna Hospital.

- Shantivana trust was established with the objective of reviewing and populari sing the traditional Indian nature cure system of healthcare and propagating moral education.Along with managing two nature cure hospitals as a part of moral education activity till now 1,10,000 books have been distributed to the students through the establishment of Srig uru Yoga Sanga, yoga and meditation training is given in schools covering students.
- Sampoorna Suraksha Group Health Inusrance Programme is a unique initiative . Under this programme the Self Help Group member contributes a definite annual subscription whic h is pooled and used as an insurance premium for a group policy covering the members . Since 2004 -05 3553877 families have been enrolled.
- Another important people's awareness programme has been the SDM De - addiction and Research centre. 914 de -addiction camps organi sed and 60481 addicts treated in 28 districts of the state (upto March 2016). Every year 1.25 lakh students awakened to the hazar ds of bad habits through Swastya Sankalpa programme. Illegal preparation and selling of arrack, cock -fighting, gambling have been considerably controlled.

Two leaders in social health can come together. SDM Narayana Heart Centre, a joint venture of SDM College of Medical Science & Hospital and Narayana Health came into existence in the month of Jan, 2009 under the dynamic leadership of Dr. D. VeerendaraHeggede(DharmasthalaDharmadhikari and President, SDM Educational Society), and Dr. Devi Prasad Shetty, a world renowned Cardiac Surgeon and Chairman of Narayana Health Group of Hospitals. The mission and vision of these icons is that no one should be deprived of world class quality healthcare services at affordable prices and to have integrated healthcare delivery with compassionate patient care.

Conclusion

There is evidence for strong linkages between infrastructural facilities and income generation of the people utilising the services of health infrastructure, which has led to their socio-economic development over the years. At present their services are less affordable and accessible to the rural people. Time, money and space (distance) are posing challenges to users of infrastructural services. Sometimes the quality of services is also much below the desired levels. Another reason for low accessibility of facilities is poor management of infrastructure. Pricing and distribution of services and ill managed, as we have observed in the case of electricity and irrigation. Another observation is that even the conservatives are today less sceptical about the role of private sector in infrastructure supply and management of the rural areas. Yet public sector seems to hold sway among certain categories of households (users). Therefore, PPP principle for health services has many takers.

We need to promote coordinated health and human resources development (COHHRD). Health may be 'individual' but not disease. Paul Russell said: "nothing on earth is more international than disease". Can we sit with ease having a serious malady? Countries must encourage better use of private and public resources for efficient and appropriate health-seeking and health-promoting behaviour, to

enable every individual to lead a physically, mentally socially, emotionally ethically and economically productive life. That should begin with the child, nay the womb.

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Impact of Literacy on Neo-natal and Infant Mortality in Assam- Evidence from Census, SRS and AHS data

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Abstract : *Literacy especially mother's literacy is closely related to child health and survival. Empowering women through education pays dividends by not only providing opportunities and choice to women but also uplifting the health status of the whole family and community Education has contributed more to mortality than the provision of health services. There is an inverse relationship between literacy and child mortality. Although there has been progress in improving educational attainment for female in India over the last several decades, there is a large gender disparity in India's literacy rate, while male literacy is 82.14%; female literacy rate is 65.46 %. There is also significant variation observed by place of residence, with rates in rural areas lagging behind rates in urban areas.We have therefore attempted to understand in this study the nature of this inverse relationship. Data on NNMR, IMR and female literacy on 23 districts of Assam were collected. The change in NNMR, IMR and the female literacy rate were determined. The paper also formulates the changes in IMR and NNMR for a percentage rise in female literacy. Analysis shows that Lakhimpur district record the greatest improvement in NNMR for every percent rise in female literacy.*

1.1 Introduction

Mortality is one of the important components of population change in any area. It is the result of a number of factors, which are demographic, psychological and economic in nature. Among various measures of mortality, neo-natal and infant mortality are important. Neo-natal and infant mortality are regarded as sensitive indicators of health status of a community. These reflect the standard of living of the people and effectiveness of intervention for improving maternal and child health in a country. High child mortality reveals lack of proper health care, lack of education and societal preferences.

The death of live born before completing four weeks or 28 days of life is called neo-mortality. As per SRS statistical report 2014, the neo-natal mortality rate (NNMR) in India is 26 and ranges from 15 in urban areas to 30 in rural areas. In Assam, the neo-natal mortality rate is 26 per 1000 live births.

Infant mortality rate (IMR) is defined as the number of infant deaths per 1000 live births. According to SRS statistical report 2014, the IMR of India is reported as 39. Assam recorded IMR as 49 per 1000 live births for the same period which is much higher than the national level.

The Millennium Development Goal 4 (MDG 4) calls to reduce child mortality by two- thirds between

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1990 and 2015. However, India is lagging behind on targets for reducing child and infant mortality. Reduction of child mortality is crucial in India, many studies have documented that achievements of the Millennium Development Goal to reduce child mortality at global level is largely dependent on India's contribution towards the reduction of death in children younger than 5 years, and in particular, reductions during the neonatal period at national, regional and sub- regional level (Hallad et.al, 2013).

Literacy especially mother's literacy is closely related to child health and survival. Empowering women through education pays dividends by not only providing opportunities and choice to women but also uplifting the health status of the whole family and community (Shetty and Shetty, 2014). Education has contributed more to mortality than the provision of health services. There is an inverse relationship between literacy and child mortality. Although there has been progress in improving educational attainment for female in India over the last several decades, there is a large gender disparity in India's literacy rate, while male literacy is 82.14%; female literacy rate is 65.46 %. There is also significant variation observed by place of residence, with rates in rural areas lagging behind rates in urban areas. In urban India, female literacy rate is 79.9 % whereas in rural area, the female literacy rate is only 58.8%.

The present study is undertaken with the objective of exploring the role of literacy particularly female literacy in reducing neo-natal and infant mortality in Assam at district level.

1.2 Data and methodology:

The entire study is based on secondary data taken from Census, Sample registration system and Annual Health Survey, Registrar General and Census Commissioner, India on literacy and child mortality (neo-natal and infant), of Assam at district-level. District-wise data on literacy, neo-natal and infant mortality were collected from Annual Health survey reports of Assam of 2010-11, 2011-12 and 2012-13. The percentage change in neo –natal and infant mortality rates between three consecutive years have been calculated. We have also calculated the percentage change in total and female literacy rate of Assam at district level. The change in NNMR and IMR for every percentage rise in female literacy rate has also been determined.

2. Results and Discussion:

Literacy level and educational attainment are vital developmental indicators as they are key variable of measure of development as they indicate quality of life, awareness level and also level of skill of people in the society. Table 1 shows that the total literacy as well as the female literacy rate in India have gradually increased. Female literacy rate in India has increased from 39.29 % in 1991 census to 65.46 % in 2011 census.

The National Population Policy 2000 aims at achieving IMR of 30 by the year 2010, Government of India (2000). The MDG is to reduce infant and child mortality by two-thirds between 1990 and 2015. In the case of India this would imply a reduction of the IMR to 27 and of the under-five mortality rate to 32 by 2015 (The World Bank, 2004).

Table 1: Literacy and infant mortality rate of India and Assam, 1991-2011

Year	Total Literacy Rate		Female Literacy rate		Infant Mortality Rate	
	India	Assam	India	Assam	India	Assam
1991	52.21	52.89	39.29	43.03	80	81
2001	64.83	63.25	53.67	54.61	66	73
2011	74.04	73.18	65.46	67.27	44	55

Source: Census of India and SRS Bulliten, 1991-2011, Registrar General and Census Commissioner, India

In India, the infant mortality rate has declined from 80 per 1000 live births in 1991 to 44 in 2011. The latest data from the sample registration system shows that the infant mortality rate has declined to 39 in 2014 from 40 in 2013 at the National level. In Assam too it is found that the IMR has reduced to 55 in 2011 from 81 in 1991. During this period the literacy rate in Assam has gradually increased from 52.89% in 1991 to 73.18% in 2011 census. Female literacy rate in Asaam also rose to 67.27 % for the Census year 2011 from 43.03% in 1991.

Table 2: Neo-natal mortality rate of Assam and its districts, 2010-11-2012-13

State/Districts	Neo-natal mortality rate			Percent change	
	2010-11	2011-12	2012-13	2010-11 & 2011-12	2011-12 & 2012-13
Assam	39	38	37	-2.6	-2.6
Kokrajhar	41	42	43	2.4	2.4
Dhubri	50	50	50	0.0	0.0
Goalpara	39	40	38	2.6	-5.0
Bongaigaon	31	29	27	-6.5	-6.9
Barpeta	33	34	31	3.0	-8.8
Kamrup	30	28	25	-6.7	-10.7
Nalbari	48	44	46	-8.3	4.5
Darrang	39	41	40	5.1	-2.4
Marigaon	44	42	41	-4.5	-2.4
Nagaon	41	40	40	-2.4	0.0
Sonitpur	46	43	43	-6.5	0.0

				-	
Lakhimpur	41	37	33	-9.8	-10.8
Dhemaji	27	26	25	-3.7	-3.8
Tinsukia	39	37	35	-5.1	-5.4
Dibrugarh	37	36	34	-2.7	-5.6
Sibsagar	37	37	38	0.0	2.7
Jorhat	43	42	39	-2.3	-7.1
Golaghat	47	45	43	-4.3	-4.4
Karbi Anglong	36	36	38	0.0	5.6
North Cachar Hills	35	33	33	-5.7	0.0
Cachar	36	35	35	-2.8	0.0
Karimganj	46	46	44	0.0	-4.3
Hailakandi	36	35	36	-2.8	2.9

Source: Annual Health Survey Fact Sheet, 2010-11 to 2012-13, Registrar General and Census Commissioner, India

It is found that (Table 2) the percentage change in the level of Neo-natal mortality rate between the period 2010-11 and 2012-13 for Assam and its districts. The neo-natal mortality rate in Assam has declined to 37 in 2012-13 from 39 in 2010-11. During the consecutive years, neo-natal mortality rate in Assam has declined by only 2.6 %. Dhubri district has the highest percentage of neo-natal mortality rate (50) for the three consecutive years. Whereas the least NNMR has observed in Dhemaji district during 2010-11 and 2012-13. There was no change in NNMR of Dhubri district during the reference period.

Table 3:IMR of Assam and its districts, 2010-11-2012-13

State/Districts	Infant mortality rate			Percent change	
	2010-11	2011-12	2012-13	2010-11 & 2011-12	2011-12 & 2012-13
Assam	60	57	55	-5.0	-3.5
Kokrajhar	76	74	74	-2.6	0.0
Dhubri	72	68	69	-5.6	1.5
Goalpara	56	56	53	0.0	-5.4
Bongaigaon	53	49	48	-7.5	-2.0
Barpeta	48	46	43	-4.2	-6.5
Kamrup	46	42	39	-8.7	-7.1
Nalbari	64	59	58	-7.8	-1.7
Darrang	69	73	70	5.8	-4.1
Marigaon	72	66	63	-8.3	-4.5
Nagaon	66	64	62	-3.0	-3.1
Sonitpur	68	65	61	-4.4	-6.2

Lakhimpur	56	53	48	-5.4	-9.4
Dhemaji	44	40	37	-9.1	-7.5
Tinsukia	55	51	50	-7.3	-2.0
Dibrugarh	55	52	51	-5.5	-1.9
Sibsagar	58	56	56	-3.4	0.0
Jorhat	57	55	50	-3.5	-9.1
Golaghat	62	59	56	-4.8	-5.1
Karbi Anglong	59	59	60	0.0	1.7
North Cachar Hills	58	56	54	-3.4	-3.6
Cachar	57	54	53	-5.3	-1.9
Karimganj	69	68	65	-1.4	-4.4
Hailakandi	55	54	52	-1.8	-3.7

Source: Annual Health Survey Fact Sheet, 2010-11 to 2012-13, Registrar General and Census Commissioner, India

Table 3 provides the district wise Infant Mortality Rate (IMR) of Assam for the three consecutive years 2010-11, 2011-12 and 2012-13 and the percentage change in IMR during the same periods. According to Annual Health Survey 2012-13, the IMR of Assam has declined from 60 in the year 2010-11 to 55 in the year 2012-13. Among the districts of Assam, Kokrajhar has the highest IMR during the reference periods. Whereas the lowest IMR has observed in Dhemaji district during 2010-11 and 2012-13. Among the districts, the highest percentage of decline (9.4 %) is found in Lakhimpur district between 2011-12 and 2012-13. Kokrajhar and Sibsagar are the only districts, not showing a decline in IMR during the same period.

Table 4: Literacy rate of Assam and its districts, 2010-11-2012-13

State/Districts	Literacy rate			Percent change	
	2010-11	2011-12	2012-13	2010-11 & 2011-12	2011-12 & 2012-13
Assam	78.8	81.0	81.6	2.8	0.7
Kokrajhar	71.1	72.5	72.9	2.0	0.6
Dhubri	77.3	77.1	77.9	-0.3	1.0
Goalpara	80.2	81.3	83.0	1.4	2.1
Bongaigaon	74.5	76.2	79.3	2.3	4.1
Barpeta	74.5	76.8	78.6	3.1	2.3
Kamrup	85.1	86.3	87.5	1.4	1.4
Nalbari	82.3	83.5	85.8	1.5	2.8
Darrang	70.5	73.1	73.9	3.7	1.1
Marigaon	82.5	83.3	83.6	1.0	0.4
Nagaon	79.2	80.7	81.2	1.9	0.6

Sonitpur	73.0	74.9	76.7	2.6	2.4
Lakhimpur	81.6	83.2	84.6	2.0	1.7
Dhemaji	79.8	81.2	81.6	1.8	0.5
Tinsukia	73.7	75.4	74.3	2.3	-1.5
Dibrugarh	80.6	81.8	81.7	1.5	-0.1
Sibsagar	84.2	85.1	83.8	1.1	-1.5
Jorhat	84.3	85.2	84.8	1.1	-0.5
Golaghat	81.0	82.1	81.4	1.4	-0.9
Karbi Anglong	80.0	84.6	85.0	5.7	0.5
North Cachar Hills	84.4	90.4	91.6	7.1	1.3
Cachar	83.3	87.2	85.3	4.7	-2.2
Karimganj	75.8	82.3	84.0	8.6	2.1
Hailakandi	81.8	86.6	85.8	5.9	-0.9

Source: Annual Health Survey Fact Sheet, 2010-11 to 2012-13, Registrar General and Census Commissioner, India

The literacy rates of 2010-11, 2011-12 and 2012-13 along with percentage change of Assam at district level is presented in table 4. North Cachar Hills district has the highest percentage of literacy rate (91.6%) during 2012-13 whereas the lowest percentage has observed in Kokrajhar district but according to 2011 census, Dhubri district has recorded the lowest percentage of literacy rate (58.33%). Among the districts of Assam, Tinsukia, Dibrugarh, Sibsagar, Hailakandi, Cachar, Golaghat and Jorhat districts have exhibited a decreasing trend of literacy rate.

Table 5: Female literacy rate of Assam and its districts, 2010-11-2012-13

State/Districts	Female Literacy rate			Percent change	
	2010-11	2011-12	2012-13	2010-11 & 2011-12	2011-12 & 2012-13
Assam	72.7	75.0	75.6	3.2	0.8
Kokrajhar	63.0	64.3	65.0	2.1	1.1
Dhubri	68.7	71.5	72.0	4.1	0.7
Goalpara	75.1	76.2	77.1	1.5	1.2
Bongaigaon	68.2	69.9	72.9	2.5	4.3
Barpeta	67.9	70.1	71.6	3.2	2.1
Kamrup	80.1	82.3	83.0	2.7	0.9
Nalbari	75.2	76.9	79.6	2.3	3.5
Darrang	62.8	65.9	66.8	4.9	1.4
Marigaon	78.7	79.3	79.6	0.8	0.4
Nagaon	75.0	76.5	76.7	2.0	0.3
Sonitpur	66.2	68.2	70.1	3.0	2.8
Lakhimpur	74.9	76.7	78.4	2.4	2.2

Dhemaji	72.2	73.6	74.4	1.9	1.1
Tinsukia	65.0	66.8	66.0	2.8	-1.2
Dibrugarh	73.5	74.7	75.7	1.6	1.0
Sibsagar	79.2	79.9	77.6	0.9	-2.9
Jorhat	78.5	79.4	78.5	1.1	-1.1
Golaghat	74.1	75.1	74.7	1.3	-0.5
Karbi Anglong	73.4	77.6	78.2	5.7	0.8
North Cachar Hills	79.5	86.3	87.4	8.6	1.3
Cachar	77.4	81.6	80.3	5.4	-1.6
Karimganj	69.2	75.2	77.4	8.7	2.9
Hailakandi	76.4	81.3	80.4	6.4	-1.1

Source: Annual Health Survey Fact Sheet, 2010-11 to 2012-13, Registrar General and Census Commissioner, India

Table 5 depicts the female literacy rate of Assam and its districts during 2010-11 -2012-13 and percentage change during the same periods. As per Annual Health Survey, in Assam the female literacy rate has improved from 72.7% in 2010-11 to 75.6 % in 2012-13 whereas 2011 census recorded the female literacy rate of Assam as 67.27 %. Kokrajhar district has the least percentage of female literates in 2012-13 (65.0%) followed by Tinsukia (66.0%) and Darrang (66.8%). North Cachar Hills has the maximum percentage of female literates in 2012-13 (87.4%). This district shows the maximum gain (11.85 %) in the percentage of female literates during the reference periods.

Table 6: Change in NNMR for every 1% rise in female literacy

State/Districts	2010-11 to 2011-12	2011-12 to 2012-13
Assam	-0.4	-1.7
Kokrajhar	0.8	1.4
Dhubri	0.0	0.0
Goalpara	0.9	-2.2
Bongaigaon	-1.2	-0.7
Barpeta	0.5	-2.0
Kamrup	-0.9	-4.3
Nalbari	-2.4	0.7
Darrang	0.6	-1.1
Marigaon	-3.3	-3.3
Nagaon	-0.7	0.0
Sonitpur	-1.5	0.0

Lakhimpur	-2.2	-2.4
Dhemaji	-0.7	-1.2
Tinsukia	-1.1	2.5
Dibrugarh	-0.8	-2.0
Sibsagar	0.0	-0.4
Jorhat	-1.1	3.3
Golaghat	-2.0	5.0
Karbi Anglong	0.0	3.3
North Cachar Hills	-0.3	0.0
Cachar	-0.2	0.0
Karimganj	0.0	-0.9
Hailakandi	-0.2	-1.1

From analysing the data on tables 2 and 5, it is observed that Assam's female literacy rate has increased from 75.0% in 2011-12 to 75.6% in 2012-13 that is increased by only 0.8% but fall in NNMR is 2.6 %. In Karbi Anglong district, the NNMR has increased by 5.6% from 2011-12 to 2012-13 whereas in the district the female literacy rate has grown by 0.8% during the same period. This reveals that most rapid decrease in NNMR does not imply fastest growth in female literacy. In Dhubri district, the literacy rate has raised by 4.8% whereas shows no change in the percentage of neo-natal mortality during the reference periods.

Table 7: Change in IMR for every 1% rise in female literacy

State/Districts	2010-11 2011-12	2010-11 2011-12
Assam	-1.3	-3.3
Kokrajhar	-1.5	0.0
Dhubri	-1.4	2.0
Goalpara	0.0	-3.3
Bongaigaon	-2.4	-0.3
Barpeta	-0.9	-2.0
Kamrup	-1.8	-4.3
Nalbari	-2.9	-0.4
Darrang	1.3	-3.3
Marigaon	-10.0	-10.0
Nagaon	-1.3	-10.0
Sonitpur	-1.5	-2.1

Lakhimpur	-1.7	-2.9
Dhemaji	-2.9	-3.7
Tinsukia	-2.2	1.3
Dibrugarh	-2.5	-1.0
Sibsagar	-2.9	0.0
Jorhat	-2.2	5.6
Golaghat	-3.0	7.5
Karbi Anglong	0.0	1.7
North Cachar Hills	-0.3	-1.8
Cachar	-0.7	0.8
Karimganj	-0.2	-1.4
Hailakandi	-0.2	2.2

Table 7 reveals the change in IMR for every 1% rise in the female literacy rate. Marigaon showed the greatest improvement in IMR for every percent rise in female literacy from 2010-11 to 2011-12. Marigaon and Nagaon are the best performer districts which have exhibited highest reduction of IMR for 1% rise in female literacy rate. But some districts with higher female literacy rate not necessarily showed sharp decline in IMR. For example North Cachar Hills has maximum gain (11.85 %) in the percentage of female literates during the reference periods but IMR has fallen down by 6.9 % only.

Table 8: Total and female literacy rates of Assam and its districts, 2011 Census

State/Districts	Total Literacy rate	Female literacy rate
Assam	73.18	67.27
Kokrajhar	65.22	58.27
Dhubri	58.33	53.33
Goalpara	67.37	63.13
Barpeta	63.81	58.06
Morigaon	68.03	64.04
Nagaon	72.37	68.07
Sonitpur	67.34	60.73
Lakhimpur	77.2	70.67
Dhemaji	72.7	65.21
Tinsukia	69.66	61.73

Dibrugarh	76.05	68.99
Sivsagar	80.41	74.71
Jorhat	82.15	76.45
Golaghat	77.43	71.09
Karbi-Anglong	69.25	62.00
Dima-Hasao	77.54	71.33
Cachar	79.34	73.68
Karimganj	78.22	72.09
Hailakandi	74.33	67.60
Bongaigaon	69.74	64.43
Chirang	63.55	56.65
Kamrup	75.54	69.47
Kamrup-Metro	88.71	85.07
Nalbari	78.63	72.57
Baksa	69.25	61.27
Darrang	63.08	58.04
Udalguri	65.41	58.05

Source: Census of India 1991-2011, Registrar General and Census Commissioner, India

3. Major findings

1. The total literacy rate in India has increased by 41.81% dring 1991-2011 censuses whereas in Assam, it has raised by 38.36%.
2. Female literacy rate has improved by 66.6% in India during the census years 1991-2011 whereas in Assam the rate has increased by 56.3%.
3. IMR for the country has come down to 44 in the year 2011census from 80 in 1991, a decline of 36 points over last 6 decades. In Assam, the IMR has gone down by 26 point to 55 in 2011 from 81 in 1991.
4. As per Annual Health Survey, Dhubri district has the highest percentage of neo-natal mortality rate for the three consecutive years 2010-11 to 2012-13 whereas the least NNMR has observed in Dhemaji district.
5. Among the districts of Assam, Kokrajhar has the highest IMR during the reference periods whereas the lowest IMR has observed in Dhemaji district.

6. Annual Health Survey, 2012-13 has recorded the female literacy rate of Assam is 75.6% whereas as per 2011 census, Assam has a female literacy rate of 67.27%.
7. Lakhimpur (10.8) recorded the greatest improvement in NNMR for every percent rise in female literacy between 2011-12 and 2012-13.
8. Marigaon and Nagaon are the best performer districts which have exhibited highest reduction of IMR for 1% rise in female literacy rate between 2011-12 and 2012-13.

4. Conclusion:

The study finds an inverse relationship but not prominent between the literacy and Neonatal & Infant mortality in Assam. When literacy rate is increased, both the mortalities are found to be somewhat decreased or in some district like Dhubri the neo-natal mortality rate shows no change for three consecutive years under reference. According to Annual Health Survey the literacy rate of Assam has increased by 2.8% during 2010-11to 2012-13 and the female literacy has increased by 2.9% during the same period. The NNMR and IMR however, have decreased by 2 points and 5 points respectively at the same time. It is observed that female literacy rate of Assam has increased by only 0.8% from 75.0% in 2011-12 to 75.6% in 2012-13 but fall in NNMR is 2.6 %recorded in the same period. When district level impact is considered, it is found in Karbi Anglong that the NNMR has increased by 5.6% from 2011-12 to 2012-13 whereas in the district the female literacy rate has grown by 0.8% during the same period. On the other hand, in Dhubri district, the literacy rate has raised by 4.8% whereas shows no change in the percentage of neo-natal mortality during the reference periods

Considering the Infant Mortality Rate, Marigaon showed the greatest improvement in IMR for every percent rise in female literacy from 2010-11 to 2011-12 whereas the district like North Cachar Hills exhibits a low improvement in reducing IMR which is fallen down by 6.9% from 2010-11 to 2012-13 but having a higher female literacy (87.4 %) rate in 2012-13. The study concludes that the literacy rate specially the female literacy may not be the sole determinant to reduce NNMR and IMR in Assam, there may some other socio-economic and demographic factors like Age at marriage, occupation, living standard, access of Health care services, using of Family planning programme etc. can influence in both the mortalities.

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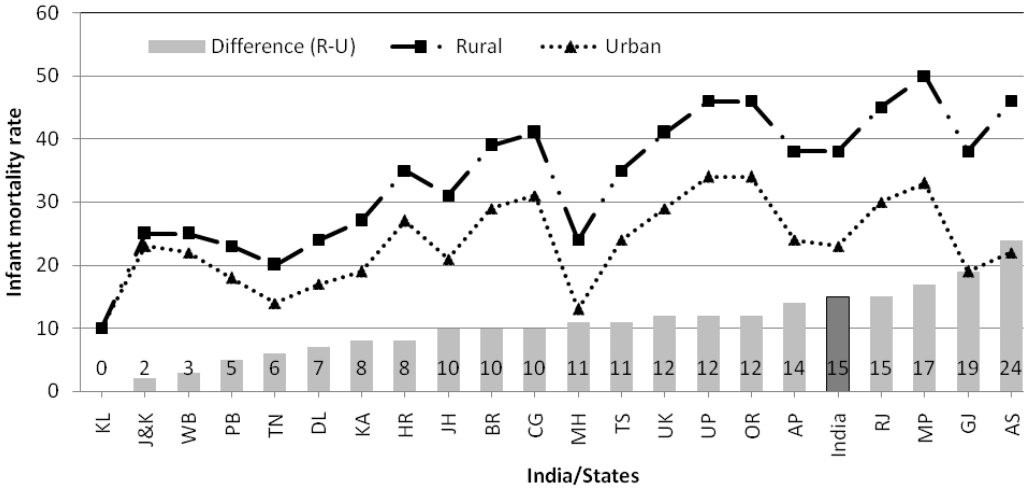
Current Statistics

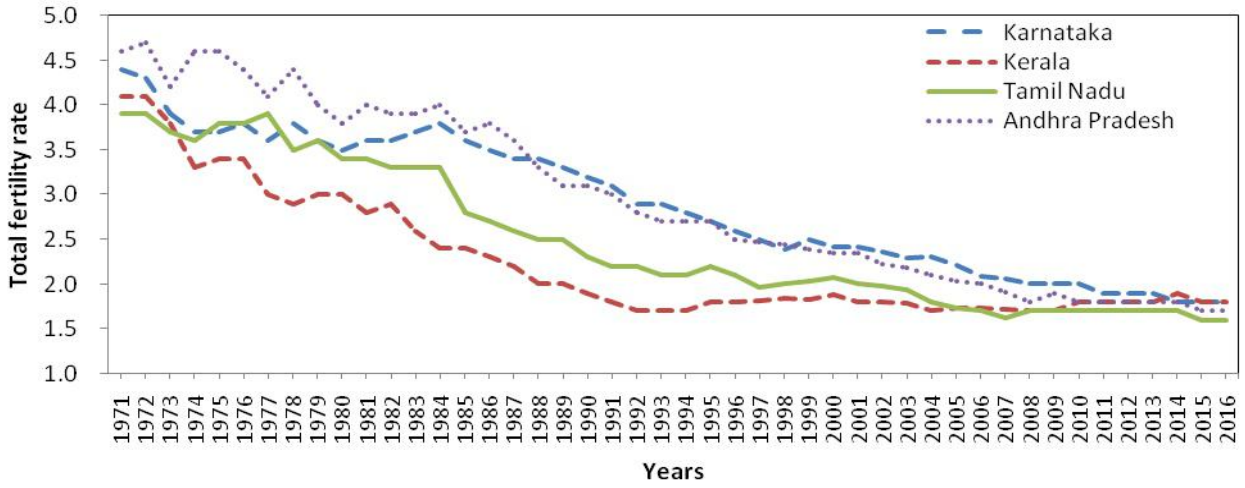
Infant mortality rate by rural-urban differences, India & bigger State, 2017



Note: AP=Andhra Pradesh; AS=Assam; BR=Bihar; CG=Chhattisgarh; DL=Delhi; GJ=Gujarat; HR=Haryana; J&K=Jammu & Kashmir; JH=Jharkhand; KA=Karnataka; KL=Kerala; MP=Madhya Pradesh; MH=Maharashtra; OR=Odisha; PB=Punjab; RJ=Rajasthan; TN=Tamil Nadu; TS=Telangana; UP=Uttar Pradesh; UK=Uttarakhand; WB=West Bengal. Infant mortality rate - Probability of dying between birth and exactly one year of age expressed per 1,000 live births.

Source: SRS bulletins, 2017.

Trend in Total Fertility Rate (TFR) in four South Indian states, SRS, 1971-2016.



Note: Total fertility rate – The number of children born to a woman if she passes through the childbearing years. Source: SRS, 1971-2016.

Trend in Expectation of Life at birth by Sex in India, 1970-75 to 2009-13

	1970-75	1976-80	1981-85	1986-90	1987-91	1988-92	1989-93	1990-94	1991-95	1992-96	1993-97	1994-98	1995-99#	1996-00#	1997-01#	1998-02	1999-03	2000-04	2001-05	2002-06	2003-07	2004-08	2005-09	2006-10	2007-11	2008-12	2009-13
Total	49.	52.	55.	57.	58.	58.	59.	60.	60.	60.	61.	61.	61.	61.	62.	62.	63.	63.	64.	64.	65.	65.	65.	66.	66.	67.	67.
Male	50.	52.	55.	57.	58.	58.	59.	59.	59.	60.	60.	60.	60.	61.	61.	61.	62.	62.	63.	63.	63.	64.	64.	64.	64.	65.	65.
Female	49.	52.	55.	58.	58.	59	59.	60.	60.	61.	61.	62.	62.	62.	63.	64	64.	65.	65.	66.	66.	66.	67.	67.	68.	68.	69.

Note: The data reveals that there is a remarkable increase in life expectancy at birth. Further, female expectation of life at birth in general is higher than the male counterpart. Actually, way back in 70s the expected life at birth was higher for male which gradually turnaround, and the gap between male and female life expectation of life is increasing year on year. Source: Health and Family Welfare Statistics in India, 2015.

Expectation of Life at birth in major States of India 2009-13

Note: Life expectancy at birth is highest in Kerala among other major states of India, and followed by J&K, Maharashtra, Punjab, etc., whereas, Assam, MP, UP and Odisha recorded lowest according to SRS Based Abridged Life Tables 2009-13.

AP=Andhra Pradesh; AS=Assam; BR=Bihar; GJ=Gujarat; HP=Himachal Pradesh; HR=Haryana; J&K=Jammu & Kashmir; KA=Karnataka; KL=Kerala; MP=Madhya Pradesh; MH=Maharashtra; OR=Odisha; PB=Punjab; RJ=Rajasthan; TN=Tamil Nadu; UP=Uttar Pradesh; WB=West Bengal.

Source: Health and Family Welfare Statistics in India, 2015.

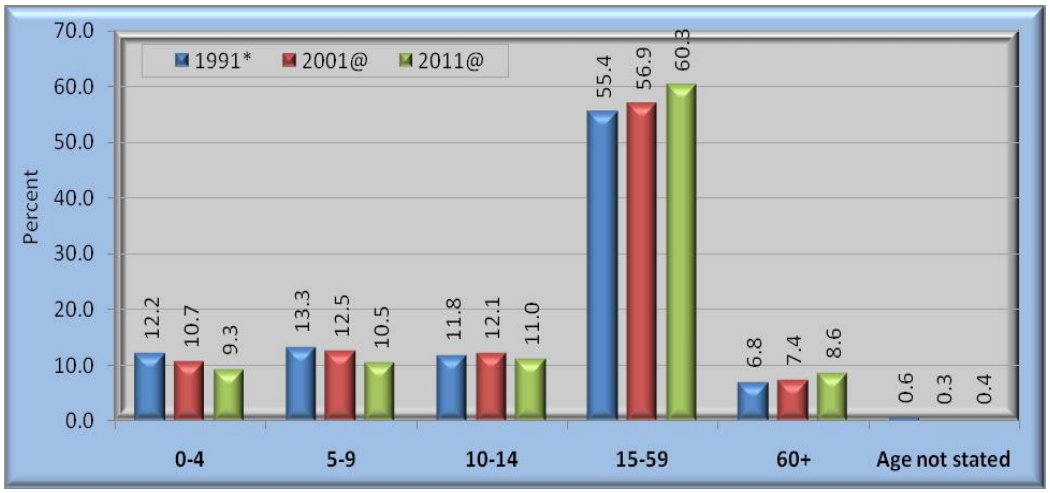
Population in selected age group, adolescent, young and adult – India,

Age Group (Years)	1991*	2001@	2011@
(1)	(2)	(3)	(4)
0-4	12.2	10.7	9.3
5-9	13.3	12.5	10.5
10-14	11.8	12.1	11.0
15-59	55.4	56.9	60.3
60+	6.8	7.4	8.6
Age not stated	0.6	0.3	0.4
Adolescent, Young and Adults			
Adolescent (10-19 Years)	21.2	21.9	20.9
Young (15-24 Years)	18.3	18.5	19.2
Adults (18 Years or more)	56.7	58.6	62.9

Note: *Excluding Jammu & Kashmir; @Excluding Mao Maram, Pao Mata and Purul sub Divisions of Senapati district of Manipur.

Source: Registrar General & Census Commissioner, India

Percentage of population in selected age groups India: Census 1991 to 2011



Note: The data presented in the above graph show the percent distribution of population according to different age group for 1991, 2001 and 2011. The result reveals that the working group (15-59 Years) population was highest in overall all population of India, this proportion has increased from 55% in 1991 to 60% in 2011.

*Excluding Jammu & Kashmir; @Excluding Mao Maram, Pao Mata and Purul sub Divisions of Senapati district of Manipur.

Source: Registrar General & Census Commissioner, India