



**INDIAN ASSOCIATION FOR
SOCIAL SCIENCES AND HEALTH**

**First Professor John Caldwell
Memorial Lecture**

24th September 2016

**Malnutrition and mortality
among children in India:
A need to revisit the ICDS Program**

by

Prof. K. Srinivasan

Professor John Caldwell



Professor John Charles (Jack) Caldwell died on 12th March 2016 at the age of 87 in Canberra. He was associated with the Department of Demography of Australian National University (ANU) for many decades. Caldwell's seminal work included documentation of the role of mother's education in fertility limitation and child mortality decline and the role of circumcision in inhibiting the spread of HIV/AIDS in Africa. He is known for his "wealth flows" theory, which relates demographic transition theory to changes in intergenerational transfers within the family. A 2009 survey of nearly 1000 demographers worldwide, named Jack Caldwell the most influential researcher of all time in the field of demography. In 1985, the Population Association of America (PAA) presented him with its highest prize, the Irene B. Taeuber Award for excellence in demographic research. In 1994, he began an elected four-year term as President of the International Union for the Scientific Study of Population (IUSSP), and, in 2004, he was presented with the prestigious United Nations Population Award. These are the three highest international honours in the field of demography and no other person has won all three of these awards. He has encouraged and mentored many young scholars from India, and good number of them received their Ph.Ds from ANU under his able guidance. His anthropological demographic work on south India, particularly on marriage, fertility and contraception, received lot of research attention.

His students, colleagues and friends have approached the Indian Association for Social Sciences and Health (IASSH) to institute a memorial lecture in his honour. IASSH decided to institute the lecture series in memory of the most famous demographer of our times. The First Prof. John Caldwell Memorial Lecture was held during the 14th Annual Conference of IASSH on 24th Sept. 2016 at Gokhale Institute of Politics and Economics (Deemed University), Pune. Distinguished Demographer Prof. K. Srinivasan (former Director of IIPS, Mumbai) delivered the lecture on the theme – "Malnutrition and mortality among children in India: A need to revisit the ICDS Program". IASSH is happy to bring out this memorial lecture for wider circulation.

Malnutrition and mortality among children in India: A need to revisit the ICDS Program.

K. Srinivasan

Abstract

This paper examines the recent trends in infant and child mortality and malnutrition levels in India, first nationally and with a study of four selected states. Two of these states, Kerala and Tamil Nadu, are among the better developed states of India. The other two, Bihar and Uttar Pradesh, are regarded as considerably less developed. It was seen that while mortality levels among children have declined significantly in all the states, a corresponding decline in malnutrition levels was not apparent. India's ICDS program, in operation since 1975 and funded by the central government, is the world's largest program of its kind. One of its major objectives of ICDS is to meet the nutritional needs of children of ages from 6 months to 6 years through supplemental feeding in the Anganwadi Centers (AWC) of which, according to norms, there is one center per 1000 population. This paper analyzed various components of the ICDS program, including budgetary provisions, using recent data to determine the extent to which the program has been successful in reducing malnutrition. The study first analyzed state-level data and then at district level in Tamil Nadu. Analysis of household-level data from NFHS-3 showed that while there is good nutritional impact on the beneficiary children who received supplemental feeding, a corresponding impact on the population was not seen. This leads to the conclusion that the positive effects of supplemental feeding are neutralized by the large numbers of malnourished children that are added to this group every year. Data confirms the widely-held belief that there is chronic hunger in a sizeable proportion of households in the country.

I. Introduction and Objectives

Many recently published studies in India and abroad have drawn attention to the country's poor ranking, even among the developing nations, in respect of malnutrition among children below the age of 5 years. This was not expected in view of its high GDP (averaging a yearly growth of 7% in the past two and a half decades) and the rapid rise in its per capita income (Country Report of NFHS-3—2008' Global Hunger Index-2014), which should have made access to nutrition easier for most people. The per capita GDP of India in PPP \$ (price parity adjusted dollars at 2011 prices) was \$1973 during 1990-1994 and rose nearly three-fold to \$ 5473 during 2011-15. During this period, the percentage of children below 5 years of age, who were considered "stunted" or lower than the expected weight for the height of the child by WHO standards, declined from 61.9 to 38.7. Stunting among children is considered an indicator of "chronic malnutrition" i.e. a continued prevalence of lack of food and nutrition; it has been found to seriously compromise their future well-being (mental and physical).

Recently published information on global hunger (Global Hunger Index, 2016) places India at the 107th position among 138 countries, indicative of chronic hunger among large segments of its population. How can a country like India, which has shown impressive economic growth since the 1990s, have a large proportion of its population (including children) in a chronic state of hunger? In this paper, I will try to examine the problem in the context of the Integrated Child Development Scheme (ICDS), in operation since 1975, and make some recommendations based on the findings for alleviating the situation.

The specific objectives of the study are:

1. To highlight the continuing problems of high child mortality and malnutrition in India and their wide variation across the country as represented by a study of four states – Kerala and Tamil Nadu, which are more developed, and Bihar and Uttar Pradesh, the less developed states – to show that while there has been significant decline in mortality, it is less so in the case of malnutrition.
2. To briefly review the ICDS program, which was launched in 1975 and then modified and expanded over the years to address these problems.
3. To review the findings of recent studies of the ICDS and assess its effectiveness in terms of select output and outcome variables and make some recommendations in the light our analysis.

II. Methodology

The study used secondary data available from various published sources to carry out the following analysis

1. First, we examined the trends in infant and child mortality rates since 1990 at five-year intervals in India and the four selected states, Kerala and Tamil Nadu (the developed states), and Bihar and Uttar Pradesh (the less developed states).
2. Then we studied the trends in child malnutrition (as evidenced by the levels of stunting, wasting and underweight) in these periods in these states and compared them with the countrywide trend and with other developing countries,
3. Thirdly, we discussed the objectives, structure and inputs for the ICDS program,
4. We then related the extent of participation of children in the ICDS program with the selected indicators of output and outcome variables.
5. Finally, based on the findings, we made some recommendations for making ICDS's supplemental feeding program more effective.

Data for our analysis was obtained from 1) Sample Registration System (SRS), 2) National Family Health Surveys (NFHS, 1, 2, 3 and 4), 3) the Random Survey of Children (RSOC), which is conducted by the UNICEF and Ministry of Women and Child Welfare (2015), and 4) country-wise comparative data published by the World Bank, UNICEF and WHO (2016).

III. Analysis and Findings

A. IMR and U5 Mortality Trends

Since 1990, on a countrywide basis, the IMR declined steadily from 84 to 40 in 2013, a 50% reduction in 23 years. Disaggregation of this data shows that IMR fell from 90 to 44 during this period in the rural areas, and from 53 to 27 in urban ones.

However, there is wide variation in IMR figures across states. Among the four states considered in this study, in 2013 it ranged from a high of 50 in UP to 12 in Kerala. IMR is higher in the rural areas compared to urban areas. In 2013, in the rural areas the range is from 53 in UP to 13 in Kerala and in the urban areas they were 38 and 9 respectively. The rate of decline in both rural and urban areas was faster in Tamil Nadu as compared to Uttar Pradesh. In the rural areas of UP, IMR fell from 111 in 1990 to 53 in 2013, a 53% decline; the corresponding figures for Tamil Nadu are 72 and 24, a fall of 67%. In the urban areas of UP, it declined from 72 (1990) to 38 (2013), a reduction of 47%. In Tamil Nadu, IMR was 41 in 1990 and 17 in 2013, a decline of 59%. Data also show that the pace of decline was higher among male children than among females.

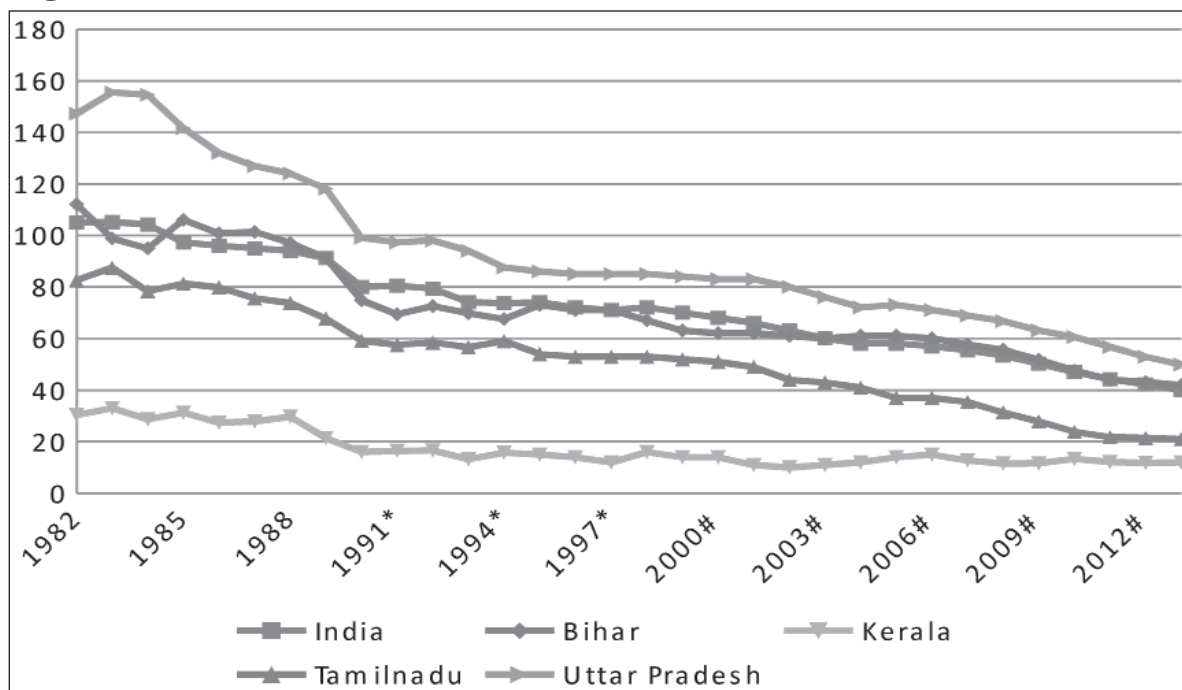
Even as infant mortality rates decline, there is concern over the widening gender gap in the rate of decline among the states and by gender. IMR continues to remain significantly higher for female than male children. Evidently, male children appear to benefit more than females from programs and interventions. These declines from 1990 to 2013 seem to a part of the long term slow declines in IMR from 1982 as the trend lines in Graph 1 indicate.

Table 1: Infant Mortality Rates: Rural (R), Urban (U) and Combined (C)

		1989-91	1994-96	1999-01	2004-06	2009-11	2013
India	R	90	79	74	63	52	44
	U	53	49	43	40	31	27
	C	84	73	68	58	47	40
Bihar	R	81	72	63	62	49	42
	U	52	57	53	46	37	33
	C	78	70	62	61	48	42
Kerala	R	19	15	13	15	13	13
	U	15	14	13	11	10	9
	C	18	15	13	14	12	12
Tamil Nadu	R	72	62	56	41	26	24
	U	41	42	37	34	22	17
	C	61	55	51	38	25	21
Uttar Pradesh	R	111	89	87	76	63	53
	U	72	66	64	53	44	38
	C	105	86	83	72	60	50

Source: SRS India

Fig. 1: IMR of India and Selected States



Tables 2 and 3 provide the estimated U5MR in India for the years between 1990 and 2014 at national level as well as state-wise. The Under 5 mortality rates (probability of a child dying before the age of 5 years, expressed as proportion of 1000 live births in a given year or period of time) show a secular decline (as was observed in IMR) – from 118 in 1990 to 45 in 2014. U5MR figures are higher in the rural areas and for female children. The rural-urban gap is wider than the female-male gap, an indication that urbanization tends to reduce gender discrimination. From Table 3 it can be seen that in UP, U5MR s in 2014 were 63 and 52 for females and males respectively. The corresponding figures for Kerala were 15 and 12. Unlike in the developed countries as well as in many developing countries, even at the lower end of infant and U5 mortality rates such as in Kerala, female children have higher mortality than male children, which reveals the gender bias in child care. Although the gender gap has narrowed with the overall decline in child mortality, it remains significant as the figures for 2014 show (Graph 2).

Table 2: Under 5 Mortality Trends in India

	Total	Male	Female	Rural	Urban
1990	118	110	126	128	71
1995	97	96	110	111	67
2000	85	84	95	98	55
2005	77	72	82	85	49
2008	69	64	73	NA	
2009	64	60	69	71	41
2011	55	51	59	NA	
2013	49	47	53		
2014	45	42	49		

Source: SRS India

Fig. 2: Under 5 Mortality Trends – India – Males/Females

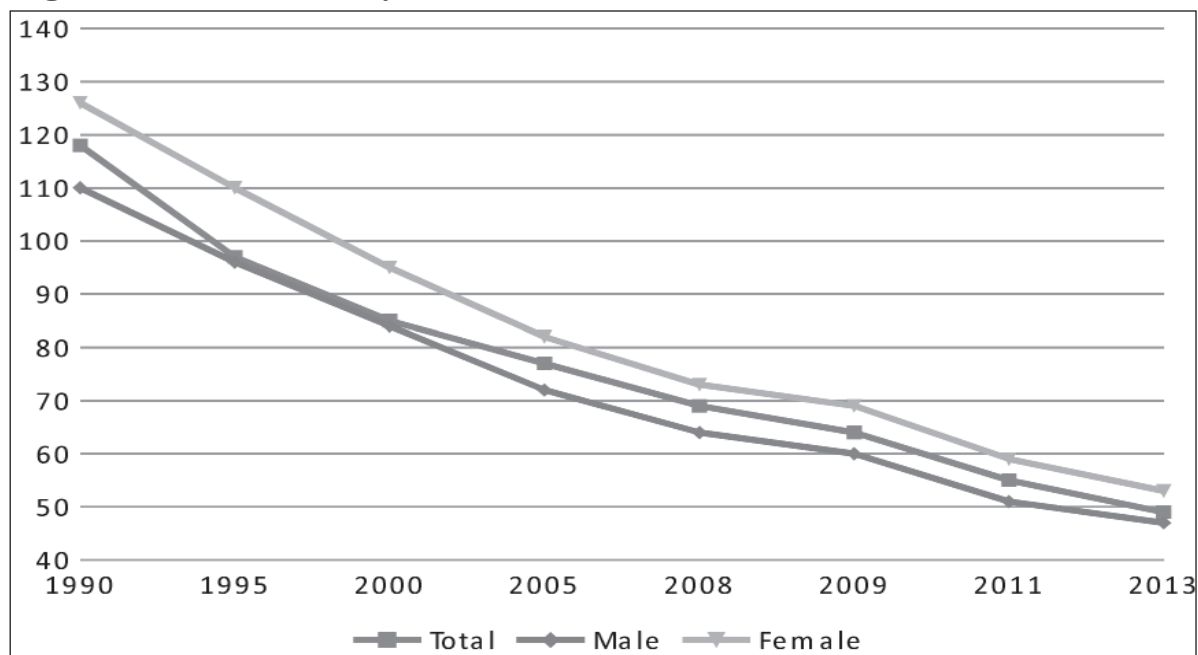


Fig. 3: Under 5 Mortality Trends – India – Rural/ Urban

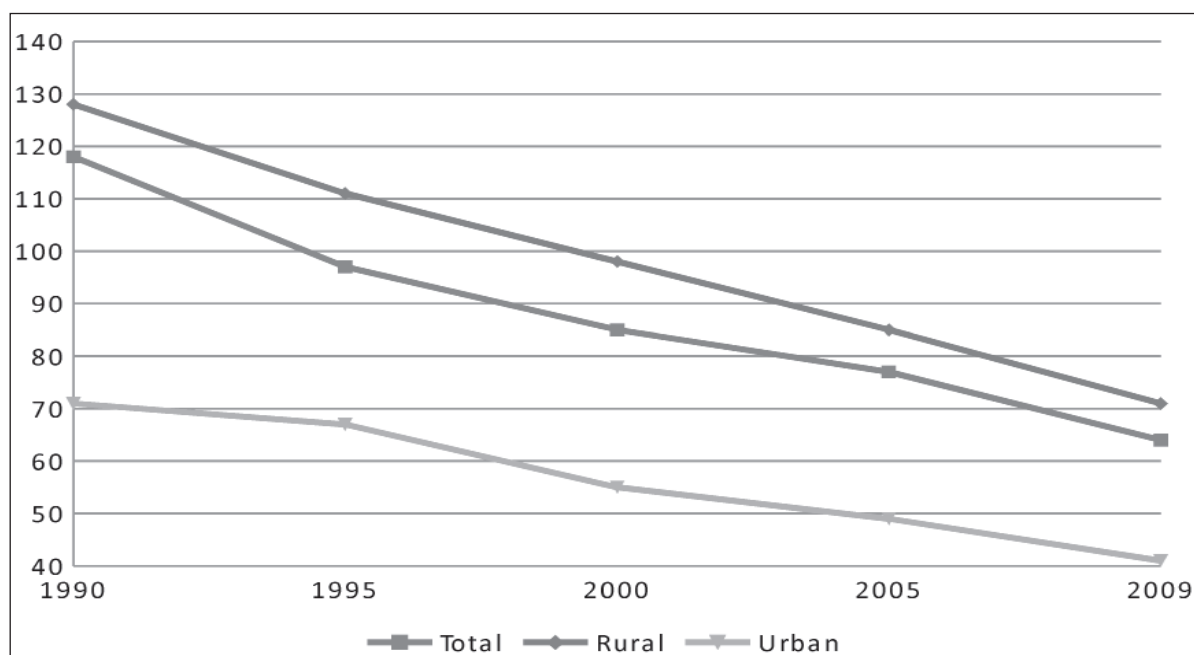
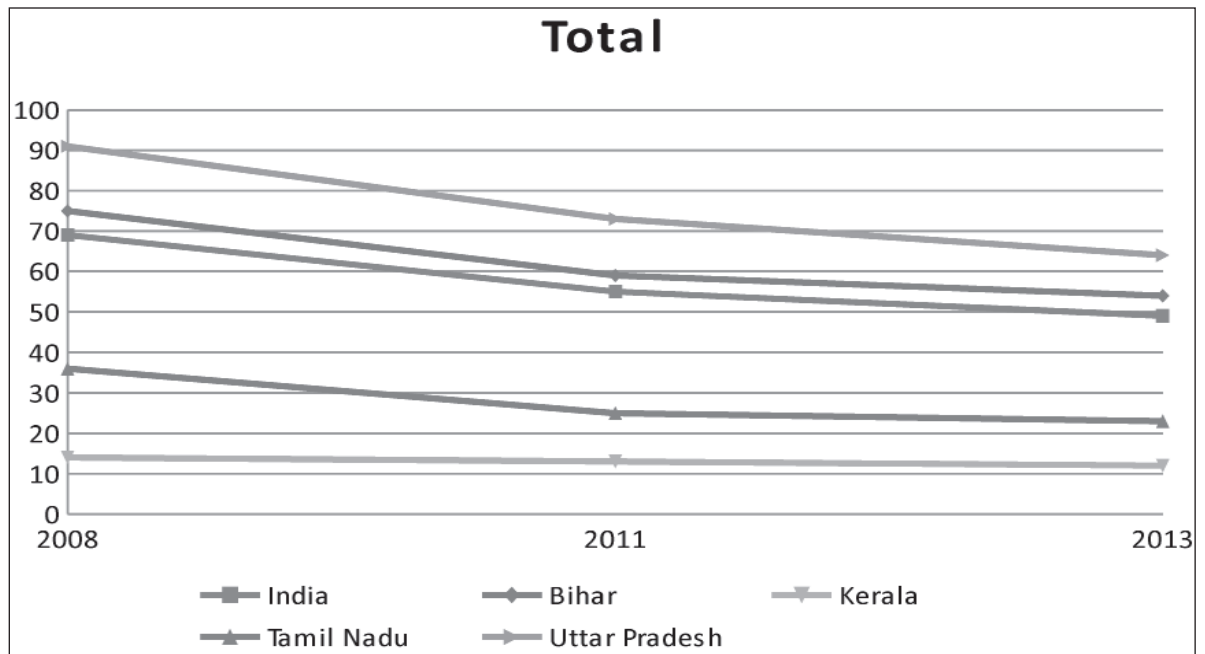


Table 3: Under 5 Mortality India and the Selected States

	2008			2011			2012			2013			2014		
	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F
India	69	64	73	55	51	59	52	49	56	49	47	53	45	42	49
Bihar	75	69	82	59	56	62	57	54	60	54	51	58	53	49	58
Kerala	14	12	15	13	12	14	13	12	14	12	11	14	13	12	15
Tamil Nadu	36	36	36	25	23	27	24	23	26	23	22	24	21	22	21
Uttar Pradesh	91	83	100	73	67	81	68	62	75	64	60	70	57	52	63

Source: SRS India

Figure 4: Under 5 Mortality Trends – India and Selected States



B. Malnutrition in India

We studied the recent trends in malnutrition levels among children using data on stunting (height for age below expected standards), wasting (weight for height below expected standards) and undernourished (weight for height below expected standards) as indicators of malnutrition in India and the four selected states. The standards are based on those set by the WHO and less than 2 SD of the expected values for a given age. These standards were based on a careful study of the heights and weights by age in weeks of normal healthy children across different countries of the world including those from developing countries that included India. The variations in the heights and weights of normal children around the average were measured within 2 and 3 standard deviations. Those below the 2 SDs were considered to be moderately stunted (height for age), wasted (weight for height) and undernourished (weight for age). Those below the 3 SD limits were considered to be severely stunted, wasted or undernourished. This is the standard international practice of assessing the nutritional status of a child or the percentage malnourished among children in specified age group in a population and facilitates comparisons of percentage of children malnourished across places and over time. Malnutrition data at national and state levels for recent years were obtained from the following sources.

1. NFHS surveys 1 to 4 (1991-92, 97-98, 2004-05 and 2013-14).
2. DLHS surveys: The latest DLHS-4 (conducted in 2005-06)
3. Latest Rapid Survey of Children by the UNICEF (2013-14).
4. SRM survey in Tamil Nadu (conducted in 2014-15 at the request of the State Government).

5. For comparisons with other countries, we compiled data on per capita GDP of countries as well as child mortality and morbidity indicators from the joint report on nutrition UNICEF and WHO (2016) and the Global Hunger Index (2016).

It needs mention here that comparison using these data must be made with due caution. For example, NFHS 1 data on malnutrition was based on measurements of height and weight of children below age four while the upper age limit for this purpose in NFHS 2 was three years. The data sets in the other surveys pertain to children below age five.

Though the IMR and U5 mortality rates have declined steadily over the years, the pace of decline in malnutrition among children below five years of age has been irregular. Child malnutrition rates remain high. According to the latest survey conducted by the UNICEF (RSOC: Rapid Survey of Children, in 2013-14), two out of five children are stunted (below their expected height for age), a condition that may prevent the achievement of their full potential as they grow older.

Table 4 shows the proportions of children who are stunted, wasted and underweight, both for India and the four selected states for the years from 1992-93. This information was compiled from all the data sources described earlier. Country wide information and state-wise data were taken from the NFHS rounds. The data on Bihar and Tamil Nadu were taken from the most recent survey, NFHS-4, conducted in 2015-16. Also used was data from the DLHS-4 conducted by IIPS, Mumbai during 2012-13 and the Rapid Survey of Children (RSOC) conducted by UNICEF during 2013-14.

In India, the percentage of stunted children was 52 in 1992, 46 in 1998, 48 in 2005 and 39 in 2013. As stated earlier also, the first three estimates are drawn from NFHS-1, 2 and 3, and the last one from RSOC of UNICEF. The trends from 1998 are not steady and RSOC estimates are lower than the NFHS-3 ones. Bihar and Uttar Pradesh have highest rates of stunting at 49 and 50 % in 2013 as compared to 19 and 23 in Kerala and Tamil Nadu respectively.

About wasting, nationally, the figure was 18% in 1992, 15 in 1998, 29 in 2015 and 15 in 2013. Among the states, slightly higher levels of wasting were observed in Kerala (16) and Tamil Nadu (19) than in Bihar (13) and Uttar Pradesh (10). A possible reason for this anomaly is that while stunting is a result of chronic malnutrition affecting the heights of children, in a population with high percentage of stunted children, the percentage of wasted children can be expected to be less because the weight is related to the height. This hypothesis needs further examination.

RSOC (2014) data showed that, in India, 39% of children in the age group of 0-59 stunted, i.e., they are short for their age, 15% are wasted or thin for their height and 29% are underweight or light for their age. Of the stunted children 17% are severely stunted and rest, moderately so. In other words, every sixth child in India is severely stunted. About 5% percent of the children are severely wasted and 10% severely underweight.

It was also found that the percentage of stunted children had declined from 52 in 1992 to 39 in 2013; the percentage of wasted children increased marginally from 18 to 15, and that of the malnourished decreased from 53 to 29. In Bihar and UP, these percentages are cause for serious concern. The 2013 survey showed 50% of the children were stunted and the percentages of wasted and malnourished children were 37 and 34 respectively. These figures are poor reflection on the progress made by the country in improving child health during the past 69 years. Bihar and UP are two of India's most populous states.

Severe malnutrition levels among children in UP and Bihar is also evident from the high 3-sigma figures in Table 5. It can be seen that 26 and 28 % of the children under-5years of age in Bihar and Uttar Pradesh are severely stunted as compared to 8 and 9% in Kerala and Tamil Nadu respectively. On the other hand the variations in the percentage “wasted” among children did not conform to expectations and surprisingly were lower in UP (2.9) and Bihar (3.9) compared to Kerala (5.4) and Tamil; Nadu (6.3). This is because since ‘wasting’ is measured in terms of weight against the height of a child, in situations where stunting is high and where large proportion of children are less than expected heights (because of chronic hunger) their weights when compared to their diminutive heights may not show that level of “wasting” as among children with normal heights. This is taken as indicative of “acute “malnutrition. The percentages of children “under nourished” are based on weight for age of children and indicative of the combined effects of acute and chronic hunger and malnutrition. In this dimension the differential across the states again become large and in the expected directions; with 37 % in UP and 34% in Bihar compared to 19% in Kerala and 23% in Tamil Nadu.

Table 4: Trends in Child Nutrition Status

	NFHS - 1*			NFHS 2@			NFHS - 3#			DLHS 4#			RSOC#			NFHS - 4#		
	(1992-93)			(1998-99)			(2005-06)			(2012-13)			(2013-14)			(2015-16)		
	S	W	U	S	W	U	S	W	U	S	W	U	S	W	U	S	W	U
India	52	18	53	46	15	47	48	20	43				39	15	29			
Bihar	61	22	63	54	21	54	56	27	56				49	13	37	48	21	45
Kerala	27	12	29	22	11	27	25	16	23	23	24	21	19	16	19			
Tamil Nadu	NA	NA	48	29	20	37	31	22	30	27	28	33	23	19	23	27	20	24
Uttar Pradesh	60	16	59	52	12	52	57	15	42				50	10	34			

* Data for children below 4 yrs; @ Data for children below 3 yrs; # Data for children below 5 yrs

S: Stunted; **W:** Wasted; **U:** Undernourished as percentages of children in the respective age groups

Source: NFHS 1, 2, 3 and 4, DLHS 4 and RSOC 2013-14

Fig. 5: Stunting trends in India and the Selected States (Tamil Nadu, Kerala, Bihar and Uttar Pradesh)

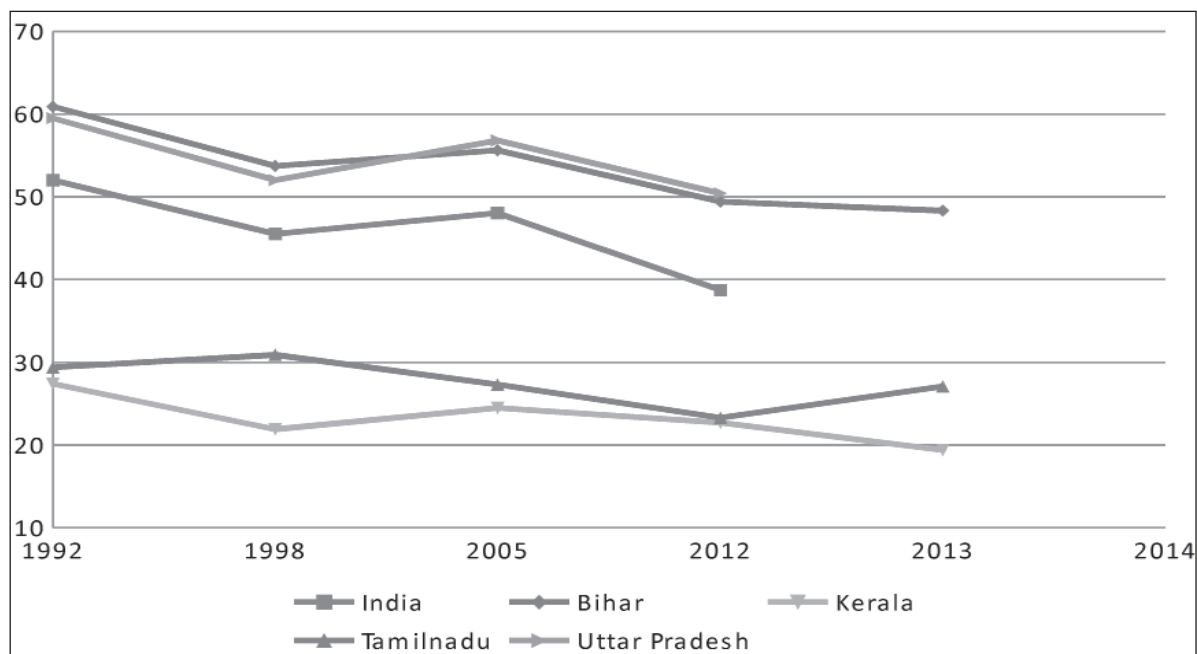


Table 5: Results of statistical analysis of severe and moderate malnutrition among children

State	Height-for-age			Weight-for-height			Weight-for-age		
	Percentage below		Mean Z - Score	Percentage below		Mean Z - Score	Percentage below		Mean Z - Score
	3 SD	2 SD		3 SD	2 SD		3 SD	2 SD	
India	17.3	38.7	-1.4	4.6	15.1	-0.5	9.5	29.4	-1.3
Bihar	26.1	49.4	-1.9	3.9	13.1	-0.5	14.7	37.1	-1.6
Kerala	8	19.4	-0.6	5.4	15.5	-0.1	5.7	18.5	-0.6
Tamil Nadu	9.3	23.3	-0.7	6.3	19	-0.5	6.1	23.3	-0.9
Uttar Pradesh	28.4	50.4	-1.9	2.9	10	-0.3	12.9	34.3	-1.5

Source: RSOC 2013 – 14

Fig. 6: Wasting trends in India and the Selected States (Tamil Nadu, Kerala, Bihar and Uttar Pradesh)

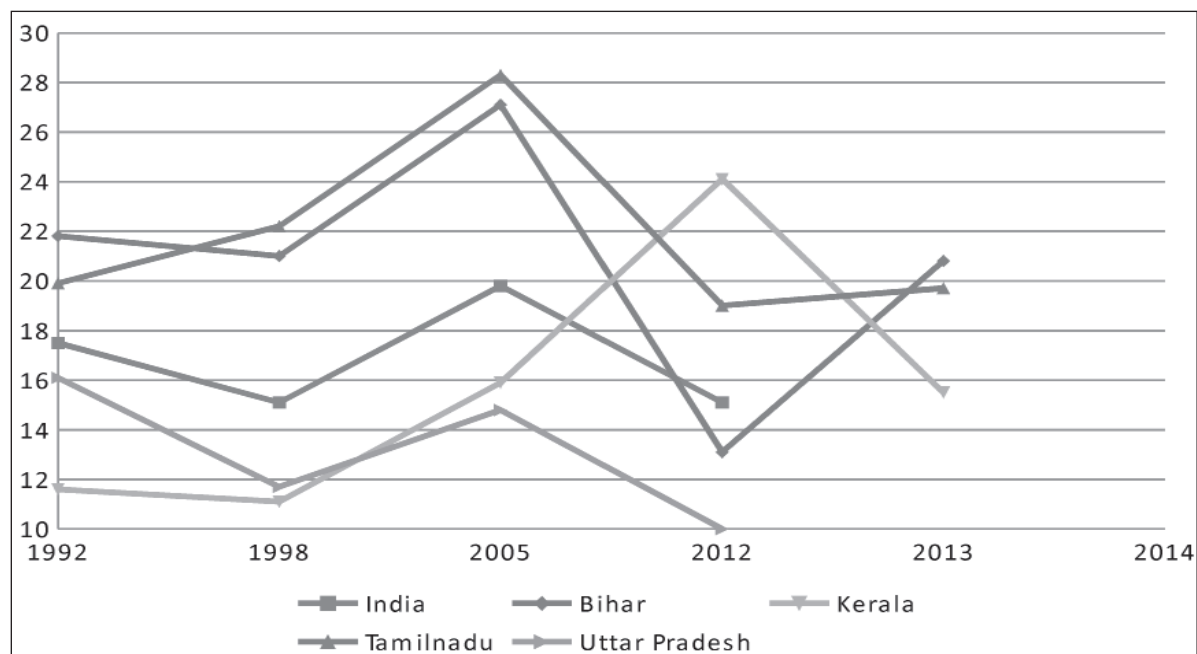
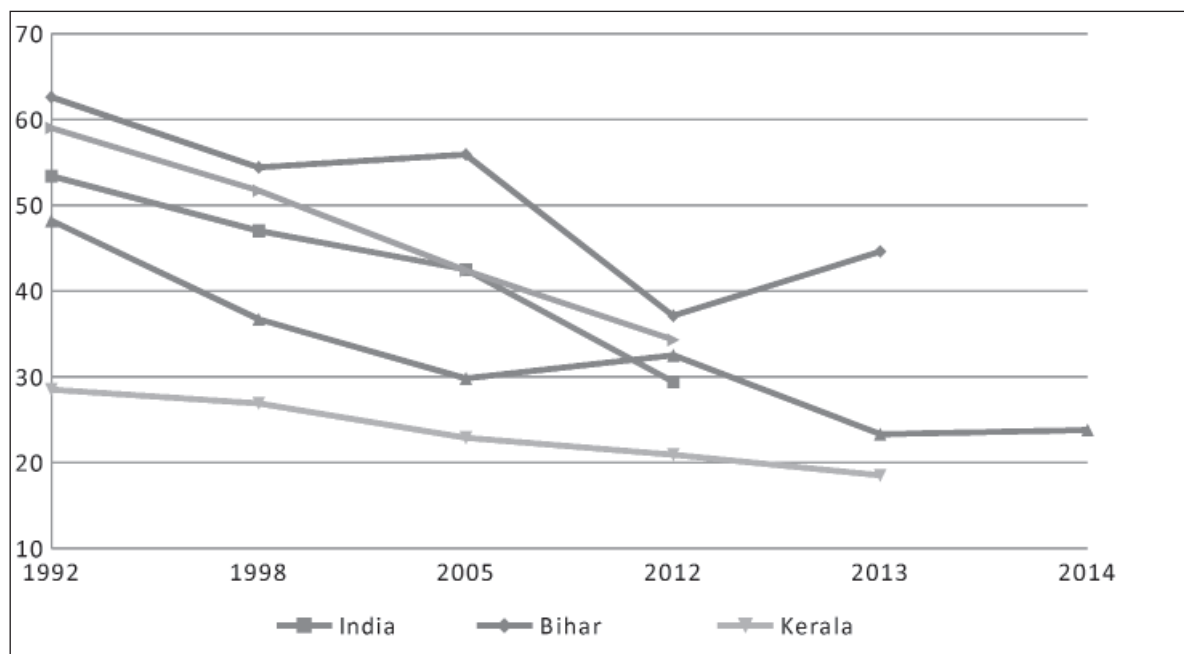


Table 6: Child Malnutrition by age

Child age in months	Stunted	Wasted	Underweight
< 6	17.1	17.8	17.8
6 - 8	23.9	16.5	22.9
9 - 11	29.5	18.1	26.6
12 - 17	37.7	16.2	26.4
18 - 23	45.8	16.5	33.3
24 - 35	42.8	14.3	30.1
36 - 47	44.1	13.7	31.6
48 - 59	43.1	13.7	35

Source: RSOC 2013-14

Fig. 7: Underweight Children – trend in India and the Selected States (Tamil Nadu, Kerala, Bihar and Uttar Pradesh)



It must be mentioned here that there is a difference in the proportions of malnourished, stunted, wasted and underweight children for some states as estimated from the RSOC and the National Family Health Survey-3 (2005-06) and NFHS-4 (2014-15).

Table 6 provides the estimates of stunting, wasting and underweight among children in different age-groups below the age of 5 years (6 to 59 months). One observation that is worthy of note is that the stunting percentage increased steadily with age. From 17% for infants below 6 months of age it rises to 29.5% for children aged 8-11 months, and continues to increase to 45.8% 18-23-month-olds. Thereafter, it declined marginally to 43.1% for children aged 48-59 months. This trend is indicative of chronic malnutrition in children after the end of complete breast feeding, which is usually at 6 months. Children are neither given adequate supplementary food nor fully fed after weaning. Lack of supplementary food seems to be the main problem.

On the other hand, the wasting (weight for height) percentage remained practically unchanged. In fact, it even declined slightly from about 17% in children up to 9 months of age to 14% in children in the 48-59 months (4-5 years) age-group. Since stunting is indicative of chronic malnutrition and wasting of acute malnutrition, this table indicates that chronic malnutrition has remained an unresolved problem over the years. The combined effects wasting and malnutrition are reflected in the high proportion (35%) of underweight children by ages 4 to 5 years.

C. Comparison with other developing countries

We compiled data for about 70 developing countries including India available from various international publications on seven variables viz; per capita GDP in PPP\$; youth dependency ratio; IMR; U5MR; and the two mal nutrition variables for children viz. stunting and wasting and percentage undernourished in the whole population for

different quin-quennial periods from 1990 to 2015 for which data were available. The developing countries were from the continents of Asia, Africa and South America for which data was available and data were available for differing number of countries for each variable in different periods of time ranging from 54 countries for population undernourished circa 1990 to 78 for child mortality variables in the same year. These data were compiled from the UNICEF and WHO joint report on Nutrition (2016) and the Global Hunger Index (2016) are given in Appendix 1.

India's per capita GDP in PPP\$ increased more than threefold during the 24 year, 1990 to 2014 from \$1773 to \$5439 at 2011 prices. During the same period IMR declined from 88 to 38 per 1000 live births, U5MR declined from 126 to 48, percentage of the undernourished (in terms of weight for age) in the population declined from 22 to 15; and the percentage of children below age 5 who were considered "wasted" decreased from 20 to 15 while that of stunted from 62 to 39.

Although these statistics indicate impressive progress in India, other developing countries have fared better in the area of reducing malnutrition among children compared to India. This is evident from the change in India's ranking based on various parameters (higher income, and lower mortality and malnutrition levels). In terms of per capita GDP, India was placed in the 38th position from the top among 64 developing countries in 1990. In 2014 it had moved up to the 18th rank out of 72 countries. On IMR, however, India's ranking improved only marginally from 46 to 40 and for U5MR India's ranking changed even less from 40 to 38, and in stunting from 66 to 54. However, there was a significant decline in India's ranking in terms of percentage of the population that was malnourished – from 15 to 29. In terms of wasting among children it improved its ranking from 68 to 65 and in terms of stunting it improved from 66 to 54.

Table 7 shows the values of various indicators and India's ranking as extracted from various international publications given in Appendix 1. Since the number of countries on which data were available for each variable from period to period varied and the actual values were also differing widely we decided to use a percentile indexed score of India calculated for each of the variables taking 0 as the best value and 100 as the worst. The formula used was:

$$\begin{aligned} \text{Index India (Ii)} &= 100 * (\text{Max- India's score}) / (\text{Max-Min}) \text{ for per capita GDP; and} \\ &= 100 * (\text{India's score} - \text{Minimum}) / (\text{Max-Min}) \text{ for the variables of} \\ &\quad \text{mortality and malnutrition.} \end{aligned}$$

The index is also used to make a fairer comparison in the context of large differences in absolute values between countries. These are shown within brackets in the last column of the Table 7.

Among the sixty five and odd developing countries studied here the "I" values based percentile rankings for India improved during the 24 year period improved from 86 to 51 in terms of per capita GDP; from 53 to 47 in terms of IMR; 66 to 30 in terms of U5MR; worsened in terms of population undernourished from 25 to 27; improved in

terms of wasting among children from 97 to 62 and on stunting from 84 to 63. India ranked 65 in the “wasted” category and 54 to 29 in the “stunted” category. Thus we see that the steep improvements in the rankings observed on the income front in India are not reflected on the child nutrition variables. Many countries with lower pace of increase in their per capita income levels have achieved greater levels of achievements in the reduction of malnutrition among children.

Table 7: Values of various Indicators and India’s ranking among 78 developing countries on selected parameters of income, mortality and malnutrition in C1990 and 2014.

Indicator	Absolute Value in C1990	India’s ranking among developing countries (a ranking of 1 is the best)	Value 2014	India’s ranking among the developing countries
Per capita GDP (\$PPP)	1773	38 out of 64 (86.2)	5439	18 out of 72 (51.4)
IMR	88	46 out of 78 (53.3)	38	40 out of 78 (46.8)
U5MR	126	40 out of 78 (65.6)	48	38 out of 78 (29.8)
Population under nourished	22	15 out of 54 (25.1)	15	29 out of 61 (26.8)
Percent of children under 5 wasted	20	68 out of 69 (96.9)	15	65 out of 71 (62.3)
Percent of children under 5 stunted	62	66 out of 69 (84.4)	39	54 out of 71 (63.2)

Based in data in Appendix 1

Figures in bracket indicate the index values (I) computed as explained in the text.

IV. The ICDS Program

(a) The Program

One of the questions that challenging policymakers and planners is that, despite running the world’s biggest nutrition programs, the problem of malnutrition among children continues to persist for over four decades. The Integrated Child Development Services (ICDS) program was launched in 1975. The ICDS itself was preceded in the early ’sixties by a program for providing milk powder (supplied by the UNICEF) to the country’s primary health centers as supplementary nutrient to children, an initiative of its founder-director, Dr. Grant, a missionary. So, it can be said that India’s efforts to tackle malnutrition began well before the ICDS.

The primary objective of the ICDS is to improve the nutritional and health status of children up to 6 years as well as pregnant and nursing women. In 2005, following a Supreme Court order, the scheme was universalized to cover all children of the country. The specific objectives of the program are:

- To improve the nutritional and health status of children in the age-group 0-6 years;
- To lay the foundation for proper psychological, physical and social development of the child;
- To reduce the incidence of mortality, morbidity, malnutrition and school dropout;
- To achieve effective co-ordination of policy and implementation amongst the various departments to promote child development;
- To enhance the capability of the mother to look after the normal health and nutritional needs of the child through proper nutrition and health education.

These objectives are sought to be achieved through delivery of the following six services to the target beneficiaries:

- Supplementary Nutrition for the family
- Pre-school non-formal education
- Nutrition & health education
- Immunization
- Health check-up and
- Referral services

(b) Financing of the program.

ICDS is a centrally-sponsored scheme but implemented by the state governments and union territories. Till the financial year (FY) 2005- 06, the Government of India (GOI) provided 100% financial support and all inputs except for the supplementary nutrition program (SNP), which was funded entirely from the state budgets. The funding pattern was modified in FY 2009-10 from which time the SNP's funding was divided equally between the state and central governments. An exception was made for the north-eastern states in which the funding arrangement was in a 90:10 ratio. For all other components of the ICDS, the GOI provides 90% of the budget.

The central government's budgetary allocation in FY 2015-16 for the Ministry of Women and Child development (MoWCD) was Rs. 10,382 crore (1 crore is 10 million) of which Rs. 8,754 crores were meant for ICDS. One point of concern is that the budgeted amount for FY 2015-16 is almost half of that of the previous years. As seen in Table 8, which shows the amounts spent since 2007-08, this is a sharp reversal of the trend in budgetary allocations. Table 9 provides the revised cost norms per child as provided for in the twelfth plan.

Table 8: Budgetary Allocation and actual Expenditure in ICDS during the Eleventh Plan and the first 3 years of the XII Plan (in crores or Rs. 10 million)

Sl. No.	Year	Budget Allocation (RE)	Expenditure	Percentage spent
1	2007-08	5396.3	5257.09	97.42
2	2008-09	6300	6379.36	101.25
3	2009-10	8162	8157.76	99.94
4	2010-11	9280	9763.11	105.2
5	2011-12	14048	14272.21	101.59
6	2012-13	15850	15701.5	99.06
7	2013-14	16312	16267.49	99.73
8	2014-15	16553.6	12862.34 (As on 31.12.2014)	77.7
9	2015-16	8754	NA	

Source: ICDS Reports

Table 9: Revised Cost Norms for Supplementary Nutrition under ICDS

Category	Existing norms per beneficiary	Revised cost Norms per beneficiary per day (as per phased roll-out)
Children (6 months to 72 months)	Rs. 4.00	Rs. 6.00
Severely malnourished Children (6 months- 72 months)	Rs. 6.00	Rs. 9.00
Pregnant women and lactating mothers	Rs. 5.00	Rs. 7.00

Source: RSOC 2013-14

The Twelfth Five-Year Plan (2012-17) allocated Rs. 1, 23,580 crore to ICDS, a three-fold increase over the previous plan. The number of operational Anganwadi Centers (AWCs) increased by 30% between March, 2009 and March, 2014. The number of beneficiaries per AWC continues to be high. As of March 2014, on average, one functioning AWC provided supplementary nutrition to 68 children. The average number of children per AWC was the highest in Bihar and Uttar Pradesh, with each AWC, as per the records, serving food to 193 and 101 children.

About the staffing position, vacancy rates for Anganwadi Workers (AWWs) and Anganwadi Helpers (AWHs) have declined since March 2011. As of March 2014, only 5% of AWW posts were reported vacant. However, many supervisory positions remain unfilled. As of March 2014, 31% of Child Development Project Officer (CDPO)/ Assistant Child Development Project Officer (ADPO) posts and 30% of supervisor posts were vacant across India.

(c) Staffing.

In compliance with the Supreme Court Order, the norms were revised to one AWC for a population of 500-1500 in the plains and 300-1500 in the Tribal areas, and one mini-AWC per 150 – 400 Population in Rural/ Urban areas and one mini AWC per 150 – 300 population in Tribal/ Riverine/ Desert places.

V. Evaluation of the Effectiveness of the Program

Many nation-wide surveys as well as local studies on select places have been carried out to evaluate ICDS. The findings of these studies largely affirm that program has had significant impact on several health behavior variables such as immunization of children, the extent of ante-natal care for pregnant women and on institutional deliveries. In addition, ICDS also had positive impacts on programs such as those in which the AWCs played supportive and coordinating roles for the health department personnel, the Auxiliary Nurse Mid-wife (ANM) and other primary health center staff. Table 10 shows the percentage changes observed in the immunization levels of children between the years 2005-6 (NFHS-3 data) and in 2013-14 (data from ROCH study of India, and the states of Bihar, Uttar Pradesh, Tamil Nadu and Kerala). There has been a significant increase in the immunization by BCG, DPT, Measles and Poliomyelitis vaccines. As the table also shows, there has been a dramatic increase in the percentage of children who have immunized against common preventable diseases between 2005-06 and 2013-14 from 49.5% to 65.3.

Table 10: Recent Trends in Immunization of Children

Survey Year	BCG	DPT			Polio			Measles	All	None
		1	2	3	1	2	3			
NFHS-3 (2005-06)	78.1	76	66.7	55.3	93.1	88.8	78.2	58.8	43.5	5.1
RSOC (2013-14)	91.1	89.4	84.1	74.8	90	83.4	73.5	78.9	65.3	6.6

Source: RSOC 2013-14

Owing to better nutritional care and advice to pregnant women, the percentage of underweight babies (less than 2.5 kg) born in India decreased from 21.5 to 18.6. Even in the less developed states of Bihar and Uttar Pradesh, the decline was significant – from 27.6% to 15% in Bihar, and 25.1% to 22.5% in UP. (See Table 11).

Table 11: Recent Trends in Birth weight of the child

	RSOC (2013-14)		NFHS 3 (2005-06)	
	Less Than 2.5 Kg	2.5 Kg and More	Less Than 2.5 Kg	2.5 Kg and More
India	18.6	81.4	21.5	78.5
Bihar	15	85	27.6	72.4
Kerala	13	87	16.1	83.9
Tamil Nadu	16.7	83.3	17.2	82.8
Uttar Pradesh	22.5	77.5	25.1	74.9

Source: RSOC 2013-14

The rate of utilization of various services provided by the Anganwadi centers (AWC) is, as expected, highest for the supplementary food program and the lowest for health services with the latter being provided by personnel from the public health department. Nationwide, the percentage of eligible population availing supplementary feeding program of the ICDS was 42.4%. State-wise this percentage varied from 15% in Kerala and 39.3% in Bihar, among the four states studied, Surprisingly, the percentage of children benefitting from this program was much higher in the more developed state of Tamil Nadu (30.5%) than in the less developed state of Uttar Pradesh (23.6%) when the opposite must be expected (See Table 12).

Table 12: Utilization of services provided at AWC

State	Type of services availed						
	Percentage of users for any AWC service	Supplementary	Immuni-zation	Health Check-up	Referral Services	NHE or advice on feeding and care of young children	Other
India	47.8	42.4	33	11.8	16.1	6.5	8.2
Bihar	51.3	39.3	42.7	21.7	7.9	11.2	10.4
Kerala	17.2	15	12.3	11.9	7.6	8.9	4.4
Tamil Nadu	36	30.5	22.2	21.7	20.4	23.5	10.1
Uttar Pradesh	26.5	23.6	18.1	11.5	5	3.2	2.7

Source: RSOC 2013-14

ICDS and malnutrition Linkages

We could study the linkages between the performance of ICDS program at district level and malnutrition among children in Tamil Nadu by combining data available from two recently conducted studies. The first was conducted by SRM University during 2014-15 and the second was NFHS-4 conducted in Tamil Nadu during 2013-14 and the Fact Sheet for Tamil Nadu, which was published in 2015.

On the request of the Tamil Nadu Government, SRM University (Chennai) undertook a study of representative samples of households in the state with children below 6 years, and of AWCs from each district. The purpose of the study was to evaluate, based on a study of the samples, the impact of the ICDS program in the state.

The study used several criteria for evaluation and computed a score for each district as measure of the performance of the AWCs in each district for each of the six dimensions of the ICDS program (Supplementary nutrition for the family, pre-school non-formal education, nutrition & health education, immunization, health check-up and referral services). A consolidated performance score was derived from the individual scores.

Strict statistical procedures were followed in the study. The Fact Sheet of NFHS-4 for Tamil Nadu provided district-wise data on the levels of malnutrition (stunting, wasting and underweight) among children below 5 years of age. We combined these two sets of data— from SRM's study and the Fact Sheet – to study the linkages between performance of ICDS and malnutrition at the district level in Tamil Nadu.

Table 13 presents the performance score on nutrition (supplementary feeding) and the overall score assigned to each district and its ranking among the 32 district as well as data on height for age, weight for height and weight for age, which was compiled from NFHS-4. The performance scores were constructed using standard statistical procedures and range from 0 to 1 with 0 indicating poor performance for that dimension and a score of 1 excellent. Data on the nutrition levels of children were taken from NFHS-4 (2014-15) which was released almost at the same time as the SRM report. Thus, we could relate performance of the ICDS program and malnutrition levels among children by combining data from two carefully conducted district-level studies in Tamil Nadu. The correlation coefficients and their statistical significance are given in Table 14.

Kanyakumari district showed the least malnutrition among children in all the three indicators (height for age, weight for height and weight for age) but it is not the best performing district in terms of supplementary nutrition or overall. It ranks 15th in overall score and 12th on nutrition. The worst performing district in child malnutrition is the Nilgiris but it is not the worst overall. In fact, it ranks 11th, which is higher than Kanyakumari, and 26th on the supplementary nutrition index. Clearly, there are factors affecting AWC performance, besides supplementary feeding and other services provided by the ICDS, which significantly influence malnutrition levels in the children. Larger forces, social and economic, are at play that determines the malnutrition levels in the general populations and children in particular.

Table 13: Scoring of ICDS activities and malnutrition among children in Tamil Nadu at district level - 2016

District	OI Rank	OI Score	Nutrition Rank	Nutrition Score	Height for Age	Weight for Height (2 SD)	Weight for Height (3 SD)	Weight for Age
Tamil Nadu		0.863		0.901				
Ariyalur	26	0.834	23	0.888	37	20.8	8.1	29.7
Chennai	1	0.918	14	0.911	30.9	18.1	12.6	17.2
Coimbatore	8	0.891	3	0.935	27.3	21.3	8.9	22.9
Cuddalore	10	0.888	20	0.899	28.2	19.7	7	25
Dharmapuri	2	0.909	10	0.918	24.2	33	18.3	29.6
Dindigul	19	0.859	21	0.896	31.1	26.5	12	29.8
Erode	21	0.854	17	0.905	25.6	16.3	6.1	16.1
Kancheepuram	9	0.889	27	0.884	25	13.9	2.9	16.1
Kanyakumari	15	0.874	12	0.915	17.2	9	2	12.8
Karur	14	0.875	2	0.939	27.5	23	9.5	28.9
Krishnagiri	17	0.869	19	0.901	25.1	20.1	9.7	23.1
Madurai	3	0.898	5	0.926	21.2	12.7	2.6	19.5
Nagappattinam	32	0.790	30	0.844	24.5	17.4	8.1	22.9
Namakkal	6	0.892	1	0.939	25.2	15	4.5	18
Nilgiris	11	0.877	26	0.884	33.1	31	17.1	30.7
Perambalur	23	0.844	25	0.885	24	18.2	4.8	22
Pudukkottai	29	0.824	28	0.875	26.7	20.9	5.4	25
Ramanathapuram	18	0.862	13	0.911	22.5	17	2.9	22.6
Salem	13	0.876	6	0.924	27	22.5	8.4	22.2
Sivaganga	12	0.877	9	0.918	20.9	18.8	7.8	22.7
Thanjavur	22	0.844	18	0.903	26	20.4	7.5	22.9
Theni	28	0.829	22	0.893	27.4	14	3.4	22
Thiruvallur	4	0.893	16	0.907	30.1	23.3	10.7	26.6
Thiruvarur	25	0.836	8	0.921	28.4	22.1	6.7	29.6

District	OI Rank	OI Score	Nutrition Rank	Nutrition Score	Height for Age	Weight for Height (2 SD)	Weight for Height (3 SD)	Weight for Age
Thoothukkudi	20	0.856	15	0.909	21.2	12.4	5	17.6
Tiruchirapalli	27	0.832	24	0.886	30	19	8.2	27.6
Tirunelveli	24	0.844	29	0.867	30.8	12.9	3.3	22.7
Tiruppur	7	0.891	4	0.933	29.4	20.4	10	24.9
Tiruvannamalai	30	0.813	32	0.818	24.5	34.6	18.7	34.7
Vellore	5	0.892	11	0.917	29	27.5	12	32.6
Viluppuram	31	0.802	31	0.840	31.8	16.3	3	28.6
Virudunagar	16	0.873	7	0.923	29.9	17.7	4.4	25.7

Source: TN ICDS Performance evaluation project – SRM University

NFHS – 4 District fact-sheet

OI: Rank based on the Overall Index of performance of AWCs in the district as explained in the text

Table 14 provides the correlation coefficients among variables used to study ICDS performance (overall score and supplementary nutrition score) and the levels of malnutrition among children in the population of the district. Surprisingly, there is no significant correlation coefficient between the ICDS performance score (overall or in nutrition) and the levels of malnutrition among children. The correlation between overall ICDS score and child stunting, wasting and underweight were found to be -0.066, 0.071 and -0.242, which are not statistically significant. Similarly, the correlation between the score on supplementary nutrition and malnutrition levels in the children was found to be -0.111, -0.142 and -0.286, which are also statistically insignificant.

This finding should alert program planners to the possibility that the problem of child malnutrition in society cannot be addressed solely by the ICDS program. It is a fact that families utilizing all services provided by ICDS, particularly supplementary feeding, have shown significant improvements in the weights of children but not in height for age indicating, thereby, that while ICDS program helps in alleviating acute malnutrition, it is less effective in alleviating chronic malnutrition.

There are also millions of children that are not living in villages covered by the AWCs and are, hence, left out of the program. While supplementary feeding contributes to reduction in the level of wasting among children (acute malnutrition); it does not prevent chronic malnutrition (as indicated by height-for-age) among beneficiaries of ICDS as well as the non-beneficiaries.

Table 14: Correlation between ICDS Score and Malnutrition

		Overall Index Score	Nutrition Score	Height-for-age 2 SD	Weight-for-height 2 SD	Weight-for-height 3 SD	Weight-for-age 2 SD
Overall Index Score	Pearson	1	.745**	-0.066	0.071	0.198	-0.242
	Sig.	0	0.715	0.698	0.277	0.181	
	N	33	33	33	32	32	32
Nutrition Score	Pearson	.745**	1	-0.111	-0.142	-0.112	-0.286
	Sig.	0	0.539	0.44	0.54	0.113	
	N	33	33	33	32	32	32
Height-for-age 2 SD	Pearson	-0.066	-0.111	1	0.334	0.283	.547**
	Sig.	0.715	0.539	0.062	0.116	0.001	
	N	33	33	33	32	32	32
Weight-for-height 2 SD	Pearson	0.071	-0.142	0.334	1	.911**	.811**
	Sig.	0.698	0.44	0.062	0	0	
	N	32	32	32	32	32	32
Weight-for-height 3 SD	Pearson	0.198	-0.112	0.283	.911**	1	.624**
	Sig.	0.277	0.54	0.116	0	0	
	N	32	32	32	32	32	32
Weight-for-age 2 SD	Pearson	-0.242	-0.286	.547**	.811**	.624**	1
	Sig.	0.181	0.113	0.001	0	0	
	N	32	32	32	32	32	32

Source: Report on Evaluation of ICDS in Tamil Nadu by SRM University

Comparison with other countries

As mentioned earlier, we analyzed data from 65 plus developing countries on per capita GDP (in PPP\$), youth dependency ratios (0-14 to 15-64 age group), IMR and UI5MR, and the proportion of the population that was undernourished and of children below age 5 who were wasted, stunted and undernourished. The source of data (See Appendix1) was the report of a joint UNICEF and WHO study (2016).

The correlation matrix of the seven variables is given in Table 15. At cross-national level, per capita GDP seems to have a high negative correlation with IMR, U5MR; and malnutrition levels in the population and among children, especially with stunting. The correlation coefficients of IMR and U5MR with child malnutrition levels, though significant, are quite low (-0.129 and -0.507 for wasting and stunting respectively). Income levels appear to have greater influence on stunting than wasting.

While wasting, which is indicative of acute malnutrition, can be alleviated by

supplementary feeding, stunting is indicative of chronic malnutrition and can be arrested by higher income levels so that families with stunted children can afford to provide the necessary nutrition on sustained basis. This is an economic issue that is determined by development policies and the nature of development in the given area. Needless to mention economic development must be inclusive and minimize the gross inequalities that characterize early phases of economic growth. Nutrition supplementation programs must necessarily be an integral part of the employment generation and food subsidy programs.

Table 15 Correlation coefficients between per capita income, child mortality and malnutrition among developing countries , circa 2014

	GDP_PPP	YDR	IMR	U5M	Pop_UN	Wasting	Stunting
GDP_PPP	1	-.703**	-.629**	-.628**	-.419**	-0.120	-.507**
YDR	-.703**	1	.670**	.708**	.282*	0.208	.577**
IMR	-.629**	.670**	1	.986**	.258*	.297*	.540**
U5M	-.628**	.708**	.986**	1	0.250	.296*	.535**
Pop_UN	-.419**	.282*	.258*	0.250	1	-0.009	.374**
Wasting	-0.120	0.208	.297*	.296*	-0.009	1	.405**
Stunting	-.507**	.577**	.540**	.535**	.374**	.405**	1

Data Source: Appendix 1

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

VI. Conclusions and Recommendations

To summarize, it is clear that, since 1990, there has been an appreciable decline (by 58%) in child mortality (U5MR) from 119 to 49 in 2013. However, the decline in malnutrition levels in India, taken as a whole, has been considerably less (25% in stunting, 6% in wasting and 43% in underweight). Even in 2013-14, per the survey conducted by the UNICEF and MoW & CW, the proportion of stunted, wasted and undernourished children were 39%, 15% and 29% respectively. With 138.86 million children below the age 6 years (Census 2011), in absolute terms, there are 54 million stunted children in India, the highest for any country.

While there has been appreciable decline in the levels of child malnutrition among at national level, wide differences among states persist. For example, malnutrition levels in Bihar and Uttar Pradesh in 2015-16 are higher than Kerala's in 1990. In 1992-93, 27% of children in Kerala were stunted and 12% wasted. In Bihar and Uttar Pradesh in 2014-15 the corresponding proportions were 48% and 21% for Bihar, and 27% and 20% for UP. Thus, many Indian states are lagging Kerala in child nutrition by over two decades. A malnourished child, especially one that is stunted, has a high probability of growing into an underweight adult with impaired brain development. Therefore, the

nation's future in terms of the physical and mental health of its people will be put in jeopardy if the problem of chronic child malnutrition is not addressed immediately on a war footing. The huge expenditures on ICDS in the large, less developed states have not resulted in commensurate improvements in the levels of malnutrition among children.

While it is true – as many studies have shown – that the ICDS program has resulted in impressive improvements in maternal and child care, and reduction in the number of underweight babies, there remain significant numbers of babies in the age group 6 months to 6 years that do not get enough food and supplementary nutrition at home after they are weaned away from breast milk. The nutrition gap is not adequately compensated by the supplementary nutrition provided by ICDS. An obvious inference is that more malnourished children are being born into society than can be covered by the ICDS program.

Cross-national analysis and comparison of data from developing countries showed high correlation between per capita income and levels of child malnutrition, especially stunting, which indicate chronic malnutrition. Such high correlations are not observed within India. Kerala is not a rich state in terms of per capita state domestic product; but it has the lowest levels of malnutrition among its children.

The ICDS performance index developed for Tamil Nadu (overall as well nutrition-specific functions) does not correlate significantly with stunting levels and undernourished children at district level. The relatively good governance practices of the state and administration of a sound food subsidy program for all households below poverty line seems to have played a more crucial role in containing child malnutrition in its early stages before the onset of stunting. Once it sets in, stunting is not easily treatable by the supplementary nutrition provided by ICDS. Tamil Nadu's model of supplying essential food items to all Below Poverty Line (BPL) through its PDS is worth emulating by other states.

Child malnutrition, whether in India or elsewhere in the world, cannot be attributed to a single factor but due to multiple interconnected causes. Four factors are identifiable from our analysis. First and foremost is the lack of a minimum income – an outcome of the absence of gainful employment – needed by families below the poverty line (estimated at about 360 million persons in 90 million households, about 28% of total) to enable access to nutrition on a sustained basis. This segment of the population is vulnerable to chronic hunger one consequence of which is malnutrition of the children in it.

The employment guarantee program launched by the government of India under the MGNREGA scheme is helping to alleviate this problem but it must be strengthened and more efficiently implemented. The poorer sections of the society must be involved in economically gainful activities, which is the primary responsibility of all democratically elected governments. The trickle-down effects of India's rapid economic growth in the past quarter century does not seem to have added any significant value to the efforts to reduce child malnutrition. Macro-economic growth has neither created commensurate employment opportunities for the jobless nor has made them. These require urgent policy attention.

Chronic malnutrition does not set in overnight. It begins with an underweight condition and wasting, which is exacerbated by diarrheal and other childhood diseases, which deplete the child's body of essential nutrients. There is also a need to improve sanitation and hygiene in households. This is the second major causal factor that must be attended to. Reduction in child mortality is relatively more easily achieved by medical interventions such as immunizations and antenatal care; however, reduction of malnutrition caused by diarrheal diseases and dysentery need fundamental changes in personal hygiene practices and environmental sanitation of the population.

It is recommended that the budget for the ICDS program should not be reduced, especially in respect of nutrition supplementation, as was done in the budget of 2014-15. This, however, should not replace the food subsidy program since the two are directed at different segments of the population. An increase in monthly allowances to pregnant women to help them purchase nutritious food for themselves and their children till they reach three years of age seems desirable. This can be made a part of the popular Janani Suraksha Yojana (JSY).

Finally, there is also the urgent need for a sustained, massive educational campaign to promote a scientific and evidence-based approach to maternal and child care, especially on supplementary feeding after the child has reached six months of age, and eliminate reliance on many traditional practices (such as administering castor oil) that are detrimental to a child's growth and development. The campaign must also include improved sanitation and hygiene practices at personal as well as household and community levels.

Acknowledgement

I am thankful to Mr. M. Senthil Selvan who has assisted me in the preparation of this paper

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APPENDIX 1:

Income, Child Mortality and Malnutrition Data for developing countries (1990 to 2014)

Country Name	GDP per capita, PPP (constant 2011 international \$)		Age dependency ratio, young (% of working-age population)		Mortality rate, infant (per 1,000 live births)		Mortality rate, under-5 (per 1,000)		Proportion of undernourished in the population (%)				Prevalence of wasting in children under five years (%)				Prevalence of stunting in children under five years (%)			
	1990	2014	1990	2014	1990	2015	1990	2015	'91-'93	'99-'01	'07-'09	'14-'16	'90-'94	'98-'02	'06-'10	'11-'15	'90-'94	'98-'02	'06-'10	'11-'15
Sri Lanka	3679	10599	51	37	18.1	8.4	21.2	9.8	31.3	29.9	27.6	22	17.5	15.5	13.3	21.4	29.7	18.4	18.3	14.7
Egypt	6014	10049	75	53	63	20.3	85.9	24	3.9	2.7	3.5	1.9	4.3	6.9	7.9	9.5	33.1	24.6	30.7	22.3
Indonesia	4477	10033	61	42	62.2	22.8	84.7	27.2	19	17.2	17.7	7.6	14.1	5.5	14.8	13.5	53.3	42.4	40.1	36.4
Georgia	8018	8742	37	25	40.8	10.6	47.7	11.9	—	14.8	6.8	7.4	3.6	3.1	1.6	2.4	22.6	16.1	11.3	10.9
Kosovo		8695																		
Ukraine	10490	8267	32	21	16.7	7.7	19.5	9	—	4.1	1.3	1.2	2	8.2	1.5	1.6	9.8	22.9	7.5	7.6
El Salvador	4532	7967	72	43	45.9	14.4	59.4	16.8	15.1	12.5	11.2	12.4	1.4	1.5	1.6	2	29.5	32.3	20.6	14
Swaziland	6316	7911	98	64	56	44.5	74.7	60.7	16.6	21.7	21.3	26.8	2.2	1.7	1.1	2	38.2	36.6	40.4	25.5
Armenia	3736	7699	47	26	42.5	12.6	49.8	14.1	—	21.4	6.1	5.8	4.6	2.5	4.2	3.3	24	17.7	20.8	12.9
Bhutan	2333	7456	82	41	93.3	27.2	133.7	32.9	—	—	—	—	5.9	2.5	4.7	4.4	60.3	47.7	34.9	26.9
Morocco	3933	7146	70	41	63.1	23.7	80.1	27.6	6.7	6.5	5.4	4.4	2.6	4.2	3.5	2.3	29.9	24.3	18.3	14.9
Guatemala	5159	7112	88	64	59.8	24.3	80.9	29.1	15.4	22.1	15.1	15.6	2.2	3.7	1.1	0.7	58.2	50	48	46.5
Philippines	4010	6649	73	51	40.8	22.2	58.2	28	27	21.3	13.8	13.5	8.8	8	6.9	7.9	40.9	38.3	32.3	30.3
Bolivia	3707	6325	76	54	85.6	30.6	124.4	38.4	35.9	34.6	28	15.9	3.6	1.6	1.4	1.6	37.1	33.1	27.2	18.1
Cabo Verde	1660	6220	93	46	48.2	20.7	62.7	24.5					6.9				21.4			
Congo, Rep.	5257	5988	83	79	60.9	33.2	93.6	45	43.3	35.9	33.3	30.5	6.5	6.9	7.3	8.2	28.2	28.7	29.5	21.2
Nigeria	3030	5639	86	83	125.9	69.4	212.5	108.8	17.9	9.2	5.9	7	20.6	17.6	14.4	7.9	43.8	39.7	41	32.9
Samoa	3648	5523	72	65	25.8	15	31	17.5		1.3		6.4		1.3				6.4		
India	1773	5439	65	45	88.3	37.9	125.8	47.7	22.2	17	17.2	15.2	20	17.1	20	15.1	61.9	54.2	47.9	38.7
Vietnam	1501	5370	66	33	36.6	17.3	50.8	21.7	44.8	28.1	16.8	11	6.7	9	9.7	5.7	61.4	43	30.5	19.4
Uzbekistan	3032	5317	74	43	58.8	33.9	71.5	39.1	—	11.5	9.4	4.2	7.6	8.9	4.5	5.8	29.8	25.3	19.6	18.7
Lao PDR	1621	5076	85	57	111.1	50.7	162.4	66.7	43.6	39.2	24.7	18.5	11.8	17.5	7.3	6.4	53.6	48.2	47.6	43.8
Moldova	6440	4754	44	21	27.3	13.6	33.1	15.8	—	17	15.2	12.2	5.2	3.9	3.3	1.9	13.6	12.3	8.4	6.4
Nicaragua	3020	4692	90	47	50.9	18.8	66.9	22.1	52.7	34.8	21.5	16.6	2.4	2.3	1.5	1.1	29.6	25.2	23	15.5
Honduras	3205	4683	89	52	45.1	17.4	58.2	20.4	22.7	19	15.3	12.2	2.1	1.2	1.4	1.4	42.5	34.5	29.9	22.7
Pakistan	3057	4590	81	58	106.1	65.8	138.6	81.1	25.7	22.4	22.2	22	12.5	14.2	12.6	10.5	54.5	41.5	40.6	45
West Bank and Gaza		4302	98	72	35.6	18	44.4	21.1						3.6	3.3	1.2		10.6	10.9	7.4
Ghana	1920	3894	82	67	79.8	42.8	127.4	61.6	36.9	17.5	8.3	2.3	10.9	9.9	8.7	4.7	41.2	31.3	28.6	18.7
Sudan	1753	3882	88	73	79.9	47.6	127.5	70.1	—	—	—	—	—	—	—	16.3	—	—	—	38.2
Mauritania	2801	3732	85	71	77.9	65.1	118.1	84.7	14.4	11.5	9.2	5.6	17.4	15.3	8.1	11.6	54.8	39.5	23	22
Zambia	2318	3725	95	90	113.3	43.3	190.6	64	34.9	42.9	53.5	47.8	6.3	5.7	5.6	6.3	46.4	57.9	45.8	40
Micronesia, Fed. Sts.	2763	3177	84	56	43.4	28.6	55.6	34.7												
Kyrgyz Republic	3475	3169	65	48	54.1	19	65	21.3						2.9	3.4	2.8		8.1	10.7	7
Djibouti	3112	3120	85	52	92.7	54.2	119.4	65.3	76.8	52.4	26.2	15.9	18.1	19.4	17	21.5	34.1	26.5	33	33.5
Cambodia	3113	84	50	85.4	24.6	117.3	28.7	29.7	32	17.5	14.2	13.9	16.9	8.9	9.6	58.6	49.2	39.5	32.4	
Cote d'Ivoire	3220	3108	85	79	104.9	66.6	152.6	92.6	10.8	14.9	14.1	13.3	8.3	6.9	14	7.6	34.2	31.5	39	29.6
Sao Tome and Principe		3030	100	79	70.5	34.6	110.7	47.3												
Bangladesh	1290	2979	78	46	99.7	30.7	143.7	37.6	33.2	23.1	17	16.4	16.1	13.8	17.5	14.3	71.5	54	43.2	36.4

Country Name	GDP per capita, PPP (constant 2011 international \$)		Age dependency ratio, young (% of working-age population)		Mortality rate, infant (per 1,000 live births)		Mortality rate, under-5 (per 1,000)		Proportion of undernourished in the population (%)				Prevalence of wasting in children under five years (%)				Prevalence of stunting in children under five years (%)			
	1990	2014	1990	2014	1990	2015	1990	2015	'91-'93	'99-'01	'07-'09	'14-'16	'90-'94	'98-'02	'06-'10	'11-'15	'90-'94	'98-'02	'06-'10	'11-'15
Vanuatu	2549	2891	83	62	29.2	23.1	35.6	27.5						6.8	5.9	4.4		25.7	25.9	28.5
Cameroon	2768	2836	92	79	85.6	57.1	138	87.9	37.5	32.3	16.9	9.9	4.5	6.2	7.3	5.2	36.3	38.2	36.4	31.7
Kenya	2376	2818	101	76	65.8	35.5	102.3	49.4	35.3	32.3	25.7	21.2	7.1	7.4	7	4	40.2	41	35.2	26
Papua New Guinea	1607	2723	76	63	65.3	44.5	89.4	57.3	—	—	—	—	8.6	8.3	8.1	14.3	50.1	48	47.2	49.5
Tajikistan	3635	2567	83	56	85	38.5	108.4	44.8	—	38.8	38.2	33.2	11	9.4	5.5	9.9	41.1	42.1	34	26.8
Lesotho	1301	2517	85	61	70.8	69.2	88.1	90.2	15.2	13	11.2	11.2	3.2	6.7	3.9	2.8	39.2	53	42	33.2
Tanzania	1473	2421	90	88	100.4	35.2	165.2	48.7	24.8	36.8	33.8	32.1	7.9	5.6	2.7	3.8	49.7	48.3	43	34.7
Nepal	1198	2265	79	55	97.7	29.4	140.7	35.8	23.4	22.2	13.3	7.8	11.9	11.3	12.7	11.3	61.6	57.1	49.3	37.4
Senegal	1864	2226	94	82	70.3	41.7	140.4	47.2	25.5	29.4	16.6	10	9	10	8.3	5.8	34.4	29.5	23.8	19.4
Chad	1110	2082	96	97	115.8	85	214.6	138.7	56.4	40.1	40.8	34.4	15.2	13.9	15.7	13	44.6	39.3	38.7	39.9
Solomon Islands	1793	2032	88	70	32.2	23.6	39.7	28.1					7.4		4.3		33.7		32.8	
Benin	1456	1937	91	78	108	64.2	179.5	99.5	27.7	23.9	13	7.5	11.5	9	8.4	4.5	43.9	39.1	44.7	34
South Sudan	1926	83	78	149.7	60.3	253.2	92.6	—	—	—	—	—	—	—	23.8	—	—	—	33.7	
Sierra Leone	1375	1876	84	78	156.5	87.1	264.3	120.4	41.7	38	32.4	22.3	10.2	11.6	10.5	9.4	40.9	38.4	37.4	37.9
Afghanistan	1844	97	85	122.5	66.3	181	91.1	35.6	45.2	27.7	26.8	11.4	13.5	8.9	9.5	51.1	54.7	51.3	40.9	
Zimbabwe	2526	1709	91	75	51.2	46.6	75.8	70.7	44.4	43.7	37.3	33.4	5.3	8.5	3.8	3.2	28.5	33.7	35.1	26.8
Uganda	773	1689	98	98	111.4	37.7	187.1	54.6	24.4	28.4	24.8	25.5	6	5	6.3	4.3	44.7	44.8	38.7	34.2
Haiti	1652	82	56	101	52.2	145.8	69	61.5	55.2	54.4	53.4	5.9	5.6	10.3	5.2	40.1	28.3	29.7	21.9	
Rwanda	850	1584	104	74	93.2	31.1	151.8	41.7	53.9	60.6	42.8	31.6	5	8.3	4.3	2.2	56.8	47.5	43	37.9
Gambia, The	1517	1556	90	90	80	47.9	170.2	68.9	13.5	14.1	13.1	5.3	9.4	8.9	8.4	11.1	31.5	24.1	25.5	25
Burkina Faso	821	1545	96	88	102.5	60.9	202.2	88.6	24.5	26.6	24.2	20.7	15.5	15.7	11.3	10.9	40.7	45.5	35.1	32.9
Mali	1096	1526	94	95	130.6	74.5	254.4	114.7	17.3	13.9	6.3	4.1	15.1	12.6	15.3	11.6	46.4	42.7	38.5	37.7
Ethiopia	652	1431	92	77	121.6	41.4	204.6	59.2	75.2	57.9	41.1	32	9.2	12.4	10.7	8.7	66.9	57.4	48.8	40.4
Madagascar	1661	1373	87	76	98.1	35.9	160.7	49.6	29.1	34.8	31.9	33	6.4	10.9	10.3	9.5	60.9	55.6	49.2	48.6
Comoros	1531	1364	92	71	87.9	55.1	125.1	73.5	—	—	—	—	5.3	13.3	9.2	11.1	38.5	46.9	39.8	32.1
Guinea-Bissau	1507	1322	87	73	135.5	60.3	229.3	92.5	21.8	28.4	25.1	20.7	9	11.8	4.8	6	42.6	36.1	27.7	27.6
Guinea	1125	1165	83	79	140.8	61	238.2	93.7	22.8	27.2	19.8	16.4	10.1	10.3	8.3	7.8	39.9	46.9	40	33.5
Mozambique	375	1077	96	89	159.7	56.7	239.7	78.5	58.8	42	35	25.3	10.5	6.8	4.2	6.1	55.3	49.6	43.7	43.1
Niger	906	895	95	107	138.1	57.1	328.2	95.5	31	22.8	12.8	9.5	18.9	16.2	12.9	18.7	48.3	54.2	47	43
Liberia	873	804	87	78	170.1	52.8	255	69.9	27.6	36.5	36.6	31.9	6.7	7.4	7.8	5.6	42.7	45.3	39.4	32.1
Malawi	543	784	89	89	142.5	43.4	242.4	64	45.7	28.6	23.1	20.7	6.6	6.8	1.8	3.8	55.8	54.6	48.8	42.4
Burundi	1049	734	97	84	103.9	54.1	171.8	81.7	—	—	—	—	7.2	8.2	7.3	6.1	59.1	63.1	58	57.5
Congo, Dem. Rep.	1268	712	89	91	119.8	74.5	186.5	98.3	—	—	—	—	11.4	20.9	14	8.1	44.1	44.4	45.8	42.6
Central African Republic	936	567	82	69	115.3	91.5	176.5	130.1	47.6	44.1	37.1	47.7	9.8	10.5	12.2	7.4	42.8	44.6	45.1	40.7
Guyana	2928		58	46	46.6	32	60.4	39.4	22	10.4	11.2	10.6	9.2	12.1	6.8	6.4	18.4	13.8	18.9	12
Korea, North			39	31	33.4	19.7	43.4	24.9	24.7	37.9	39.5	41.6	9.1	12.2	5.2	4	43.5	51	32.4	27.9
Myanmar			65	42	78.3	39.5	109.9	50	62.7	52.4	26.4	14.2	12.7	10.7	7.9	7.1	53.6	40.8	35.1	31
Yemen, Rep.	3392		113	72	88.7	33.8	126.3	41.9	28.6	29.6	27.7	26.1	14.3	15.8	14.4	16.2	52.4	54.6	47	46.8
Eritrea			91	78	93	34.1	151.4	46.5	—	—	—	—	11.8	14.9	15.3	12.5	69.6	43.7	50.3	49.1
Syrian Arab Republic			94	62	30.4	11.1	37.2	12.9	—	—	—	—	10	4.9	11.5	—	32.9	24.3	27.5	—
Somalia			86	93	108.4	85	180.2	136.8	—	—	—	—	—	19.3	14.9	—	—	29.2	25.9	—

Source: WDI, 2016; UNICEF and WHO joint Report on Nutrition 2015; Global Hunger Index 2016

My association with (Late) Prof. John C. Caldwell

I met Prof Caldwell, called Jack, briefly when he passed through UNESCAP, Bangkok, in 1974 when he was visiting the UN office. Our contacts became more regular and informal when I came to Bangalore, as Director, Population Center of the India Population Project in 1975. He did a number of field studies in and around Bangalore on the living conditions and demography of the rural populations there. Many of the research assistants and officers who participated in these studies were offered doctoral fellowships to do their PH.D in demography at the Australian National University. Many students of his from the Bangalore Center later became distinguished demographers in their areas of specialization. He had a fondness to India, its history, culture and diversity. His field of study at the Graduate level, I think, was history.

Jack and I became good friends when we were members of an expert group invited by the WHO regional office in Manila, in 1983 to visit China for two weeks and study and recommend on their population research activities undertaken by their universities. The one – child policy of China was already well in place at that time and fertility levels were tumbling down. The states' permission to marry , move from one place to the other and to have even the first child was mandatory and we could hardly imagine that partly because of such drastic reductions in fertility and population growth rates that China would advance so rapidly in the economic arena and become a superpower. It was appalling to us that state can intervene so effectively in people's personal lives and we were constantly discussing during our travels together how the two year emergency period in India during 1975-77 could not succeed even with the two child policy while China succeeded with its one child policy. After the China visit we did a paper together on Nuptiality in China published in PDR.

I was later invited to ANU as a Visiting Faculty during 1985-86 and my stay was made quite comfortable thanks to the warm hospitality of Pat and Jack Caldwell. Later when he became very famous internationally as President IUSSP and involved in international organizations I could not keep in regular touch with him. His wife Pat was a warm and friendly person and was his constant lifelong companion in personal and professional matters.

I have always appreciated Jack for his enormous productivity in demographic research and voluminous outputs. Every night he used to write in his own handwriting many pages to be typed out by his secretary next day morning. He was passionately committed to women's education as a panacea for many social ills including high fertility and mortality. On a personal side, I found him and his wife Pat very helpful souls and was always ready to support and guide a student. His love for Indian food was also great and he had enormous digestive powers. He could eat any fried and spicy Indian food from wayside vendors and relish it and digest it. He loved to travel by road long distances with his family and he has driven across Europe and Asia with his family.

I am honored to give this first lecture instituted in his memory.

K. Srinivasan

Prof. Krishnamurthy Srinivasan



Prof. K. Srinivasan is a distinguished demographer who has made valuable contributions in the country and abroad in the areas of teaching, research and consultations in Population Studies and Programs for over five decades. He is not only an internationally acclaimed teacher and researcher in the field of Demography, but also served the country through various national and international committees and associations. He was a member of the National Commission on Population with the Hon'ble Prime Minister of India as Chairman during 2000-02 and a member of the National

Statistics Commission during 2000-01. As Executive Director of Population Foundation of India in New Delhi during 1995 to 2002 (an organization founded by late JRD Tata) he has promoted and enhanced the role of NGOs and the corporate sector in family planning and reproductive and child health programs.

As a Senior Professor and Director of the International Institute for Population Sciences in Mumbai from 1978 to 1992, he expanded on the academic and geographic scope of the Institute by making it a Deemed University and training a large number of students from other countries in Asia with financial assistance from the UNFPA. He was also instrumental in starting the National Family Health Survey (NFHS) during 1991-92. This survey with all other similar subsequent surveys has given us a better picture of the conditions of health and family planning. He has more than 15 books and 100 national and international peer reviewed academic publications to his credit. His seminal work on birth intervals are still being cited widely.

He has also made his contributions to other developing countries in the field of Population Studies and research under the auspices of the United Nations and other international organizations. He was employed with the Population Division of the United Nations at their ESCAP office in Bangkok. He was chairman of a group set up by the WHO and the United Nations Populations Fund (UNFPA) to review and recommend on Population Research Centers in China during 1981 and 1983 and his contributions have been appreciated by the Government of China by a scroll of honor. He was a Visiting Senior Fellow at the Australian National University in Canberra during 1985-86 and was a visiting Professor at the Carolina Population Center, University of North Carolina, USA during 1992-93.

Prof. Srinivasan obtained his MA in Mathematics from the Madras University and subsequently graduated with distinction from the Indian Statistical Institute, Kolkata, with a Masters in Statistics. He went on to obtain a Master degree from Harvard University in Public Health. He was the first student to obtain his Ph.D in Demography from Kerala University in 1968.

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INDIAN ASSOCIATION FOR SOCIAL SCIENCES AND HEALTH (IASSH)

The Indian Association for Social Sciences and Health (IASSH) is a registered society (No. 218/2006AP). IASSH has currently 1,200 life members.

VISION

- ◆ To position IASSH as a knowledge transformation organisation in Social Sciences and Health Research in India.

GOALS

- ◆ To encourage YOUTH participation and develop knowledge transformation in Social Sciences and Health Research.
- ◆ To attain Sustainable Development in capacity building of Youth in Social Sciences and Health Research.

The Aims and Objectives of the Association are:

- ◆ To bring together scientists, practitioners and policy makers from various disciplines on to one forum to explore and work in the areas of social and cultural dimensions of illness, health and health care in the country
- ◆ To encourage mutual and collective efforts to develop, promote and apply health and social sciences
- ◆ To improve health via inter-disciplinary and trans-disciplinary approaches
- ◆ To assess current status and best practices in relation to application of social sciences in health
- ◆ To strengthen networking with other sub-regional, regional and trans-regional organisations linking social scientists, health scientists, health activists and policy makers
- ◆ To organise seminars, workshops and conferences to enable sharing of research results and experiences relating to the social aspects of health
- ◆ To disseminate new theories and innovative inter-disciplinary and trans-disciplinary approaches for understanding and addressing emerging health problems
- ◆ To initiate steps to evolve an equitable health care system in the country through appropriate and affordable health sector reforms
- ◆ To publish books, journals and such other literature that will promote the dissemination of knowledge in the field of health social sciences
- ◆ To enable scholars in health social sciences to enhance their career opportunities and fulfil their professional commitments
- ◆ To do all such things and perform all such acts as are necessary and appropriate for the achievement of any or all of the above objectives.

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