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How Childhood Stunting Reduced in Tamil Nadu: An Analysis of Change Between 1992 and 2016

Report

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ABOUT POSHAN

POSHAN (Partnerships and Opportunities to Strengthen and Harmonize Actions for Nutrition in India) is a multiyear initiative that aims to build evidence on effective actions for nutrition and support the use of evidence in decision-making. It is supported by the Bill & Melinda Gates Foundation and is led by International Food Policy Research Institute (IFPRI) India.

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LIST OF ABBREVIATIONS

AAY	Antyodaya Anna Yojana
ACDPO	Additional Child Development Project Officer
ALMSC	Anganwadi Level Monitoring and Support Committee

ANC	antenatal care
ARI	acute respiratory infection
ASHA	Accredited Social Health Activist
AWC	Anganwadi Center
AW-MPR	Anganwadi Monthly Progress Report
AWW	Anganwadi Worker
BPL	below poverty line
CDPO	Child Development Project Officer
CEmONC	Comprehensive Emergency Obstetric and Newborn Care
DHFW	Department of Health and Family Welfare
DWCD	Department of Women and Child Development
ECCE	Early Childhood Care and Education
EIBF	early initiation of breastfeeding
HAZ	height-for-age z-scores
ICDS	Integrated Child Development Services
ICU	intensive care unit
IFA	iron and folic acid
IGMSY	Indira Gandhi Matritva Sahyog Yojana
IMR	infant mortality rate
IYCF	infant and young child feeding
JSY	Janani Suraksha Yojana
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MIS	management information system
MO	medical officer
NCD	non-communicable disease
NFHS	National Family Health Survey
NRHM	National Rural Health Mission
ORS	oral rehydration solutions
PDS	Public Distribution System
PHC	Primary Health Center
PNC	postnatal care
POSHAN	Partnerships and Opportunities to Strengthen and Harmonize Actions for Nutrition in India
RBSK	Rashtriya Bal Swasthya Karyakram
RCH	Reproductive and Child Health
RMNCH	Reproductive, Maternal, Newborn, and Child Health
SES	socio-economic status
SHG	self-help group
SIDA	Swedish International Development Agency
SUN	Scaling Up Nutrition
TINP	Tamil Nadu Integrated Nutrition Project
TNAHCP	Tamil Nadu Area Health Care Project
TNCSC	Tamil Nadu Civil Supplies Corporation
TNHSP	Tamil Nadu Health Systems Project
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VHN	Village Health Nurses
WB	World Bank

EXECUTIVE SUMMARY

India comprises one-sixth of the world's population and one-third of the global burden of undernutrition. Between 2006 and 2016, India made progress in reducing stunting among children below five years; the progress, however, has not been uniform across all its states (Menon et al. 2018). There are interstate differences in stunting reduction despite a common national policy framework for nutrition-specific and nutrition-sensitive programs. Given the paucity of insights on what factors drive successful change in nutritional outcomes such as stunting at the state level in India, we conducted studies in the four states of Chhattisgarh, Gujarat, Odisha, and Tamil Nadu.

In this report, we document the story of change in Tamil Nadu, which is one of the exemplary states in India. With a long history of nutrition and health reforms, it stands out as a leader in social development. We aimed to update prior work on Tamil Nadu to assess more recent changes in nutritional outcomes, determinants, and coverage of interventions. Our key goals were to: 1) examine changes in child stunting, known determinants of stunting and key health and nutrition interventions between 1992 and 2016; 2) assess the contribution of diverse determinants and intervention coverage changes to the changes in stunting between 2006 and 2016; and (3) interpret the changes in the context of policies, programs, and other changes in the state.

Methods

We used a mix of research methods in our case study. Using multiple rounds of data from surveys, we developed a 24–year (1992–2016) timeline of changes in stunting and its known determinants. We specifically analyzed four rounds of the National Family Health Survey: NFHS–1 (1992/1993), NFHS–2 (1998/1999), NFHS–3 (2005/2006), and NFHS–4 (2015/2016)(IIPS (International Institute for Population Sciences) 1993; 1999; 2006; 2016); we also used the Annual Health Survey (where necessary). First, we examined the data on stunting reduction and changes in known drivers of undernutrition descriptively. Next, we used regression–decomposition analysis to examine the contributions of changes in known determinants of stunting between 2006 and 2016. We conducted a literature review to assess changes in policies and programs pertaining to key drivers of nutrition between 1992 and 2016. The literature review was used to construct a timeline of policies and programs over the period of stunting reduction, and to support overall analysis and interpretation. We conducted stakeholder interviews to supplement our analysis and to add experiential insights on potential reasons for changes in key programs and policies. Finally, we integrated insights from all these different sources of information to interpret what drove change and what contributed to that change in Tamil Nadu.

Findings

What changes were seen on stunting and its known determinants and coverage of interventions between 1992 and 2016 in Tamil Nadu?

In 1992, children's heights were not measured in Tamil Nadu and therefore data on the status of stunting for that period is unavailable. Between 1998 and 2006, stunting prevalence declined from 35 to 31 percent among children below three years in Tamil Nadu. Between 2006 and 2016, there was a 3.7 percentage point (pp) drop in stunting prevalence among children

below 5, declining from 31 to 27 percent. There were greater declines in stunting among children 24 to 59 months (9 pp) than there were among children 6 to 23 months (1 pp).

Changes in the **immediate determinants** of stunting have been mixed over the 24-year period. Comparable measures of child feeding practices are not available between 1992 and 2005. Between 1998 and 2005, there were steady improvements in women's health and in infant and young child feeding (IYCF) practices. Between 2006 and 2016, women's nutrition status improved, and by 2016 less than 20 percent of women had low body mass index (BMI). During the same period, early initiation of breastfeeding remained stagnant at 58 percent and exclusive breastfeeding increased dramatically from 33 to 47 percent. However, there was an 18 pp decline in the timely initiation of complementary feeding (from 90 to 72 percent) and a marginal decline in minimum meal frequency (from 54 to 53 percent). On a positive note, the proportion of children consuming food from the recommended number of food groups increased dramatically by 29 pp (from 27 to 56 percent). Changes in the disease burden among children were mixed; the proportion of children who had had diarrhea in the two weeks before the survey increased from 5 to 8 percent, but the proportion of children who had had acute respiratory infections in the previous two weeks declined from 4 to 3 percent.

Between 1992 and 2016, there were improvements in the **underlying determinants** of stunting in Tamil Nadu. Since 1992, there have been steady improvements in women's education and age at marriage; further remarkable improvements were noted between 2006 and 2016. The proportion of women with more than 10 years of education nearly doubled, moving from 32 to 62 percent. Although there has been a decline in the proportion of women getting married before the legal age of marriage, in 2016, 32 percent of women in the age group of 20 to 49 years reported getting married before the age of 18 years.

Tamil Nadu has also achieved improvements in infrastructure. By 2016, 90 percent of households had access to improved drinking water and 99 percent had access to electricity; only 49 percent of households, however, were using improved sanitation facilities.

Since 1990, the **coverage of nutrition-specific interventions** has been high compared to the national average; the coverage has steadily improved over the years for several interventions. The positive trend has continued between 2006 and 2016. Some notable changes include:

Pregnancy care: Between 2006 and 2016, coverage of four or more antenatal care (ANC) visits declined from 86 to 82 percent. The percentage of women who received iron and folic acid (IFA) supplements increased from 91 to 95 percent. During this period there was also a dramatic increase of 37 pp (28 to 65 percent) in the proportion of pregnant women who consumed IFA supplements for 100 or more days, and in the proportion of women who received food supplements (50 to 62 percent).

Delivery/birth care: There have been steady improvements in the coverage of interventions such as delivery in health facilities and births assisted by a health professional; by 2016, coverage of these interventions approached 100 percent.

Postpartum and early childhood: Between 2006 and 2016, the proportion of women receiving food supplements during lactation increased by 19 pp, moving from 41 to 60 percent. A similar remarkable increase was observed in the proportion of children under 3 who were receiving food supplements. Although there was a significant increase in the number of children receiving vitamin A supplementation, the coverage is still less than 70 percent. In the

early period (1992–1998), there was improvement in the coverage of immunization, but by 2016 this had declined to 70 percent.

What factors contributed to changes in stunting between 2006 and 2016? Insights from decomposition analysis

Historically, stunting prevalence has been lower in Tamil Nadu than most parts of India; between 2006 and 2016, it declined by a further 5 pp, from 32 to 27 percent. Our analysis indicates that improvements in socio-economic status (SES) accounted for 30 percent of the actual changes in stunting; this was followed by maternal education (20 percent), health and nutrition services (12 percent), household hygiene (10 percent), village sanitation and availability of electricity (10 percent), having health insurance (7 percent), maternal body mass index (5 percent), birth order (3 percent), and marriage before 18 years (1 percent). These factors together explained 100 percent of the actual change in stunting.

Based on these findings, we prioritized three areas for deeper policy and stakeholder analysis: 1) advancements in nutrition and health services, 2) improvements in SES, and 3) improvements in care for women.

How did changes in the key drivers of stunting take place? Insights from policy analysis and stakeholder interviews

Advancements in nutrition and health services: Tamil Nadu is known for its social sector investments and for its citizen actions rooted in social movements. The state has been visionary in setting goals for the well-being of its population and has shown significant commitment to the welfare of women and children. As early as the 1980s, the Tamil Nadu Integrated Nutrition Project (TINP) laid the foundation for nutrition programs in the state; it focused on improving the coverage and quality of interventions delivered under the Integrated Child Development Services (ICDS) program. The vision to improve maternal and child nutrition was articulated in the state's 1993 development plan (Government of Tamil Nadu 2003), and health and nutrition programs evolved under an overarching women-focused developmental agenda. Even as other states in India were struggling to lower the infant mortality rate (IMR) and maternal mortality rate (MMR), Tamil Nadu was shifting its policy focus from survival to child growth and development.

The state's vision was supported by the availability of opportunities to expand health and nutrition programs in the state under the national-level program mandates as well as state-level initiatives and innovations. In early 2000s, at the national level, both ICDS and health programs took initiatives to improve coverage of nutrition and health interventions. The ICDS was in the process of universalization across the country and the Ministry of Health launched the National Rural Health Mission (NRHM) to increase reach and coverage of maternal and child interventions.

In 2003, Tamil Nadu released a policy for a "Malnutrition Free Tamil Nadu" (Government of Tamil Nadu 2003), which guided the state's long-term multisectoral response to malnutrition and included clear targets for 2020. The goal of the policy was to reduce malnutrition of all types—including subclinical micronutrient deficiencies— "to the levels of the best performing countries in the world". The policy included language that described Tamil Nadu's political commitment to "promote, protect, and fulfill the rights of all people to food and nutrition" (Government of Tamil Nadu 2003).

Between 1992 and 2016, several state level programs geared toward improving maternal and child health and nutrition were implemented. These included:

- 1990–2000: Implementation of centrally-funded programs including the Reproductive and Child Health Programme (RCH), Universal Immunization Program, Pulse Polio Immunization campaigns, and the Adolescent Anemia Control Programme
- 1995: Implementation of a state initiative to improve infrastructure, manage supply chains, and prevent corruption
- 1995: Launch of polio eradication campaign
- 1997: Initiation of a program to provide antenatal care and childcare at subcenters, for women who could not access care at a Primary Health Center (PHC)
- 2003: Release of a state health policy which focused on improving the health status of low-income and disadvantaged citizens
- 2004: Tamil Nadu becomes the first Indian state to become polio free
- 2005: Launch of the Tamil Nadu Health Systems Project (TNHSP)
- 2006 and 2013: Implementation of a state government initiative to modernize Anganwadi Centers (AWCs), wherein new AWCs were constructed and their infrastructure improved.
- 2008: Comprehensive Emergency Obstetric and Newborn Care (CEmONC)
- 2010–2011: Initiation of the Maternal Anemia Control Programme
- 2011: Introduction of pentavalent vaccine
- 2012: Introduction of Menstrual Hygiene Programme

The programs were focused on improving pregnancy and postnatal care and early childcare through strengthening both supply- and demand-side factors; the infrastructure of facilities was improved, and beneficiaries were offered incentives to utilize services. The state's efforts were complemented by several development partners, including the World Bank, UNICEF, and the Danish International Development Agency (Danida). These organizations played a key role in initiating and supporting state-level innovations and programs that facilitated the strengthening of programmatic platforms and the delivery of health and nutrition interventions. From a governance perspective, Tamil Nadu's Health and Family Welfare Department has a unique feature in that it has three key directorates, Public Health, Medical Services, and Medical Education; all of these are equally placed organizationally, and each has its independent budget and human resources. This facilitates effective planning for public health work and contrasts sharply to the situation in other states, where public health services are merged under medical services. In addition, the Tamil Nadu Public Health Act 1939 provides the legislative basis for the planning and implementation work of the Directorate of Public Health; this is not the case in several other states.

Improvements in SES

Tamil Nadu is one of India's richest states. Poverty declined steadily since 1994; from 2005 onward Tamil Nadu has also been among the country's fastest growing states. In 1994, 45 percent of Tamil Nadu's population was below the poverty line. By 2004, per capita income was above the national average, and between 2004 and 2013 it had doubled (Government of Tamil Nadu 2017). In 2010, the state introduced flexibility options into the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). To attract women's participation, it began to allow flexible work hours and raised the daily amount to INR 100. By 2012, only 12 percent of the state's population was below the poverty line (World Bank 2017). The growth in the state's economy could be attributed primarily to development in the service sector.

The state also implemented other social safety net programs over the years, which are likely to have helped families build social and economic capital. In 1982, the Noon Meal Programme was launched in Tamil Nadu; it became the model for the eventual national Mid-Day Meal Scheme, which provides food to children 2 to 15 years old. The Public Distribution System (PDS) has remained a universal benefit in Tamil Nadu, even as other states have implemented first geographic, and then economic, targeting to identify groups of beneficiaries. Over the years, the program has maintained its commitment to providing subsidized rice to all; it also became the first state to introduce other commodities into the PDS.

Improvements in care for women

Historically, Tamil Nadu has had a strong focus on women's well-being; the state's development agenda has for many years been inclusive of women's care and empowerment. Several state initiatives have been implemented over the years to improve the gender ratio (Cradle Baby Scheme), to delay age at marriage (Marriage Assistance Scheme), and to improve women's socio-economic empowerment through training via self-help groups (Mahalir Thittam).

Through investments in infrastructure, Tamil Nadu has continued its work to improve overall development in the state. In 2009, the State Water and Sanitation Mission was formed to achieve full household coverage of drinking water and to ensure effective implementation of the National Rural Drinking Water Programme. Relative to the national average, Tamil Nadu is in a better position in terms of road connectivity, power and renewable energy, water, and sanitation infrastructure (Government of Tamil Nadu 2017).

The building and strengthening of systems took place in an overall enabling policy environment, and over the years, the state has either maintained or increased the level of budget support to nutrition. Between 1992 and 2016, even though the chief ministerial leadership changed, social sector programs continued uninterrupted. Convergence of these multiple factors facilitated improvements in programs targeting key determinants of stunting.

Looking Forward

In the era of India's commitment to global nutrition targets, it is an opportune time for Tamil Nadu to accelerate actions necessary to meet these nutrition targets. There are some clear areas for improvement in nutrition outcomes and determinants. Anemia rates in children and women are still high. There is a need for attention to IYCF practices, particularly early initiation of breastfeeding and complementary feeding practices. The coverage gaps in ANC and immunization need to be addressed without delay. Sanitation remains a challenge in the state and needs to be urgently prioritized.

Despite overall gains across the state, there is interdistrict variability in the prevalence of different nutrition outcomes, in immediate and underlying determinants, and in the coverage of nutrition and health interventions. Additional analytic work is necessary in each district to further understand the contextual factors and to develop tailored strategies for addressing the various determinants that can in turn deliver improvements in nutrition.

Finally, Tamil Nadu is transitioning rapidly from being a state with a burden of undernutrition to being a state that faces multiple forms of malnutrition including overweight and obesity, and non-communicable diseases (NCDs). It is therefore imperative that the state takes a holistic

approach and develops an integrated health and nutrition strategy for tackling multiple forms of malnutrition.

1. INTRODUCTION

In recent years, there has been an increase in global attention to nutrition. Political commitment to the reduction of undernutrition has intensified, and there is a demand from countries for guidance on how to effectively translate nutrition-relevant policies into impacts on the ground. This has been marked by the launch of the Scaling Up Nutrition (SUN) Movement in 2010, the 2008 and 2013 Lancet Nutrition Series, the 2013 Nutrition for Growth Summit, and the 2014, 2015, and 2016 Global Nutrition Reports. Given the investments that have already been made in improving nutrition, and the considerations for future investments, there is a need for experiential learning that draws on the experiences of nutrition leaders, program implementers, and policy makers to shed light on what has or has not worked for improving nutrition outcomes in different contexts.

India is one of the largest countries in the world, comprising of one-sixth of the world's population and contributing to one-third of the global burden of undernutrition. Between 2006 and 2016, India made progress in reducing stunting among children under five; this progress, however, has been variable across states (Menon et al. 2018). There are interstate differences in stunting reduction despite a common national policy framework for nutrition-specific programs that provide health and nutrition services, and nutrition-sensitive programs that address food security. Some studies have found that interstate differences in poverty reduction and nutritional outcomes across India could be correlated with political regimes(J Harriss 2003; John Harriss and Kohli 2009); few studies, however, have examined the potential factors and processes involved in bringing about state-level change in nutrition. To our knowledge, there are only three subnational studies on drivers of change in nutrition outcomes in India. These are based in Chhattisgarh, Maharashtra and Odisha, where a number of policy and programmatic drivers of change in nutrition outcomes have been identified (Kohli et al. 2020; Cavatorta, Shankar, and Flores-martinez 2015; Kohli et al. 2017).

In this report, we have documented the changes in Tamil Nadu over time as a success story in tackling undernutrition. Tamil Nadu is situated on the extreme southern coast of India; it accounts for 4 percent of the country's area. The state includes 32 districts, which are subdivided into 385 blocks, 12,618 villages, and 561 towns. The state is home to more than 70 million people, or 6 percent of the population of India. Tamil Nadu fares better than many other states in terms of its economy, infrastructure, industrialization, governance, and social indicators. In 2011, it ranked sixth among India's states on the Human Development Index and it has a literacy rate of over 80 percent. Historically, Tamil Nadu has focused on the social sector; it has invested in improving service delivery, with a focus on equity. A few national initiatives have had their origins in Tamil Nadu, including the Mid-Day Meal Scheme and maternity benefits. A systematic documentation of how the state became a front runner in India in improving maternal and child nutrition is a valuable exercise; such a study can provide directions for other states to follow in their efforts to achieve a similar status.

2. OBJECTIVES

Our key goals were to 1) document changes in child stunting, as well as the known determinants of child growth and the reach of interventions designed to improve child growth between 1992 and 2016; 2) assess the contribution of diverse determinants to the changes in stunting seen in the decade between 2006 and 2016; and 3) assess the changes in the key drivers of nutrition between 1992 and 2016. We aimed to then synthesize insights on how state-level leadership, policies, programs, and other changes across society came together to support

the changes seen in child growth outcomes over this period, and to offer insights on actions that are needed in looking ahead toward the achievement of national nutrition goals.

3. METHODS

We used a variety of data sources and research methods in our research. Using multiple rounds of data from surveys, we developed a 24-year (1992–2016) timeline of changes in stunting and its known determinants. We began by identifying a list of indicators that was based on UNICEF's conceptual framework (Figure 1); this included outcomes, determinants (immediate and underlying), and interventions. The list of indicators was selected based on the well-known UNICEF conceptual framework (Figure 1).

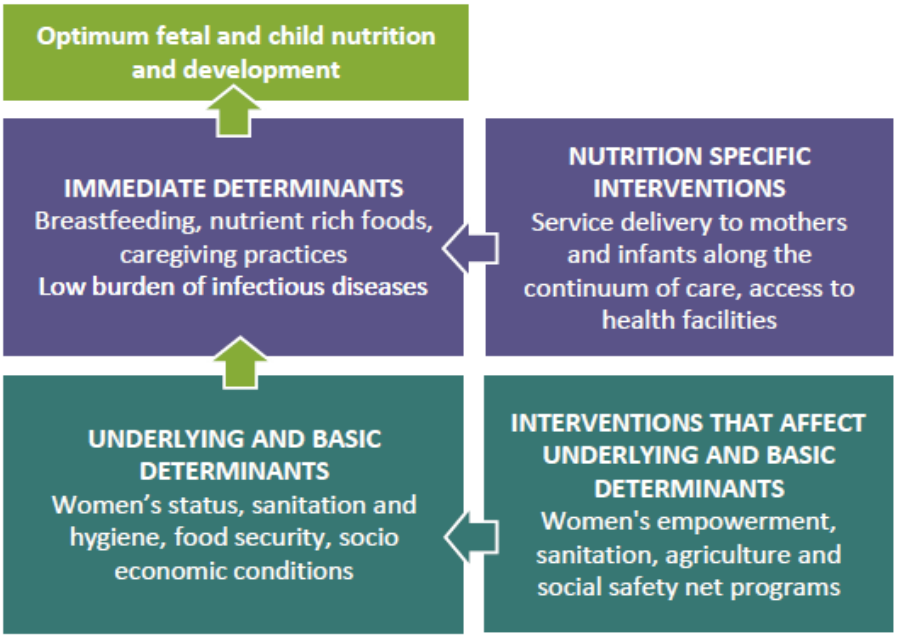
The list of selected indicators included:

- **Nutrition outcomes:** stunting;
- **Immediate determinants:** women's body mass index (BMI), fertility rate, infant and young child feeding (timely initiation of breastfeeding, exclusive breastfeeding, timely introduction of complementary foods, meal frequency), and health indicators (incidence of diarrhea, acute respiratory infection, and access to oral rehydration solutions);
- **Underlying and basic determinants:** women's education, women's social and economic empowerment, access to sanitation, electricity and drinking water, and population below the poverty line;
- **Coverage of nutrition-specific interventions** during pregnancy, delivery, infancy, and childhood.

Specifically, we analyzed four rounds of the National Family Health Survey (NFHS–1992/1993, 1998/1999, 2005/2006, 2015/2016) (IIPS (International Institute for Population Sciences) 1993; 1999; 2006; 2016). First, we examined the data on stunting reduction and changes in known drivers of undernutrition descriptively. Next, we used regression–decomposition analysis to examine the contributions of changes in known determinants of stunting between 2006 and 2016; this combines the analysis of differences in means of the explanatory variables (X) between 2006 and 2016 and regression estimates of the coefficients associated with these variables (BX) from a pooled regression model. If, for example, a determinant has a large regression coefficient ("marginal effect") and a large change in its mean over time, then this determinant will play a large role in explaining stunting reduction over time. This method has been used widely in previous studies to examine changes in undernutrition in Nepal (Headey and Hoddinott 2015; Cunningham et al. 2017) and in other countries (Headey 2013). The decomposition analysis combined the marginal effects of the determinants of stunting estimated from national data, and changes in means of determinants in Tamil Nadu over time.

We conducted a literature review to assess changes in policies and programs pertaining to nutrition between 1992 and 2016. The literature review had two objectives: to construct a policy timeline and analyze policy changes over the period of stunting reduction, and to gather additional literature to support overall analysis and interpretation. To construct a policy timeline and analyze policy changes between 1992 and 2016, we reviewed government program documents, key development plans, national policies, strategies, and reports. We searched electronic databases including Google Scholar and PubMed, as well as program-relevant websites. The literature was screened for information on program objectives, components, target populations, implementation structures, institutional and financial structures, and any significant changes in programs over time.

Figure 1. Conceptual framework



Source: Adapted from UNICEF (1990) and Ruel and Hoddinott (2008).

We also conducted 24 in-depth, semi-structured interviews with select stakeholders. All the interviews were conducted in English. A desk review of policy documents guided the selection of initial key informants and the development of a semi-structured interview guide. Purposive and snowball sampling was used in the selection of former and current policy advocates, government officials, and state-level implementers of policies and programs. Selected stakeholders included health economists and researchers with expertise in specific health and nutrition policies and programs in Tamil Nadu, medical professionals, and implementers from specific programs and organizations. We also interviewed former and current government officials from departments that are relevant for health and nutrition programming in the state; these included representatives from the Departments of Agriculture, Public Health and Preventive Medicine, as well as from the State Planning Commission, the Ministry of Health and Family Welfare, and the Ministry of Women and Child Development (Table 1).

Twenty of the interviews were audio recorded and transcribed verbatim; extensive field notes were taken for the four interviews that were not audio recorded. Transcripts were coded using NVivo 12, using a constructivist grounded theory-based approach and open, axial, and selective coding with constant comparison. The data from this analysis provided insight into how stakeholders viewed the changes in nutrition and health outcomes and in relevant programs during the study period.

Table 1. Stakeholders interviewed

Stakeholder type	Number
Integrated Child and Development Services	3
National Health Mission	1
Non-Governmental Organization	3

Stakeholder type	Number
Other government departments (Agriculture, State Planning Commission, Ministry of Health and Family Welfare, Ministry of Women and Child Development)	5
Research institutions	7
Medical institutions	2
Advocacy organizations	3
Total	24

Source: Authors

4. FINDINGS

The results section is organized according to changes in outcomes, determinants, and coverage of interventions between 1992 and 2016. (During this study period, data was not available between 2000 and 2005.) This section also presents results of the analysis of drivers of change in stunting, and policy and programmatic changes that influenced such changes.

4.1 Nutrition and Health Outcomes and Their Determinants in Tamil Nadu, 1992–2016

4.1.1 Changes in nutrition and health outcomes, 1992–2016

Between 1992 and 2016, child nutrition and health outcomes improved in Tamil Nadu, including in stunting, underweight, wasting, and child mortality; anemia, however, remains a challenge.

As children's heights were not measured in Tamil Nadu in 1992, stunting prevalence estimates are unavailable for that year. Among children under three years, stunting prevalence declined from 35 percent in 1998 to 31 percent in 2006, underweight declined from 31 to 26 percent, but wasting prevalence remained stagnant at 22 percent (Table 2).

Between 2006 and 2016, stunting prevalence declined from 31 to 27 percent among children under five years (Table 2). Between 2006 and 2016, underweight prevalence declined from 30 to 26 percent among children under five years and wasting remained stagnant (Table 2).

Anemia among children and women remains a significant public health concern. Although the prevalence of anemia among children declined between 1998 and 2016 (69 to 51 percent), more than half of the children in Tamil Nadu still suffer from anemia. There was a considerable decline in the prevalence of anemia among pregnant women between 2005 (59 percent) and 2016 (49 percent), however it increased marginally among women of reproductive age during that period.

Between 2000 and 2016, Tamil Nadu's infant mortality rates (IMR) and maternal mortality rates (MMR) were below the national average. IMR declined from 51 per 1000 live births in 2000 to 17 per 1000 live births in 2016, which is half the national average (NITI Aayog, n.d.). MMR declined from 111 per 100,000 live births between 2004 and 2006, to 66 between 2014 and 2016, again nearly half the India average (NITI Aayog, n.d.).

Table 2. Changes in nutrition and health outcomes in Tamil Nadu as compared to the national average, 1992–2016

	1992/1993[1]		1998/1999[2]		2000/2005	2005/2006[3]		2015/2016[4]	
Indicators	India	Tamil Nadu	India	Tamil Nadu	India/Tamil Nadu	India	Tamil Nadu	India	Tamil Nadu
					Percent (%)				
Stunting (< 3 year-old children)	n/a	n/a	51.0	35.2	No data	45.0	31.1	n/a	n/a
Stunting (< 5 year-old children)	n/a	n/a	n/a	n/a	No data	48.0	30.9	38.0	27.2
Wasting (< 3 year-old children)	n/a	n/a	19.7	22.5	No data	22.9	22.9	n/a	n/a
Wasting (< 5 year-old children)	n/a	n/a	n/a	n/a	No data	20.8	22.2	21.7	21.2
Underweight (< 3 year-old children)	n/a	n/a	42.7	31.5	No data	40.4	25.9	n/a	n/a
Underweight (< 5 year-old children)	n/a	n/a	n/a	n/a	No data	42.5	29.8	36.6	26.1
Children 6 to 59 months with any anemia	n/a	n/a	74[a]	69[a]	No data	69.6	63.6	58.7	50.8
Women 15 to 49 years with anemia	n/a	n/a	52	56.5	No data	60.9	53.2	57.3	55.0
Pregnant women with anemia	n/a	n/a	49.7	57.1	No data	62.1	54.7	55.7	44.4

Source: [1]National Family Health Survey–1 (1992/1993), IIPS (1993); [2]National Family Health Survey–2 (1998/1999), IIPS (1999); [3]National Family Health Survey–3 (2005/2006), IIPS (2006); [4]National Family Health Survey–4 (2015/2016), IIPS (2016).

Note: [a]Figures for 1992/1993 and 1998/1999 are for children under 3; figures reported for 2005/2006 and 2015/2016 are for children under 5; n/a = information not available.

4.1.2 Changes in immediate determinants of stunting in Tamil Nadu, 1992–2016

The immediate determinants of child nutrition outcomes include maternal nutritional status, infant and young child feeding, and illness/health in early childhood. There were mixed improvements in these determinants between 1992 and 2016.

Between 1998 and 2016, the proportion of women with low BMI declined from 25 to 14 percent (Table 3). During this period, there was a dramatic increase of 37 pp (28 to 65 percent) in the proportion of pregnant women who were consuming IFA supplements for 100 or more days. With regard to infant and young child feeding, early initiation of breastfeeding more than doubled between 1992 and 2006 but remained stagnant for the subsequent decade. In 2016, only 58 percent of children below two years had been breastfed within one hour of birth. Between 2006 and 2016, exclusive breastfeeding increased by 14 percentage points (pp), moving from 33 to 47 percent; still more than half the infants in Tamil Nadu were not exclusively breastfed. There was an 18 pp decline in the timely introduction of complementary foods (90 percent to 72 percent) and a marginal decline in the percentage of children receiving the recommended number of meals. At the same time, there was a remarkable increase (27 to 56 percent) in the proportion of children who were consuming foods from the recommended number of food groups for their age. These results call for an examination of the reasons for both poor breastfeeding practices and the decline in feeding frequency; they also suggest the need for continued efforts to improve dietary diversity (Figure 2).

The proportion of children who had had diarrhea in the two weeks preceding the survey increased between 1992 and 1998 but had declined substantially by 2016. Between 1992 and 2016, the proportion of children who had had symptoms of acute respiratory infection (ARI) in the two weeks preceding the survey declined from 9 to 3 percent (Table 3).

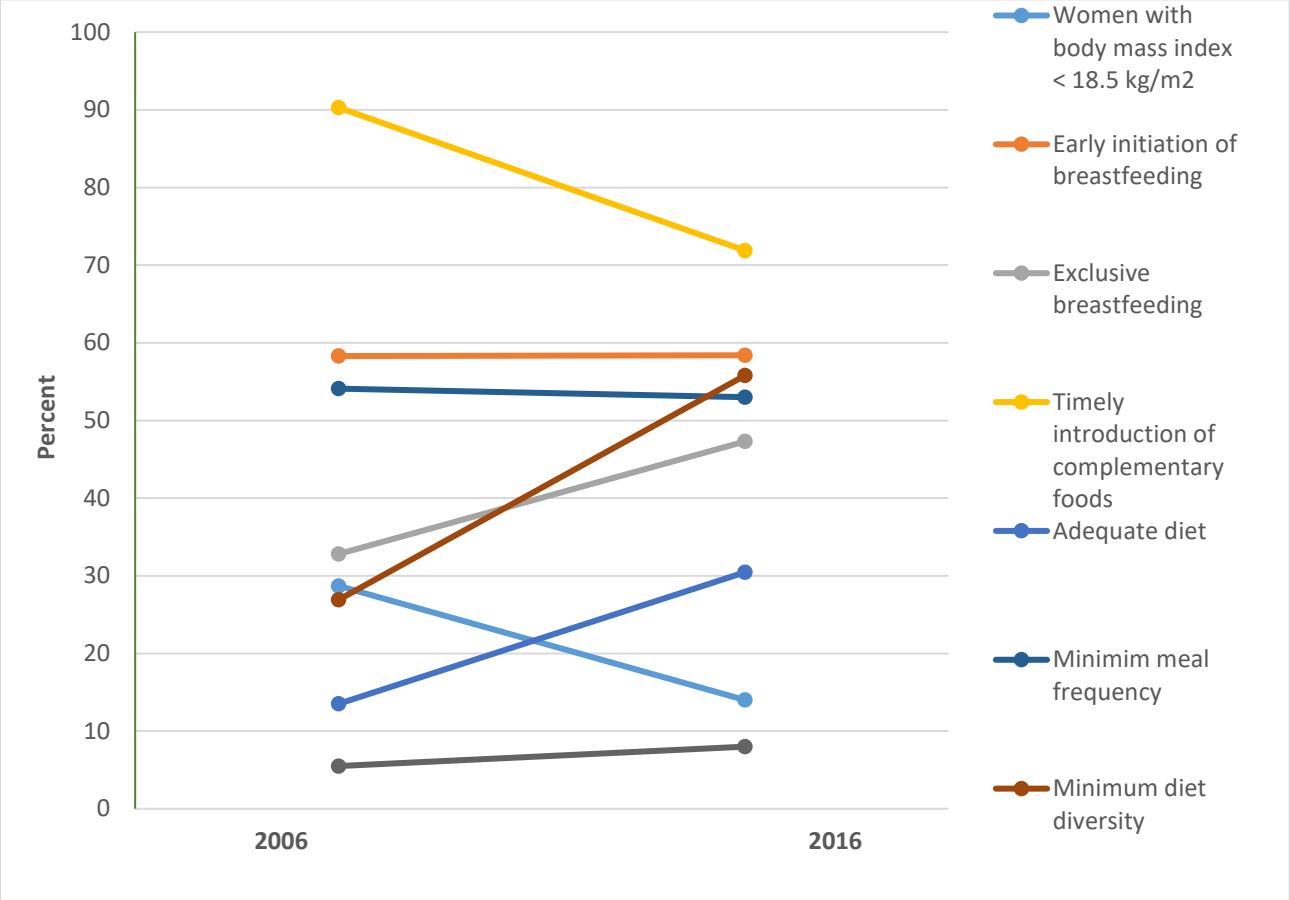
Table 3. Changes in immediate determinants of stunting in Tamil Nadu in comparison to the national average, 1992–2016

	1992/1993[1]		1998/1999[2]		2000–2005	2005/2006[3]		2015/2016[4]	
Indicators	India	Tamil Nadu	India	Tamil Nadu	No data	India	Tamil Nadu	India	Tamil Nadu
	Percent (%)								
Women with body mass index under 18.5 kg/m^2	n/a	n/a	35.8	25.0	No data	39.6	28.7	28.8	14.0
Women who consumed IFA during pregnancy for at least 100 days	n/a	n/a	n/a	n/a	n/a	15.2	27.8	30.3	64.0
Children breastfed within 1 hour of birth[a]	10	21.8	16	50	No data	23.7	58.3	43.3	58.4
Children under 6 months who were exclusively breastfed	n/a	n/a	n/a	n/a	No data	45.9	32.8	54.6	47.3
Children 6 to 8 months receiving solid/semi-solid food and breast milk	31	n/a	34	n/a	No data	55.2	90.3	45.2	71.9

	1992/1993[1]		1998/1999[2]		2000–2005	2005/2006[3]		2015/2016[4]	
Indicators	India	Tamil Nadu	India	Tamil Nadu	No data	India	Tamil Nadu	India	Tamil Nadu
				Percent (%)					
Breastfed children 6 to 23.9 months receiving minimum meal frequency	n/a	n/a	n/a	n/a	No data	41.8	54.1	36.4	53.0
Children 6 to 23.9 months receiving minimum dietary diversity	n/a	n/a	n/a	n/a	No data	14.8	26.9	20.8	55.8
Children who had had diarrhea in the previous two weeks[b]	10	12.7	19.2	14.4	No data	9.0	5.5	9.2	8.0
Children who had had ARI in the previous two weeks[b]	6.5	8.6	19.3	10.3	No data	5.8	3.7	2.7	2.8

Source: [1]National Family Health Survey–1 (1992/1993), IIPS (1993); [2] National Family Health Survey–2 (1998/1999), IIPS (1999); [3]National Family Health Survey–3 (2005/2006), IIPS (2006); [4]National Family Health Survey–4 (2015/2016), IIPS (2016).
Note: [a] Indicators calculated for the last 3 years (1992/1993 and 1998/1999) and the last 5 years (2005/2006 and 2015/2016); [b] indicators calculated for children 0 to 47 months (1992/1993), 0 to 35 months (1998/1999), 0 to 59 months (2005/2006 and 2015/2016); n/a = information not available.

Figure 2. Changes in immediate determinants of nutrition in Tamil Nadu, 2006–2016



Source: NFHS–3 (2005/2006), IIPS (2006) and NFHS–4 (2015/2016), IIPS (2016).

4.1.3 Changes in underlying determinants of nutrition in Tamil Nadu, 1992–2016

Between 1992 and 2016, most of the underlying determinants of nutrition improved, but areas of concern still exist. Since 1994, there has been a steady improvement in women's education and age at marriage (Table 4); further remarkable improvements were noted between 2006 and 2016 (Figure 3). The proportion of women with more than 10 years of education improved substantially (32 to 62 percent). Although there has been a decline in the proportion of women getting married before the legal age of marriage, by 2016, 32 percent were still getting married before the legal age.

Tamil Nadu has also achieved improvements in infrastructure. By 2016, 90 percent or more of households had access to improved drinking water and electricity. Between 2006 and 2016, households with access to improved sanitation facilities more than doubled, however it remains low at 49 percent. The proportion of open defecation has declined over time but, at 40 percent, it is still high (Table 4).

Open defecation was mentioned as a serious concern by 16 out of the 24 stakeholders interviewed. They linked the still-high rate of open defecation with persistent anemia, and also identified it as a probable contributor to the slowed decline in stunting. They observed that poor sanitation practices combined with income inequality contribute to the prevalence of diarrheal disease and the resulting persistent stunting rates, especially among lower socio-economic classes.

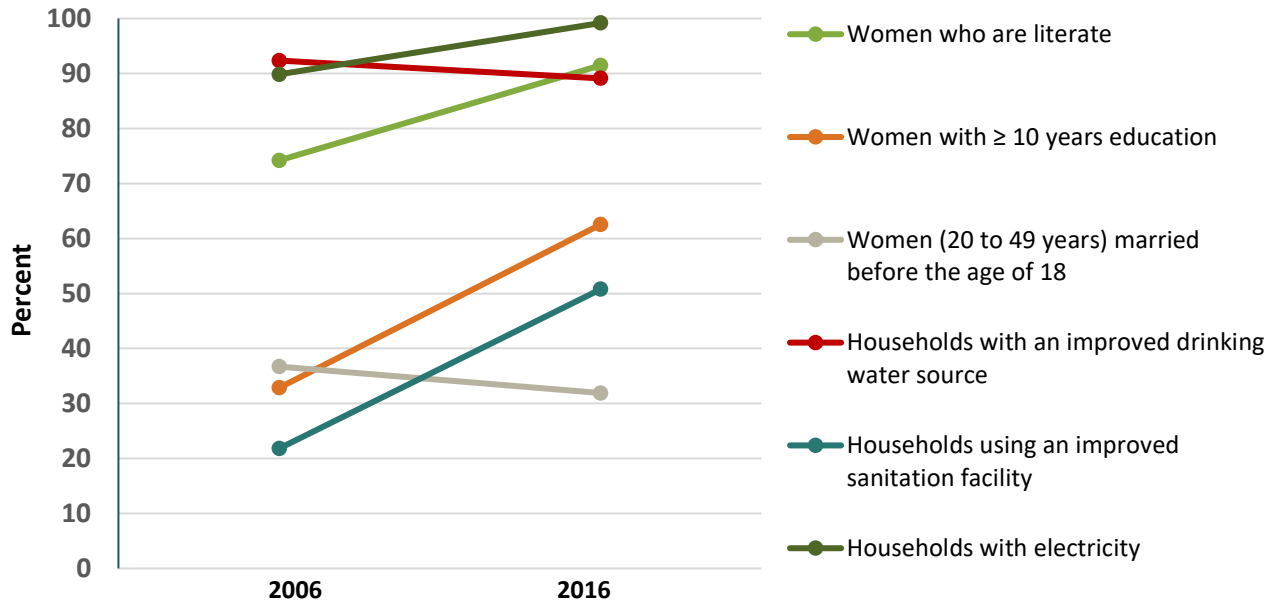
Table 4. Changes in underlying determinants of nutrition in Tamil Nadu in comparison to the national average, 1992–2016

	1992/1993[1]		1998/1999[2]		2000/2005	2005/2006[3]		2015/2016[4]	
Indicators	India	Tamil Nadu	India	Tamil Nadu	No data	India	Tamil Nadu	India	Tamil Nadu
	Percent (%)								
Women who are illiterate (15 to 49 years)	56.7	50	58.2	47.5	No data	44.9	30.6	31.6	8.5
Women with 10 or more years of education	9.2	19.1	14.2	21.5	No data	22.4	31.9	35.7	62.5
Women (20 to 49 years) married before the age of 18	64.5	n/a	61.1	37.8	No data	57.9	36.7	40.1	31.9
Women (20 to 24 years) married before the age of 18	n/a	n/a	n/a	n/a	No data	65.4	42.4	47.8	32.7
Households with access to improved drinking water	68.2*	74.6*	77.9 *	85 *	No data	86.3	92.3	89.5	89.4

	1992/1993[1]		1998/1999[2]		2000/2005	2005/2006[3]		2015/2016[4]	
Households with access to an improved sanitation facility	30.3	29.4	35.9	34	No data	22.3	20.5	40.1	49.0
Open defecation	69.7	70.6	64	66	No data	63.6	57.1	47.2	38.3
Household below poverty line[5]	n/a	n/a	n/a	n/a	No data	37.2	31	n/a	12
Households with electricity	50.9	63.8	60.1	78.8	No data	59.2	89.5	84.1	99.1

Source: [1]National Family Health Survey–1 (1992/1993), IIPS (1993); [2]National Family Health Survey–2 (1998/1999), IIPS (1999); [3]National Family Health Survey–3 (2005/2006), IIPS (2006); [4]National Family Health Survey–4 (2015/2016), IIPS (2016). [5]World Bank (2012).
Note: * Drinking water from pump/pipe; n/a = information not available.

Figure 3. Changes in underlying determinants of nutrition, 2006–2016



Source: NFHS–3 (2005/2006), IIPS (2006) and NFHS–4 (2015/2016), IIPS (2016).

4.1.4 Changes in the coverage of nutrition-specific interventions in Tamil Nadu, 1992–2016

Between 1992 and 2016, coverage of a majority of interventions during the first 1,000 days improved (Table 5):

Pregnancy care: Between 2006 and 2016, the coverage of 4 or more antenatal care (ANC) visits declined from 86 to 82 percent. There was a marginal decline in the proportion of women who received IFA supplements between 1999 and 2006; between 2006 and 2016, however, this increased from 91 to 95 percent. There was also an increase in the receipt of

food supplements from 50 to 62 percent (Figure 4). However, there needs to be further investigation into the reasons for the decline in coverage of the key interventions such as ANC visits, which are a prerequisite condition for receiving maternity benefits. Stakeholders indicated delayed pregnancy registration, migration to parental homes for deliveries, lack of enforcement of eligibility criteria, poor coordination between the ICDS and health workers, and corruption as plausible reasons for decline in ANC visits. In order to close the gaps, there needs to be a systematic examination of the reasons for low coverage so that the gains made in health outcomes in previous decades can be sustained. Urgent attention is needed to prevent a further decline in the coverage of interventions during pregnancy, a decline which is likely to have implications for early-life child growth.

Delivery/birth care: Over the last 24 years, there has been a steady improvement in interventions such as delivery in health facilities and the proportion of births assisted by a health professional; all are approaching 100 percent coverage.

Postpartum and early childhood: Between 2006 and 2016, the proportion of women receiving food supplements during lactation increased by 19 pp, moving from 41 to 60 percent. Similar remarkable increase was observed in the receipt of food supplements by children under 3 (34 to 64 percent). Although there has been a significant increase in the number of children receiving vitamin A supplementation, the coverage is still less than 70 percent.

In the early period (1992–1998), there was improvement in the coverage of immunization; by 2016, however, this had declined to 70 percent. This is of huge concern and requires further investigation. The decline in immunization rates could have been contributed by staff vacancies, poor outreach to marginalized populations, and the false attribution of child deaths to a measles vaccination in 2008.

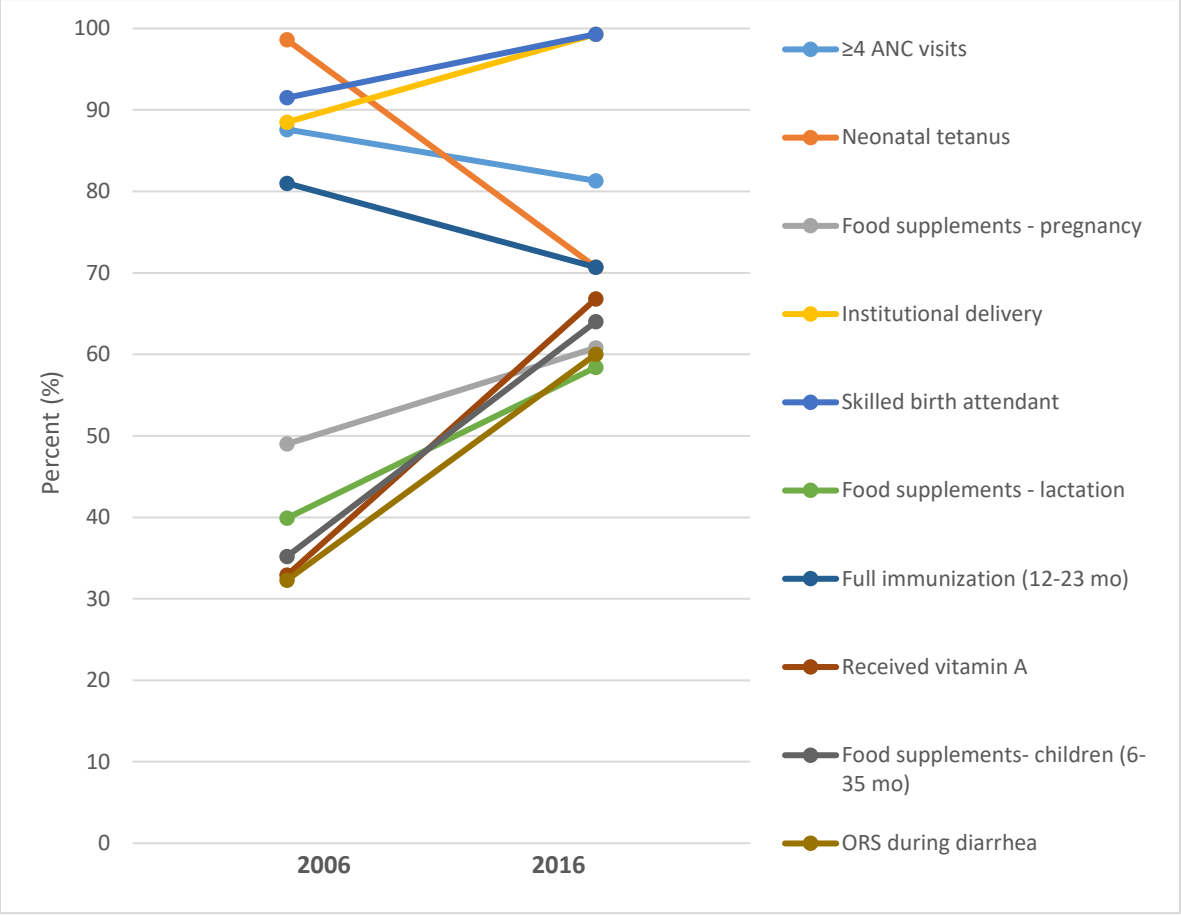
Table 5. Changes in the coverage of nutrition-specific interventions in Tamil Nadu in comparison to the national average, 1992–2016

	1992/1993[1]		1998/1999[2]		2000–2005	2005/2006[3]		2015/2016[4]	
	Percent (%)								
Interventions	India	Tamil Nadu	India	Tamil Nadu	n/a	India	Tamil Nadu	India	Tamil Nadu
Mothers who had four or more ANC visits for their last birth	n/a	n/a	n/a	n/a	n/a	33.8	86.1	48.4	81.7
Women who received/bought IFA supplements during pregnancy [a]	51	84.1	58	93.2	n/a	63.4	91.5	76.6	94.8
Receipt of ICDS food supplements during pregnancy	n/a	n/a	n/a	n/a	n/a	18	49.8	52.1	61.8
Delivery in health facility [a]	26	63.4	34	79.3	n/a	38.6	87.9	79.0	99.0
Births assisted by a health professional [a]	33	71.2	42	83.8	n/a	46.4	90.6	81.4	99.3

	1992/1993[1]		1998/1999[2]		2000–2005	2005/2006[3]		2015/2016[4]	
	Percent (%)								
Interventions	India	Tamil Nadu	India	Tamil Nadu	n/a	India	Tamil Nadu	India	Tamil Nadu
Receipt of ICDS supplements during lactation (until six months after birth)	n/a	n/a	n/a	n/a	n/a	14.1	40.8	47.2	59.8
Children 12 to 23 months who were fully immunized	35.5	65	42	88.8	n/a	43.5	81.0	62.3	70.3
Children 6 to 59 months who had received vitamin A in the previous six months	n/a	n/a	17[b]	n/a	n/a	14.6	33.1	57.8	66.4[c]
Children 6 to 59 months who received ICDS food supplements	n/a	n/a	n/a	n/a	n/a	25.9	34.8	46.8	58.4
Children with diarrhea in the two weeks prior to the survey who had received ORS[e]	18	27.1	27	27.9	No data	26.3	32.2	50.7	61.9

Source: [1]National Family Health Survey–1 (1992/1993), IIPS (1993); [2] National Family Health Survey–2 (1998/1999), IIPS (1999); [3]National Family Health Survey–3 (2005/2006), IIPS (2006); [4]National Family Health Survey–4 (2015/2016), IIPS (2016).
Note: [a] figures reported for the previous 4 years (1992/1993, 1998/1999), and for the previous 5 years (2005/2006 and 2015/2016); [b] children 12 to 35 months; [c] children 9 to 59 months; [e] received oral rehydration solutions (ORS): indicators calculated for children 0 to 35 months (1992/1993 and 1998/1999), 0 to 59 months (2005/2006 and 2015/2016); ANC = antenatal care; IFA = iron and folic acid; ICDS = Integrated Child Development Services; n/a = information not available.

Figure 4. Changes in the coverage of nutrition-specific interventions in Tamil Nadu, 2006–2016

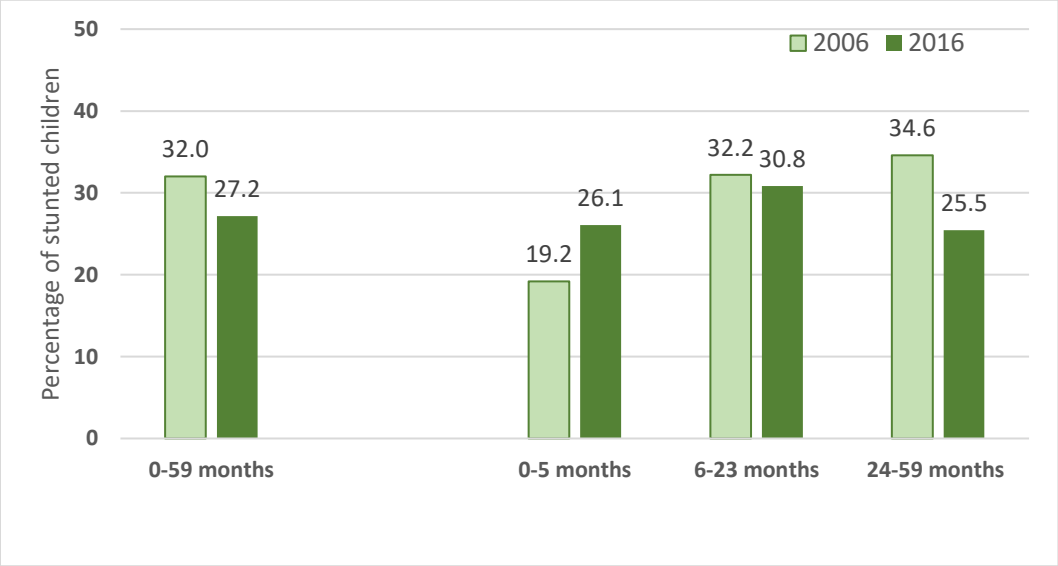


Source: NFHS–3 (2005/2006), IIPS (2006) and NFHS–4 (2015/2016), IIPS (2016).
Note: ANC = antenatal care; ORS = oral rehydration solutions.

4.2 Determinants of Changes in Stunting in Tamil Nadu, 2006–2016

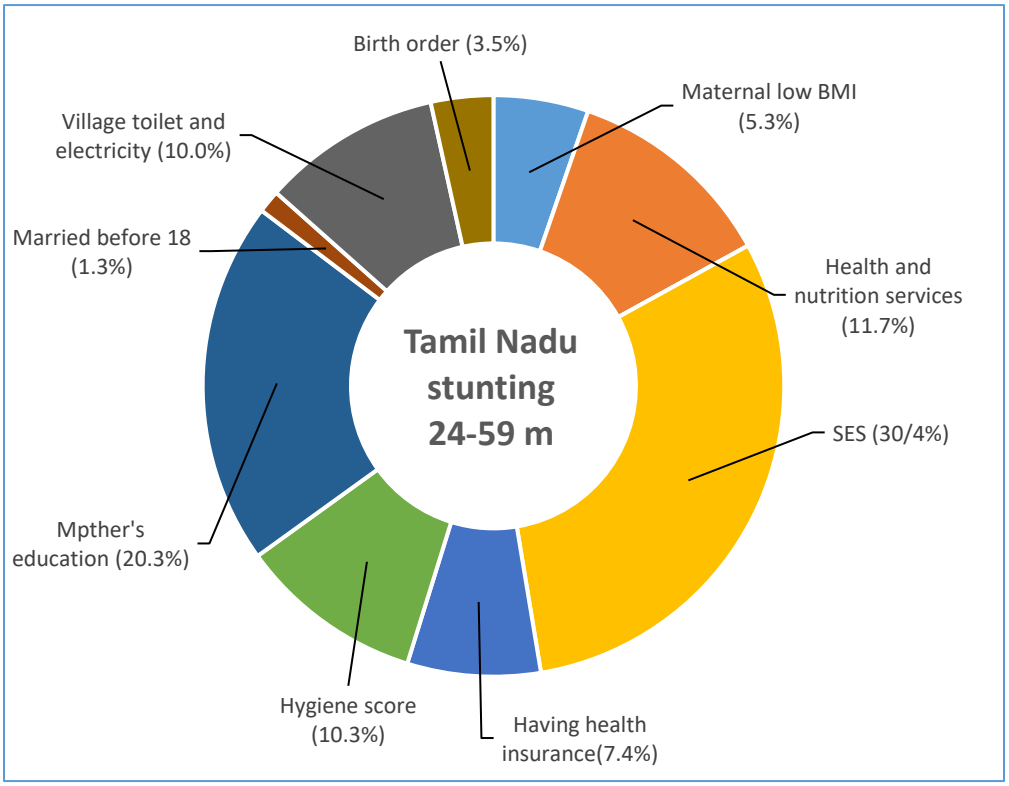
Between 2006 and 2016, the prevalence of stunting among children under five declined from 32 to 27 percent in Tamil Nadu; however, stunting prevalence increased among children under 6 months, declined only marginally among children 6 to 23 months, and showed a 9 pp decline among children 24 to 59 months (Figure 5). Our analysis of the determinants of stunting decline among children 24 to 59 months age indicates that improvements in SES accounted for 30 percent of the actual changes in stunting. This was followed by maternal education (20 percent), health and nutrition services (12 percent), household hygiene (10 percent), village sanitation and availability of electricity (10 percent), having health insurance (7 percent), maternal BMI (5 percent), birth order (3 percent), and marriage before 18 years (1 percent). All these factors together explained 100 percent of the actual change in stunting (Figure 6).

Figure 5. Changes in stunting among children by age group in Tamil Nadu, 2006–2016



Source: NFHS–3 (2005/2006), IIPS (2006) and NFHS–4 (2015/2016), IIPS (2016).

Figure 6. Factors contributing to changes in stunting, 2006–2016



Source: NFHS–3 (2005/2006), IIPS (2006) and NFHS–4 (2015/2016), IIPS (2016).
Note: SES = socio-economic status; BMI = body mass index.

4.3 Advancements in Nutrition and Health Policies and Programs in Tamil Nadu

Historically, Tamil Nadu has been a leader in the implementation of social sector policies and programs that are focused on improving nutrition outcomes through a multisectoral approach (Figure 7); there has been a strong focus on children and women's well-being through multiple state-level initiatives. In the context of such an overall enabling environment, several programmatic changes took place in the ICDS and health programs between 1992 and 2016 at both the national and state levels.

ICDS program: To develop an integrated nutrition program and bridge the gap in the implementation of a targeted program for children, the Tamil Nadu Integrated Nutrition Project (TINP) was piloted in 1980 in one block; this was a collaboration between the state government and the World Bank. The TINP included growth monitoring, feeding of children and pregnant women, health and nutrition education, and health services. In the early 1990s, of the 111 centrally sanctioned ICDS projects, only 79 were functioning in Tamil Nadu, indicating a poor uptake of central schemes by the state (Shekar 1991). TINP-I and II were implemented between 1980 and 1997 (ibid). The Swedish International Development Agency (SIDA) supported ICDS projects in three districts. The TINP was targeted at identifying high-risk groups, with the aim of preventing severe and moderate malnutrition in children under five and reducing infant mortality, low birth weight, vitamin A deficiency in children, and anemia in pregnant and lactating women.

In 1997, Tamil Nadu closed the TINP program. It was converted to a World Bank–sponsored ICDS-III program in the majority of rural areas through the Woman and Child Development Project and a centrally sponsored ICDS program; at that point, additional rural, tribal, and urban slum areas were included in the program. The focus of ICDS-III was on improving the quality of services rather than expanding coverage. Services included weight monitoring, supplementary nutrition for children under six and for pregnant and lactating women, preschool education, immunization, deworming, and micronutrient supplementation. As this change occurred, Tamil Nadu moved from a two-worker model under the TINP to a one-worker ICDS model, increasing the staff workload.

The World Bank–assisted ICDS-III program began in 1999 and ended in 2006; in 2003, it merged with the general ICDS program. Due to a tsunami in 2004, 42 percent of the Anganwadi Centers that had been sanctioned for construction under the World Bank's ICDS-III program had not yet been completed by 2006.

As of 2006, a total of 42,677 AWCs were operational in Tamil Nadu. In response to a 2006 Supreme Court order to universalize the ICDS program, the Government of India sanctioned a single Anganwadi Worker (AWW) for every 500 to 1,500 population in "plain areas" and one AWW for every 300 to 1,500 population in tribal areas. This resulted in the addition of 3,049 AWCs in Tamil Nadu, bringing the total of functional AWCs to 45,726 AWCs; these were operational in 30 districts under the centrally sponsored ICDS scheme. In 2008, additional mini centers were started; this further brought up the total to 50,433 AWCs in 30 districts of Tamil Nadu, by which full coverage for all children was achieved, notably including those from Scheduled Castes and Scheduled Tribes. In 2010, during the expansion phase of ICDS–III, a remapping exercise of the number of AWWs per population was undertaken; as a result, new centers were constructed, which increased the total number of AWCs to 54,439 in 32 districts.

Between 2006 and 2012, under state government initiatives, AWCs were modernized to include gas connections, gas stoves, and pressure cookers; these were followed by another round of initiatives undertaken from 2011 to 2013 whereby infrastructure was improved through new constructions, repairs, electrification, baby-friendly toilets, and kitchen modernization. A 2006 report entitled "Focus on Children Under Six", by the Citizens' Initiative for the Rights of Children Under Six (CIRCUS) (Right to Food Campaign 2006), found that Tamil Nadu performed better than other states with respect to training, amount and payment of salary, infrastructure, service delivery, beneficiary satisfaction, and community engagement.

In 2013, the National Food Security Act was passed, according to which all children under six were entitled to one free meal a day through the ICDS.

Health program*:* Between 1992 and 2000, multiple health programs were put in place. These programs focused on improving the health and nutrition of women and children. The Department of Health and Family Welfare implemented centrally funded programs that addressed the health of children, including the Universal Immunization Program, Pulse Polio Immunization campaigns, Reproductive and Child Health Programme (RCH), and the Adolescent Anemia Control Programme; programs for pregnant and lactating women initiated during this period included the Child Survival and Safe Motherhood program.

In 1995, Tamil Nadu created the Tamil Nadu Medical Services Corporation to manage the purchase and distribution of medicines to public hospitals and Primary Health Centers, and eventually to purchase important diagnostic equipment. The purpose of this effort was to reduce

corruption and misuse of funds, ensure a ready stock of critical medicines and equipment in health centers and to increase patient satisfaction through improved quality and decreased cost. The state launched the polio eradication campaign in the same year.

Starting in 1997, under the RCH program, ANC and childcare began to be offered in every health subcenter to women who were unable to access the care that was being offered at PHCs on a fixed day of the month. Danida, the Danish NGO, also assisted in the renovation, repair, and construction of new health subcenters in four districts in Tamil Nadu as part of their assistance to the Tamil Nadu Area Health Care Project (TNAHCP). The TNAHCP also provided two-wheelers and training to Village Health Nurses (VHNs) to improve access to health care in rural areas.

In 2004, Tamil Nadu became the first Indian state to become polio free. Multiple initiatives were launched in 2005 to strengthen delivery of services to pregnant and lactating women and children. These included the National Rural Health Mission (NRHM), which is a national-level program aimed at reducing IMR and MMR and ensuring universal access to women's and children's health; further initiatives included the second phase of the Reproductive and Child Health Programme (RCH–II), and several state-level initiatives including the World Bank–assisted Tamil Nadu Health Systems Development (TNHSD) project, Comprehensive Emergency Obstetric and Newborn Care (CEmONC) services, and the Birth Companion Programme.

The Janani Suraksha Yojana (JSY) program also began in 2005; under the ambit of NRHM, it provided conditional cash assistance to encourage institutional deliveries. Whereas the TNHSD program aimed at improving the health of the poorer and tribal populations and improving district and subdistrict hospitals, the CEmONC centers were implemented to provide 24-hour care to pregnant women by obstetricians, pediatricians, lab technicians, and nurses, as well as on-call anesthetists. These centers were designed to be within a one-hour journey from a hospital. They were created in response to the issue of dangerously lengthy referral times, especially in the intrapartum and postpartum periods.

The second phase of the RCH program also focused on improving the referral system, infrastructure, project management, management information systems (MIS), and emergency and essential obstetrical care. Under the supervision of VHSs, out-of-school adolescent girls were trained to become links within the community and to provide preventive counseling to high-risk families against female infanticide. Institutional deliveries were made possible 24 hours a day in almost 800 PHCs, with a new staffing model that included three medical officers, three staff nurses who could conduct normal deliveries and refer complications, two cleaners, and a driver. Accommodation was also provided for those working night shifts and ambulances were procured for emergency obstetric care. The Birth Companion Programme allowed a female companion who had been through labor to attend another's labor, with the goal of providing support and encouraging early initiation of breastfeeding. Health infrastructure was strengthened during this period, including the addition of Mobile Health Units, upgraded PHCs, government medical colleges, training schools, and regional training centers.

Between 2006 and 2016, there was an expansion of several health initiatives in the state. Infrastructure and human resources improved, including upgrading of PHC buildings to manage institutional deliveries, an increase from one to two in the number of medical officers (MOs) assigned to each PHC, and the introduction of Reproductive, Maternal, Newborn, and Child

Health (RMNCH) counselors into postpartum centers to provide counseling services. Phase II of the TNHSP expansion began in 2010, under which non-communicable disease prevention and control activities were expanded statewide, the existing infrastructure of CEmONC centers was improved, and maternal intensive care units (ICUs) were added.

In 2006, the Dr. Muthulakshmi Reddy Maternity Benefit Scheme, a conditional cash transfer program, was introduced. It aimed to provide compensation for loss of wages during pregnancy and to lower the incidence of low birth weight babies. Under this scheme, pregnant women from BPL families who were aged 19 years or older received INR 6,000 for their first two deliveries; in 2011, the financial assistance was doubled to INR 12,000.

In 2009, the Chief Minister Kalaignar Insurance Scheme for Life Saving Treatments was implemented to ensure access to quality health care to the poorest of the poor and to low-income groups who could not afford costly treatment. Under this scheme, the government would pay the entire insurance premium for life-saving treatments for the poor in government and private hospitals. In 2012, the scheme was renamed the Chief Minister's Comprehensive Health Insurance Scheme and included coverage of up to INR 100,000 per year for 4 years for all families who had an annual income of INR 72,000 or less; it included more than 1,000 procedures.

The Maternal Anemia Control Programme was implemented in 2010/2011 under the NRHM. It included deworming for all pregnant women and injectable iron sucrose for all women with moderate and persistent anemia. In 2012, the Menstrual Hygiene Programme also began. Under this program, sanitary napkins were distributed to rural adolescent girls through schools or via VHNs.

In 2008, while the state was gaining momentum in improving systems and introducing new schemes, a major setback to the immunization program occurred when several child deaths were falsely attributed to the measles vaccine. At that point, the Health and Family Welfare Department halted all outreach efforts, forcing families to bring children to institutions for immunizations. In 2009, the Coverage Evaluation Survey, commissioned by UNICEF, showed that at the national level more than 50 percent of the population accessed immunization services from outreach efforts. Although the ban was reversed in 2011, it caused a lag in again attaining levels of coverage similar to those prior to the ban.

In 2011, Tamil Nadu was picked by the Government of India as one of the two states for the introduction of the pentavalent vaccine, which protects against five life-threatening diseases by providing five separate vaccinations in a single injection.

The implementation of these various programs was facilitated by a convergence of multiple factors (Table 6). In 1993, the vision to improve maternal and child nutrition was articulated in the state's development plan, and the health and nutrition programs evolved under an overarching women-focused development agenda. In addition to state-level initiatives and innovations, the state's vision was supported by opportunities to expand health and nutrition programs under national-level program mandates. The programs were focused on improving pregnancy and postnatal care and early childcare through strengthening both supply- and demand-side factors. The infrastructure of facilities was improved, and beneficiaries were offered incentives to utilize their services. State efforts were supported by several development partners including the World Bank, UNICEF, and Danida; these organizations played a key role in initiating and supporting state-level innovations and programs that facilitated the

strengthening of programmatic platforms and delivery of health and nutrition interventions. A unique feature of Tamil Nadu's Health and Family Welfare Department is that it has three key directorates, Public Health, Medical Services, and Medical Education; all of these are equally placed organizationally and have independent budgets and human resources, which facilitates effective planning for public health work (Gupta et al. 2010).This is in sharp contrast to other states, where public health services are merged under medical services. Unlike in many other states, Tamil Nadu's public health staff are professionally trained; in addition, and also the Tamil Nadu Public Health Act 1939 provides a legislative basis for the planning and implementation work of the Directorate of Public Health (Gupta et al. 2010).

The building and strengthening of systems took place in an overall enabling policy environment. Over the years, the state also either maintained or increased budget support to nutrition. Although chief ministerial leadership changed between 1992 and 2016, social sector programs continued uninterrupted (Table 6).

The stakeholders considered the conditional cash transfer programs to be the major reason for the nearly 100 percent coverage of institutional delivery, assisted births, and birth registration. Several respondents also mentioned that institutional deliveries were facilitated by the 24-hour care during delivery that was provided through the improved public health care infrastructure. Respondents, however, listed some implementation challenges of the cash transfer program, including discrepancies in enforcing eligibility criteria, corruption, poor coordination between AWWs and VHNs in identifying pregnant women, and delayed registration of pregnancy.

Some respondents described the high percentage of vacancies as a major problem affecting both ANC and immunization rates. Vacancies were attributed to expansion of PHCs and AWCs without the accompanying necessary staff increases. They also mentioned the ongoing court cases that were holding up staff appointments, the perceived low pay of workers, and the corruption in the appointment of AWWs which could entail high financial costs to applicants.

Stakeholders perceived that the government was strongly committed to improving the quality, access to, and usage of, public health facilities. Most of the respondents believed that Tamil Nadu could legitimately claim to have a stronger and more robust health care delivery system than most other states in India.

4.4 Improvements in Socio-economic Status in Tamil Nadu

Tamil Nadu is one of India's richest states. Since 1994, there has been a steady decline in poverty, and after 2005, the state was among the country's fastest growing states. By 2004, per capita income had also increased and was above the national average, and between 2004 and 2013 it doubled (Government of Tamil Nadu 2017). In 1994, 45 percent of the population was below the poverty line, but by 2012 this had decreased to only 12 percent. The growth in the state's economy could be attributed primarily to development in the service sector.

In addition, the state implemented several social safety net programs, which are likely to have helped families build social and economic capital. In 2005, Tamil Nadu introduced the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA). The act guaranteed 100 days of work per year for people living below the poverty line and provided INR 80 after completion of every 9 am to 5 pm workday. In 2010, to attract women's participation, the state introduced flexible hours into the program and raising the daily amount to INR 100.

In Tamil Nadu, the Public Distribution System (PDS), an important point of access to food grains for many families, provides rice, sugar, wheat, and kerosene in fixed quantities and at reduced prices. It has remained a universal benefit in the state even as the rest of the country has implemented first geographic, and then economic, targeting to identify groups of beneficiaries. As reasons for continuing a universal PDS system, the Tamil Nadu government has cited difficulty in creating and administering error-free targeting criteria, as well as the possibility of frequent natural disasters impacting the economic status and food security of vulnerable households. Over the years, the program has maintained its commitment to providing subsidized rice to all, becoming the first state to introduce other commodities.

In 2001, the Antyodaya Anna Yojana (AAY) program began nationally as an addition to the PDS. Through the AAY, the ultra-poor were to be given 35 kgs of rice at INR 3 per kilogram, but states were left to determine priority groups under BPL guidelines. Tamil Nadu identified priority groups for this scheme as being widows, the terminally ill or disabled, people above 60 years of age with no family or social support, primitive tribal households, those who were HIV positive/affected or leprosy-affected, and the urban homeless. In 2003, the state began the Annapurna Scheme, which provides 10 kg of free rice to indigent senior citizens over 65 years of age.

Between 2006 and 2016, Tamil Nadu continued to expand its nutrition and food programs. The price of rice distributed through the PDS was the lowest in the country, reaching INR 2 per kg in 2006, INR 1 per kg in 2008, and becoming free after 2011. By 2012, Tamil Nadu had achieved a higher density of ration shops and a larger percentage increase in the number of ration cards than in India as a whole. Over the years, the state has put several measures in place to increase transparency and accountability, including digital allotment/billing systems, fixed schedules and routes for delivery of commodities, daily communication to the Tamil Nadu Civil Supplies Corporation (TNSCS) about stock availability, electronic weighing scales, and GPS monitoring of trucks transporting food grains.

In 2011, the Government of India again reduced eligibility for the targeted PDS through the National Food Security Act. Tamil Nadu chose to maintain a universal system of coverage, despite the resulting increased financial burden to the state; the government cited public support as a reason for this approach.

Stakeholders perceived that there was also a downside to the improved quality and standards of life in Tamil Nadu. Quality of life has improved, poverty has decreased, and the population is experiencing economic and nutrition transitions; respondents, however, perceived rapid changes to lifestyle. They felt that life had become more hectic with less community cohesion, more westernization, and increased consumerism, all of which they felt might be contributing to a rise in overweight/obesity and diet related NCDs.

4.5 Improvements in Care for Women in Tamil Nadu

Tamil Nadu has historically had a strong focus on women's well-being, and the state's development agenda has been inclusive of women's care and empowerment. Between 1990 and 2000, Chief Minister Jayalalithaa implemented several state-level initiatives geared toward improving the status and welfare of women. The Cradle Baby Scheme was one such program; it was initiated in 1992 to address female infanticide and to improve the gender ratio. The project was launched in one district and then extended to five more districts which had a low female-to-male gender ratio. Under this scheme, cradles were provided at hospitals, Primary Health

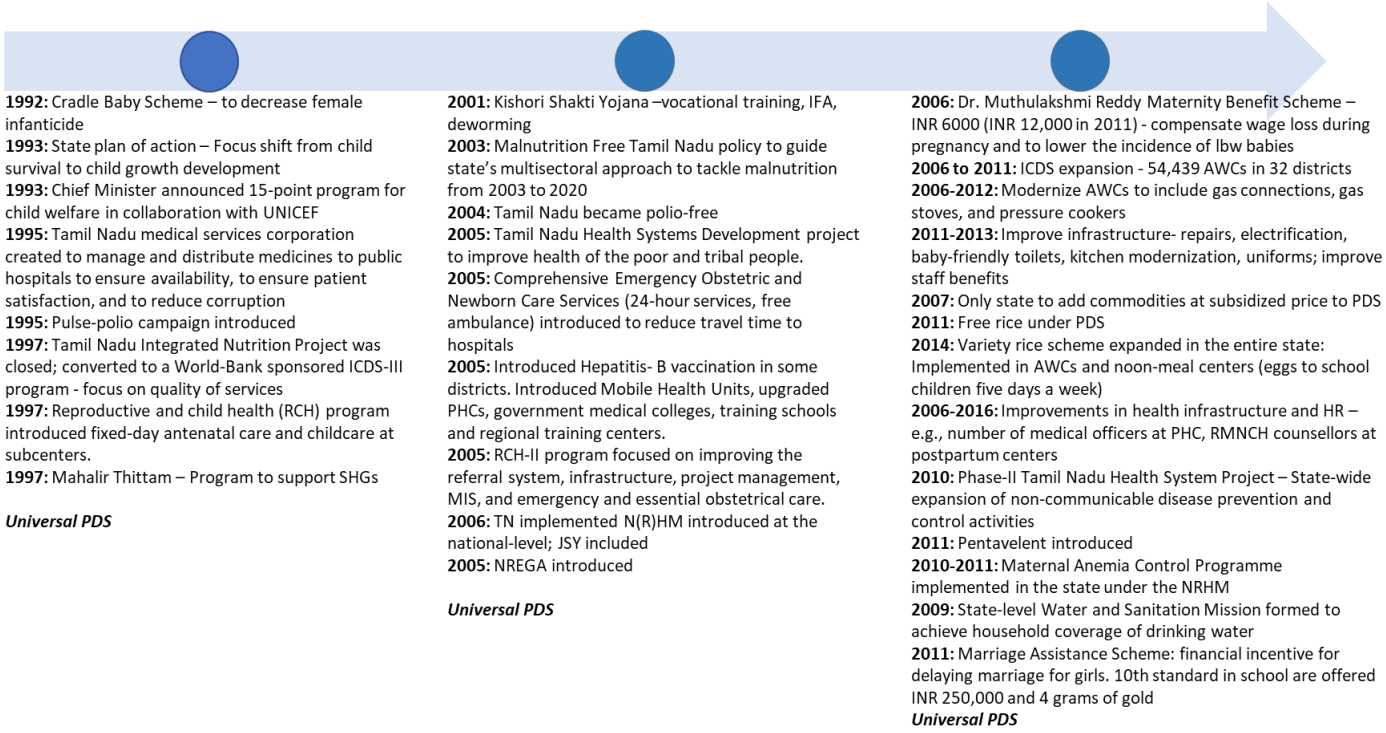
Centers, and Children's Homes where parents could anonymously and without penalty give up their children to the care of the government. To encourage girls to continue their education, the state government also provided free bicycles to high school girls and free textbooks and uniforms to all children up to the eighth standard in government and government-aided schools.

In 1993, Chief Minister Jayalalitha launched a 15-Point Programme for Child Welfare. This was a development plan for women and children that was supported by UNICEF. Among the goals of this program were raising the average age of marriage for girls, universalizing primary education, and increasing women's literacy. In 1997, Mahalir Thittam, a program for the socio-economic empowerment of women, was initiated in all state districts. With the help of NGO facilitators, this program helped women's self-help groups (SHGs) obtain bank credit and procure loans at 12 percent interest with no collateral, the repayment of which the SHGs would be collectively responsible.

The Marriage Assistance Scheme, launched in 2011, provided financial incentives for delaying marriage for girls; under this scheme, families of daughters who passed the tenth standard in school were offered INR 2,50,000 and 4 grams of gold to help alleviate marriage expenses.

Between 1992 and 2016, Tamil Nadu's investments in multiple programs targeting key determinants of undernutrition.

Figure 7. State health and nutrition-focused policies and programs and developmental programs, 1990–2016



Note: AWC = anganwadi center; ICDS = integrated child development services; lbw = low-birth weight; PDS = public distribution system; PHC = primary health center; RMNCH = reproductive, maternal, newborn, and child health

4.6. Political Transitions in Tamil Nadu, 1992–2016

Between 1992 and 2016, Tamil Nadu was ruled by two major political parties, the Dravida Munnetra Kazhagam (DMK) and the All India Anna Dravida Munnetra Kazhagam (AIADMK). With the exception of a period in 1991 when President's rule was briefly imposed, the state had stable leadership (Table 6). During the study period, chief ministerial leadership changed as did the party in power; however, despite changes in leadership, social sector programs continued uninterrupted.

4.7 Summary

Even in the early 1990s, Tamil Nadu was well ahead of India across multiple health and nutrition indicators, including stunting, wasting, underweight, IMR, and MMR. The state became polio free in 2004, much before India could declare the same for the country. Tamil Nadu's burden of undernutrition continued to decline and by 2016 was lower than the national average.

Between 2006 and 2016, the prevalence of stunting declined from 32 to 27 percent among children under 5. There were greater declines in stunting among children 24 to 59 months (9 pp) than among children 6 to 23 months (1 pp); however, there was a 6.8 pp increase in the prevalence of stunting among children under 6 months, suggesting that the changes were likely due to improvements in the early childhood period. Our analysis indicates that improvements in socio-economic status, maternal education, health and nutrition services, and sanitation were major contributing factors to changes in stunting.

From early on, the state has had a strong overall development focus with a specific emphasis on health, nutrition, women's agency, and education. As early as 1993, the state's vision shifted from child survival to child growth and development and the state began to focus on a multisectoral approach to realizing its vision for child development. Several state initiatives were implemented to improve the gender ratio, the status and welfare of girls and women, and state infrastructure.

Health and nutrition programs evolved under an overarching women-focused developmental agenda. Between 1992 and 2016, the health and nutrition policy and program landscape in Tamil Nadu underwent several changes. Several initiatives were implemented in the state which were later scaled up or integrated into national programs. The TINP laid the foundation for improving coverage of ICDS interventions, and under the ICDS-III program the state invested in building AWCs and improving its infrastructure.

Several health programs geared toward improving maternal and child health and nutrition were implemented. Between 1990 and 2000, the state implemented several centrally funded programs, and in 2005, multiple state initiatives were launched to complement national programs. These state programs strengthened and supported the implementation of programs to improve pregnancy and postpartum care, improve health infrastructure and human resources, and incentivize the use of services by beneficiaries. Development partners including the World Bank, UNICEF, and Danida played a key role in supporting a number of state initiatives. The state's Public Health directorate with its independent budgets and human resources could facilitate effective planning for public health work.

Tamil Nadu has had the political will to bring public policy attention to bear on hunger, malnutrition, and child development. The state government over the years has either maintained or increased the level of budget support to nutrition; it has also continued its investments in other development programs including the PDS, MNREGA, and education programs. The state has maintained its commitment to universal PDS coverage, introduced flexible hours into the MNREGA program and increased the daily rate of pay. The state also implemented a universal primary education program. Tamil Nadu has invested in multiple initiatives to improve women's status including those to improve gender ratio, delay age at marriage, improve education, and improve financial empowerment.

Between 2006 and 2016, despite investments in building systems, Tamil Nadu has seen a decline in the coverage of a few nutrition-specific interventions. Further investigation is required in order to assess the reasons for the changes in coverage patterns; coverage must be maintained at a high level to sustain the gains of past investments. The state needs to focus on bridging the gaps in coverage and improving IYCF practices; complementary feeding practices particularly need immediate attention. The state should continue to maintain its investments in the social sector and should urgently ramp up efforts to address sanitation issues.

Table 6. Factors supporting changes in nutrition and health programs and policies in Tamil Nadu, 1992 to 2016

Factors	1990–1995	1995–2000	2000–2005	2005–2010	2010–2015
Vision or goal	1) Make Tamil Nadu a "malnutrition free state" and provide nutrition security program for those below the poverty line, with a special focus on pregnant and lactating women, infants under three, children, adolescent girls, and the elderly.[1] 2) Reduce maternal mortality rate and infant mortality rate and total fertility rate.[2]				
Political commitment	Tamil Nadu has had the political will to bring public policy attention to combat the problem of hunger and malnutrition.				
Interventions	1981–1997: World Bank–supported Tamil Nadu Integrated Nutrition Project, Phases I and II (TINP–I and TINP–II). TINP–II added rural blocks.[3] 1995: Pulse Polio campaign introduced.[4](Department of Health & Family Welfare: Government of Tamil Nadu, n.d.) 1989–1996: Launch of Danida-assisted Tamil Nadu Area Health Care Project (TNAHCP) Phase II to improve facilities for the delivery of health services.[5]	1997–2002: implementation of the World Bank–assisted Reproductive and Child Health (RCH) Sub Project in Madurai and Theni Districts.[6] 1999–2004: World Bank–supported ICDS implemented in TN with an emphasis on improving quality of services. Standard ICDS and former TINP (World Bank–assisted ICDS–III project) implemented simultaneously.[7] Implementation of TNAHCP Phase II and III.[5] 1999: Operationalization of 24-hour delivery services in 90 Primary Health Centers (PHCs).[8]	2003–2005: With Project Udisha funds and assisted by the World Bank, TN sets up its own training institute for Child Development Project Officers (CDPOs) and Additional Child Development Project Officers.[9] 2005: World Bank–supported Tamil Nadu Health Systems (TNHS) project.[10] 2005: State Rural Health Mission (SRHM) launched for the period 2005–2012.[11] 2006: Anganwadi Center (AWC) expansion under World Bank–assisted ICDS–III project.[9]	2006: ICDS expansion Phase–I.[12] 2007: ICDS expansion Phase–II.[12] 2006–2012: State government initiative to modernize AWCs and their infrastructure.[13] 2006: Tamil Nadu State Health Mission constituted.[11] 2006: RCH–II (24-hour delivery care services) implemented in 180 PHCs.[14] 2008: Provision of Comprehensive Emergency Obstetric and Newborn Care (CEmONC) services under TNHS–II.[15] 2009: Strengthening of First Referral Units of the SRHM.[14] 2009: Mobile Medical Units set up in 385 blocks.[14]	2010: ICDS–III expansion;[12] remapping exercise undertaken to ensure compliance with Supreme Court order. 2010: Implementation of 24-hour CEmONC services.[15] 2011: National guidelines for monitoring and supervision visits by state and central government officials to ICDS blocks and AWCs.[17] 2011/2013: Government action plan to improve AWCs' infrastructure.[18]

Factors	1990–1995	1995–2000	2000–2005	2005–2010	2010–2015
				2009: State provides ICDS staff with uniforms, and with benefits including medical allowance, festival advance, leaves, promotional opportunities, pension, six months maternity leave, increased additional charge allowance, and medical leave for surgery.[16]	2011: Construction of maternity blocks with neonatal intensive care units in several hospitals.[19] 2011: National government selected the state to implement pentavalent vaccination.[20] 2013: State guidance for constitution of monitoring and review committees at district and block levels to review progress in implementation of ICDS.[21] In 2013/2014, restructured ICDS was implemented in 13 districts and in 2014/2015 the entire state was covered.[22] 2013: The Variety Rice Scheme was introduced in one pilot block;

Factors	1990–1995	1995–2000	2000–2005	2005–2010	2010–2015
					in 2014, it was expanded to the whole state.[23] 2014: Launch of Mission Indradhanush, a national drive to achieve more than 90 percent immunization coverage by 2020.[24]
Funding	Between 1991/1992 and 2015/2016, the budgetary provision for public healthcare delivery system increased from INR 410 crores (US$ 4.1 billion) to 8,245 crores (US$ 82.4 billion). In 2013/2014, the state had received INR 1,300 crore (US$ 1.3 billion) under NRHM budget, which was one of the highest amounts received and utilized among all states. The state's overall spend on health sector, however, was only 1 percent of its gross domestic product.[25]				
Measurement, learning and accountability				2009: Implementation of web-based health management information systems (HMIS).[26]	2015: A scheme launched to provide a BSNL Broad Band Connection to all 434 projects to facilitate the sending of online monthly progress reports. [27] May 2016: Minister for Women and Child Development launches ICDS Rapid Reporting System via digitization of Anganwadi

Factors	1990–1995	1995–2000	2000–2005	2005–2010	2010–2015
					Monthly Progress Report (AW-MPR). [27] Anganwadi Level Monitoring and Support Committees (ALMSCs) established in all functioning AWCs.[21]

Source: [1]Tamil Nadu, State Planning Commission (2003);[2]Tamil Nadu, State Planning Commission (2012);[3]World Bank (1994);[4]Tamil Nadu, Health & Family Welfare Department (n.d). *Details of notifiable diseases;*[5]Tamil Nadu, Health & Family Welfare Department (n.d). *Aided Projects*;[6]Tamil Nadu, Health & Family Welfare Department (2003). *Reproductive and child health project (G.O. (2D) No. 11);*[7]Heaver (2002);[8]Tamil Nadu, Health & Family Welfare Department (2003). *Reproductive and child health project (G.O. (Ms) No. 396);*[9]India, Ministry of Women & Child Development (2006). *Implementation Completion Report of World Bank assisted ICDS-III/WCD Project;*[10] Tamil Nadu, Department of Health & Family Welfare (n.d). *The World Bank and TNHSP*;[11]Tamil Nadu, Department of Health & Family Welfare (n.d). *National Health Mission Tamil Nadu*;[12]Tamil Nadu, Integrated Child Development Services (n.d). *Expansion of ICDS*;[13]Tamil Nadu, Social Welfare and Nutritious Meal Programme Department (2012). *Modernization of AWCs;*[14]India, National Health Mission (n.d.). *Tamil Nadu State Report*; [15] Tamil Nadu, Department of Health & Family Welfare (n.d). *Tamil Nadu Health Systems Project*;[16] Tamil Nadu, Integrated Child Development Services (n.d.). *Service benefits to AWW/AWH*;[17] India, Ministry of Women and Child Development (2015). *ICDS Scheme, Public Accounts Committee Report 2014-15*;[18] Tamil Nadu, Integrated Child Development Services (n.d.). *Infrastructure facilities of Anganwadi Centres.* [19] Tamil Nadu, Department of Health & Family Welfare (2013). *Construction of maternity blocks with neonatal intensive care units in hospitals*;[20] Tamil Nadu, Department of Health & Family Welfare (2011). *Immunization programme;*[21] Tamil Nadu, Social Welfare and Nutritious Meal Programme Department (2013). *Constitution of monitoring and review committee (G.O. (Ms) No.35*;[22] Tamil Nadu, Integrated Child Development Services (n.d.). *Mission*; [23] Tamil Nadu, Social Welfare and Nutritious Meal Programme Department (2015). *Variety Rice Scheme (G.O. (Ms No.36)*;[24] India, National Health Mission (n.d.). *Mission Indradanush;*[25]Tamil Nadu, State Planning Commission (2017); [26] Tamil Nadu, Department of Health & Family Welfare (2011). *Documentation and dissemination of a best practice, Health Management Information System;*[27] Tamil Nadu, Integrated Child Development Services (n.d). *Rapid Reporting System.*

4.8 Looking Ahead

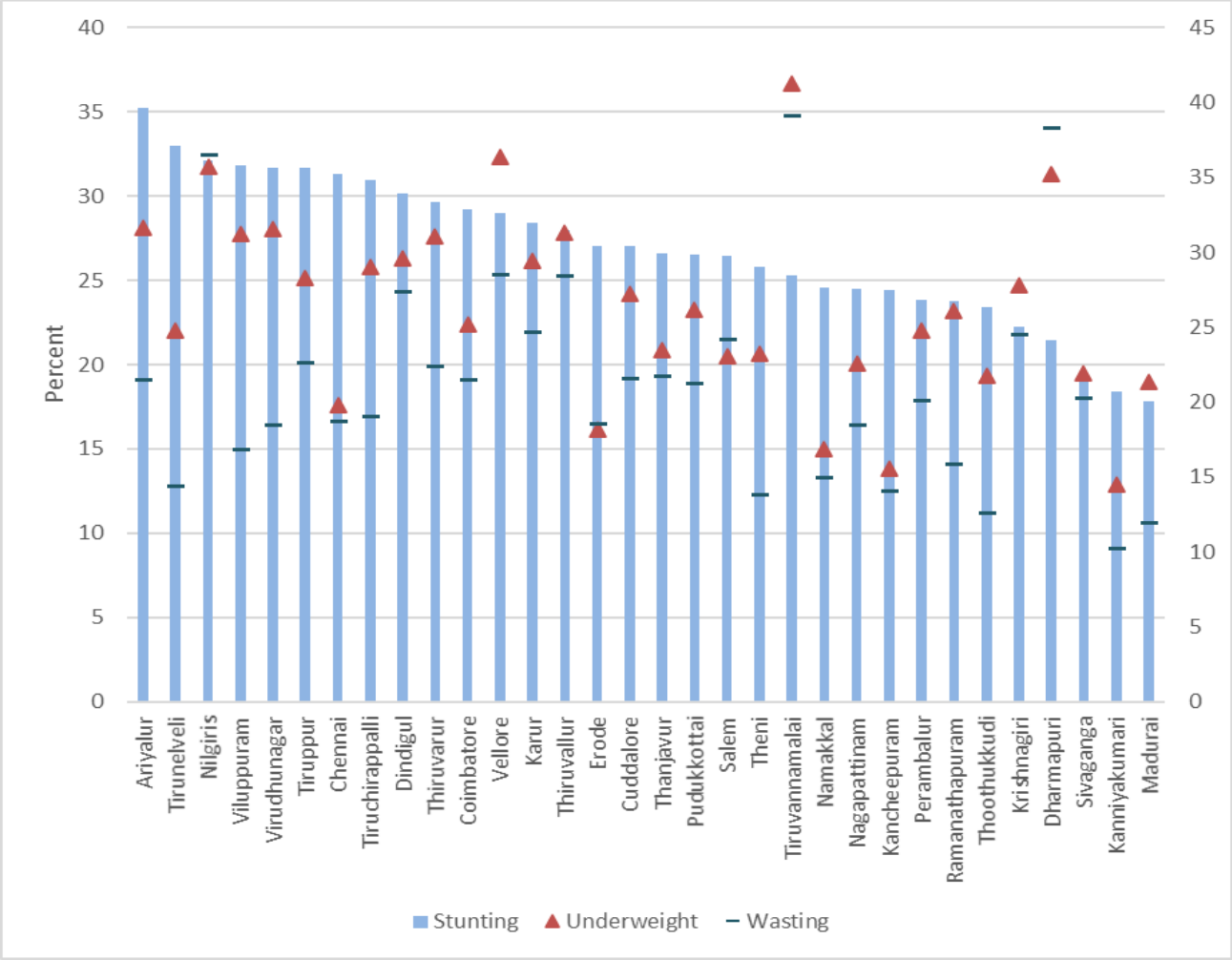
Looking ahead to the support of future nutrition actions, we examined the interdistrict variability among nutrition outcomes and determinants using district-level data from NFHS–4. These analyses helped to assess which districts need more attention to the solving of multiple determinants of undernutrition and which determinants need attention across all districts. As with the previous analysis, we examined the variability in nutrition and health outcomes across districts in terms of both their immediate and underlying determinants and the coverage of nutrition programs.

4.8.1 Interdistrict variability in nutrition and health outcomes and their determinants in Tamil Nadu in 2016

Nutrition outcomes among children under five varied widely among districts. Stunting prevalence ranged from 18 percent to 35 percent, underweight ranged from 14 to 41 percent, and wasting ranged from 10 to 39 percent. Stunting rates were greater than 30 percent in 9 districts. Wasting prevalence was greater than 15 percent in 21 districts. In Nilgiris, prevalence of all three nutrition indicators was higher than 30 percent (Figure 8).

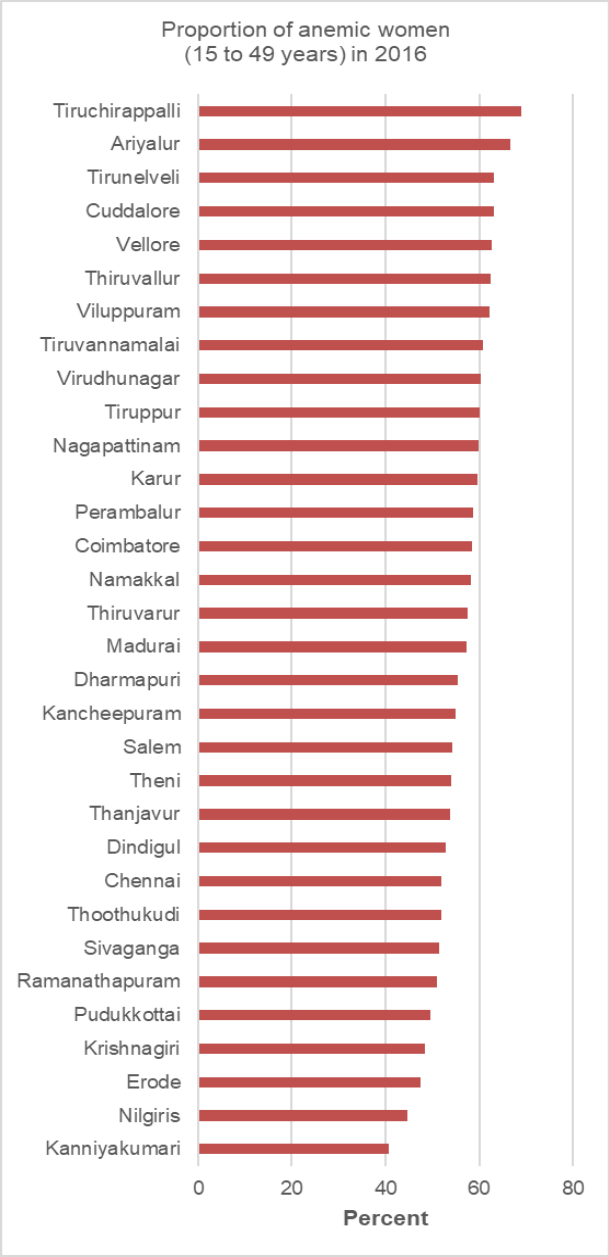
The prevalence of anemia in women and children was high across Tamil Nadu. Anemia in women of reproductive age ranged between 40 to 69 percent and was below 50 percent in only 5 districts (Kanniyakumari, Nilgiris, Erode, Krishnagiri, and Pudukkottai). Data on anemia in pregnant women was available for only 9 districts; the rates of anemia in this population ranged from 26 to 69 percent. Anemia in children 6 to 59 months ranged between 38 and 62 percent. The lowest rate of child anemia was in the district of Kanniyakumari and the highest rate was seen in Tiruchirappalli (Figure 9).

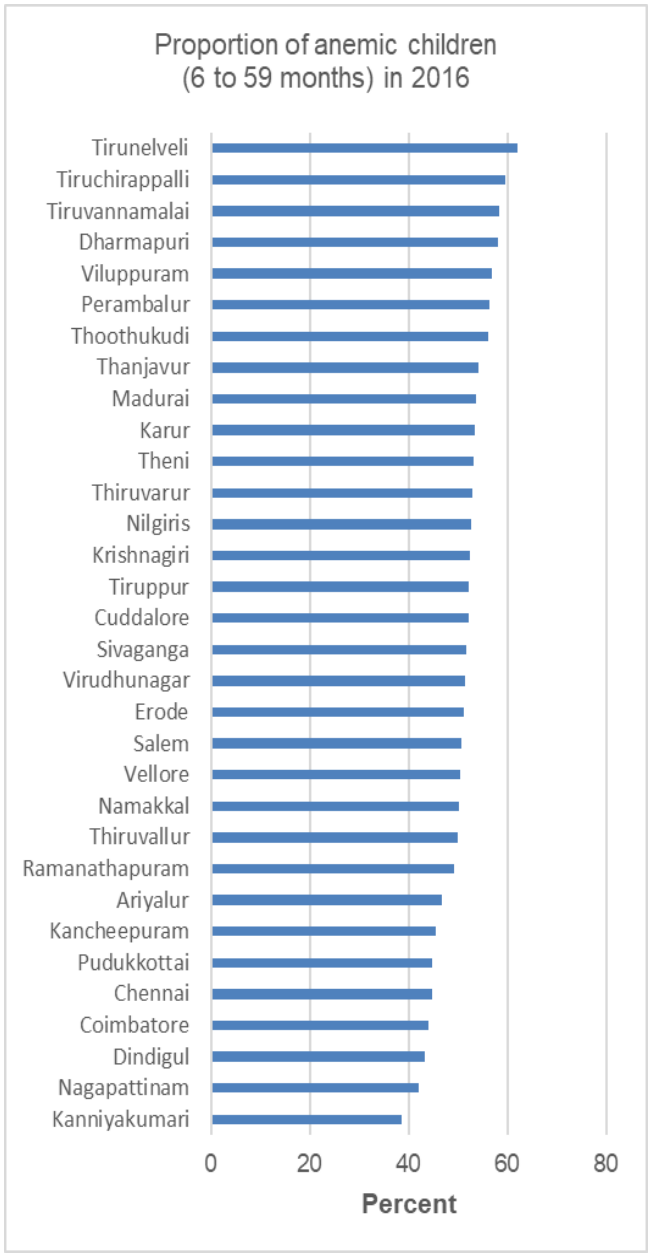
Figure 8. Interdistrict variability in prevalence of stunting, underweight, and wasting in Tamil Nadu in 2016



Source: NFHS–3 (2005/2006), IIPS (2006) and NFHS–4 (2015/2016), IIPS (2016).

Figure 9. Interdistrict variability in anemia among women of reproductive age and among children in 2016





Source: NFHS–4 (2015/2016), IIPS (2016).

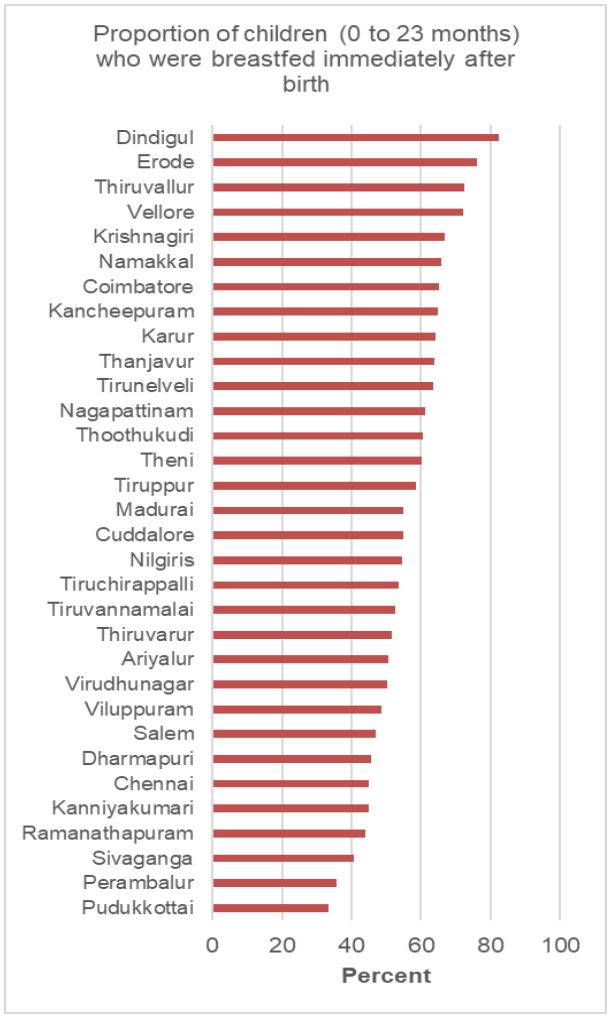
4.8.2 Interdistrict variability in immediate determinants of nutrition in 2016

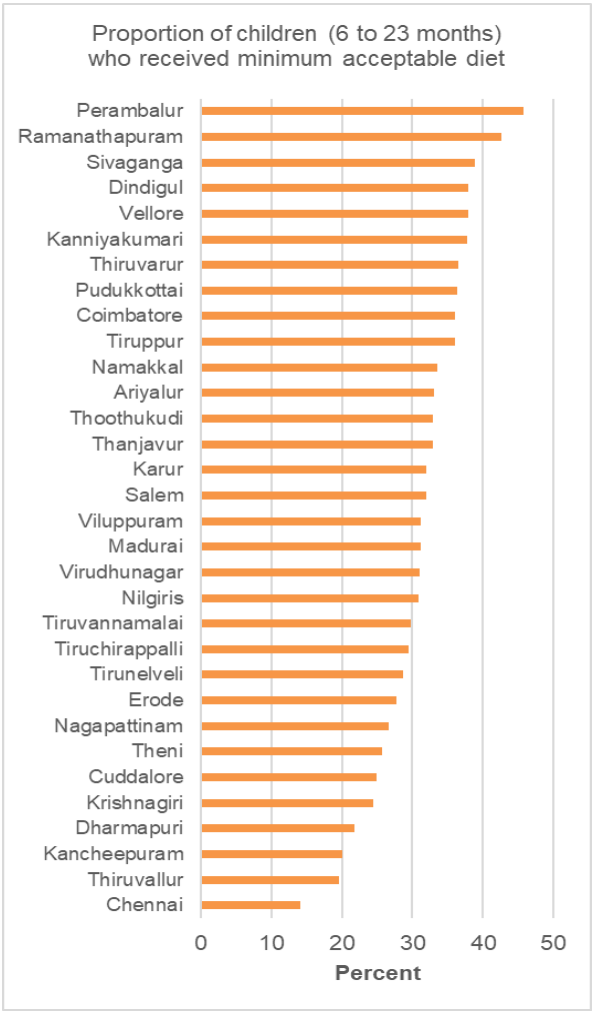
Among child feeding practices, there is high interdistrict variability in the early initiation of breastfeeding (EIBF), ranging from 33 to 82 percent; in 9 of the 32 districts, EIBF was below 50 percent (Figure 9). Exclusive breastfeeding could be calculated for three districts:[1] Pudukkottai (35 percent), Vellore (43 percent), and Krishnagiri (53 percent).

The proportion of children 6 to 23 months who received an acceptable diet varied greatly between districts, ranging from 14 percent in Chennai to 46 percent in Perambalur. In 19 districts, fewer than a third of children received the minimum acceptable diet (Figure 10).

The prevalence of morbidity among children was low in Tamil Nadu. The proportion of children who had had diarrhea in the previous two weeks varied between 4 and 15 percent; in 26 districts, the prevalence of diarrhea was less than 10 percent. There was little variability among districts in the proportion of children who had had ARI in the previous two weeks; this ranged from 0.4 to 7 percent (Figure 11).

Figure 10. Interdistrict variability in infant and young child feeding practices in 2016

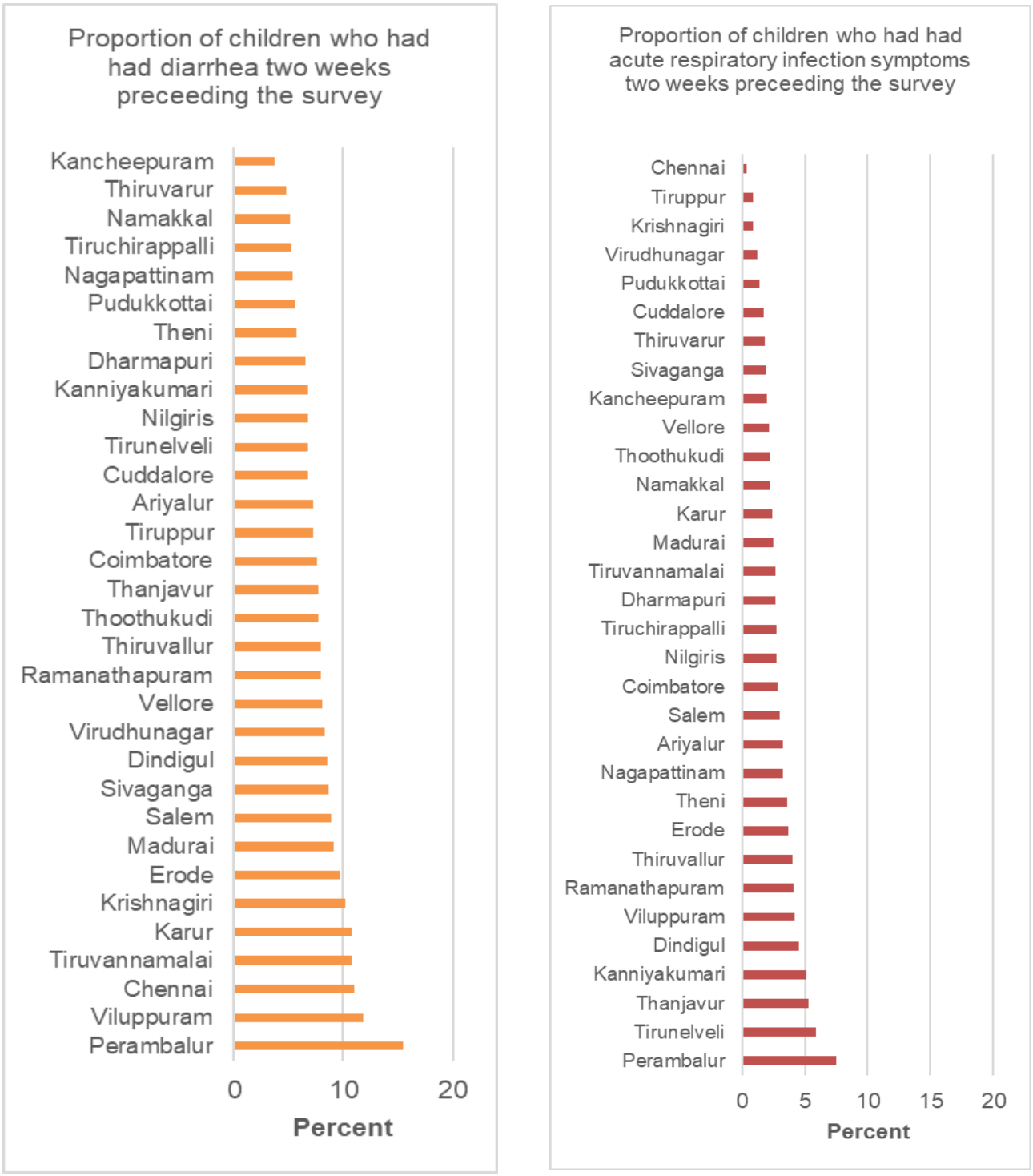




Source: NFHS–4 (2015/2016), IIPS (2016).

[1] Exclusive breastfeeding estimates for districts with fewer than 25 observations were not included.

Figure 11. Interdistrict variability in child morbidity in 2016



Source: NFHS–4 (2015-2016), IIPS (2016).

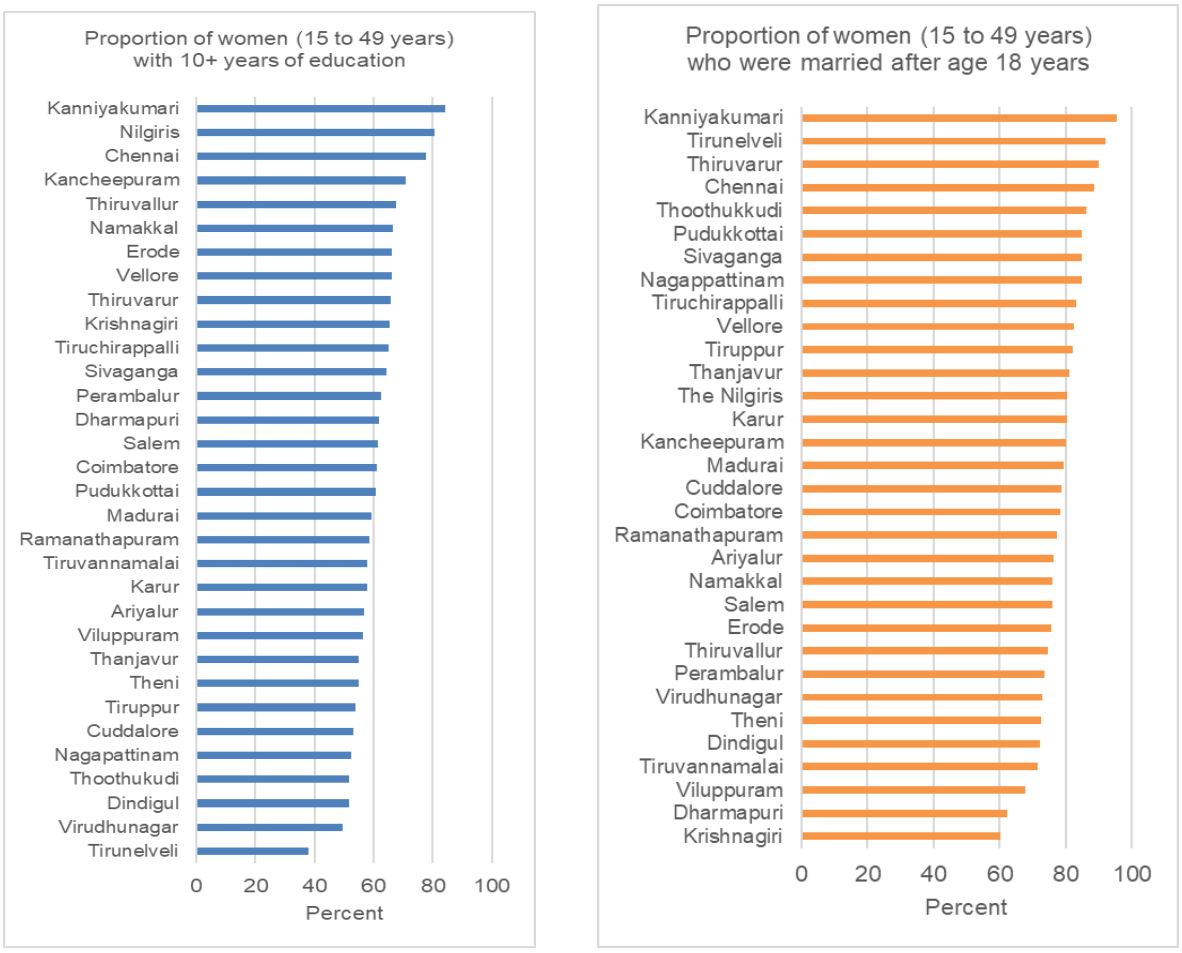
4.8.3 Interdistrict variability in the underlying determinants of nutrition in 2016

There was little variability in women's literacy rates, which ranged from 85 to 100 percent; in 22 districts, more than 90 percent of women were literate. The proportion of women with over 10 years of schooling was in the range of 38 to 84 percent; only in 17 districts did more than 60 percent women receive 10 or more years of schooling. The proportion of girls married after the age of 18 years was greater than 75 percent in 23 districts (Figure 12).

The proportion of households with access to improved drinking water sources was high across the state with little interdistrict variability. More than 70 percent of households in all the districts had access to an improved drinking water source; the coverage was above 90 percent in 21 districts (Figure 13).

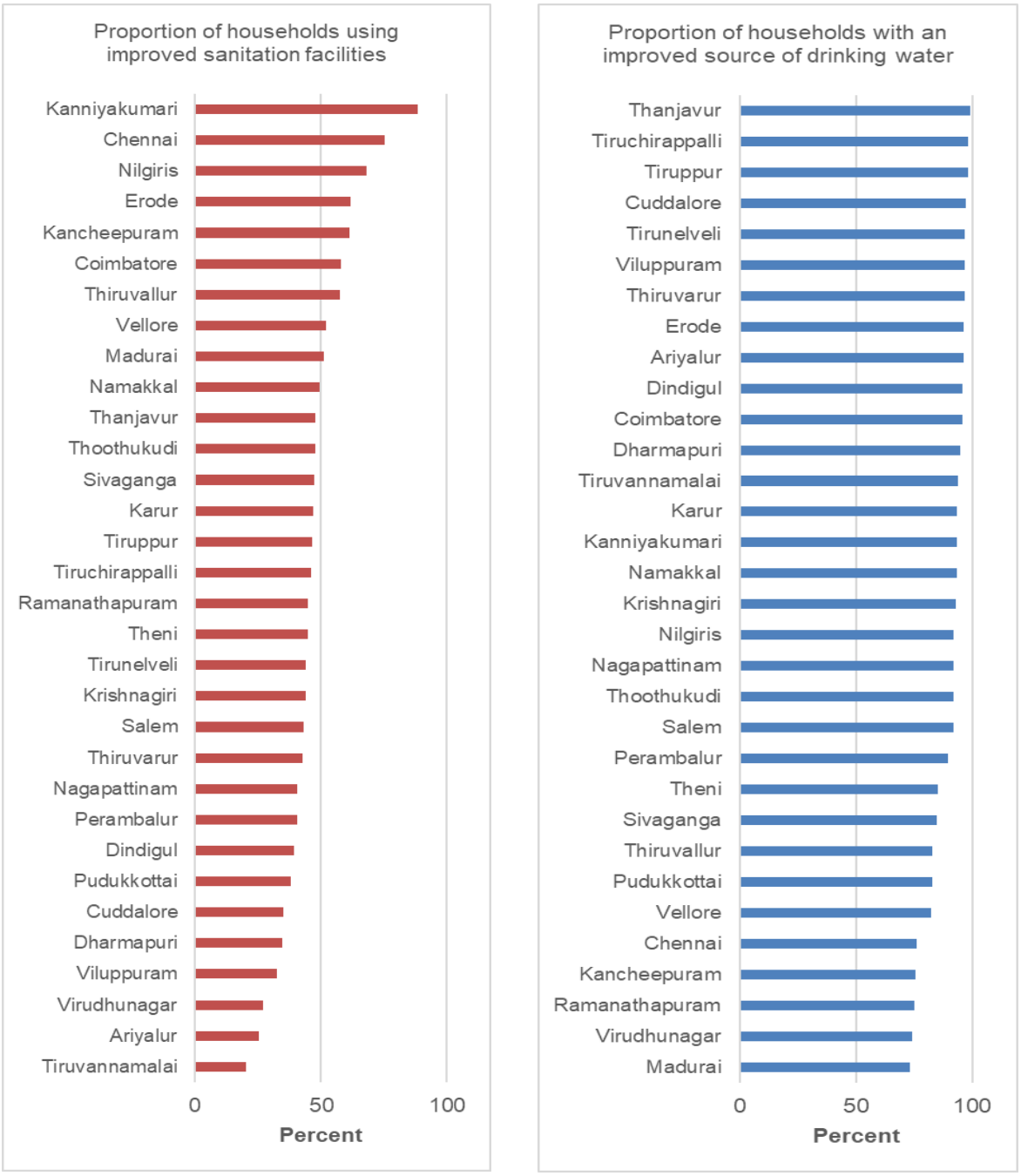
In all the districts of Tamil Nadu, access to electricity was very high (above 96 percent). There was interdistrict variability in the proportion households using improved sanitation facilities; this ranged from as low as 20 percent in Tiruvannamalai to 88 percent in Kanniyakumari, and in 23 of the 32 districts, less than 50 percent of households used improved sanitation facilities (Figure 13).

Figure 12. Interdistrict variability in women's status in 2016



Source: NFHS–4 (2015/2016), IIPS (2016).

Figure 13. Interdistrict variability in hygiene and sanitation in 2016



Source: NFHS–4 (2015/2016), IIPS (2016).

4.8.4. Interdistrict variability in coverage of nutrition-specific interventions in 2016

In a majority of the districts, interventions during pregnancy (including any ANC visits, 4 or more ANC visits, receipt of IFA supplements, and weighing) showed a high level of coverage (more than 75 percent). Deworming medicine was received by more than 50 percent of pregnant women in only 10 districts (Figure 14).

Institutional births were nearly universal in all districts and so were births assisted by health professionals. Postnatal care for mothers varied among districts, ranging from 55 percent in Ariyalur to 91 percent in Thiruvarur. Care for babies in the first two days after birth, however, was low, ranging from 18 percent in Kanniyakumari to 50 percent in Coimbatore; opportunities were being missed for conducting health checks of babies while mothers were receiving their postnatal visits.

Coverage of interventions during early childhood varied among districts. The proportion of children who were fully immunized ranged from 39 percent in Nagapattinam to 93 percent in Tiruppur; in 17 districts, more than 70 percent of children were fully immunized. The coverage of vitamin A supplementation in children in the 6 months preceding the survey was above 60 percent in a majority of the districts; coverage was highest in Tiruvannamalai (88 percent) and lowest in Ramanathapuram and Chennai (56 percent). The proportion of children were weighed in the 12 months preceding the survey varied from 37 percent in Chennai to 78 percent in Tiruppur. In 26 districts, more than 50 percent of children were weighed. Counseling of caregivers after weighing of children was, however, low ranging from 27 percent in Kanniyakumari to 64 percent in Karur. Opportunities were missed for counseling caregivers on child feeding practices after their children were weighed.

Figure 14. Interdistrict variability in the coverage of nutrition and health interventions in 2016

< 25% | 25-< 50% | 50-< 75% | ≥ 75%

State/District		TAMIL NADU	Ariyalur	Chennai	Coimbatore	Cuddalore	Dharmapuri	Dindigul	Erode	Kancheepuram	Kanniyakumari	Karur	Krishnagiri	Madurai	Nagapattinam	Namakkal	Perambalur	Pudukkottai	Ramanathapuram	Salem	Sivaganga
Pre-pregnancy	Demand for FP satisfied	83.2	78.5	89.0	88.7	80.9	86.2	89.3	89.2	89.7	75.4	88.6	88.1	75.2	84.9	86.0	75.6	73.0	58.5	89.6	74.7
	Iodized salt	81.4	62.7	95.5	90.7	73.2	81.1	81.1	86.9	91.0	80.4	88.3	82.6	81.5	79.7	88.7	83.9	84.5	66.6	88.0	64.9
Pregnancy	Any ANC visits	92.4	94.3	93.8	96.7	94.8	96.7	99.5	100.0	93.8	87.8	90.6	94.8	86.4	89.8	96.3	88.4	85.5	77.3	87.2	91.9
	≥ 4ANC	81.2	79.1	78.4	88.4	85.5	86.3	88.8	77.4	73.8	81.5	82.9	86.3	69.5	68.6	81.6	77.7	77.0	66.5	78.7	86.5
	Received MCP card	91.5	93.7	97.4	93.8	94.7	93.4	95.8	99.3	95.8	62.7	96.2	91.2	87.8	90.6	94.2	89.0	84.3	83.3	91.5	89.5
	Received IFA tab/syrup	94.5	98.2	93.2	99.1	94.7	95.3	94.6	91.5	94.2	95.1	94.9	95.4	94.1	94.8	95.0	96.3	94.2	94.3	96.4	97.0
	Consumed IFA 100+ days	64.7	52.2	70.2	75.6	65.5	51.1	67.5	68.3	60.8	72.0	73.4	81.6	66.9	54.6	66.8	57.3	63.2	54.9	65.0	70.5
	Deworming	47.2	46.0	45.9	52.1	40.1	56.9	41.8	43.2	49.5	31.9	42.5	51.4	43.4	38.4	49.8	44.3	37.8	33.1	57.8	30.5
	Weighing	92.2	93.7	93.8	96.7	93.3	96.7	99.2	100.0	93.8	87.8	90.6	94.8	86.4	89.3	96.3	87.1	85.0	76.5	87.2	91.9
	Breastfeeding counselling	60.5	75.2	37.0	69.7	64.5	77.5	61.4	62.1	52.9	44.5	65.4	58.4	59.2	59.4	55.8	60.8	62.4	50.6	65.2	51.1
	Food supplementation	60.7	75.6	41.2	61.4	59.6	74.7	71.6	66.4	57.0	38.7	74.3	62.9	54.6	65.7	71.3	73.0	60.2	48.7	71.6	46.3
	Health & nutrition education	57.3	75.5	40.4	60.7	58.4	74.1	67.8	62.4	54.3	35.8	72.7	62.2	52.2	57.1	65.8	63.8	57.8	37.2	64.1	40.1
	Tetanus injection	70.7	50.0	79.7	85.2	77.6	58.9	73.3	64.2	73.0	62.3	79.0	82.3	63.1	67.8	63.0	72.6	73.8	67.4	85.1	65.7
Delivery & postnatal	Institutional birth	99.3	98.7	100.0	99.5	99.1	99.1	99.4	100.0	100.0	99.5	100.0	96.3	100.0	100.0	100.0	100.0	99.6	99.3	97.9	99.4
	Skilled birth attendant	99.3	99.3	99.5	99.1	100.0	99.6	99.7	100.0	100.0	98.6	100.0	96.8	100.0	99.5	100.0	100.0	99.1	99.3	97.4	99.0
	Postnatal care for mothers	74.1	54.6	67.8	89.4	83.7	67.8	84.4	81.0	83.6	76.1	79.5	79.8	74.6	82.6	87.6	64.4	66.5	62.8	68.9	83.4
	Postnatal care for babies	35.4	36.8	30.8	50.0	39.2	47.6	45.7	42.4	33.0	18.0	41.4	39.4	31.3	35.2	35.9	21.2	23.3	26.9	25.0	30.0
	Food supplementation	58.4	75.0	39.6	65.4	59.6	75.1	67.7	67.7	54.1	35.4	70.9	61.3	45.2	59.4	70.9	62.6	51.4	43.7	66.0	44.3
	Health & nutrition education	55.1	71.4	39.5	63.1	57.0	74.3	65.1	60.6	51.1	32.4	67.0	59.2	42.7	52.7	68.4	57.2	50.7	35.9	61.1	39.8
Early childhood	Full immunization	70.7	63.0	85.5	80.3	64.4	51.6	80.8	84.4	57.2	55.9	89.5	84.0	59.2	38.9	57.2	73.1	57.0	64.4	74.9	70.6
	Vitamin A	66.8	76.8	55.9	59.9	59.0	80.5	62.6	62.1	67.0	62.7	73.0	65.0	60.8	65.8	59.1	66.4	66.5	56.0	68.6	60.3
	Paediatric IFA	34.4	45.2	35.3	33.9	37.9	44.7	37.3	43.0	23.9	12.7	40.0	38.7	21.3	26.3	31.4	37.8	36.0	29.4	42.8	22.5
	Deworming	52.4	62.5	56.5	57.4	57.9	62.7	57.9	61.7	44.1	40.9	54.6	59.8	44.4	44.7	47.5	46.5	39.2	47.3	54.3	56.3
	Care seeking for ARI	81.6	71.3	96.9	92.2	78.1	78.1	75.3	80.3	79.6	78.9	79.0	86.4	86.3	70.5	72.9	85.5	66.8	76.7	78.9	79.8
	ORS during diarrhea	60.0	57.2	63.1	58.6	41.0	76.9	54.7	68.3	38.5	58.8	32.7	59.0	74.7	62.5	57.5	68.1	40.3	39.2	64.7	78.4
	Zinc during diarrhea	41.4	42.7	68.9	43.8	25.7	30.6	52.4	61.5	30.7	22.6	29.0	58.5	36.7	37.0	28.5	34.0	15.4	18.0	40.8	29.3
	Food supplementation	64.0	81.7	28.2	64.4	54.6	74.4	66.9	70.8	60.1	54.0	67.8	61.6	50.1	62.1	66.3	76.0	69.3	57.4	75.5	61.0
	Weighing	58.0	69.9	37.4	58.3	56.4	71.1	63.4	62.1	51.9	42.3	69.3	58.1	49.9	54.9	60.9	71.7	62.6	48.4	65.8	52.9
	Counselling on child growth	47.6	59.1	29.8	49.9	42.7	63.5	55.3	52.6	42.9	27.4	64.5	49.9	35.0	43.1	53.5	58.9	47.2	32.1	55.4	37.0

	< 25%	25-< 50%	50-< 75%	≥ 75%

State/District		Thanjavur	Nilgiris	Theni	Thiruvallur	Thiruvarur	Thoothukudi	Tiruchirappalli	Tirunelveli	Tiruppur	Tiruvannamalai	Vellore	Viluppuram	Virudhunagar
Pre-pregnancy	Demand for FP satisfied	77.6	90.0	82.5	86.8	79.5	70.1	74.1	69.4	88.6	88.0	87.0	89.3	65.2
	Iodized salt	78.2	87.1	61.0	92.6	75.8	65.3	79.5	43.0	92.9	71.6	86.9	87.0	61.9
Pregnancy	Any ANC visits	98.0	98.6	87.2	98.1	91.1	77.6	94.3	79.5	98.2	94.5	98.4	90.2	79.1
	≥4ANC	90.2	88.8	75.9	91.5	83.4	64.7	85.7	71.0	89.4	83.5	92.5	79.5	65.8
	Received MCP card	93.1	97.6	88.3	96.2	90.1	80.9	85.4	77.6	97.8	94.1	98.4	92.2	81.1
	Received IFA tab/syrup	94.2	96.2	96.1	94.4	97.6	93.1	86.8	91.0	96.4	97.3	95.9	92.3	91.1
	Consumed IFA 100+ days	64.7	57.3	56.6	71.4	72.6	53.0	60.3	45.3	68.0	58.9	69.6	62.2	37.9
	Deworming	54.3	65.1	35.1	53.7	41.6	44.7	39.0	35.3	71.4	52.2	61.9	43.5	33.9
	Weighing	97.6	98.6	86.5	98.1	90.6	76.4	93.8	78.8	98.2	94.5	98.4	90.2	78.3
	Breastfeeding counselling	64.2	73.7	65.6	61.7	68.1	49.1	60.9	52.1	73.8	80.9	65.4	64.1	56.8
	Food supplementation	62.8	67.6	59.4	56.5	61.4	48.0	56.6	51.6	72.7	75.8	60.1	73.5	56.6
	Health & nutrition education	60.7	67.7	53.4	51.2	56.4	42.7	55.6	46.9	64.5	76.2	57.5	70.2	50.8
	Tetanus injection	66.2	68.4	39.0	68.4	78.9	61.6	49.5	57.8	80.8	61.7	81.4	75.0	45.3
Delivery & postnatal	Institutional birth	99.3	99.8	96.9	99.4	99.5	98.8	97.8	100.0	100.0	99.0	100.0	99.3	96.4
	Skilled birth attendant	99.6	99.8	98.9	99.4	99.5	96.5	98.8	100.0	100.0	99.0	100.0	99.5	100.0
	Postnatal care for mothers	64.4	70.4	54.7	75.6	91.5	70.4	67.6	57.6	79.5	68.4	71.4	66.0	55.0
	Postnatal care for babies	30.7	48.4	33.3	37.1	32.8	28.5	43.7	27.8	47.2	43.8	39.8	20.7	37.9
	Food supplementation	59.3	66.5	58.1	53.9	58.8	42.0	59.7	48.4	68.3	72.8	60.2	69.2	59.7
	Health & nutrition education	52.5	66.1	50.9	51.6	53.7	39.1	56.1	40.2	65.6	72.2	58.6	67.3	53.1
Early childhood	Full immunization	76.3	81.9	55.6	80.2	73.3	49.1	73.3	48.5	92.9	60.5	75.9	75.6	54.6
	Vitamin A	69.3	81.2	82.3	61.6	68.0	67.5	65.8	68.4	86.3	88.4	68.8	67.3	81.0
	Paediatric IFA	35.9	44.8	37.2	35.4	39.9	34.1	37.8	25.5	34.1	45.5	32.2	37.1	43.9
	Deworming	51.2	67.3	49.7	56.7	60.2	61.4	36.1	47.2	58.3	57.0	52.6	45.0	52.4
	Care seeking for ARI	84.9	86.2	100.0	89.0	86.5	82.1	88.8	86.9	91.0	73.6	81.1	80.9	51.4
	ORS during diarrhea	53.3	63.9	68.6	75.6	34.5	43.3	66.7	39.7	53.6	57.5	74.4	63.7	75.2
	Zinc during diarrhea	42.9	63.4	46.4	38.3	47.1	13.3	38.8	9.8	30.2	47.4	51.9	31.9	62.3
	Food supplementation	76.2	68.3	63.8	49.3	59.3	55.9	65.9	57.8	80.3	73.0	75.1	76.4	61.7
	Weighing	64.1	67.0	58.9	51.3	57.3	47.4	58.8	42.2	78.1	74.1	64.5	69.2	52.6
	Counselling on child growth	56.9	56.2	47.2	42.0	43.0	35.1	49.4	28.8	63.1	64.4	57.3	59.4	42.0

Source: NFHS–4 (2015/2016), IIPS (2016).
Note: FP = family planning; ANC = antenatal care; MCP = mother and child protection card; IFA = iron and folic acid; ARI = acute respiratory infection; ORS = oral rehydration solutions.

4.9 Summary

In summary, there is interdistrict variability in the prevalence of different nutrition outcomes, in immediate and underlying determinants, and in the coverage of nutrition and health interventions. A deeper in-depth district level analysis is warranted to identify context-specific and relevant strategies for closing the gaps in the determinants and interventions and improving outcomes. Tiruchirappalli, Thirunalveli, Virudhunagar, and Viluppuram Districts have performed poorly on several measures and need particular attention. To ensure equitable development, the state must endeavor to understand the contextual features of these districts and identify reasons for their poor performance.

5. CONCLUSIONS AND RECOMMENDATIONS

Tamil Nadu, a state of 74 million people in southern India, accounts for 6 percent of India's population and is the most urbanized state in the country. With the second-largest economy in the country in terms of gross state domestic product, it is one of India's high-income states. Tamil Nadu is considered to be a model state for its human development indicators. It is often cited as an exemplary state in India; it is a leader in social development with a long history of nutrition and health reforms.

Compared to the rest of India, the state has historically had a low prevalence of stunting. Between 2006 and 2016, decline in stunting was higher among children 24 to 59 months compared to children 6 to 23 months, suggesting that the changes were likely due to improvements in the early childhood period. Our analysis indicates improvements in SES accounted for 30 percent of the actual changes in stunting; this was followed by maternal education, health and nutrition services, household hygiene, village sanitation and availability of electricity, having health insurance, maternal, birth order, and marriage before 18 years. All these factors together explained 100 percent of the actual change in stunting. These changes could be achieved because of a long-standing vision for child development and a recognition that its achievement requires a multisectoral approach.

Tamil Nadu has implemented several state-level initiatives to improve maternal and child health and nutrition in addition to the national programs. All these efforts were complemented by strong economic growth and improvements in per capita income, along with the support of strong social safety net initiatives. Collaborations with development partners provided the further necessary impetus and resources for implementing the interventions. Finally, the state has had a stable social sector implementation paradigm. Although leadership has alternated between the two major political parties in the state, social sector investments have continued uninterrupted. Together, these factors have enabled gains in maternal and child well-being and improvements in the levels of stunting among children under five.

Recommendations

To continue to be an exemplary state, Tamil Nadu, it is imperative to determine the reasons for poor IYCF practices and identify measures to improve the full spectrum of IYCF. There is an urgent need to focus on improving sanitation in the state. The state must continue to deliver interventions at a high level of coverage, ensuring quality and continuity.

Finally, the substantial interdistrict variability across most determinants and interventions highlight the importance of taking a strong district-specific focus. Additional analytic work is necessary in each district to further understand the contextual factors and to develop tailored strategies for addressing the various determinants that can in turn deliver improvements in nutrition.

Tamil Nadu is rapidly transitioning from a state with a burden of undernutrition to a state that is facing multiple forms of malnutrition; these include overweight and obesity, and NCDs. A holistic approach is thus imperative in the development of an integrated health and nutrition strategy that is able to tackle multiple forms of malnutrition.

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