HEALTH, NUTRITIONAL SECURITY AND POVERTY AMONG WOMEN AND CHILDREN: A CASE STUDY OF TWO PANCHAYATS OF KERALA

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BY

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CERTIFICATE

This is to certify that the thesis entitled **"Health, Nutritional Security and Poverty among Women and Children: A Case Study of Two Panchayats of Kerala"** submitted by **Anju Susan Thomas** bearing registration number **13SEPH11** in partial fulfillment of the requirements for the award of **Doctor of Philosophy** in the School of Economics is a bonafide work carried out by her under my supervision and guidance.

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A. Published in the following publication:

1. Anju Susan Thomas (2020) "Air Pollution and Nutritional Transition as Risk Factors for Non-Communicable Diseases: The Emerging Trends in Health Scenario of Kerala, India, Plant Archives, Vol 20, Supplement 2, pp.3296-3300, e-ISSN:2581-6063(Online), ISSN:0972-5210.

B. Presented in the following conferences:

1. Presented a paper on "Nutritional Outcome Among Women and Preschool Children in India, With Particular Reference to Kerala: Evidence From NFHS" in the 8th Annual Conference of Indian Health Economics and Policy Association (IHEPA) held at National Institute of Science Education and Research (NISER) Bhubaneswar during January 23-24 th 2020.

2. Presented a paper titled "Indicators of Nutritional Status Among Children Under Five And Mothers Among Indian States: Evidence From NFHS" at the International Conference on Research insights on Social Science, Literature, Science and Law held during 20 – 21 st February 2020 organized by St. Thomas College, Kozhencherry, Kerala.

Further, the student has passed the following courses towards the fulfillment of the coursework requirement for Ph.D. and is exempted from doing coursework (recommended by Doctoral Committee) on the basis of the following courses passed during her MPhil programme and the MPhil degree was awarded:

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4.	EC751	Study Area	4	A+

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DECLARATION

I, Anju Susan Thomas, hereby declare that this thesis entitled "**Health, Nutritional Security and Poverty among Women and Children: A Case Study of Two Panchayats of Kerala**" submitted by me under the guidance and supervision of **Dr. G. Sridevi,** School of Economics, University of Hyderabad, is a bonafide research work which is also free from plagiarism. I also declare that it has not been submitted previously in part or in full to this University or any other University or Institution for the award of any degree or diploma. I hereby agree that my thesis can be deposited in Shodhganga /INFLIBNET.

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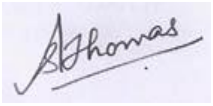

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Finally, I would like to add that I am alone responsible for the errors and omissions in the study and none other may be blamed for it.

By,

Anju Susan Thomas

"We are guilty of many errors and many faults, but our worst crime is abandoning the children, neglecting the fountain of life. Many of the things we need can wait. The child cannot. Right now is the time his bones are being formed, his blood is being made, and his senses are being developed. To him we cannot answer 'Tomorrow,' his name is today."

— Gabriela Mistral

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LIST OF ABBREVIATIONS

ARI	Acute Respiratory Infection
BMI	Body Mass Index
CNNS	Comprehensive National Nutrition Survey
GDP	Gross Domestic Product
ICDS	Integrated Child Development Services
IYCF	Infant and Young Child Feeding
LBW	Low Birth Weight
MAD	Minimum Acceptable Diet
MDD	Minimum Dietary Diversity
MMF	Minimum Meal Frequency
MoHFW	Ministry of Health and Family Welfare
NFHS	National Family Health Survey
SD	Standard Deviation

CHAPTER 1

INTRODUCTION

1.1 Introduction

The debate, what constitutes progress, brought to the forefront the interlinkage among economic growth, poverty and components of human capital- health and education. A healthy workforce shifts the production function upwards, thereby increasing overall productivity, less absenteeism on account of illness, less expenditure on health bills and therefore higher savings (Strauss, 1986; Deolalikar, 1988; Sahn & Alderman, 1988). The poor should be targeted for improving their health parameters, which would enhance their income and ability to access food and adequate nutrition.

Without nutritional and health security, food security will be an unfinished agenda. Availability, accessibility, and utilisation are the factors that contribute to the realisation of food security (FAO Committee on World Food Security, 1992; FAO, 1996). In India, near self-sufficiency in food grain production, to a moderate extent, addressed the issue of availability of food grains (Government of India & The World Food Programme, 2019). Economic accessibility of food is influenced both by employment opportunities and wages on one hand, and food prices on the other. Adequate provisioning of water, sanitation, and health care facilities are essential for better health and nutritional outcome.

Nutrition is an essential element and a critical input of human development. Inadequacies, disparities in “energy and/or nutrients intake” result in malnutrition (WHO, 2016). There are different variants of malnutrition- resulting from lack of micronutrients, protein-calorie deficiencies, overnutrition, and secondary malnutrition (Mayer, 1976). Secondary malnutrition occurs due to a disorder or disease that inhibits food digestion and can be mitigated through public health measures. Overnutrition is a problem faced by high-income countries. 'Protein malnutrition' was presented in the third session of Joint FAO/WHO Expert Committee on Nutrition, held in Gambia in 1952 and protein gap surfaced in 1968 (Food and Agriculture Organization (FAO) of the United Nations, 1968). Till 1970s, nutritionists considered protein deficiency to be a central problem. Studies by McLaren (1974) argued that protein malnutrition is not the main form of malnutrition among children. The concept of protein gap was "no longer tenable", and the problem was mainly of "quantity rather than quality" (Waterlow & Payne, 1975). The sixth World Food Survey (FAO, 1996) points to calorie deficiency as a more significant problem compared to protein deficiency.

Recent studies highlight the importance of adequate protein and amino acid requirements to limit linear growth retardation among children (Ghosh et al., 2012; Semba, 2016).

Undernutrition affects “immunological and non-immunological” defences of the human body (Suskind, 1977; Bourke et al., 2016), resulting in the increased occurrence of illness (Mc Neish, 1986), risk of untimely death, blights intellectual capabilities, stunts growth, impedes learning and lowers labour efficiency (Scrimshaw, 1997). Sufficient nutrition is a crucial input in averting not only diseases of impoverishment, but also chronic diseases, affecting irrespectively the haves and the have- nots (Banerjee & Duflo, 2011). Poverty is a multidimensional concept and poverty is seen as deprivation of well being, measured in terms of deprivation of a minimum threshold of income, health status, education assets and rights in a society (World Bank, 2000). In the present study, by poverty, it is meant as food poverty and is measured in terms of nutritional insecurity.

1.2 Measurement of Nutritional Status

The following are the measures for determining the nutritional outcome of an individual:

1. Clinical assessment.

It relies on the examination of the physical sign on the body for determining nutritional status (Jelliffe, 1966).

2. Biochemical Assessment.

It needs testing of body fluids like blood and urine, to find immediate nutritional issues.

3. Dietary assessment.

Dietary assessment can be undertaken through (1) Dietary recall- tries to capture the food consumption during the previous twenty-four hours or the last week; and (2) dietary records wherein, the quantity of food consumed is recorded. Consumption patterns are less likely to be modified, but the estimates of the amount consumed are prone to recall errors.

4. Anthropometric assessment.

It is a science of measuring the human body. The most obvious physical manifestation of undernutrition is in the individual's size. Jelliffe (1966) provided a set of standardised anthropometric measurements for anthropometric assessment. The building blocks for anthropometric assessments are age, sex, height and weight. The three commonly used indicators to assess child nutritional status are:

a) Low height for age or stunting: An individual whose height is low for his/her age is stunted. It is a symptom of past undernutrition.

b) Low weight for height or wasting: People who are currently undernourished are thin. Weight loss results from either acute starvation or disease.

c) Low weight for age or underweight is a symptom of either past or current undernutrition and "is a composite index of height for age and weight for height" (International Institute for Population Sciences (IIPS) & ICF, 2018, p.292). "Weight for age represents a convenient synthesis of both linear growth and body proportions" (Food and Agriculture Organization(FAO), 1996, p.65). Due to its composite nature, its interpretation is problematic. It "fails to distinguish between short children of adequate body weight and tall, thin children" (Babu & Sanyal, 2009, p.346).

To assess an individual's nutritional outcome, using anthropometric measurement, requires the following procedures:

1. Take body dimension of the person.
2. To juxtapose that person to "reference group"- By observing how much one person deviates from others of a similar status (age and sex), one can draw inference about nutritional status.
3. Decide the nutritional status based on that comparison.

Table 1.1 gives some of the anthropometric classification systems for comparing an individual to the reference group.

Table: 1.1 Malnutrition Classification Systems

System	Range	Malnutrition category
World Health Organisation	Z-Score of -1 to -2	Mild
	Z-Score of -2 to -3	Moderate
	Z-Score < -3	Severe
Body mass index(Adult greater than 18 years)	Greater than 18.5	Normal
	17-18.49	Mild thinness
	16.00 – 16.99	Moderate thinness
	Less than 16	Severe thin
MUAC(6-59 months)	Less than 115 mm	Moderate Acute Malnutrition
	≥115 mm to <125mm	Severe acute malnutrition

Source: Cashin and Oot (2018); Cogill, 2003; WHO, 2013

WHO uses "three different systems by which a child or a group of children can be compared to the reference population: Z-scores (standard deviation scores), percentiles, and

per cent of median" (de Onis & Blössner, 1997, p.49). Growth curves were formulated by WHO using Multi Centre Growth Reference Study (MGRS), to measure growth of infants and children throughout the world. WHO new standards provided an efficient means for screening the growth of children (de Onis et al., 2004).

(1) Z-Score or standard deviation (SD) unit is "defined as the difference between the value for an individual and the median value of the reference population for the same age or height, divided by the standard deviation of the reference population" (Babu & Sanyal, 2009, p.347).

$$\text{Z-score (or SD score)} = \frac{\textit{(observed value)- (median reference value)}}{\textit{Standard deviation of reference population}}$$

Z-score cut off is -2 SD (WHO, 1986). Children having a value between -2 and -3SD are moderately malnourished concerning anthropometric failures (stunting, wasting and underweight).

(2) Percentage of the median

It is the "ratio of observed value of the individual to the median value of the reference data for the same age or height for the specific sex, expressed in percentage" (Babu & Sanyal, 2009, p.348).

(3) Percentile

It measures what percentage of the reference population has a weight/height less than the individual. For instance, if the individual weight is at the 30th percentile, it means that 30 per cent of the reference population weighed less than the individual.

The other two commonly used classification system are:

Body Mass Index (BMI)

BMI is the most appropriate anthropometric measure of adult nutritional outcome and can be used to assess underweight, overweight and obesity (Shetty & James, 1994). BMI below 18.5 is regarded as lower than normal and is considered as underweight (FAO, 1996).

BMI<17.0 indicates moderate and severe thinness.

BMI<18.5 indicates underweight

BMI 18.50 to 24.9 indicates normal weight.

BMI > 25.0 indicates overweight.

BMI> 30.0 indicates obesity.

Mid upper arm circumference (MUAC)

To overcome the practical issues in various anthropometric measures namely, absence of correct information of age, untrained staff etc, Shakir (1975) developed a screening device to identify severely undernourished preschoolers.

1.3 Nutritional Status of Children in India

Thirty eight percent of children below five years are chronically malnourished or stunted in India. One out of every five children is wasted. Thirty-five per cent of children under age five are underweight (IIPS & ICF, 2017). National Family Health Survey (NFHS) 4 reveals some unhealthy and disturbing trends, regarding the nutritional status of children among states and across regions. The percentage of stunting ranges from 20 percent in Goa to about 40 percent in Bihar. Compared to NFHS 4, in the recently published NFHS 5 fact sheets for 22 states / Union Territories(UT), chronic undernutrition has increased in 13 states/UTs, whereas, underweight has increased in 16 states/UTs. Despite ambitious programs like Poshan Abhiyaan, malnutrition is still high. The partially released data is a grim reminder that India should rethink its nutritional strategy, a strategy away from a piecemeal approach to a holistic approach, such as direct intervention, including supplementary nutrition, growth oriented approach, and enhancing the operation efficiency of Integrated Child Development Services (ICDS). Economic growth alone does not guarantee improvements in nutritional outcomes, as evident from the poor nutritional performance of economically advanced states. Rise in nutritional status is not consistent with poverty reduction.

Health conditions in Kerala have always remained better than other states of India. Despite Kerala's striking achievements in the health parameters, Kerala is the most morbid state, with morbidity in Kerala more than three times than the all India average (Government of India, Ministry of Statistics and Policy Implementation, & National Statistical Office, 2019). As per the NFHS 4 report, Kerala has climbed the ladder, in comparison to other states, in terms of nutritional outcome- stunting, wasting, and underweight- among children below 5 years. The percentage of underweight children is 16 percent in Kerala. Kerala faces a hidden hunger problem. According to the latest Comprehensive National Nutrition Survey

(CNNS) 2019 report, one in every five children are malnourished in Kerala, lagging Jammu and Kashmir, Goa, and Tamil Nadu (Government of India & Population Council, 2019).

1.4 Major Issues from Review of Literature

Poverty has declined across all social groups commensurate to the rate of growth of gross domestic product (GDP), yet the prevalence of malnutrition is rampant. It is indicative of the critical factors of nutritional status India is lagging. Assessment of nutritional status should not be solely based on calorie intake, but rather a combination of diet survey data, anthropometric data, clinical examination, socio-economic and environmental assessment, and biochemical evaluation needs to be employed (Gopalan, 1983). Calorie intake, as a measure of malnutrition, is riddled with specific conceptual and practical difficulties. It is an economic measure of poverty. There is a risk of overestimation of calorie intake among children, since an assessment of calorie intake among them depends on overall household calorie intake and is computed based on coefficients of physiological requirements. It neglects the inadequacy of essential micronutrients in the diet and also the inter and intra-individual variations in calorie requirements (Sukhatme, 1978). Gopalan proposes a new adaptive mechanism whereby, the body lowers the limit of calorie adequacy, and stunted children are adapted that their growth is limited to size in response to the low-calorie intake (Gopalan, 1983).

Deaton and Drèze (2009) point to the decline of average calorie intake during the last 25 years, on one hand, and an increase in real average household expenditure on the other. Three hypotheses, explaining the plausible causes of stunting stems from the social determinants, genetic potential and gradual catch up hypothesis (Deaton & Dreze, 2009). Social determinants hypothesis points to the social factors such as poor epidemiological surroundings, insufficient social support, and improper infant and young child feeding(IYCF) practices, as the significant determinants of stunting among privileged children. The genetic potential hypothesis argues that children differ in their genetic potential and children in India are short by nature, despite being adequately fed. Gradual catch up hypothesis admits that even though Indian children have the same genetic capability compared to children in the reference population, it takes time to catch up. Panagariya (2013) argues that flawed measurement methodology of WHO, providing common height and weight standards, regardless of differences in genetic, environment, cultural and geographical factors exaggerated the extent of stunting in India to a level higher than that of Sub Saharan African

countries. Height of an individual can vary for both genetic and nutritional reasons, and a detailed medical examination can disseminate the causes for stunting. He calls for region-specific height norms to gauge malnutrition. Critics of Panagariya's claim, accept the WHO international growth reference standards and point to the determinants of nutritional status such as poverty, low status of women, differential allocation of resources within the household, post-birth factors, and disease environment etc. for the poor performance of India in tackling malnutrition (Desai & Thorat, 2013; Gupta et al., 2013; Jayachandran & Pande, 2013; Ghosh et al., 2014).

1.5 Statement of the Problem

Poverty, hunger and malnutrition are some of the challenges faced by India. Malnutrition continues to plague the lives of vulnerable groups, in particular women and children. The reduction in malnutrition among children has not kept pace with income growth (Ramalingaswamy et al., 1996; Panagariya, 2013). Gender discrimination renders unequal access to health services, especially for marginalised women. Women need adequate nutrition throughout their life cycle; it is their nutritional levels that determine the health of future generation. Child malnutrition is accentuated due to heightened vulnerability to infection and poor feeding practices. Researchers have analysed how poor nutrition during infancy affects a child's future school joining, educational achievement, intellectual ability and lifetime income (Morgane et.al., 1993; Pollitt, 1997). It is a widely considered notion that inadequacy of food is the chief reason of undernourishment. Hence, most of the programs and policies targeting this menace have been tilted to food-based interferences, neglecting the other determinants of nutritional outcome (The World Bank in India, 2009). Good nutrition can break the intergenerational chain of poverty.

1.6 Need for the Study

The various rounds of NFHS provide the major source of macro-level statistics on nutritional status of children under five in India. Often, aggregate results may be misleading as the severity of malnutrition at the disaggregated level may be masked by the average and may fail to capture the real cause of the problem at the micro-level. Within a state, there are inter-district disparities in nutritional outcomes and the health and nutritional status of marginalised communities are precarious. Most of the studies at micro-level focused on the

high burden malnutrition states in India. Hence, it has not attracted much interest of researchers to analyse the nutritional status of children in Kerala at the household level.

Kerala boasts of striking achievements in the health sector. Despite, Kerala being ahead of other Indian states concerning health indices, the sustainability of these achievements is dubious as the state is grappling to tackle non-communicable diseases (NCDs). Many of the markers of NCDs have links to nutritional status in childhood. The triple burden of malnutrition is an emerging issue of concern, and the nutritional outcome of marginalised groups in Kerala is far behind that of other social groups. Malnutrition among children under five (stunting, wasting and underweight) and low nutritional status of their mothers (low BMI) is a serious concern among the marginalised, especially the tribal population- 'Adivasis'. Their educational and health achievements are behind the other segments of the population. They are confronted with poverty, malnutrition, and are often deprived of their traditional sustenance. Even within districts with a considerable size of tribal population, there are wide inter-district variations in nutritional outcome. Several existing micro-level studies have either focused on studying the nutritional outcome of either children of tribal communities or children of 'other communities' separately and the majority of them were confined to a specific district, area or a sect of tribal population. The present study is undertaken in two tribal dominated panchayats of two districts in Kerala. The study gains relevance as no inter district comparison of nutritional outcome of preschool children (0-5 years) has been undertaken so far. The study also looks into the health profile of the mothers of these children. It tries to analyse panchayat wise variations and association of selected child and maternal indicators on the nutritional outcome of children. The difference in spatial determinants of malnutrition is also attempted. Quantitative research ruled the roost in most of the macro and micro level studies. A blend of quantitative and qualitative analysis is attempted. Qualitative analysis tries to capture the possible determinants of undernutrition by undertaking an in-depth analysis of malnourished children.

1.7 Objectives

(1) To study the changing context of the nutritional status of children under five and women across states of India.
(2) To analyse the IYCF practices and maternal health care indicators across the selected states.
(3) To examine the panchayat specific determinants of nutritional status of preschoolers in the study area.
(4) To explore the IYCF practices and community-specific maternal and child care customs and traditions at household level (in the study area).

1.8 Data Source

Primary and secondary data sources are employed. Secondary data sources include, Census reports 2011, NFHS reports, National Nutrition Monitoring Bureau(NNMB) reports of National Institute of Nutrition, information from Kerala Institute for Research Training and Development Studies for Scheduled Castes and Scheduled Tribes (KIRTADS), Handbook of Scheduled Tribe Development Department, 2017, UNICEF/WHO/World Bank-Joint Child Malnutrition estimates, 2020, CNNS 2019 etc. have also been used.

Using a pre-tested interview schedule, primary data has been collected. A pilot study, based on 10 percent of total sample size, was conducted to test the efficacy of the questionnaire. Modifications were done based on the response from the pilot study and comments received from the experts. Preschool children's (aged 0 to 59) mothers were the respondents. Part one of the interview schedule deals with the basic socio-economic and household characteristics of the respondents. Part two deals with child details pertaining to gender, birth order, birth weight, type of delivery and anthropometric measurements. Part three consists of relevant maternal information, parental education, occupation, sources of information, details of other children, miscarriage etc. Part four deals with the health status of child, the incidence of illness, hospitalization reasons, immunisation history, infant feeding practices etc. It also deals with maternal care during pregnancy, health complications etc. Part five pertains to food frequency chart, expenditure pattern on food and non-food items. Access to basic health care and Anganwadi services and their utilization is also enquired.

Apart from mothers of the children, primary data is obtained from social workers, old settlers, ward members, *ooru moopan* (head of the tribal hamlet) and aged women folk. The household survey was conducted in Vithura Panchayat during June-July 2019 and in Thirunelly Panchayat from August - November 2019. Recumbent length in cm is taken in case of children less than two years and for children greater than two years, height is measured using an inch measuring tape. The height of the mothers is also collected similarly. Calibrated weighing machine has been used to measure the weight of children and their mothers. For younger infants, initially, the weight of mother and child is taken together, and then the weight of the mother alone is deducted to arrive at infant weight.

1.9 Methodology

The study employs a multi-stage sampling technique. The tribal population of Kerala is geographically concentrated. Out of the 14 districts, those districts which have at least five percentage tribal population have been considered for identifying the farthest and the closest lying district from Kerala state average in terms of anthropometric parameters. Almost 75 percent of tribals reside in the six districts of Wayanad, Idukki Palakkad, Kasaragod, Kannur, and Trivandrum.

Table 1.2 Percentage of Children Under Five Classified as Stunted, Wasted and Underweight for Selected Districts in Kerala

District	Stunting			Wasting			Underweight		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Kasaragod	18.1	19	18.7	9.1	10.1	9.7	19.9	9.9	13.9
Kannur	28.9	15.9	25.3	7.5	17.1	10.2	8.5	15.9	10.5
Wayanad	NA	26.2	27.7	NA	23.8	23.9	NA	26.9	27.2
Palakkad	NA	18.6	20.2	NA	8.2	10.3	NA	18	19.1
Idukki	NA	15.5	15.1	NA	23.1	24.2	NA	15.3	14.8
Thiruvananthapuram	24.3	14.4	19.5	11.5	14.8	13.1	19.8	23.3	21.6
Kerala	19.8	19.5	19.7	16	15.5	15.7	15.5	16.7	16.1

Source: NFHS 4 Kerala Report, 2015-16

Table 1.3 Mean Absolute Deviation and Ranking of Districts

District	Mean absolute deviation				
	Stunting	**Wasting**	**Underweight**	**Combined**	**Rank**
Kasaragod	0.050761	0.382166	0.13664596	0.569573	4
Kannur	0.284264	0.350318	0.34782609	0.982409	2
Wayanad	0.406091	0.522293	0.68944099	1.617825	1
Palakkad	0.025381	0.343949	0.1863354	0.555665	5
Idukki	0.233503	0.541401	0.08074534	0.855649	3
Thiruvananthapuram	0.010152	0.165605	0.34161491	0.517372	6

Source: Researchers calculation

From the Kerala average of stunting, wasting and underweight (based on NFHS 4), mean absolute deviation of these indicators, scaled by state average, are calculated for six districts. The districts are ranked based on the combined sum so obtained. Based on these calculations, Wayanad is farthest, and Thiruvananthapuram closest to the Kerala state average and are hence chosen for the study.

1.9.1 Sample Size Determination

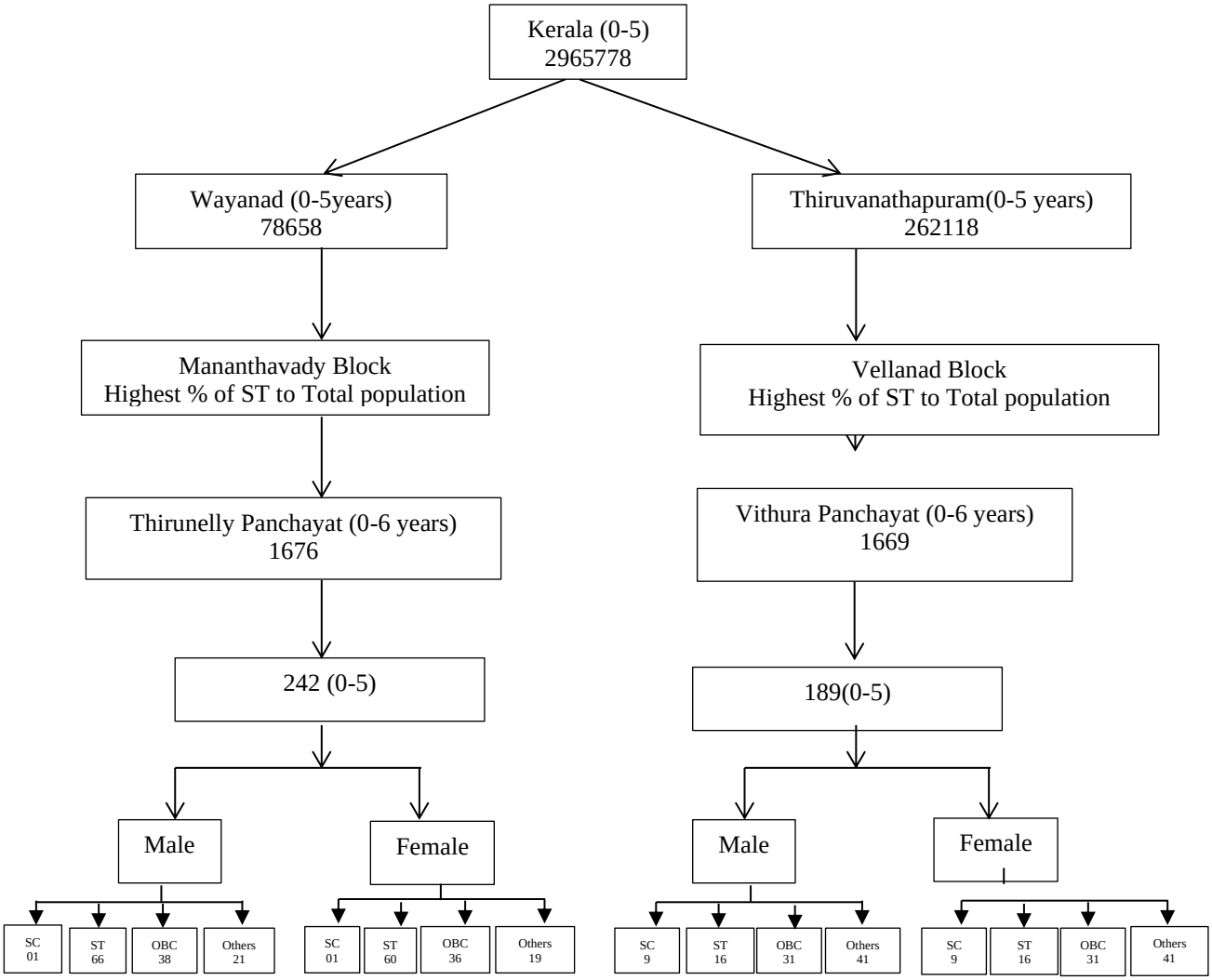
The total size of children based on single-year age returns between 0-5 in Kerala is 29,65,778 (Government of India, 2011 b). The sample size from the state was selected based on precision rule and confidence interval. The formula for the selection of the sample size is as follows.

$$n = \frac{z^2.p.q.N}{e^2(N-1) + z^2.p.q}$$

Here, 'p' represents the proportion of the population with a particular characteristic. We need to select the sample from the age group 0-5 years, to look into the nutritional outcome of the sample group. Since, underweight is a composite indicator of nutritional status, the data on underweight children in Kerala, in the age group 0-5 is 16.1 percent (NFHS 4). Thus, p is equal to 0.161 and the corresponding value of q = (1-p). The value of 'z' represents the standardized normal value for the given level of the confidence interval, 'e' is the percentage of expected error and N is the total population. Here, N is equal to 29,65,778. The value of z is 1.96 which is equal to the standardized value for 95 percent confidence interval and 'e' or percentage error is assumed to be 4 percent. Thus, the arrived sample size is 325. While selecting the sample, the non-response on the part of the respondents should be taken into

account. If the non-response on the part of the respondents is assumed to be 10 percent, then the total sample size is 357. Though the required minimum sample size is 357, a sample of 400 has been selected. The sample is divided between the selected districts based on the criteria of the proportion of underweight in these respective districts. The percentage of underweight children in the age group of 0-5 in Wayanad district is 27.2 whereas it is 21.6 in Thiruvananthapuram district. Thus, the sample size from Wayanad and Thiruvananthapuram are respectively 220 and 180. While collecting the sample from each region, proportional weightage is assigned for the socio-demographic characteristics such as gender and caste as revealed from the district census handbooks of Wayanad and Thiruvananthapuram. In addition to the main sample size, an additional 31 samples were collected from the sample districts as part of the pilot survey. The sample collected from Wayanad for the pilot survey is 22 and from Thiruvananthapuram is 9. Thus, the total sample size for the study is 431, and the share of Wayanad and Thiruvananthapuram are 242 and 189 respectively.The sample frame of the study is provided in Fig 1.1.

Fig 1.1 Sample Frame



1.9.2 Study Area: An Overview

Wayanad

Wayanad is a Northern district in Kerala. Literacy rate as per 2011 census is 89 percent. Wayanad consists of Mananthavady, Kalpetta and Sulthanbathery community development (CD) blocks. Wayanad has the distinction of housing the highest proportion of the tribal population in the state, as per 2011 census (31.24 percent). They comprise 18.5 percent of the total population. Manathavady block has the highest percentage of tribal to total population (21.6 percent). Among the panchayats of Manathavady block, Thirunelly panchayat has 44.3 percent tribal population followed by Panamaram Panchayat (23.7 percent). Since the study attempts to do a comparative analysis of the nutritional status of preschoolers in a predominantly tribal panchayat, to get an adequate representation of tribals, purposively selected Thirunelly panchayat of Manathavady CD block, Wayanad district as the study area.

Major tribal groups residing in Thirunelly panchayat are *Paniya, Adiyan, Kattunaika, Kurichyar, Kuruma* etc.

Thiruvananthapuram

Thiruvananthapuram is the southernmost district and the capital city of Kerala. Thiruvananthapuram district has 11 blocks. Out of the total tribal population of Kerala, 5.52 percent live in Thiruvananthapuram district. Tribal group of Thiruvanthapuram are called *Kanikar*. As per the 2011 census, the district has 7,822 tribal households, and the total population is 26,759 (both rural and urban combined). The literacy rate as per 2011 census is 93 percent, whereas among tribals of the district it is 80.36 percent. Tribal population in the district is spread across 14 panchayats in the blocks of Vellanad, Perungadavilla, Nemom, Vamanapuram, Nedumangadu and Kilimanoor. In Vellanad block, Vithura Grama panchayat has a total of 1,644 households residing in 78 settlements. Hence, Vithura is taken as the area of study in Thiruvananthapuram district.

1.9.3 Study Sample Identification

The study includes preschool children in the selected panchayats-Vithura in Thiruvananthapuram district and Thirunelly in Wayanad district, Kerala. If a mother has more than one child in the age group 0-5, only youngest child has been included. If on enquiry, the child is under treatment for chronic illness (like congenital heart disease, macrocephaly etc) he/ she has been excluded. Motherless child has been excluded since the vital information regarding breastfeeding and mother's health status cannot be collected.

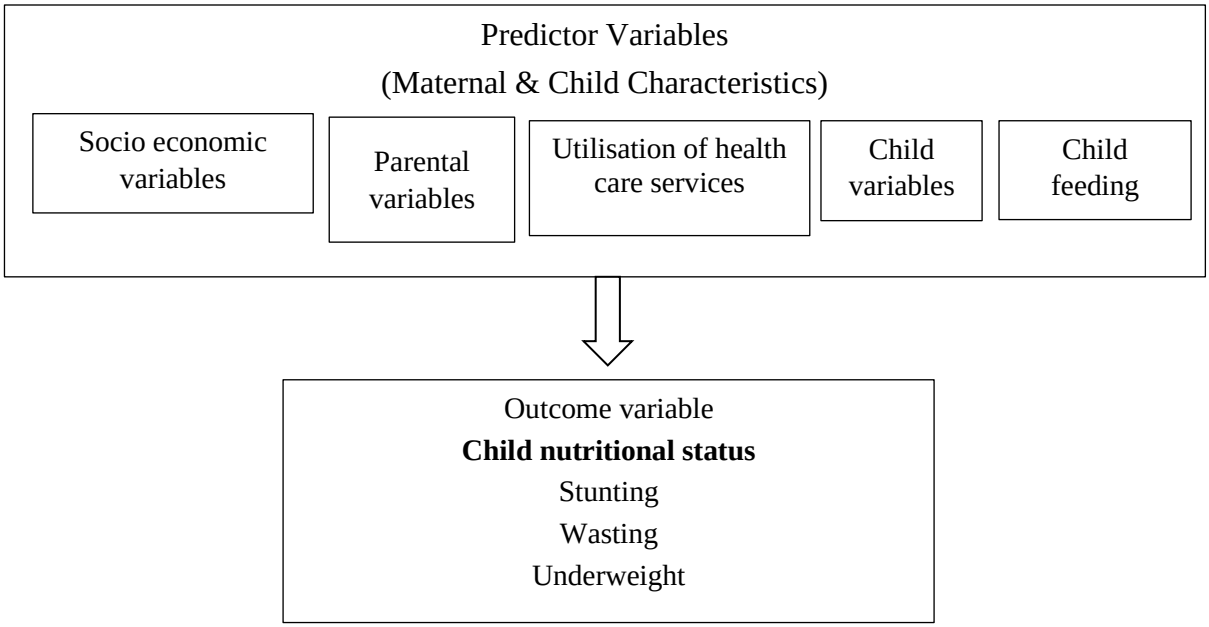
Each Anganwadi, under Integrated Child Development Services (ICDS) scheme, has a complete list of pregnant ladies and children under the age of five, coming under their geographical jurisdiction. Samples were identified with the assistance of ASHA workers and Anganwadi teachers. Tribals in Kerala live in settlements called as *ooru* or tribal hamlets (colonies). Here, samples were identified with the assistance of tribal promoters and *ooru moopan* (tribal head). Each of Thirunelly and Vithura panchayat has 40 and 33 Anganwadis respectively spread across 17 wards and sample households were randomly selected.

1.10 Theoretical and Conceptual Framework

The theoretical framework is based on the contributions of Becker (1965), Engle and Ricciuti (1995) and Engle et al. (1999). A nutrition production function can be estimated, wherein a child's nutritional outcome is dependent on a range of health inputs like child's intake of nutrition, health care use, exogenous individual, domestic and community characteristics. Caregiving behaviour is also an essential input to child nutritional status (Engle et al., 1999). Caring action is governed by the quantity of care (time spent in taking care of children like bathing, feeding etc.) and quality of care (nature of activities performed). Quality of care is divided into caregiver and psychosocial care practices. Caregiver practices influence the child's nutrient intake by strengthening their psychomotor capabilities (say, handling of spoons etc.) and encouraging the child to eat. Psychosocial care is depicted by the love and affection shown by the caregiver to the child. Quality psychosocial care has a constructive influence on health and nutrition (Engle & Ricciuti, 1995).

Several conceptual models tried to analyse the multitude and complex set of factors that determine the nutritional outcome (UNICEF, 1990; Smith and Haddad, 2000; FAO, 2000; Engle et al. 1999; Benson, 2004). Nutritional outcome is governed by factors like accessibility and availability of food, physical wellbeing and care (UNICEF, 2013). Optimal nutritional status requires access to reasonable, varied and healthy food, appropriate care practices, health services and environment. Several studies categorise the determinants of malnutrition into demographic variables (age and sex of the child, age of the father, mother’s age, birth order, birth spacing, total children in the family and family size), socioeconomic variables (literacy of mother, literacy of father, occupation of mother and father, family income, religion, caste, type of family, type of house and availability of sanitary toilet) and child care variables (breastfeeding and Immunisation). Demographic and socio-economic characteristics are expected to influence child care behaviour and cause undernutrition.

Fig 1.2 Conceptual Framework for the Study of Child Nutritional Status and its Determinants



Source: A simplified framework developed by the researcher

The conceptual framework used in the present study is given in Fig 1.2. The predictor variables in the model are maternal and child characteristics and the variables pertaining are divided into socio-economic variables, parental characteristics, utilization of health care services, child characteristics, and child feeding practices. These, in turn, affect the child nutritional status, and the outcome is measured using anthropometric indicators, namely stunting, wasting and underweight.

1.11 Methods of Data Analysis

To study the trends in child malnutrition at national and state levels, an exploratory analysis, using secondary data sources is attempted. Certain indicators related to IYCF from NFHS 4 report are employed to examine the child feeding practices. Rank correlation matrix, coefficient of variation, and averages are used.

The study uses a mixed-method for primary data analysis. A quantitative led qualitative method has been employed. The study explores, using qualitative tools -ethnographic content analysis, IYCF, the traditional practices and customs followed by each community for preserving and maintaining maternal and child health. Since the main objective is to assess the nutritional and health outcome of women and children, direct methods of nutritional assessment, namely anthropometric and dietary evaluation methods, are used. Inputs on

weight, height and age of children are used to compute anthropometric failures among children in the study area, using WHO child growth standards. The nutritional status of women is gauged, based on BMI.

For primary data analysis, univariate and bivariate analysis are employed. Statistical techniques used are mean, standard deviation, Z-score, Chi-square, ANOVA and logistic regression. In bivariate analysis, Chi-square test is used to assess the potential risk factors associated with childhood stunting, wasting and underweight. Binary logistic regression models are employed to analyse the effects of explanatory variables on normal height for age, normal weight for height and normal weight for age among the sample group across the two panchayats. Dietary evaluation, using 24-hour recall method, is done on a sub-sample, consisting of 10 percent of the total sample size to assess the adequacy of energy and protein intake of both mother and child based on Recommended Dietary Allowances (RDA). Diet chart (food frequency chart) is also employed to evaluate the frequency of intake of pulses, cereals, vegetables, non-vegetables, tuber, fruits, milk, and other beverages.

1.12 Chapter Scheme of the Thesis

The thesis has been divided into seven chapters.

Chapter 1 deals with introduction, major issues from the available literature, statement of the problem, need for the study, objectives, data source, methodology and chapter scheme.

Chapter 2 discusses issue wise literature review on poverty and malnutrition, nutrition and productivity, and various determinants of child nutritional status.

Chapter 3 looks into trends in nutritional status of children and women in India, IYCF practices, maternal health care indicators across the selected states of India, and child and maternal care indicators for selected districts of Kerala.

Chapter 4 gives an overview of the socio-economic demographic profile, child characteristics, health and nutritional profile, and dietary assessment of preschoolers and their mothers in the study area.

Chapter 5 deals with the association of stunting and wasting by socio-economic, parental, utilization of health care services, child characteristics and child feeding practices for panchayats combined and separately. Determinants of normal height for age and weight for height are also ascertained.

Chapter 6 deals with the association of underweight by selected predictor variables in the study area. Determinants of normal weight for age are also investigated. IYCF practices and the traditions relating to maternal and child care are also studied.

Chapter 7 discusses the significant findings, limitations and suggestions of the study.

1.13 Limitation of the Study

(1) Clinical assessment of nutritional status is not possible as it is beyond the scope of social science research.

(2) Anthropometric methods of ascertaining nutritional status reflect the current nutritional outcome and don't differentiate between acute and chronic changes.

(3) Respondents were mothers of the children aged 0-59 months. Head of the household were not the primary respondents.

(4) The study is confined to two tribal dominated panchayats.

(5) Poverty is seen as nutritional insecurity and not in terms of income poverty.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

Issue wise review of literature is attempted, pertaining to poverty and malnutrition, the impact of nutrition on productivity, the various important determinants of child nutritional status, and maternal health and health care utilization.

2.2 Poverty Reduction, Income Growth and Malnutrition

Poverty is directly or indirectly responsible for malnutrition (Gebhart, 1920). Poverty adversely affects family food supply, leads to unhealthy food habits and compromises a person's choice of food and other amenities. Sukhatme (1987) observes that malnutrition is a result of factors beyond purchasing power. Reduction in income poverty mitigates child malnutrition (Strauss & Thomas, 1998). Poverty, hunger and malnutrition are interlinked (Haddad et al., 2003). Using household survey data from 12 countries and cross-country data for 61 countries (1970-95), they concluded that an increase in income at household and macro level, reduce underweight among children under five. Reduction in malnutrition has not kept pace with reduction in income poverty. Whereas an increase in income has an immediate impact on poverty, there is a lag in its effect on malnutrition reduction. Apart from income growth, direct nutrition interventions are essential to reduce malnutrition. Alderman (2005) reviews linkages between economic growth and decline in malnutrition. Rather than relying on income growth as a strategy to address malnutrition, investments in nutrition programs are the most viable alternative. The reduction in malnutrition entails economic benefits emerging from both cost reduction and increased productivity. Improved nutrition reduces infant and child mortality, health care cost, entails productivity gains and improved health. The mere GDP growth does not mean that the full benefit would be transmitted to the poor: additional policy will be required to target the poor, like improved sanitation, access to clean drinking water (Burger & Esry, 1995). Bringing water source closer to home saves time and energy, increases time for child care activities and improves nutritional status. Alderman et al. (2004) using a longitudinal survey of households and children of rural Zimbabwe, assessed the impact of height for age on human capital formation. Horton (1999) used a comparative approach to estimate productivity loss due to the various types of malnutrition. A study conducted in Vietnam by Glewwe and Koch (2003), looked into the effect of an

increase in income on child nutritional outcome. Household spending does not have any significant influence on child nutrition. Stunting is strongly related to the child age. Distance to nearest dispensary had substantial impacts on nutritional status.

The paradox of the rising economic growth in India without a commensurate decline in malnutrition has given rise to many economic puzzles (Deaton & Dreze, 2009, Patnaik, 2010). Removal of poverty alone cannot guarantee the annihilation of malnutrition (Radhakrishna et al., 2004). A surge in the standard of living lowers the peril of undernourishment. Those states with liberal social policy could achieve substantial reductions in the prevalence of malnutrition. Using various rounds of NFHS, Subramanyam et al. (2011) failed to find consistent evidence of a reduction in malnutrition due to economic growth. Using data from the NFHS3, Mazumdar (2010) explores the correspondence between poverty and inequality in undernutrition and found poverty to account for more than 50 percent of the disparity.

2.3 Determinants of Child Nutritional Status

An attempt is made to review the critical risk factors that influence nutritional outcomes of children under five. A host of interrelated factors at the individual, household, and community levels are important determinants of nutritional status.

Khadse and Chaurasia (2020) aim to assess the nutritional status and inequalities among children in Maharashtra, using NFHS 4. The factors contributing to poor nutritional outcomes are wealth quintile of the household, religion, caste, maternal education and the geographical region of birth. Undernutrition is concentrated among marginalized communities. Maternal BMI is a significant predictor of underweight and stunting among children. Among children born to illiterate mothers, more than 50 percent of the children are underweight, 45 percent stunted, and 26 percent wasted. Chopra (2003) tries to verify the risk elements associated with child undernutrition in a rural area of South Africa. He investigates the result of a "community-based growth monitoring intervention". From 516 randomly identified households, questionnaire and anthropometric survey of 868 children in the age group 3 to 59 months are conducted. Socio-economic characteristics of the household and maternal features influence stunting and underweight. Presence of migrant father, maternal education, the existence of toilet facility, optimal breastfeeding and low birth weight (LBW) are significantly associated with underweight.

Aturupane et al. (2008) using data from Sri Lanka's Demographic and Health Survey,2000 employs a quantile regression approach to analyse the antecedents of weight and height of Sri Lankan children. Parental education, electricity facility, and proximity of piped water have large effects on the height and weight of children at upper rather than at lower quantiles. To reduce the risk of undernutrition in lower quantile, direct nutritional intervention is more effective than general intervention. Vitolo et al. (2008) analysed the factors associated with anthropometric failures among children in Southern Brazil. Wasting is associated with LBW and maternal age less than 20 years whereas, stunting is associated with low socioeconomic status, poor sanitation, LBW, age of the child being less than 36 months and maternal age less than 20 years. The odds of stunting is three times higher among children with three or more siblings compared to a single child. Meshram et al. (2012) conducted a tribal community-based cross-sectional study among preschool children in nine states of India. He found that children from the lowest and middle household wealth index and children born to mothers with no education are significantly prone to the risk of underweight and stunting. Fenske et al. (2013) employ additive quantile regression to analyse socio-economic, nutritional and environmental determinants of child stunting in India. Child's age and gender are non-modifiable risk factors and household wealth, maternal education and BMI are protective factors that have a significant effect on stunting.

The association of anthropometric status and the presence of anaemia of children in rural Kerala is looked into by George et al. (2000). Female children are more anaemic, and undernutrition is a significant cause for nutritional anaemia. Both vegetarians and non-vegetarians are equally susceptible to anaemia. A study by Sanghvi et al. (2001) tries to analyse the risk elements for underweight among children in Mangalapuram, Kerala. The factors identified were the present bodyweight of the mother, BMI, birth weight of the child and excessive morning sickness. Priyanka et al. (2016) found underweight and stunting to be more among females. Undernutrition is linked with low birth weight, protein inadequacy, respiratory tract infections, diarrhoea and worming. Sabu et al. (2020) attempted to analyse inequality in the nutritional status of children aged 2 to 5 years belonging to Paniya and Kurichya tribes of Wayanad district, Kerala. The study found a significant inter-tribal difference in nutritional status. Composite Index of Anthropometric Failure (CIAF) was employed as a measure of undernutrition. CIAF was significantly associated with community identity, early marriage of mother and household food insecurity. Domestic violence emerged as a risk factor for all three forms of anthropometric failure.

Kaushal (2019) tries to determine the status of primary immunization coverage among children aged 1 to 5 in the urban slums of Karimnagar town and its association with nutritional and morbidity among children. Immunization status of the child and malnutrition is statistically significant. Nasreddine et al. (2018) attempted a comprehensive review of literature from 1990 to 2016, to analyse the nutritional outcome and food intake of children in selected countries in the Eastern Mediterranean Region (EMR). Key issues identified from the literature review are the triple burden of malnutrition (underweight, nutrient inadequacies coexisting with overweight) exacerbated by poor dietary habits, and an absence of national-level nutritional surveys.

2.3.1 Caste and Nutrition

There are significant intergroup differences in nutritional outcome. The study by Sabharwal (2011), using NFHS 3 data, intrigues the reasons for the abysmally low levels of nutrition among Scheduled Caste (SC), tribals and Muslims. Income, education of mother and access to health care are important determinants of undernourishment. The probability of SC and ST children to be malnourished is 1.4 times than that of children from 'other' categories. In case of the marginalised groups, even after controlling for factors such as income, education levels and access to health services, the levels of malnutrition are high – an indicator of the constraints associated with their social and religious belonging. The plausible reasons for high malnutrition are inequitable access to income avenues and low utilization of flagship programs of the Government. A study by Gangadharan (2011) found nutritional status among children from marginalised communities (SC and ST) to be low in rural Kerala.

2.3.2 Gender and Malnutrition

Sex bias in families results in nutritional deprivation among girls. Sen and Sengupta (1983) studied nutritional outcome among children under 5 in two villages, namely Sahajapur and Kuchli of Birbhum district of West Bengal. They found that sex bias resulted in more undernourishment among girls. Boys are given preferential treatment. Land redistribution and nutrition interventions are effective in combating malnutrition. A study in Bangladesh reaffirms gender inequalities in nutritional status and found that females are 1.44 times likely to be severely undernourished (Choudhury et al., 2000). The study by Acquah et al. (2019) reported that underweight among females exceeds that of males. In contrast, the study by

Meshram et al. (2012) reported the prevalence of underweight to be significantly higher among males. Lessons from India by Benjamin and Zachariah (1993), Banerjee and Mandal (2005) found that females suffer from more protein-energy malnutrition, compared to their male counterparts**.**

2.3.3 Parental Education and Household Education

Parental schooling is related to nutritional outcome and child health. This finding does not deny the significance of maternal education in mortality reduction of children (Caldwell & McDonald, 1982; Cochrane et al., 1982; Caldwell et al., 1983). Tulasidhar (1993) attempted to correlate the linkage between the duration of mothers' education and child mortality. Jain (1994) identifies the mechanism through which the mother's education influence the risk of child mortality. Female education is said to be complementary to that of health service. It is presumed that education of mother influences the degree of preventive care. The data for the present study is taken from a representative survey of married women from two districts of Gujarat. Education plays only a minor role in health-seeking behaviour, whereas the level of maternal education is related to the increased use of available health services. Educated mothers make use of the public health care facility more than non-educated mothers.

Sahn and Alderman (1997) employed data from Maputo, Mozambique to identify the variables other than household resources on the nutritional status of children. They estimated the age specificity of determinants of nutritional status. For children less than two, education of the mother is an important factor. For those between 25 and 72 months, factor like an increase in household income improves nutritional outcome. A study done in Jamaica by Handa (1999) proved that child's height is positively impacted by the education of mother or caregiver, and dissemination of information through television and approach to private doctors are supportive inputs.

Mother's education is found to have the most potent independent influence on child malnutrition in India (Mishra & Retherford, 2000). Compared to children born to more educated mothers, children of mothers with less education have a low nutritional outcome. There is a collaborative effect between the education of mother and feeding practices (Guldan et al., 1993). Using data from Latin America, Ruel and Menon (2002) establish the impact of feeding practices on nutrition.

A case-control study was undertaken by Ambadekar and Zodpey (2017) to identify the risk factors of severe acute malnutrition (SAM) in rural areas of Maharashtra. The odds of a child being SAM increases significantly for a host of factors linked to socio-economic, child and infant and young child feeding characteristics, illness episodes etc. The strongest association of SAM was observed with child feeding practices.

The role of parental education in influencing child's nutritional outcome has been well established in the literature. Burchi (2012) tries to analyse the role of literacy of household members, apart from parental education, in influencing stunting and underweight. Using the 2003 DHS survey in Mozambique, the determinants of child nutrition are estimated. Educational externalities generated from educated caregivers have a positive influence in reducing stunting and not underweight. Parental years of schooling have a beneficial impact on a child's long-term nutritional status.

Alderman and Garcia (1994) use data from the first year (1986-87) of a three- year survey, conducted in the least developed districts of each of the four provinces in Pakistan. From a total of 52 villages randomly chosen, 1,200 households were selected as the sample. Child nutrition is exceedingly receptive to health inputs. Wasting could be decreased to less than 50 percent of the present level, provided all mothers are given education up to the primary.

2.3.4 Nutritional Information as Inputs to Child Nutrition

Abbi et al., (1988) and Gupta et al., (1991) analysed the influence of maternal nutrition knowledge in reducing malnutrition. This finding was reaffirmed by Webb and Block (2004). He found that formal schooling is an important determinant of stunting and acquired nutritional information influences short term nutritional status. Paternal schooling contributes to long term nutritional outcomes. Nutritional information can successfully substitute mother's lack of formal education in influencing short term child nutritional outcome.

A study by Block (2007) confirmed that maternal nutrition knowledge acts as a substitute for schooling at least at lower levels of income. Appoh and Krekling (2005) found a significant association of child nutritional status with predictor variables like the commencement of breastfeeding, mother’s awareness of colostrum, and time of introducing supplementary diet. Maternal practical understanding of nutrition is crucial than their formal learning. Glewwe (1999), uses data from Morocco to assess the three possible causal

mechanisms between mothers education on child health and nutrition. Child health can be improved by maternal health knowledge.

2.3.5 Employment Status of Mother

Grossman's (1972) 'household production of health' (as cited in Tulasidhar, 1993), hypothesised the effectiveness of better health care practices as the by-product of mother's education. Educated mothers can better handle child's health-promoting decisions and have superior health-seeking behaviour. The study reaffirms that, compared to the labour force participation rate, maternal education has a more decisive influence to reduce female child mortality.

Article by Basu and Basu (1991) established, using the case of India that child mortality is higher among children born to working mothers. Some of the positive impacts of female employment are poverty reduction, more resources for child welfare, women empowerment, autonomy in decision making, and knowledge about childbearing and child-rearing. Working women are in shortage of time, and they face physical inability to look after their children. Shortened duration of breastfeeding by working mothers can have an adverse health impact on children. General childcare is adversely affected, and the mothers have to rely on their elder children to take care of their younger children. These elder children are prematurely withdrawn from schools, and they are deprived of education, thereby negatively affecting their knowledge in health-related areas. The additional burden of looking after their sibling, deteriorates their physical health too, an explanation for higher mortality levels among children of working women. They also found that sex differentials in child mortality are lower when the mothers work, a positive aspect of female employment. Women employment results in an egalitarian sex ratio of child mortality, due to their sheer lack of time in discriminating against their daughters.

Géa-Horta et al. (2016) analysed the effect of mother's education and employment on nutritional result among Brazilian children, using data from the National Survey of Children and Women's Demographics and Health, 2006-2007. The impact of maternal education and employment on nutritional outcome were looked into. There was no association between maternal employment and stunting. Children born to mothers with less education had a greater chance of stunting. Employment status of mothers of Central Ethiopia was collected by Wondafrash et al. (2017), consisting of a total sample of 638 participants (319 employed

and 319 unemployed mothers). The findings confirmed that the nutritional status of children born to employed mothers is better.

2.3.6 Women's Status

A study conducted in Ghana and Kenya by Kennedy and Haddad (1994), analysed the influence of the extent of income and gender of the head of the household on nutritional status. Better child nutritional status could be ensured by female-headed poor households.

The association between women's working conditions and nutritional outcome among children of Nigeria was explored by Ukwuani and Suchindren (2003). Women's working condition can be taken as a proxy of their status and it can affect nutritional status. Smith et al. (2003) use educational variation as a tool to measure women's status and it, in turn, influences the levels of nutrition. Using the fourth round of NFHS, a significant relationship between child marriage and the probability of their offsprings to be stunted and wasted was found by Paul et al. (2019).

Women Empowerment

Holland and Rammohan (2019) analyse rural women's empowerment on food and nutritional security of children under 5, using a household survey from Bangladesh. The focus is female empowerment through agricultural activities and its impact on food security. Women's overall autonomy, their role in decision making at the household level and courage to speak in public is associated with lower stunting. Mulugeta et al. (2017) analyse the socio-economic factors linked to nutritional status of children in Ethiopia. The determinants are family size, parental education, household wealth, antenatal care, disease and sanitation. Using the NFHS 3 data (2005-2006), Sinha et al. (2017) try to analyse how gender inequality affects poor nutritional outcome among children and highlights the influence of maternal caregiver features on child nutrition. Significant protective factors influencing child nutrition are child residing in gender-equal states, enrolment in ICDS, forward caste, better socioeconomic conditions and maternal characteristics. The findings based on a study in rural Bangladesh, conducted by Hossain (2020), confirms the linkage between maternal education and intrafamilial bargaining power on the nutritional status of children less than 24 months. Maternal education has a weak influence on nutritional status. Her enhanced capabilities will

result in the distribution of household resources for the benefit of children, thereby positively influencing the child's nutritional outcome.

Women's asset ownership and child nutritional status

Rodgers and Kassens (2018), uses evidence from 2009- 2010 Household Income and Expenditure Survey of Papua New Guinea, to examine how women's asset ownership influences the nutritional status of children less than 72 months. Women's ownership of assets can increase their ability to attain collateral loans, which can generate income and thereby increase household expenditure on inputs into child wellbeing, including food, education and health expenditure. Maternal asset ownership has a statistically significant association with stunting, wasting and underweight. Asset ownership matters for wasting and health status. Women's education is not associated with child nutritional status. Garikipati (2009) argues that though female labour force participation is increasing in a country like India, her household status, wages and working conditions are dismal.

2.3.7 Birth Spacing

Birth spacing influences infant and early childhood mortality (Boerma & Bicego, 1992; Fotso et al., 2013; Molitoris et al., 2019). Short birth intervals have a moderate effect on nutrition and health status, and there is no evidence for sibling effect (Boerma & Bicego, 1992). Longer birth spacing results in a lower malnutrition risk in some populations. A birth spacing of greater than or equal to 36 months, results in roughly 10 to 50 percent reduction in stunting. (Dewey & Cohen, 2007). Birth interval greater than 24 months exercised a defensive effect on stunting among children in Peru (Sobrino et al., 2017).

2.3.8 Maternal Height and BMI

Ozaltin et al. (2010) try to examine the association between maternal stature, offspring mortality and anthropometric failures, based on Demographic and Health Surveys conducted between 1991 and 2008 in 54 low- to middle-income countries. An increase in mother's height to the tune of 1 cm, decreases the peril of child mortality, and anthropometric failures. Similar results were obtained by Subramanian et al.(2009) using NFHS 3. Subramanian et al. (2010) examine the impact of parental BMI on malnutrition, using NFHS 3. A single unit gain in maternal BMI lowers the risk of anthropometric failures. Similar results were obtained for paternal BMI. Corsi et al. (2016) analyse the risk factors for chronic child undernutrition in India using NFHS 3. Essential predictor variables of childhood

stunting/underweight were mother being short, illiterate mother, poor household, maternal underweight and substandard dietary diversity.

2.3.9 Age at Childbirth

Mehra and Agrawal (2004) observe the important risk factors for 'poor pregnancy outcomes' to be adolescent pregnancies (15-19 years), lack of education, low socioeconomic position, maternal undernutrition and limited approach to maternal health services. Low birth weight is a significant adverse outcome for the infant, which may lead to increased child mortality.

2.3.10 Age of the Child

A study by Joseph et al. (2002) on the prevalence of malnutrition among 256 children (12-60 months) in rural Karnataka attending Anganwadis revealed that stunting was predominantly higher among children of older age group. In contrast, wasting was common in younger age group children. Bhutta et al. (2013) observe that children below two, actively respond to nutritional interventions. Teshome et al. (2009) study conducted in Northern Ethiopia concluded that age of the child, gender, diarrhoeal incidence, colostrum deprivation, breastfeeding duration etc are the deciding factors for stunting. Rajpal et al. (2020), using data from NFHS 3 and 4, found that stunting was significantly concentrated among children greater than two years. Children from economically disadvantaged households could achieve a considerable decrease in stunting between the two rounds of NFHS.

2.3.11 Maternal Health and Nutrition

The outcome of pregnancy is determined not only by nutritional risk but also, by dietary risk like insufficient food intake, poor food selection and distribution (King, 1983, as cited in Jacobson, 1987).

Iron supplementation in pregnancy lowers the risk of low birth weight. Haider et al. (2013) reviewed the evidence from 48 randomised control trials and 44 cohort studies and proved a positive correlation between prenatal iron use and pregnancy outcomes. Iron use increased maternal haemoglobin and reduced iron deficiency anaemia and low birth weight. Daily prenatal use of iron substantially improved birth weight. Bharati et al. (2020) using NFHS 4 data, found socioeconomic conditions, low birth weight and low maternal nutrition to be the factors contributing to anaemia among children.

Prakasamma (2009) enquires into the reasons for the sluggish progress in maternal mortality reduction in Andhra Pradesh. The study makes use of both primary and secondary data for three years period from 2005-2007. Some of the reasons for high maternal mortality are low awareness, and less access to maternal health care services. Vora et al. (2009) identified lack of reliable data on maternal mortality, shortage of human resources, and fewer institutional deliveries to be the reasons for limited success in improving maternal health. Patel et al. (2018) enquire into the factors contributing to the low use of maternal health facilities by scheduled caste women in Bihar. They face triple discrimination based on caste, socio-economic status and gender. Barriers to health-seeking were the insufficient number of ASHA workers, poor access to information, high transportation cost and other charges. The research paper by Mahapatro and Kumar (2009) explore the health status of women in the marginalized Bhattara tribal population in the district of Nowrangpur, Orissa. Breastfeeding tradition underwent a transition and 80 percent of infants were initated breastfeeding within first two days. Colostrum is discarded as it is considered as impure. Shortage of referral health services and social infrastructure leads to overdependence on the traditional birth attendant and older women of the community for delivery. The study by Krishnammal et al. (2013) tried to examine the health status of women in contemporary Tamil Nadu. Closely spaced birth erodes mother's nutritional status leading to premature birth, LBW and also heightened health hazard of mothers. High incidence of malnutrition and iron deficiency anaemia among women are serious concerns.

Hunter et al. (2014) conducted a systematic evaluation of literature relating to the impact of demand-side financing (DSF) on the utilization of maternity services. No Indian studies dealt with the use of vouchers for merit goods. The study highlights critical issues like targeting and eligibility criteria, overburdened health facilities, inadequate referral systems and quality care, the influx of private sector providing health services in urban areas bypassing public health services and insufficient and timely care for women with obstetric complications. Demand-side financing modes were found to increase the utilisation of maternal healthcare services (Murray et al., 2014).

To effectively address the issue of maternal deaths and to promote institutional deliveries, the Government of India launched the conditional cash assistance programme called the Janani Suraksha Yojana (JSY) to cover the direct and indirect cost of delivery. Staff and recently delivered women belonging to four Indian states were interviewed by Devadasan et al. (2008), to determine the functioning of JSY and its impact on increasing institutional

deliveries. Due to the lack of quality data, the increase in institutional deliveries could not be attributed to JSY alone. Lack of awareness among poor women, the cumbersome documentation process and delay in getting the cash benefit were some of the implementation issues.

2.3.12 Malnutrition and Learning

Combination of malnutrition and poverty perpetuates a cycle of illness, education failure and more poverty (Bakan, 1970). Based on evidence from animal studies (rats), malnourishment during pregnancy results in 'double deprivation', whereby the offsprings have lesser number of brain cells. A test known as "transillumination" developed by Monckeberg (1969), proved that malnutrition during the first years of life will curtail the normal rate of increase in head circumference and thereby affects IQ (as cited in Bakan, 1970). The earlier the malnutrition, the more severe are the effects, and the more likely the effect cannot be reversed. One of the most harmful effects of poverty is malnutrition, and the important cause of malnutrition is poverty.

2.4 Findings and Research Gap from Literature

Reduction in child undernutrition depends on factors other than food security and income growth. Despite rapid economic growth, India is discredited with a high prevalence of malnourished children. India's aspiration to become a five trillion-dollar economy can be realized, only if India tackles the menace of hidden hunger and the triple burden of malnutrition.

Only a few studies in Kerala looked into the nutritional profile of children under five. Existing studies at the micro-level have focused on the nutritional status of children belonging to a particular district in Kerala or concentrating on a specific tribe. Though Kerala claims to have many 'firsts', levels of malnutrition are higher among marginalised groups. So far, no study has been conducted, analysing the spatial determinants of nutritional status of children focusing on two tribal dominated panchayats of two districts. Hence, a transverse study is done in two tribal dominated panchayats of Kerala. IYCF practices, nutrition awareness of mothers, qualitative assessment of the risk factors of nutritional outcome and the traditional ways for preserving maternal and child health have not been researched so far. Hence the present study is unique.

CHAPTER 3

INTENSITY OF MALNUTRITION AMONG WOMEN AND CHILDREN: MACRO ANALYSIS

3.1 Introduction

There is a close connection between food insecurity and malnutrition. Food insecurity can adversely influence the quality of diet, leading to the twin stress of undernutrition and overnutrition. India's experience reveals that improvement in the various dimensions of food security, namely availability and accessibility to food has not concomitantly reduced the extent of malnutrition among children. Immediate factors affecting nutritional status are a balanced diet, health, and care environment. Child immunization, maternal health and health-seeking behaviour (availability, accessibility and utilization of maternal health care services) are intermediate factors influencing child health and survival. Underlying factors of nutritional insecurity are polluted drinking water, unhygienic sanitary conditions and practices. For the active realisation of nutritional security, concurrent improvements should be made in the immediate, intermediate and underlying causes of malnutrition.

Secondary data sources, NFHS reports and CNNS 2019 are employed to look into the changing context of the nutritional status of children under five and women across the states of India. Nutritional outcome among children in various districts of Kerala, health and nutritional indicators of children across social groups, IYCF practices, and maternal health care indicators are also analysed.

3.2 Drift in Nutritional Outcome of Preschool Children and Women

NFHS employs anthropometric indicators, namely stunting, wasting and underweight to measure the nutritional outcome among children. They are indicated in terms of Z -score from the median of the "international reference population".

Table 3. 1: Percentage of Children Under Five Years Stunted, Wasted and Underweight

Nutritional indicators	NFHS 1 (1992-93)	NFHS 2 (1998-99)	NFHS 3 (2005-06)	NFHS 4 (2015-16)	Percentage change (NFHS 1and 2)	Percentage change (NFHS 3 and 4)
Stunted	NA	46	48	38	NA	-20
Wasted	NA	16	20	21	NA	-5
Underweight	52	47	43	36	-9.6	-16.2

Source: Various rounds of NFHS reports
Note: "Children whose height-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are considered short for their age (stunted), or chronically undernourished" (IIPS & ICF, 2017, p.292).
"Children whose Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are considered thin (wasted), or acutely undernourished" (IIPS & ICF, 2017, p.292).
"Children whose weight-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are classified as underweight"(IIPS & ICF, 2017, p.292).

Table 3.1 gives the percentage of children stunted, wasted and underweight as revealed from various rounds of NFHS surveys. In NFHS 1 and 2, nutritional indicators are calculated for children under three, whereas NFHS 3 and 4 calculated it for children under five, following WHO/ World Bank studies on nutritional status. In India, according to NFHS 4, there has been a decline in stunting rate in comparison to NFHS 3 (2005-06). Thirty eight percent of preschoolers are stunted, 21 percent are wasted. Thirty six percent are underweight, compared to 43 percent in 2005-06. Between NFHS 2 and 3, there is a slight decline in stunting. Even though, since 2005-06, there is a decline in the percentage of both stunting and underweight, wasting remains the same. Among the three nutritional indicators, the percentage decline in stunting has been the highest, followed by a reduction in underweight.

Table 3.2: Nutritional Status of Children - Urban and Rural area (in percentage)

Nutritional indicator	NFHS 3				NFHS 4			
	Urban	Rural	All India	Rural urban ratio	Urban	Rural	All India	Rural urban ratio
Stunted	39.6	50.7	48	1.28	31	41.2	38.4	1.32
Wasted	16.9	20.7	19.8	1.22	20	21.5	21	1.07
Underweight	32.7	45.6	42.5	1.39	29.1	38.3	35.7	1.31

Source: NFHS 4 Fact sheet, Computed from NFHS 4

As evident from Table 3.2, the rural-urban differential in nutritional indicators of children shows that undernourishment among rural children stands above that of urban. In NFHS 3

also, a similar pattern was evident. Children under five who are stunted in rural areas were 50.7 percent, compared to 39.6 percent in the urban area. The rural-urban differential in case of stunting, wasting and underweight is almost the same over the last ten years. Rural areas often lack supplies of fresh and affordable food. Lack of refrigeration facilities at home necessitates travel to retail shop to purchase perishable commodities and the dearth of public transport often makes it cumbersome. Superior child and maternal care practices, stemming from beneficial socioeconomic situations, leads to low levels of malnutrition in urban areas (Smith et al., 2005).

Table 3.3: Health Status Indicators for Children Across Social Groups in India

Health Status Indicators	SC		ST		OBC		Others		ALL	
	NFHS3	NFHS4	NFHS 3	NFHS 4	NFHS3	NFHS3	NFHS3	NFHS4	NFHS3	NFHS4
Infant mortality rate	66.4	45.2	62.1	44.4	56.6	42.1	48.9	32.1	57	40.7
Neonatal mortality	46.3	33	39.9	31.3	38.3	30.5	34.5	23.2	39	29.5
Post neonatal mortality	20.1	12.2	22.3	13.1	18.3	11.6	14.5	8.9	18	11.3
Child mortality	23.2	11.1	35.8	13.4	17.3	9	10.8	6.6	18.4	9.4
Under 5 mortality	88.1	55.9	95.7	57.2	72.8	50.8	59.2	38.5	74.3	49.7

Source: NFHS 3 and NFHS4 4 India Report

At all India level, the marginalised groups are at a disadvantage position concerning almost all the health status indicators of children (See Table 3.3). Though there have been improvements in these indicators when compared to NFHS 3 levels, it is still worrisome. The infant mortality rate is 45 per 1000 live births among scheduled caste, compared to 32 per thousand live births among forward caste. Post neonatal mortality, child and under-five mortality are highest among tribal community. They are the most undernourished segment of Indian society, compared to children of economically and socially advanced sections. Income insecurity resulting from deprivation of their rights to access forest land, displacement from forest land, debts, alcoholism, lack of education, sanitation, inaccessibility to health services, inappropriate infant feeding and child care practices, etc. place the tribal children at a perilous position.

Table 3.4: Nutritional Status Indicators for Children Across Social Groups in India

Child Nutritional Status indicators	SC		ST		OBC		Others		ALL	
	NFHS3	NFHS4	NFHS 3	NFHS 4	NFHS3	NFHS4	NFHS3	NFHS4	NFHS3	NFHS4
Stunting	53.9	42.8	53.9	43.8	48.8	38.7	40.7	31.2	48	38.4
Wasting	21	21.2	27.6	27.4	20	20.5	16.3	19	19.8	21
Underweight	47.9	39.1	54.5	45.3	43.2	35.5	33.7	28.8	42.5	35.7
Anaemia	72.7	60.6	76.8	63.3	70.3	58.6	63.8	54.2	69.5	58.5

Source: NFHS 3 and NFHS 4 India report

Table 3.4 reveals that at the national level, anthropometric failures, as well as anaemia, are more among children belonging to SC and ST, compared to Other Backward Caste and 'others'. Stunting is 43.8 percent among tribal children compared to 31 percent among 'others'. Status of wasting among scheduled caste and tribes have been stagnant across NFHS 3 and 4, whereas considerable improvements in case of underweight and anaemia are visible. Apart from other determinants of child nutritional status, the excluded social groups in particular encounter difficulties concerning the availability of health care services, health-seeking behaviour, and poor environment (Navaneetham & Dharmalingam, 2002; Patel et al., 2018)

3.2.1 Changing Context of Nutritional Status of Preschoolers

Based on the prevalence of stunting, wasting and underweight children in each state, 21 major states are divided in terms of nutritional insecurity into low, medium and high nutritional insecure states. Majority of the North-Eastern states have better child nutritional performance and Mizoram is included in this group of states because of its excellent performance in wasting and underweight. Phase 1 of NFHS 5 was released for 17 states and five Union Territories during December 2020. The nutritional matrix for some of the major states have not been published and hence the secondary data analysis done using NFHS 5 is confined to eleven major states. The transition of states, as between various rounds of NFHS and CNNS 2019 reports, are analysed. Table 3.5 gives the classification of states based on nutritional insecurity.

Table 3.5 Classification of States Based on Nutritional Insecurity

Nutritional outcome	Low	Medium	High
Stunting	≤30 percent	31-40 percent	≥41percent
Wasting	≤15 percent	16-24 percent	≥25 percent
Underweight	≤30 percent	31-40 percent	≥41 percent

Source: Researcher's classification

Stunting

Table 3.6: Grouping of States Based on Stunting

States	NFHS 5 (2019-20)	CNNS (2019)	NFHS4 (2015-16)	NFHS 3 (2005-06)	NFHS 2 (1998-99)
Low nutritional insecurity (Group L)	Mizoram, Kerala, J&K, Himachal Pradesh	Mizoram, Kerala, J&K, Himachal Pradesh, Punjab, Tamil Nadu, Telangana	Mizoram, Kerala, J&K Himachal Pradesh, Punjab, Tamil Nadu, Telangana	Kerala, Tamil Nadu	Kerala, Tamil Nadu
Medium nutritional insecurity (Group M)	Andhra Pradesh, West Bengal, Telangana, Karnataka, Maharashtra, Gujarat	Andhra Pradesh, West Bengal, Uttarakhand, Haryana, Odisha, Maharashtra, Karnataka, Chhattisgarh, Gujarat, Rajasthan	Andhra Pradesh, West Bengal, Uttarakhand, Haryana, Odisha, Maharashtra Karnataka, Chhattisgarh, Gujarat, Rajasthan	J&K, Punjab, HP, Mizoram	Mizoram, Karnataka, Andhra Pradesh, J&K, Punjab, Maharashtra
High nutritional insecurity (Group H)	Bihar	Madhya Pradesh, Jharkhand, Uttar Pradesh, Bihar	Madhya Pradesh, Jharkhand, Uttar Pradesh, Bihar	Andhra Pradesh, Rajasthan, Karnataka Uttarakhand, West Bengal, Odisha, Haryana, Maharashtra, Jharkhand, Madhya Pradesh, Gujarat, Chhattisgarh, Bihar, UP	HP, West Bengal, Gujarat, Odisha, Haryana, Madhya Pradesh, Rajasthan, Bihar, Uttar Pradesh

Source: Calculated from NFHS Reports (Various rounds), CNNS 2019.
Note: For NFHS 2, data is not available for Uttarakhand, Chhattisgarh, and Jharkhand

Table 3.6 gives the grouping of states based on stunting. In the case of stunting, in both NFHS 2 and 3 rounds, Kerala and Tamil Nadu, two South Indian states, are in the category of low nutritional insecurity. Political, institutional factors, and social capital influence the extent of undernutrition among states (Harris & Kohli, 2009). One of the reasons for the

success of Tamil Nadu in reducing child malnutrition can be attributed to the Tamil Nadu Integrated Nutrition Programme (TINP) (Heaver, 2002). From 1980s until late 1990s, TINP was able to address the nutritional requirements of children under three years effectively. In the late 1990s, after it was merged with ICDS, Tamil Nadu retained its existing model of two workers instead of one, whereby one staff could concentrate on younger children under three and other on older children. With respect to Public Distribution System (PDS), Tamil Nadu had been implementing universal PDS, thus reducing the extent of exclusion from food security safety net. According to the Human Development Index 2018, Kerala stands first. Kerala has made laudable achievements in the health sector. Easy accessibility and widespread network of medical care facilities provided by both private and public sector, along with other factors such as high literacy rate, high level of wages in informal sector relative to other states, efficient functioning of Anganwadis, evenly spread Public Distribution System in both rural and urban areas, high social status of women, nutrition awareness and care of children have played a pivotal role in the achievement of Kerala in tackling malnutrition. In NFHS 4 as well as in CNNS, apart from Kerala and Tamil Nadu, states of Mizoram, Telangana, Himachal Pradesh, and Jammu and Kashmir transitioned from medium to low nutritional insecurity. The transition of Himachal Pradesh from the high nutritional insecure state (NFHS 2) to low nutritional insecure state (NFHS 4 and CNNS) has been steady. As between NFHS 4 and 5, Telangana deteriorated from low to medium nutritional insecurity. Rajasthan, Gujarat, Odisha, and West Bengal have reduced their nutritional insecurity from high to medium level as between NFHS 2 and 3, and they failed to further improve their nutritional security in terms of stunting. States with very little progress made in mitigating nutritional insecurity are the states of Madhya Pradesh, Jharkhand, Uttar Pradesh and Bihar.

Wasting

Table 3.7: Grouping of States Based on Wasting

States	NFHS 5 (2019-20)	CNNS(2019)	NFHS4(2015-16)	NFHS 3(2005-06)	NFHS 2(1998-99)
Low nutritional insecurity (Group L)	Mizoram, Kerala	Mizoram, J&K, Himachal Pradesh, Punjab, Kerala, Uttarakhand, Haryana Odisha, Rajasthan, Bihar	Mizoram, J&K, Himachal Pradesh, Punjab, Kerala	Mizoram, Punjab, Andhra Pradesh, J&K, Uttar Pradesh, Kerala	Haryana, Punjab, Andhra Pradesh, Mizoram, Uttar Pradesh, Rajasthan, J&K, Kerala, West Bengal
Medium nutritional insecurity (Group M)	J&K, Himachal Pradesh, Andhra Pradesh, Telangana, West Bengal, Karnataka, Bihar	Tamil Nadu, Telangana, West Bengal, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh, Karnataka, Maharashtra, Chhattisgarh, Gujarat	Andhra Pradesh, Uttar Pradesh, Telangana, Uttarakhand, Tamil Nadu, West Bengal, Odisha, Bihar, Haryana, Rajasthan, Chhattisgarh	Maharashtra, West Bengal, Karnataka, Gujarat, Uttarakhand, Haryana, Himachal Pradesh, Chhattisgarh, Odisha, Rajasthan, Tamil Nadu	Gujarat, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, Karnataka, Bihar, Maharashtra, Odisha
High nutritional insecurity(Group H)	Maharashtra, Gujarat	Jharkhand	Maharashtra, Madhya Pradesh, Karnataka, Gujarat, Jharkhand	Bihar, Jharkhand, Madhya Pradesh	NIL

Source: Calculated from NFHS Reports (Various rounds), CNNS 2019.

Nutritional insecurity in terms of wasting is shown in Table 3.7. It reveals that Mizoram, Punjab, Jammu and Kashmir, and Kerala consistently had low nutritional insecurity throughout the entire period of analysis. Bihar, a medium nutritional insecure state in NFHS 2, deteriorated to a high nutritional insecure state in NFHS 3 and 4. It showed a tremendous advancement to become a low nutritional insecure state in CNNS. Jharkhand had consistently been a high nutritional insecure state. Odisha, Rajasthan, Uttarakhand, and Haryana have improved from medium to low nutritional insecure states as between NFHS 4 and CNNS 2019. Between NFHS 4 and 5, Jammu and Kashmir, and Himachal Pradesh worsened their position from low to medium nutritional insecure group whereas, Karnataka improved from high to medium nutritional insecurity.

Underweight

Table 3.8: Grouping of States Based on Underweight

States	NFHS 5 (2019-20)	CNNS (2019)	NFHS 4 (2015-16)	NFHS 3 (2005-06)	NFHS 2 (1998-99)
Low nutritional insecurity (Group L)	Mizoram, Kerala, J&K, Himachal Pradesh, Andhra Pradesh	Mizoram, Kerala, J&K Himachal Pradesh, Punjab, Tamil Nadu, Uttarakhand, Telangana, Haryana, West Bengal, Odisha, Maharashtra	Mizoram, Kerala, J&K Himachal Pradesh, Punjab, Tamil Nadu, Uttarakhand, Telangana, Haryana	Mizoram, Kerala, Punjab, J&K, Tamil Nadu	Kerala, Mizoram, Punjab
Medium nutritional insecurity (Group M)	Karnataka, Telangana, West Bengal, Maharashtra, Gujarat	Andhra Pradesh, Karnataka, Rajasthan, Chhattisgarh, Gujarat, Uttar Pradesh Madhya Pradesh, Bihar	West Bengal, Andhra Pradesh Odisha, Karnataka, Maharashtra, Rajasthan, Chhattisgarh, Gujarat, and Uttar Pradesh	Andhra Pradesh, Himachal Pradesh, Maharashtra, Karnataka, Uttarakhand, West Bengal, Haryana, Rajasthan, Odisha	J&K, Haryana, Tamil Nadu, Andhra Pradesh
High nutritional insecurity (Group H)	Bihar	Jharkhand	Madhya Pradesh, Bihar and Jharkhand	Uttar Pradesh, Gujarat, Chhattisgarh, Bihar, Jharkhand, Madhya Pradesh	Himachal Pradesh, Karnataka, Gujarat, West Bengal, Maharashtra, Rajasthan, Uttar Pradesh, Bihar, Odisha, Madhya Pradesh

Source: Calculated from NFHS Reports (Various rounds), CNNS 2019.

From Table 3.8, it is evident that Kerala, Mizoram, and Punjab were consistently low nutritional insecure states in terms of underweight, across the various rounds of NFHS. In NFHS 2, majority of the states including Himachal were in the category of high nutritional insecure states. By NFHS 4, majority of the states have improved their position to either become a medium or low nutritional insecure state. Odisha, initially a high nutritional insecure state progressed to become a low nutritional insecure state by the fourth round of NFHS. Jharkhand is the only state with high nutritional insecurity for all the three indicators of anthropometric failure among children under five. Literacy rate of Jharkhand is 67.63 percent, below the national average (Government of India, 2011 a). Human Development Index rank of Jharkhand in 2018 is 34 (out of 36). Lack of specialized human resources, health care infrastructure, a poor diet comprising of predominantly starchy food are some of the causes for the dull performance of Jharkhand in nutritional front (Pairvi, 2013; Kumar, 2020). In Jharkhand, ‘Triranga’ meals or inclusion of food items of three colours are being

encouraged to tackle malnutrition. As between NFHS 4 and 5, Andhra Pradesh improved to become a low nutritional insecure state whereas, Telangana worsened its nutritional insecurity in terms of underweight.

Based on NFHS 3, 4, and 5 major trends in child undernutrition at all India and state level, are looked into. It is examined in terms of the percentage of underweight, as it is a composite index (Nair, 2007; Shiva Kumar, 2007; Sharma, 2019) and is apt for comparison across various rounds. States are ranked based on (i) the prevalence of underweight according to the fourth round of NFHS 4 and (ii) the shortfall reduction between third and fourth rounds of NFHS. States with maximum shortfall reduction in underweight are listed as good performers and those with minimum shortfall reduction is categorized as poor performers. Using indicators, like child and women nutritional status, maternal and delivery care and child care, these two groups of states are compared.

Table 3.9 Anthropometric Indicators and Ranking of States Based on Percentage of Underweight Children (NFHS 3, NFHS 4 and NFHS 5)

States	NFHS 3			NFHS 4			NFHS 5		
	% of Stunted	% of wasted	% of under weight	% of Stunted	% of wasted	% of under weight	% of Stunte-d	% of wasted	% of under-weight
Mizoram	39.8	9	19.9	28.1	6.1	**12.0**	28.9	9.8	12.7
Kerala	24.5	15.9	22.9	19.7	15.7	**16.1**	23.4	15.8	19.7
Jammu & Kashmir	35	14.8	25.6	27.4	12.1	**16.6**	26.9	19.0	21.0
Himachal Pradesh	38.6	19.3	36.5	26.3	13.7	21.2	30.8	17.4	25.5
Punjab	36.7	9.2	24.9	25.7	15.6	21.6	*	*	*
Tamil Nadu	30.9	22.2	29.8	27.1	19.7	23.8	*	*	*
Uttarakhand	44.4	18.8	38.0	33.5	19.5	26.6	*	*	*
Telangana	NA	NA	NA	28	18	28.3	33.1	21.7	31.8
Haryana	45.7	19.1	39.6	34	21.2	29.4	33.8	20.3	32.2
West Bengal	44.6	16.9	38.7	32.5	20.3	31.5	*	*	*
Andhra Pradesh	42.7	12.2	32.5	31.4	17.2	31.9	31.2	16.1	29.6
Odisha	45.0	19.5	40.7	34.1	20.4	34.4	*	*	*
Karnataka	43.7	17.6	37.6	36.2	26.1	35.2	35.4	19.5	32.9
Maharashtra	46.3	16.5	37	34.4	25.6	36.0	35.2	25.6	36.1
Rajasthan	43.7	20.4	39.9	39.1	23.0	36.7	*	*	*
Chhattisgarh	52.9	19.5	47.1	37.6	23.1	37.7	*	*	*
Gujarat	51.7	18.7	44.6	38.5	26.4	39.3	39.0	25.1	39.7
Uttar Pradesh	56.8	14.8	42.4	46.2	17.9	39.5	*	*	*
Madhya Pradesh	50.0	35.0	60.0	42.0	25.8	42.8	*	*	*
Bihar	55.6	27.1	55.9	48.3	20.8	43.9	42.9	22.9	41.0
Jharkhand	49.8	32.2	56.5	45.3	29	47.8	*	*	*
CV	18.47	34.45	28.47	21.90	27.44	31.52			

Source: Calculated from NFHS Reports

Note: * data not available

The performance of states in reducing child malnutrition as between NFHS 3, 4 and 5 is attempted in Table 3.9. Widespread disparities in nutritional status are evident across the states. An analysis of stunting among the 21 main states reveals that in NFHS 3, the prevalence of stunting ranges from 56.8 percent in Uttar Pradesh to 24.5 percent in Kerala. In contrast, in NFHS 4, it ranges from 48.3 percent in Bihar to 19.7 percent in Kerala. The proportion of underweight children varies from 19.9 percent in Mizoram to 60 percent in Madhya Pradesh in NFHS 3. Mizoram has further improved its position in terms of underweight children, and Jharkhand has the highest percent of underweight children in NFHS 4. In both the rounds of NFHS, wasting is lowest in the North-Eastern state of Mizoram and the fourth round of NFHS, it is highest in Jharkhand. In NFHS 5, of the eleven states considered, 7 states have worsened in terms of stunting, whereas 4 states (Jammu and Kashmir, Andhra, Karnataka and Bihar) have improved. The prevalence of wasting has increased in Mizoram, Kerala, Jammu and Kashmir, Himachal Pradesh, Telangana and Bihar. The percentage of underweight increased in 8 states considered, whereas in Andhra, Karnataka, and Bihar it has declined. States of Mizoram, Kerala, Himachal Pradesh, and Telangana have worsened in terms of stunting, wasting and underweight as per NFHS 5. Kerala has shown dismal performance in NFHS 5, compared to the previous rounds; stunting increased from 19.7 percent to 23.4 percent, wasting marginally increased from 15.7 to 15.8 percent and underweight increased from 16.1 to 19.7 percent. The coefficient of variation across states is computed for both rounds of NFHS. In NFHS 3, variation among states is largest in case of wasting whereas, in NFHS 4, it is for underweight.

3.2.2 Inter-Temporal Changes in Child Nutritional Status among States in India

The comparison of various rounds of NFHS helps us to evaluate the inter-temporal changes in child nutritional status among 21 major states in India. The rank correlation coefficient shows the changes in the relative position of various states in the current period as compared to the base year.

Table 3.10 shows the rank correlation coefficient of nutritional indicators among states between NFHS 3 and NFHS 4. All values of rank correlation coefficients are high and positive, imply that there is not much change in the relative status of states on child nutritional outcome over the period. As compared to wasting, the rank correlation coefficient of stunting and underweight are very high and positive. It is inferred that the relative status of states on stunting and underweight remain the same. The states that witnessed a high percentage of stunting and underweight children during NFHS3 period could not make any

dent even during the NFHS 4. Despite overall progress in stunting, wasting and underweight in the country, the relative status of states remains the same. The results also indicate that the rank correlation coefficients are not only high but also very significant.

Table:3.10 Rank Correlation Coefficient of Nutritional Indicators

Nutritional indicators	Rank correlation coefficient between NFHS 3 and NFHS 4
Stunting	0.888**
Wasting	0.616**
Underweight	0.911**
**Correlation is significant at the 0.01 level (2-tailed) *Correlation is significant at the 0.05 level (2-tailed)	

Source: Calculated from NFHS 3 and 4

Table 3.11 shows the rank correlation coefficient of relevant key indicators between NFHS 3 and 4 period. The values of rank correlation coefficient show that the relative status of states in terms of percentage of anaemic children (6-59 months), percentage of women whose BMI is below the normal, percentage of women had iron-folic acid during pregnancy, institutional birth and birth attended by a health professional, remain the same. It implies that the states could not make any change in their relative status in these aspects over the period. At the same time, there is a perceptible change in the position of states concerning the percentage of children immunized, children with diarrhoea taken to hospital and mothers who had at least four antenatal check-ups. The states which are backward in the above aspects in NFHS 3 improved in NFHS 4. This is inferred from the low and negative values of correlation coefficients. It also implies that the progress achieved in these key indicators in India is not uniformly distributed across the states.

Table:3.11 Rank Correlation Coefficient of Relevant Key Indicators between NFHS 3 and NFHS 4

Key indicators	Rank correlation coefficient between NFHS 3 and NFHS 4
Percentage of children 6-59 months anaemic	0.720**
Percentage of children aged 12-23 months fully immunized	-0.269
Percentage of children with diarrhoea taken to a health facility	-0.259
Percentage of women whose BMI is below normal	0.943**
Percentage of all women aged 15-49 years who are anaemic	0.353
Percentage of mothers who had at least four antenatal check-ups	-0.501*
Percentage of women during last pregnancy took Intake of iron-folic acid for 100 days or more	0.889**
Percentage of institutional birth	0.730**
Percentage of births assisted by trained professional	0.714**
**Correlation is significant at the 0.01 level (2-tailed) *Correlation is significant at the 0.05 level (2-tailed)	

Source: Calculated from NFHS 3 and 4

Table 3.12 shows the relationship of stunting, wasting and underweight among children with the chosen key indicators relating to the nutritional status of women, maternal and delivery care, child care etc. The values indicate the rank correlation coefficient of child nutritional outcome during NFHS 3 and 4 with the selected indicators. In NFHS 3, the status of stunting is highly positively associated with anaemia among children, women with BMI below normal, and the percentage of anaemic women. Those states which have a high ranking in the indicators mentioned above also reported a high percentage of children with stunting. At the same time, the status of stunting among states is negatively associated with full child immunisation, medical treatment of children suffering from diarrhoea, anti-natal check-up of mothers, intake of iron-folic acid during pregnancy, institutional birth and delivery attended by health professionals. Those states having a high status in the above indicators also witnessed a low percentage of children with stunting. It also points towards the determinants or factors which facilitated the states to achieve progress in stunting among children in India. The rank correlation coefficient of wasting during NFHS 3 period shows that wasting is highly positively associated with both of the women nutritional indicators, and it is negatively associated with the rest of the indicators considered. The rank correlation coefficient of underweight during NFHS3 shows that underweight is highly positively associated with anaemia among children, women with BMI below normal, and the percentage of women suffering from anaemia. Those states which have a high ranking in the indicators as mentioned above also reported a high percentage of children with underweight. Underweight is negatively associated with child immunisation, anti-natal check-up of mothers, intake of iron-folic acid during pregnancy, institutional birth and delivery attended by health professionals.

The rank correlation coefficient of stunting during NFHS 4 shows that stunting is highly positively associated with child anaemia. It is negatively associated with the same indicators as in NFHS 3 rd round. In NFHS 4, the status of wasting as well as underweight is highly positively associated with anaemia among children and women with BMI below normal. At the same time, both are negatively related to full child immunisation, medical treatment of children suffering from diarrhoea, anti-natal check-up of mothers, intake of iron-folic acid during pregnancy, institutional birth and delivery attended by health professionals. Those states having a high status in the above indicators also witnessed a low percentage of wasting as well as underweight among children during NFHS 4.

Table 3.12: Rank Correlation Coefficient of Key Indicators With Stunting, Wasting and Underweight for Various Rounds of NFHS

Key indicators	Rank correlation coefficient with stunting for NFHS3	Rank correlation coefficient with wasting for NFHS3	Rank correlation coefficient with underweight for NFHS3	Rank correlation coefficient with stunting for NFHS4	Rank correlation coefficient with wasting for NFHS4	Rank correlation coefficient with underweight for NFHS4
Percentage of children 6-59 months anaemic	0.723**	0.421	0.743**	0.650**	0.528*	0.641**
Children aged 12-23 months fully immunized	-0.706**	-0.216	-0.660**	-0.598**	-0.323	-0.433
Children with diarrhoea taken to health facility	-0.246	-0.381	-0.370	-0.502*	-0.158	-0.418
Women whose BMI is below normal	0.809**	0.665**	0.913**	0.898	0.786**	0.950**
All women aged 15-49 years who are anaemic	0.536*	0.558	0.687**	0.181	0.228	0.345
Mothers who had atleast 4 antenatal checkups	-0.770**	-0.512	-0.805**	-0.719**	-0.304	-0.600**
Intake of iron folic acid during pregnancy	-0.587**	-0.309	-0.596**	-0.776**	-0.379	-0.684**
Institutional birth	-0.698**	-0.532*	-0.791**	-0.546*	-0.117	-0.432
Births assisted by trained professional	-0.700**	-0.506*	-0.780**	-0.634**	-0.215	-0.535*
**Correlation is significant at the 0.01 level (2-tailed) *Correlation is significant at the 0.05 level (2-tailed)						

Source: Calculated from NFHS 3 and 4

Interstate variation in the proportion of underweight children is analysed in greater detail, by comparing three states with the highest percentage of underweight and those three states with the lowest percentage of underweight. Child nutritional indicators, nutritional status of women, maternal, delivery care, child care and child feeding practices are considered.

Table 3.13: Child And Maternal Care Indicators for States with Highest and Lowest Malnutrition Rates (NFHS 4) (in Percent)

	States with the Highest percentage of Underweight children			**States with the Lowest Percentage of Underweight children**		
	Jharkhand	**Bihar**	**MP**	**Mizoram**	**Kerala**	**Jammu & Kashmir**
Child Nutritional indicators	NFHS 4	NFHS 4	NFHS 4	NFHS 4	NFHS 4	NFHS 4
((a) Under weight	47.8	43.9	42.8	12.0	16.1	16.6
(b) Children age 6-59 months who are anaemic	69.9	63.5	68.9	19.3	35.7	54.5
Nutritional status of women						
(a) Women whose BMI is below normal (BMI<18.5 Kg/m^2)	31.5	30.4	28.4	8.4	9.7	12.1
(b)All women age 15-49 years who are anaemic	62.6	60.3	54.6	24.8	34.3	49.4
Maternal care						
(a) Mothers who had at least 4 antenatal care visit	30.3	14.4	35.7	61.4	90.1	81.3
(b) Mothers who consumed iron-folic acid for 100 days or more when they were pregnant	15.3	9.7	23.5	53.6	67.1	30.2
Delivery Care						
(a) Institutional Birth	61.9	63.8	80.8	79.7	99.8	85.6
(b)Birth assisted by Doctor/ nurse/other health professionals	69.6	70	78	83.6	99.9	87.5
(c) Births delivered by C section	9.9	6.2	8.6	12.7	35.8	33.1
Child Immunization and health care						
(a) Children aged 12-23 months fully immunized	61.9	61.7	53.6	50.7	82.1	75.1
(b)Children aged 12-23 months who received most of the vaccination in public health facility	95.3	95.5	95.7	92.4	77.6	97.5
(c) Children with diarrhoea taken to health facility	56.7	54.9	68.2	42.0	76.3	74.1
Child Feeding						
(a)Children under 3 years breastfed within 1 hour	33.1	34.9	34.4	73.4	64.3	46
(b) Children under 6 months exclusively breastfed	64.8	53.4	58.2	61.1	53.3	65.4
(c)Children 6-8 months receiving solid or semi-solid food and breast milk	47.2	30.8	38.1	68.2	63.1	50

Source: NFHS 4 state Fact sheets, 2015-16

The child nutritional indicators are analysed in terms of percentage of underweight, and anaemia among children aged 6 to 59 months. Nutritional status of women aged 15-49 is captured based on BMI and anaemia. Maternal care is analysed based on pregnant women receiving at least four antenatal care visits, and consumption of iron-folic acid for 100 days or more. Delivery care is also looked into, by taking the proportion of institutional delivery, births assisted by trained health personnel and delivery by C-section. Child feeding practices in terms of children under three years breastfed within 1 hour, children under six months exclusively breastfed, and children 6-8 months receiving solid or semi-solid food and breast milk are also analysed. Proper and timely vaccinations are crucial to ward off childhood illness, and lack of access to health facility often increases morbidity and mortality. Children aged 12-23 months fully immunized from a public health facility and children with diarrhoea treated in a health facility is taken as a proxy for access to child health care.

From Table 3.13 it is found that states with the highest proportion of underweight children suffer from the highest proportion of anaemia. Nutritional status of women, gauged in terms of BMI as well as anaemia, is better in states with the lowest proportion of underweight. In states with the highest percentage of underweight children, 30 percent of women have BMI, which is below normal whereas; it is around 15 percent in states with the lowest percentage of underweight. Maternal care indicators are dismal in Bihar. Provisioning of maternal health care services, child care and child feeding practices are also better in states with the lowest proportion of underweight. In Kerala as per NFHS 5, the percentage of children (aged 12 to 23 months) fully immunized declined to 77.8 percent; anaemia among children (6 to 59 months) increased from 35.7 percent to 39.4 percent whereas anaemia among pregnant women increased from 22.6 percent to 31.4 percent (2015-16 and 2020).

States with the lowest percentage of underweight children may not be good performers. Major 21 states are now ranked based on shortfall reduction in the proportion of underweight.

Table 3.14: Ranking of States Based on Short Fall Reduction in Proportion of Underweight as Between NFHS 3 and 4

State	STUNTED (Percent)			Wasted (Percent)			Underweight (Percent)			
	NFHS 3	NFHS 4	Change	NFHS 3	NFHS 4	Change	NFHS 3	NFHS 4	Change	Shortfall reduction(Rank)
Himachal Pradesh	38.6	26.3	Improves	19.3	13.7	Improves	36.5	21.2	Improves	**-41.92(1)**
Mizoram	39.8	28.1	Improves	9.0	6.1	Improves	19.9	12.0	Improves	**-39.6(2)**
Jammu and Kashmir	35	27.4	Improves	14.8	12.1	Improves	25.6	16.6	Improves	**-35.16(3)**
Uttarakhand	44.4	33.5	Improves	18.8	19.5	Worsens	38	26.6	Improves	-30.00(4)
Kerala	24.5	19.7	Improves	15.9	15.7	Improves	22.9	16.1	Improves	-29.69(5)
Madhya Pradesh	50	42	Improves	35	25.8	Improves	60	42.8	Improves	-28.67
Haryana	45.7	34	Improves	19.1	21.2	Worsens	39.6	29.4	Improves	-25.76
Bihar	55.6	48.3	Improves	27.1	20.8	Improves	55.9	43.9	Improves	-21.47
Tamil Nadu	30.9	27.1	Improves	22.2	19.7	Improves	29.8	23.8	Improves	-20.13
Chhattisgarh	52.9	37.6	Improves	19.5	23.1	Worsens	47.1	37.7	Improves	-19.96
West Bengal	44.6	32.5	Improves	16.9	20.3	Worsens	38.7	31.6	Improves	-18.35
ALL INDIA	**48**	**38.4**	**Improves**	**19.8**	**21**	**Worsens**	**42.5**	**35.8**	**Improves**	**-15.76**
Odisha	45	34.1	Improves	19.6	20.4	Worsens	40.7	34.4	Improves	-15.48
Jharkhand	49.8	45.3	Improves	32.3	29	Improves	56.5	47.8	Improves	-15.40
Punjab	36.7	25.7	Improves	9.2	15.6	Worsens	24.9	21.6	Improves	-13.25
Gujarat	51.7	38.5	Improves	18.7	26.4	Worsens	44.6	39.3	Improves	-11.88
Rajasthan	43.7	39.1	Improves	20.4	23	Worsens	39.9	36.7	Improves	-8.02
UP	56.8	46.3	Improves	14.8	17.9	Worsens	42.4	39.5	Improves	-6.84
Karnataka	43.7	36.2	Improves	17.6	26.1	Worsens	37.6	35.2	Improves	**-6.38(3)**
Maharashtra	46.3	34.4	Improves	16.5	25.6	Worsens	37	36	Improves	**-2.70(2)**
Andhra Pradesh	42.7	31.4	Improves	12.2	17.2	Worsens	32.5	31.9	Improves	**-1.8(1)**
Telangana	Na	28		Na	18.1		Na	28.4		

Source: Calculated from NFHS 3& 4 state Fact sheets; Na: Data Not available for the percentage of malnourished children under 5

Note: States are ranked in descending order of underweight children as per NFHS 4.

Table 3.14 gives the relative performance of states based on three anthropometric indicators. Across all states, the proportion of stunted has declined. Between NFHS 3 and 4, seven states have improved in terms of wasting. In the case of underweight proportion, all states have improved. The states are classified into good performer states (Himachal Pradesh, Mizoram and Jammu and Kashmir) based on the maximum gains in reduction of the proportion of underweight. The shortfall reduction in underweight is lowest in Andhra Pradesh, Maharashtra and Karnataka (Poor performer states). Kerala had the lowest percentage of underweight as per the NFHS 4. But in terms of shortfall reduction, Kerala has been displaced to the fourth position. The relative performance of states reveal that all states have improved in terms of stunting and underweight. In case of wasting, all states except

Himachal Pradesh, Mizoram, Jammu and Kashmir, Kerala, Madhya Pradesh, Bihar and Tamil Nadu have worsened.

Table 3.15: Basic Socio-Economic Indicators for the Selected States

	Changes in the proportion of children			Reduction in the proportion of under-weight children (NFHS 3&4	Rank by the percentage of under-weight children (NFHS4)	PCY (2015-16) at 2011-12 prices and rank by income	U5 Mortality rate (per 1000 live births) (NFHS 4)	Literacy rate (2011)	Female literacy (2011)
	Stunted	Wasted	Under weight	A	B	C	D	E	F
GOOD PERFORMING STATES									
Himachal	Improves	Improves	Improves	-41.9	4	1,12,723 (8)	38	83.78	76.60
Mizoram	Improves	Improves	Improves	-39.6	1	91,845(11)	46	91.58	89.40
J&K	Improves	Improves	Improves	-35.1	3	59,967(15)	38	68.74	58.01
INDIA	Improves	Worsens	Improves	-15.7		77,659	50	74.04	65.46
POOR PERFORMING STATES									
Andhra Pradesh	Improves	Worsens	Improves	-1.8	11	88,609(12)	41	67.66	59.74
Maharashtra	Improves	Worsens	Improves	-2.7	14	1,22,889 (3)	29	82.91	78.48
Karnataka	Improves	Worsens	Improves	-6.38	13	1,16,881 3(6)	31	75.60	68.13

Source: A and B-Calculated from NFHS 4 state Fact sheets, 2015-16
C: ESO, Punjab ; D: http://planningcommission.nic.in/reports/genrep/pov_rep0707.pdf
E: NFHS4; F: https://censusindia.gov.in/2011-prov-results/data_files/india/Final_PPT_2011_chapter6.pdf

Basic socio-economic indicators of the good performer and poor performer states are looked into in Table 3.15. Irrespective of being a good performer or a poor performer, the proportion of stunted has improved. All the poor performing states have worsened in terms of wasting. All the good performing states have a very low percent of underweight. All the good performing states, except Jammu and Kashmir and all poor performing states, have per capita income higher than the national average. Prosperous states like Maharashtra and Karnataka are in the group of poor performing states. Economic growth is necessary for reducing child undernutrition as it improves food availability, and income of people thereby increases their accessibility to health-promoting goods (Subramanyam et al., 2011). But economic growth per se will not reduce child malnutrition unless supplemented by inclusive growth and direct investments in health and health-related interventions (Subramanyam et al., 2011; Ao & Lhungdim, 2014). Under-five mortality rates of all the selected states are less than all India levels. Though Maharashtra and Karnataka have literacy above all India average, they come in the group of poor-performing states. In contrast, Jammu and Kashmir, with low levels of literacy are in the group of good performing states. Neither under-five mortality rates nor

literacy levels across good and poor performer states do show any discernible pattern. An explanation of the differential performance of states in reducing malnutrition, based on socio-economic conditions and growth rates of states, do not yield concrete results. It appears on a preliminary analysis that socio-economic conditions and growth rates do not seem to matter much. Hence, an analysis of trends in women nutritional indicators, and health care provisioning is analysed.

Table 3.16: Relative Performance of Selected States Based on Short Fall Reduction in Proportion of Underweight in Terms of Child and Women Nutritional Indicators

	Child Nutritional indicators						Women nutritional status					
	Percentage of Underweight			Children aged 6-59 months who are anaemic (Percent)			Women whose BMI is below normal (Percent)			All women aged 15-49 years who are anaemic (Percent)		
	NFHS 3	NFHS 4	% Point change	NFHS 3	NFHS 4	% Point change	NFHS 3	NFHS 4	% Point change	NFHS 3	NFHS 4	% Point change
	Good Performers											
Himachal	36.5	21.2	-15.3 (IMP)	54.4	53.7	-0.7 (IMP)	29.9	16.2	-13.7 (IMP)	43	53.5	10.5 (WRSN)
Mizoram	19.9	12.0	-7.9 (IMP)	43.8	19.3	-24.5 (IMP)	14.4	8.4	-6.0 (IMP)	38.1	24.8	-13.3 (IMP)
J&k	25.6	16.6	-9 (IMP)	58.5	54.5	-4 (IMP)	24.6	12.1	-12.5 (IMP)	52	49.4	-2.6 (IMP)
India	42.5	35.8	-6.7 (IMP)	69.4	58.6	-10.8 (IMP)	35.5	22.9	-12.6 (IMP)	55.3	53.1	-2.2 (IMP)
	Poor Performers											
Andhra Pradesh	32.5	31.9	-0.6 (IMP)	71	58.6	-12.4 (IMP)	33.5	17.6	-15.9 (IMP)	63	60	-3.0 (IMP)
Maharashtra	37	36	-1 (IMP)	63.4	53.8	-9.6 (IMP)	36.2	23.5	-12.7 (IMP)	48.4	38	-0.4 (IMP)
Karnataka	37.6	35.2	-2.4 (IMP)	70.3	60.9	-9.4 (IMP)	35.4	20.7	-14.7 (IMP)	51.2	44.8	-6.4 (IMP)

Source: Computed from NFHS 3 and 4 State Fact sheets.
Note: IMP stands for improvement and WRSN for worsening.

As seen from Table 3.16, in both good and poor performing states, there has been an improvement in both the child nutritional indicators and women nutritional indicator, namely a reduction in the percentage of women whose BMI is below normal. Between the two rounds of NFHS, percentage point change in anaemia among all women had been impressive for the good performers except Himachal. The percentage of children who are anaemic are relatively less in good performer states.

Table 3.17: Relative Performance of Selected States Based on Short Fall Reduction in Proportion of Underweight in Terms of Maternal Care and Delivery Care Indicators

	Maternal care indicators						Delivery care indicators					
	Mothers who had at least four antenatal care visits (Percent)			Intake of Iron folic acid for 100 days or more during pregnancy (Percent)			Institutional birth (Percent)			Birth assisted by trained health professional (Percent)		
	NFHS 3	NFHS 4	% Point change	NFHS 3	NFHS 4	% Point change	NFHS 3	NFHS 4	% Point change	NFHS 3	NFHS 4	% Point change
	Good Performers											
Himachal Pradesh	44	69.1	25.1 (IMP)		49.4	24.2 (IMP)	43.1	76.4	33.3 (IMP)	47.9	78.9	31 (IMP)
Mizoram	45.6	61.4	15.8 (IMP)	17.8	53.6	35.8 (IMP)	59.8	79.7	19.9 (IMP)	65.4	83.6	18.2 (IMP)
Jammu &Kashmir	60.4	81.3	20.9 (IMP)	16.3	30.2	13.9 (IMP)	50.2	85.6	35.4 (IMP)	56.5	87.5	31 (IMP)
India	37.0	51.2	14.2 (IMP)	15.2	30.3	15.1 (IMP)	38.7	78.9	40.2 (IMP)	46.6	81.4	34.8 (IMP)
	Poor Performers											
Andhra Pradesh	85.4[a]	76.3	-9.1 (WRS)	39.3[b]	56.1	16.8 (IMP)	64.4	91.5	27.1 (IMP)	74.9	92.1	17.2 (IMP)
Maharashtra	59.8	72.2	12.4 (IMP)	18.6	40.6	22 (IMP)	64.6	90.3	25.7 (IMP)	68.8	91.1	22.3 (IMP)
Karnataka	68	70.1	2.1 (IMP)	28.2	45.2	17 (IMP)	64.7	94	29.3 (IMP)	69.7	93.7	24 (IMP)

Source: Computed from NFHS 3 and 4 State Fact sheets. Andhra Pradesh NFHS 3 Report, 2005-06
Note: [a] Percentage of mothers who had 3 or more antenatal care visits;[b] Percentage of mothers who took Iron folic acid for at least 90 days

Access to maternal health care services has improved in all the selected states except in Andhra Pradesh(See Table 3.17). The percentage point change in mothers receiving antenatal care and intake of iron-folic tablets have seen larger improvements in all of the good performer states. In case of delivery care indicators, the percentage point change in institutional birth and births assisted by trained professional have substantially improved in all the good performing states, compared to poor performers. Though institutional delivery in Himachal Pradesh has increased from 43.1 percent to 76.4 per cent (NFHS 3 and NFHS 4 respectively), it is still low compared to the all India average of 78.9 per cent. The dominance of public sector characterises Himachal Pradesh health delivery system. Despite adequacy in primary public health care infrastructure which has made possible a higher rank in NITI Aayog SDG India index report, 2018, there has been a glaring shortfall of trained medical and paramedical human resources (Karan et al., 2018).

Table 3.18: Relative Performance of Selected States Based on Short Fall Reduction in Proportion of Underweight in Terms of Child Immunisation, Child Health Care and Child Feeding Practices.

	CHILD IMMUNISATION			CHILD HEALTH CARE			CHILD FEEDING PRACTICES		
	Children aged 12-23 months fully immunised (Percent)			Children with diarrhoea in the last two weeks preceding the survey taken to the health facility (Percent)			Children under age 3 years breastfed within one hour (Percent)		
	NFHS 3	NFHS 4	% Point change	NFHS 3	NFHS 4	% Point change	NFHS 3	NFHS 4	% Point change
Good Performers									
Himachal Pradesh	74.2	69.5	-4.7 (WRSN)	68.9	67.7	-1.2 (WRSN)	43.4	41.1	-2.3 (WRSN)
Mizoram	46.5	50.7	4.2 (IMP)	27.4	42.0	14.6 (IMP)	65.5	70.3	4.8 (IMP)
Jammu &Kashmir	66.7	75.1	8.4 (IMP)	67	74	7 (IMP)	31.9	46.0	14.1 (IMP)
India	43.5	62.0	18.5 (IMP)	61.3	67.9	6.6 (IMP)	23.4	41.6	18.4 (IMP)
Poor Performers									
Andhra Pradesh	46.0	65.3	19.3 (IMP)	65	72.7	7.7 (IMP)	24.6[a]	40.0	15.5 (IMP)
Maharashtra	58.8	56.2	-2.6 (WRSN)	78	77.6	-0.4 (WRSN)	51.8	57.5	5.7 (IMP)
Karnataka	55	62.6	7.6 (IMP)	67.2	69.7	2.5 (IMP)	35.6	56.3	20.7 (IMP)

Source: Computed from NFHS 3 and 4 State Fact sheets

Note: [a] For NFHS 3, Percentage of children born in 5 years preceding the survey breastfed within one hour in Andhra Pradesh.

Timely health service is crucial for preventing childhood illness. As seen in Table 3.18, the percentage of children fully immunized is higher among good performer states in NFHS 4. Though Himachal Pradesh is a good performer state, the indicators related to child immunization, health care and feeding practices have declined. In Mizoram, 70 percent of children are put to the breast within one hour of childbirth. Almost all North Eastern states have better breastfeeding practices, and among children aged 6-23 months, 73.9 percent of children had consumed Vitamin A rich foods in the past 24 hours before the survey. But the percentage of children fully immunized is below the national average.

It can be concluded that the success in reducing child malnutrition seems to be associated with improvements in the nutritional status of women, access to health care services, and maternal and child care.

3.3 Infant and Young Child Feeding Practices (IYCF)

Child malnutrition in India is mainly due to the continuous occurrence of infection, poor feeding and caring practices. The window of opportunity to prevent undernutrition is the initial two to three years, the same duration when IYCF is practised (The World Bank in India, 2009). It is easier, through timely, adequate, appropriate and safe complementary feeding interventions, to ward off child malnutrition at an earlier rather than at a later stage. Optimal IYCF practices are the most potent tool for enhancing child health.

Certain indicators related to IYCF are analysed across states and group of states.

Table 3.19: IYCF Practices by State

State	Percentage started breastfeeding within one hour of birth	Median duration of exclusive breastfeeding	Among breastfed children 6-23 months % fed			Among non breastfed children 6-23 months % fed		
			Minimum dietary diversity[1]	Minimum meal frequency[2]	Minimum acceptable diet[3]	Minimum dietary diversity[1]	Minimum meal frequency[4]	Minimum acceptable diet[5]
Mizoram	73.4	3.9	41.2	35.1	14.6	53.8	30.8	13.3
Kerala	63.3	2.9	37.9	43.1	21.3	44.3	54.7	22.3
Jammu & kashmir	47.1	4.5	43.7	37.4	21.8	53.8	69.2	32.1
Himachal Pradesh	40.6	4.1	24.5	40.0	11.0	37.9	78.0	10.0
Punjab	29.9	2.6	15.6	26.0	5.7	26.1	71.9	6.7
TamilNadu	55.4	2.2	46.6	41.2	21.4	76.2	71.7	47.1
Uttarakhand	28.8	2.4	19.8	35.8	8.6	29.0	74.9	7.8
Telangana	35.8	4.2	25.0	26.3	9.9	38.1	53.6	11.2
Haryana	42.3	2.4	16.4	26.3	7.0	27.4	65.5	10.0
West Bengal	47.7	2.6	36.6	36.7	19.1	55.1	56.7	25.7
Andhra Pradesh	39.2	4.4	21.0	25.1	6.5	30.2	60.7	11.9
Odisha	68.9	4.0	22.5	38.7	8.9	19.7	43.4	5.0
Karnataka	57.6	2.8	17.9	19.3	5.8	34.6	49.0	14.4
Maharashtra	57.0	3.2	20.1	24.9	5.2	28.4	45.2	12.2
Rajasthan	28.4	3.2	8.5	26.7	3.4	16.0	70.7	3.7
Chhattisgarh	47.4	5.3	18.5	56.2	11.1	28.4	67.4	8.5
Gujarat	49.7	2.9	13.3	30.8	5.8	24.3	47.7	2.8
Uttar Pradesh	25.4	1.6	9.8	31.2	5.3	17.7	73.2	5.3
Madya Pradesh	34.6	3.3	14.8	33.4	6.9	21.7	50.8	4.8
Bihar	35.3	2.7	16.8	25.8	7.3	28.5	60.5	9.2
Jharkhand	33.0	4.0	13.8	39.5	7.2	26.2	49.1	7.1
India	41.5	2.9	19.8	31.2	8.7	33.6	61.1	14.3

Source: NFHS 4

NOTE: Grouping of states based on percentage of underweight (NFHS 4) as in Table 3.5

[1]MDD, if "Children receive foods from four or more of the following food groups: a. infant formula, milk other than breastmilk, cheese or yoghurt or other milk products; b. foods made from grains or roots, including porridge or gruel, fortified baby food; c. vitamin A-rich fruits and vegetables; d. other fruits and vegetables; e. eggs; f. meat, poultry, fish, shellfish, or organ meats; g. beans, peas, lentils, or nuts; h. foods made with oil, fat, ghee, or butter"(IIPS & ICF,2017, p.319).

[2] "For breastfed children, minimum meal frequency is receiving solid or semi-solid food at least twice a day for infants 6-8 months and at least three times a day for children 9-23 months". (IIPS & ICF,2017, p.319).[3] MAD for 6-23 months breastfed if they are fed minimum dietary diversity and minimum meal frequency.

[4]"For non -breastfed children aged 6-23 months minimum meal frequency is receiving solid or semi-solid food or milk feeds at least 4 times a day" (IIPS & ICF,2017, p.319).

[5] MAD: If the child "receive other milk or milk products at least twice a day, receive minimum meal frequency" as mentioned in [4] and "receive solid or semi-solid food from at least four food groups" (excluding milk or dairy products). (IIPS & ICF,2017, p.319).

Early initiation of breastfeeding

The percentage of last-born children within 24 months before the NFHS 4 survey put to the breast within one hour of childbirth (early initiation of breastfeeding) is awfully low (41 percent). Early initiation of breastfeeding reduces the risk of neonatal morbidity and mortality (Debes et al., 2013). In Uttar Pradesh, Rajasthan, Uttarakhand and Punjab, less than 30 percent of children were breastfed within one hour of birth. Breastfeeding practices are better in Mizoram, as 70 percent of children were initiated breastfeeding within one hour of birth. Surprisingly, in Odisha, more than two-thirds of children were initiated breastfeeding within one hour of birth (See Table 3.19).

Median duration of exclusive breastfeeding

WHO recommends exclusive breastfeeding in the first six months of life. Breastfeeding confers short term and long-term benefits to the child and mother. Long term benefits of breastfeeding are a reduction in cardiovascular risk factors and the burden of NCDs in later years (Fewtrell, 2004). An increase in the duration of breastfeeding has a positive influence on intelligence in young adulthood (Mortensen et al., 2002) and also on cognitive development of children, particularly among low birth weight infants born close to term (Daniels & Adair, 2005). The median duration of breastfeeding in India is 29.6 months. As seen from Table 3.19, the median duration of exclusive breastfeeding is more than four months in the states of Jammu & Kashmir, Himachal Pradesh, Telangana, Andhra Pradesh, Odisha, and Jharkhand. It is as low as 1.6 months in Uttar Pradesh.

Complementary Feeding

After six months of age, breast milk alone is not sufficient to meet the increasing nutritional requirement of infants. Studies have shown that growth faltering occurs at the time of the introduction of complementary feeding (Shrimpton et al. 2001). To address the growing requirements of children, complementary foods that include a wide variety of diverse foods rich in nutrients and vitamins need to be added to the diet. The indicator used for analysing the timely introduction of complementary feeding is the percentage of infants 6-8 months, who receive either breast milk or any solid or semisolid food in the day or night before the survey. In India, only 45.5 percent of infants aged 6-8 months received both breast milk and any solid or semi-solid food, whereas, among infants in the age 9 to 11 months, it increased to 68.7 percent (IIPS & ICF, 2017).

Minimum Acceptable Diet

Minimum Acceptable Diet (MAD), Minimum Dietary Diversity (MDD) and Minimum Meal Frequency (MMF) are crucial for age-specific growth and development of infants and young children and to avoid micronutrient deficiencies. The WHO minimum acceptable diet recommendation is a combination of dietary diversity and meal frequency and is different for breastfed and non-breastfed children (WHO, 2010). "Dietary diversity is a proxy for the adequate micro-nutrient density of foods" (WHO, 2010, p.1). MMF is a proxy for the child's energy requirement. Percentage of breastfed and non-breastfed children aged 6-23 months, who received MDD, MMF and MAD, during the day or night preceding the survey is one of the core indicators of IYCF. At all India level, only one-fifth of the breastfed children aged 6-23 months received MDD as evident from Table 3.19. Forty seven percent and 76.2 percent of breastfed and non-breastfed children in Tamil Nadu consumed food from four or more food groups the day before the survey. MAD among non-breastfed children is also highest in Tamil Nadu. Though Rajasthan is positioned as a medium nutritional insecure(group M) state, the MDD and MAD are the lowest for both breastfed and non-breastfed children, in comparison to all high nutritional insecure (group H) states (See Table 3.19 and Table 3.20). MMF among breastfed children is highest in Chhattisgarh and the lowest in Karnataka (both belong to group M states). Himachal Pradesh, a group L(low nutritional insecure) state, has the highest minimum meal frequency (78 percent) among the non -breastfed children. At all India level, 31.2 percent and 61.1 percent of breastfed and non-breastfed children respectively receive MMF. The percentage of children receiving MMF is higher compared to the percentage of children receiving MDD and MAD. Though the children are provided with minimum meal frequency, the diet is not diverse. This is one of the reasons for slow progress in the nutritional outcome and increasing micronutrient deficiencies among children.

Table 3.20: IYCF Practices by the Percentage of Underweight Across Group of States

States / percentage Underweight	Percentage started breastfeeding		Mean duration of exclusive breastfeeding	Among breastfed children 6-23 months % fed			Among non breastfed children 6-23 months % fed		
	within one hour of birth	within one day of birth		Minimum dietary diversity	Minimum meal frequency	Minimum acceptable diet	Minimum dietary diversity	Minimum meal frequency	Minimum acceptable diet
Low nutritional insecurity (Group L)	46.2	82.7	3.2	30	34.5	13.4	42.9	63.3	17.8
Medium nutritional insecurity (Group M)	46.8	83.8	3.3	18.6	32.1	7.9	28.2	57.11	9.9
High nutritional insecurity (Group H)	34.3	82.8	3.3	15.1	32.9	7.1	25.4	53.4	7.0

Source: Calculated from NFHS 4

Notes: Grouping of states based on percentage of Underweight (NFHS 4) as in Table 3.6
Percentages are the unweighted average state estimates for each group of states

As evident from Table 3.20, the indicators considered relating to IYCF practices are better among the group of low nutritional insecure states. Putting the child to the breast immediately after birth (within one hour) is a determining factor to arrest malnutrition. In low nutritional insecure states, 46 percent of children under five were put to the breast within one hour of birth, whereas in high nutritional insecure states, its percentage is low. When it comes to the percentage of children breastfed within one day of birth and mean duration of exclusive breastfeeding, there is not much variation among all the groups. In group L states, 30 percent of breastfed children aged 6-23 months get MDD, whereas, in group H, only 15 percent of children receive MDD. Apparently, there are not many variations in MMF among breastfed children across the group of states. Children are fed either accessible food or child's preferred food rather than a diverse food with adequate nutrition. In group L, the percentage of non-breastfed children receiving MDD is double the percentage of children receiving MDD in group H. These findings alone cannot solely prove that inadequate IYCF are responsible for the poor nutritional outcome, but improvements in feeding practices can undoubtedly address the problem and can break the chain of malnutrition.

3.4 Nutritional Status of Women

Nutritional status of women, in particular, mothers affect the nutritional outcome of infants. A malnourished mother is more likely to have an undernourished child. Widely employed indicator of adult nutritional is BMI. This indicator is used to assess both thinness and obesity. According to NFHS 4, at all India level, 23 percent of women (between 15-49 years) had a BMI less than 18.5 kg/m^2, and 21 percent were overweight.

Table 3.21 Nutritional Status of Women by Percentage of Underweight Across Group of States

States / percentage Underweight	Percentage with BMI below 18.5 kg/m^2	Percentage with BMI of 25 kg/m^2 or more	Percentage of women			
			Mild anaemia (10-11.9g/dl)	Moderate anaemia (7.0-9.9g/dl)	Severe anemia (<7 g/dl)	Any anemia (<12g/dl)
Low nutritional insecurity	14.4	27	35.4	11.9	1	48.3
Medium nutritonal insecurity	23.9	20.2	38	11.9	1	51.9
High nutritional insecurity	30.16	11.8	44.7	13.7	0.9	59.3

Source: Calculated from NFHS 4
Notes: Percentages are the unweighted average state estimates for each group of states

In low nutritional insecure states, the percentage of women who are thin (less than 18.5 kg/m^2) is less compared to the other two groups(See Table 3.21). More than one-fourth of the percentage of women in group L is obese. In the H group, the percentage of women who is thin is more than twice its percentage in group L. At the national level, 53 percent of women aged 15-49 years are anaemic - 40 percent and 12 percent of women respectively are mildly and moderately anaemic. One percent of women are severely anaemic. Group of low nutritional insecure states have a lesser percentage of women suffering from anaemia (mild, moderate and any anaemia), compared to group M and H.

Optimal feeding practices can serve as immediate interventions outside the womb to prevent life long, irreversible damages caused by malnutrition. Though the group of low nutritional insecure states perform relatively better in terms of indicators of IYCF, its percentage is meagre. An area of concern is the abysmally low percentage of children receiving minimum dietary diversity. Imparting nutrition education at community and household level will improve the knowledge of mothers on the importance of providing diverse dietary food to children.

The underlying factors of child nutritional status are now analysed for the group of states, in terms of percentage of households with better source of potable water and percentage of households with toilet provision.

Table 3.22: Percentage of Households with Improved Source of Drinking Water and Toilet Facility

States / percentage Underweight	Percentage of households with an improved source of drinking water	Percentage of households with toilet facility
Low nutritional insecurity	91.3	84.4
Medium nutritional insecurity	88.9	57.8
High nutritional insecurity	86.8	35.4

Source: Calculated from NFHS 4
Notes: Percentages are the unweighted average state estimates for each group of states

Percentage of households with an improved source of drinking facility varies from 91.4 percent in Mizoram to 72.7 percent in Andhra Pradesh. In the high nutritional insecure group of states, the percentage of households with toilet facility is low as shown in Table 3.22. There is not much variation among the group of states in terms of percentage of households with a better source of potable water. Yet, its percentage is less among the high nutritional insecure group of states. Percentage of households with toilet facility ranges from 99.1 percent in Mizoram to as low as 30 percent in Odisha. In those group of states with high nutritional insecurity, the percentage of households with toilet facility is less than half of the households with toilet facility in low nutritional insecure states.

3.5 Nutritional Status of Children under Five in Kerala

The health indicators of Kerala are comparable with advanced economies. Health care facilities, efficient public distribution system, and high levels of literacy are some of the push factors that played a significant role in enhancing health and nutritional outcomes of Kerala.

Table 3.23: Comparison of Socio-Economic, Demographic and Health Profile of India and Kerala

Indicators	Kerala	India
Total population	3.34	121.6
Sex Ratio	1084	943
Child Sex Ratio	964	919
Infant Mortality Rate (IMR)	10	33
Under 5 Mortality Rate	12	37
Maternal Mortality Rate (MMR)	42	122
Expectancy of Life at Birth	75.2	69.0
Total Fertility Rate (TFR)	1.7	2.2
Literacy	93.91	74.04

Source: Government of Kerala (Kerala Economic Review), 2019; Directorate of Health Services Govt. of Kerala; https://censusindia.gov.in/2011-prov-results/data_files/india/Final_PPT_2011_chapter6.pdf

Some of the vital health indicators are compared between Kerala and India in Table 3.23. IMR in Kerala is 10 per 1000 live births; whereas it is 34 in India. Under 5 Mortality Rate is only 12 in Kerala compared to 37 for all India. MMR is three times lower than all India. Kerala's TFR is below the replacement level.

Table 3.24: Anthropometric Indicators and Ranking of Districts in Kerala Based on Percentage of Underweight Children (NFHS4)

Districts	Percentage of Stunted	Percentage of wasted	Severely wasted	Percentage of underweight Children	Rank by Percentage of underweight children
Kannur	25.3	10.2	3.5	10.5	I
Kottayam	22.0	16.2	6.2	11.3	II
Pathanamthitta	13.3	14.4	4.7	11.4	III
Ernakulam	12.4	15.9	7.9	12.0	IV
Kasargod	18.7	9.7	3.2	13.9	V
Thrissur	20.8	15.3	9.4	14.0	VI
Kollam	14.4	18.8	7.4	14.2	VII
Idukki	15.1	24.2	14.3	14.8	VIII
Kerala	**19.7**	**15.7**	**6.5**	**16.1**	
Alappuzha	14.5	16.6	3.5	17.2	IX
Malappuram	26.3	22.3	9.9	17.3	X
Kozhikode	18.0	13.5	5.4	18.5	XI
Palakkad	20.2	10.3	4.1	19.1	XII
Thiruvananthapuram	19.5	13.1	3.9	21.6	XIII
Wayanad	27.7	23.9	10.7	27.2	XIV
CV	**25.74**	**30.02**	**29.05**		
ALL INDIA	38	21	7.5	36	

Source: NFHS 4, Kerala

Table 3.24 shows the anthropometric indicators of children under five years in districts of Kerala. Fourteen districts are ranked in ascending order, based on percentage of underweight children in each district. 16.1 percent of children in Kerala are underweight- Kannur has the lowest percentage (10.1 percent) and Wayanad (27.2 percent), the highest. Six districts in Kerala, namely Alappuzha, Malappuram, Kozhikode, Palakkad, Thiruvananthapuram and Wayanad have a higher percentage of underweight children compared to Kerala state average(16.1 per cent). Coefficient of variation reveals that the variation across districts is highest in case of wasting.

Table 3.25: Health Status Indicator for Children across Social Groups in Kerala

Health Status Indicator	SC		ST		OBC		Others		ALL	
	NFHS3	NFHS4	NFHS 3	NFHS 4	NFHS3	NFHS4	NFHS3	NFHS4	NFHS3	NFHS4
Infant mortality rate	*		*		11.5	7.1	19.9	3.9	17.7	5.6
Neonatal mortality	*		*		11.5	5.3	13.9	3.9	14.5	4.4
Post neonatal mortality[1]	*		*		0.0	1.7	6.0	0.0	3.2	1.2
Child mortality	*		*		1.4	0.4	0.9	3.4	1.9	1.5
Under five mortality	*		*		12.9	7.5	20.7	7.2	19.5	7.1

Source: NFHS Reports *: Based on fewer than 250 unweighted cases

Health nutritional indicators among children across social groups in Kerala, too reveals a trend similar to that of all India levels. Infant mortality and neonatal mortality are higher among other backward class compared to 'others' as revealed from Table 3.25.

Table 3.26: Nutritional Status Indicator for Children across Social Groups in Kerala

Child Nutritional Status indicator	SC		ST		OBC		Others		ALL	
	NFHS3	NFHS4	NFHS 3	NFHS 4	NFHS3	NFHS4	NFHS3	NFHS4	NFHS3	NFHS4
Stunting	33.7	19.1	*	23.9	26.7	22.0	20.2	15.9	24.5	19.7
Wasting	13.1	18.6	*	18.8	13.8	16.0	17.1	14.4	15.9	15.7
Underweight	32.6	22.0	*	21.6	21.5	16.4	20.5	12.6	22.9	16.1
Any Anaemia[1]	47.2	32.3	*	49.9	44.8	36.0	43.8	36.0	44.5	35.6

Source: NFHS Reports
*: Not Shown (Based on fewer than 25 unweighted cases)
[1] Percentage of children age 6-59 months classified as having any anaemia (< 11 g/dl)

Compared to all India averages of nutritional outcome among children, children of Kerala are in a better position as evident from Table 3.26. In contrast to non-excluded social groups, children from the marginalised sections have an adverse nutritional outcome. The marginalised sections lie behind the 'others'. In Kerala too, stunting and anaemia are highest among tribal children. Close to 24 percent of tribal children are stunted, whereas among 'other' non excluded social groups, it is 15.9 percent. Nearly 22 percent of tribal children have low weight for age, whereas it is 12.6 percent among 'other' social groups. The relative difference across social groups is least in case of wasting.

3.6 Child Care Practices and Maternal Health Indicators in Kerala

Food security and nutritional security alone cannot tackle the problem of malnutrition among children. Caldwell (1979) in his seminal paper on Nigeria (as cited in Babu & Sanyal (Ed), 2009) emphasised the importance of maternal care and their education in child feeding practices. Maternal schooling affects nutritional outcome; educated mothers are likely to be knowledgeable about health care practices, the impact of immunisation against diseases and breastfeeding.

Table 3.27: Child And Maternal Care Indicators for Districts with the Highest and Lowest Percentage of Underweight Children below Five Years (NFHS 4) (Per cent)

	Districts with the lowest percentage of Underweight children			**Districts with the highest Percentage of Underweight children**		
	Kannur	**Kottayam**	**Pathanamthitta**	**Wayanad**	**Thiruvananthapuram**	**Palakkad**
Child Nutritional indicators						
((a) Under weight	10.5	11.3	11.4	27.2	21.6	19.1
(b) Children aged 6-59 months who are anaemic	44.1	33.8	18.4	45.6	20.5	41.4
Nutritional status of women						
(a) Women whose BMI is below normal (BMI<18.5 Kg/m^2)	9.7	5.3	10.5	12.2	9.0	13.5
(b)All women age 15-49 years who are anaemic	37.3	28.8	22.4	32.3	22.5	42.3
Maternal care						
(a) Mothers who had at least 4 antenatal care visits	93.2	85.4	90.0	91.7	89.1	90.4
(b) Mothers who consumed iron-folic acid for 100 days or more when they were pregnant	75.4	59.4	68.6	72.2	57.8	79.3
Delivery Care						
(a) Institutional Birth	100.0	100.0	100.0	99.6	100.0	100.0
(b)Birth assisted by Doctor/ nurse/other health professionals	100.0	100.0	100.0	99.6	100.0	100.0
(c) Births delivered by C section	35.8	33.6	52.1	22.8	41.0	34.4
Child Immunization and health care						
(a) Children aged 12-23 months fully immunized	87.1	95.2	78.0	72.8	81.9	88.1
(b)Children aged 12-23 months who received most of the vaccination in public health facility	82.3	68.2	75.1	87.4	55.9	88.6
(c) Children with diarrhoea taken to health facility	*	*	*	*	*	*
Child Feeding						
(a)Children under 3 years breastfed within 1 hour	74.9	79.0	44.3	62.9	59.5	70.0
(b) Children under 6 months exclusively breastfed	*	*	*	*	*	*
(c)Children 6-8 months receiving solid or semi solid food and breast milk	*	*	*	*	*	*

Source: NFHS 4 District Fact sheets, 2015-16
*Data not available

After ranking the fourteen districts of Kerala, based on the percentage of underweight, the highest and the lowest three districts are compared in Table 3.27. Kannur, Kottayam and Pathanamthitta districts have the lowest and Wayanad, Thiruvanathapuram and Palakkad have the highest percentage of underweight. Among these districts, though Kannur performed better in terms of percentage of underweight children, the incidence of anaemia is 44.1 percent. The highest incidence of anaemia is in Wayanad (45.6 per cent). In districts with the lowest percentage of underweight children, the nutritional status of women in terms of BMI, access to maternal care, child health care services and child feeding practices are better. Though Kottayam is one among the districts with the lowest percentage of underweight, the antenatal coverage (85.4 per cent) is lowest. Intake of iron-folic acid tablet for 100 days or more by pregnant women is lowest in Thiruvananthapuram district. There is a cent percent institutional delivery in the districts of Kerala. C Section is showing an increasing trend; more than half of the deliveries in Pathanamthitta district are through C section. Wayanad has the lowest child immunization coverage (72.8 per cent). Wayanad being a tribal-dominated district, beliefs and traditions may be inhibiting the full immunization coverage.

3.7 Conclusion

The chapter looked into the trends in child nutritional status at all India level, and among major states for the period from 1998 to 2019. The transition of states revealed that, when some states had made improvements in child nutritional indices, others made only a little progress. Apart from socio-economic conditions of states, health care provisioning, maternal and delivery care indicators, optimal IYCF practices can mitigate the problem of malnutrition.

CHAPTER 4

SOCIO-ECONOMIC AND HEALTH PROFILE OF PRESCHOOL CHILDREN AND THEIR MOTHERS IN THE STUDY AREA: AN OVERVIEW

4.1 Introduction

The chapter gives caste wise overview of the socio-economic demographic profile, child characteristics, health and nutritional profile. It examines the dietary pattern of preschool children and their mothers in the study area.

4.2 Socio-Economic and Demographic Profile

Socio-economic demographic profile of children is an important factor influencing their nutritional outcome. The variables considered for analysis include caste, type of family, educational and occupational status of parents, housing conditions, drinking water facility, land and asset ownership.

Table 4.1: Panchayat Wise Distribution of Children under Five Based on Caste (in percentage)

Panchayat	Caste		Total
	Tribal	Non-Tribal	
Vithura	20.8 (33)	57.4 (156)	43.9 (189)
Thirunelly	79.2 (126)	42.6 (116)	56.1 (242)
Total	100.0 (159)	100.0 (272)	100.0 (431)

Source: Primary Survey, 2019

Nutritional status of children varies according to the social category to which they belong. Table 4.1 gives panchayat wise distribution of children based on caste. Quota sampling procedure was employed and proportional weightage assigned for socio-demographic characteristics, such as gender and caste in the sample design. Out of the total 431 children considered for study from both the panchayats, 36.8 percent of children are from tribal category and 63.1 percent from other categories combined (includes general, OBC and SC category). In Vithura, out of 189 samples, 33 children are from tribal community, whereas in Thirunelly, out of 242 children, 126 children belong to various tribal communities. Category wise distribution of non-tribal communities in Vithura is SC (11.6 per cent), OBC (30.7 per cent) and General (40.2 percent) whereas in Thirunelly it is SC (0.8 per cent), ST (52.1 per

cent), OBC (30.6 per cent) and General (16.5 per cent). Out of the total 431 samples, 56.1 per cent of children are taken from Thirunelly and the rest from Vithura.

Table 4.2: Percentage Distribution of Children Under Five based on Head of the Household and Type of Family

Panchayat	Caste	Head of the Household		Type of family		
		Male	Female	Nuclear	Joint	Extended
Vithura	Tribal	17.3	18.8	60.6	12.1	27.3
	Non tribal	82.7	81.2	28.8	28.8	42.3
		$\chi^2 = 0.020$; df = 1; p = 0.887		$\chi^2 = 12.479$; df = 2; p = 0.002*		
Thirunelly	Tribal	52.2	50.0	40.5	11.1	48.4
	Non tribal	47.8	50.0	23.3	27.6	49.1
		$\chi^2 = 0.33$; df = 1; p = 0.855		$\chi^2 = 14.175$; df = 2; p = 0.001*		
Total	Tribal	37.0	35.3	44.7	11.3	44
	Non tribal	63.0	64.7	26.5	20.3	45.2
		$\chi^2 = 0.040$; df = 1; p = 0.841		$\chi^2 = 23.170$; df = 2; p = 0.000*		

Source: Primary Survey, 2019
*significant at 5 percent level

Table 4.2 gives the distribution of children based on head of the household and type of family. Out of the total male-headed households in Vithura, 82.7 percent (143 households) are nontribal and 17.3 per cent (30 households) are tribal households. 16 children live in households headed by a female, of which 81.2 percent (13 households) are non-tribal households. In Thirunelly, of the 224 male-headed households, 52.2 per cent are ST households and 47.8 per cent are non-tribal households. Females head nine households each in tribal and non-tribal categories. Combined, 397 children live in male-headed households and 34 in female-headed households. The females who head the household are usually the grandmother of the child. There is no significant association between sex of head of families and various caste groups in both panchayats.

Type of the family is classified into nuclear, joint and extended. If both the grandparents of the child live in the same household, they are categorised as joint. If one of the grandparents alone / siblings of the parent/ other relatives etc., live in the same house and share food prepared in the same kitchen, the household becomes extended. As revealed from

Table 4.2, out of the total tribal children in Vithura, 60.6 percent live in nuclear households, followed by extended (27.3 per cent) and joint (12.1 per cent). Forty-two per cent of non-ST children live in extended families. In Thirunelly, 48.4 percent of tribal children live in extended households. Majority of non-tribal children too live in extended families (49.1 per cent). There is significant association between type of family and caste in panchayats combined, and separately(5 percent level). Since the parents of the child are relatively young. and have been recently married, many of them live in their ancestral home along with their parents and siblings.

The median number of family members among tribal households in Thirunelly (6 members) is greater than tribal households in Vithura (4 members). In non-tribal households, the median number of family members is 5 in both Vithura and Thirunelly. ANOVA results show that there is significant difference in the number of family members among different caste in Vithura (F ratio=6.736; df(1,187);p=0.010) whereas in Thirunelly, there is no significant difference (F ratio=0.024; df(1,240);p=0.876) at 5 per cent level.

Table 4.3: Educational Status of Parents (in percent)

Panchayat	Caste	Fathers' education						$\chi 2$	df	P
		Illiterate	Upto primary	8-10th	Plus one and plus two	Graduation	PG and above			
Vithura	Tribal		15.2	72.7	9.1	3.0		26.157	4	0.000
	Non-tribal		1.3	48.7	37.2	11.5	1.3			
	Total		3.7	52.9	32.3	10.1	1.1			
Thirunelly	Tribal	6.3	61.1	25.4	6.3	0.8		92.450	5	0.000
	Non tribal	0.9	7.8	56.0	20.7	12.1	2.6			
	Total	3.7	35.5	40.1	13.2	6.2	1.2			
		Mothers' education								
Vithura	Tribal		3	45.5	42.4	9.1		26.163	5	0.000
	Non tribal	0.6	0.6	11.5	53.8	25	8.3			
	Total	0.5	1.1	17.5	51.9	22.2	6.9			
Thirunelly	Tribal	2.4	56.3	27	12.7	1.6		98.328	5	0.000
	Non tribal	0.9	6	23.3	38.8	27.6	3.4			
	Total	1.7	32.2	25.2	25.2	14	1.7			

Source: Primary Survey, 2019
*significant at 5 percent level

Education of parents is conceived to be an important variable affecting both the economic status and nutritional outcome of children. Educated parents can acquire a good job and

thereby secure more earnings. Women become more knowledgeable about the need for good nutrition, child feeding etc. via education. The education status of parents is shown in Table 4.3. A perusal of the educational status of parents of tribal children reveals that in Vithura panchayat majority of the tribal parents acquired 8-10th standard education, whereas, in Thirunelly, 61.1 percent of tribal males and more than half of tribal (56.3 per cent) females attained only primary education. Only a relatively lower percentage of non-tribal discontinued their education at primary level. None of the tribal parents in both the panchayats has post-graduation. Less than 3 percent of non-tribal males have post-graduation in both the panchayats and its percentage is higher in Thirunelly. Non-tribal females with PG are more in Vithura than in Thirunelly. In Vithura, there is almost cent percent literacy among parents, whereas, in Thirunelly, 3.7 per cent of males and 1.7 percent of females are illiterate. At 5 per cent level of significance, there is significant association between parental education and social groups in two panchayats.

Occupation of parents influences the financial position of the family. A secure and permanent job enhances economic security of the household, thus enabling them to cope up with any vulnerability.

Table 4.4: Occupational Status of Father (in percent)

Panchayat	Caste	Occupation of Father											χ^2	df	P
		Not employed	Agriculture	Forest produce gatherers	Wage labourer	Govt job	Private job	Business/ self-employed	Separated	Others	Abroad	Not applicable			
Vithura	Tribal	3.0			69.7	18.2			3.0			6.1	21.61	9	0.010*
	Non-tribal	2.6	0.6	0.6	42.3	15.4	12.8	14.1	2.6		8.3	0.6			
	Total	2.6	0.5	0.5	47.1	15.9	10.6	11.6	2.6		6.9	1.6			
Thirunelly	Tribal	0.8			94.4	1.6	1.6	0.8	0.8				62.07	9	0.000*
	Non-tribal		1.7	0.9	51.7	7.8	12.1	22.4	1.7	0.9	0.9				
	Tribal	0.4	0.8	0.4	74.0	4.5	6.6	11.2	1.2	0.4	0.4				

Source: Primary survey, 2019
*significant at 5 percent level

As evident from Table 4.4, in Vithura, tribals and non-tribals combined, almost 50 percent of males are employed as wage labourers. Seventy per cent of tribals work as wage labourers, compared to 42 per cent of non-tribals in Vithura. Seventy percent and 95 percent of tribals in Vithura and Thirunelly are wage labourers. The present generation is not venturing much into

agriculture, as it is a non-lucrative enterprise and they prefer to work as wage-labourers rather than toiling in their small patches of agricultural land. None of the tribal males in Vithura is either employed in private sector, doing business or working abroad. If the marital status of the mother is divorcee or widow, in such case, occupation of the father is considered as separated or not applicable respectively. There is significant association between the occupation of father and social groups in Vithura and Thirunelly.

Table 4.5: Occupational Status of Mother (in percent)

Panchayat	Caste	Occupation of mother								$\chi 2$	df	P
		Not employed	Forest produce gatherers	Wage labourer	Govt job	Private job	Business/ self-employed	Separated	Others			
Vithura	Tribal	63.6		15.2	6.1	3	6.1	3	3	35.294	6	0.000*
	Non-tribal	91.1		0.6	3.8	3.8	0.6					
	Total	86.2		3.2	4.2	3.7	1.6	0.5	0.5			
Thirunelly	Tribal	76.2	0.8	19	2.4	0.8	0.8			24.259	5	0.000*
	Non-tribal	87.9		1.7	2.6	6	1.7					
	Total	81.8	0.4	10.7	2.5	3.3	1.2					

Source: Primary Survey, 2019
*significant at 5 percent level

Irrespective of panchayats and caste, more than 80 per cent of mothers are not working(Table 4.5). Fifteen percent and 19 per cent of tribal mothers are employed as wage labourers in Vithura and Thirunelly, respectively. Majority of mothers are not working since their children are young.

Table 4.6: Type of House and Flooring (in percent)

Panchayat	Caste	Type of House			Type of Flooring			
		Kutcha	Semi pucca	Pucca	Cow dung	Cement	Tile	others
Vithura	Tribal	9.1	18.2	72.7	15.2	72.7	9.1	3.0
	Non-tribal	1.9	30.1	67.9	1.9	59.6	35.9	2.6
	Total	3.2	28	68.8	4.2	61.9	31.2	2.6
		χ^2 = 5.885; df = 2; p = 0.53			χ^2 = 18.310; df = 3; p= 0.000*			
Thirunelly	Tribal	11.9	84.1	4.0	17.5	73.8	7.1	1.6
	Non-tribal	3.4	56	40.5	4.3	56.9	37.1	1.7
	Total	7.9	70.7	21.5	11.2	65.7	21.5	1.7
		χ^2 = 49.794; df = 2; p = 0.000*			χ^2 = 37.170; df = 3; p = 0.000*			

Source: Primary Survey, 2019
*significant at 5 percent level

The economic condition of households can be indirectly gauged from the type of house they live in, type of flooring, electrification, and drainage facility. As seen from Table 4.6, in Thirunelly panchayat, irrespective of caste differences, more than 80 percent of tribals and more than 50 per cent of non-tribals live in semi pucca houses. In Vithura panchayat, more than 60 per cent of tribal and non-tribals live in pucca houses. Four per cent of tribal in Thirunelli live in a pucca house. There is no significant association between types of house and social groups in Vithura, whereas in Thirunelly there is significant association(at 5 percent level). Cow dung as a flooring material is used in 15.2 per cent and 17.5 per cent of tribal houses in Vithura and Thirunelly respectively. More than 60 per cent of homes in both the panchayats have cement flooring. At 5 per cent level of significance, there is a significant relationship in the type of flooring between tribal and non-tribal houses in both panchayats.

Ninety percent and 94 per cent of houses in Vithura and Thirunelly are electrified. In Vithura panchayat, people make use of own flush or public flush toilets. In contrast, in Thirunelly, in some tribal area, there are cases of open defecation. Here, some of the tribal settlements are in reclaimed marshy areas and Government have built public toilets for use by tribal communities. Due to specific functional difficulties, they are unable to use the public comfort station effectively, and many of them are in dilapidated condition. In Vithura, 33 per

cent of households have an open drain for the vent of kitchen waste, whereas it is as high as 66 percent in Thirunelly.

Access to safe drinking water is as vital as lifesaving medicines. Kerala is blessed with sufficient quantity of rain, which replenishes the most popular source of drinking water in Kerala- own well. People depend on multiple sources for drinking water.

Table 4.7: Sources of Drinking Water (in percent)

Panchayat	Caste	Source of drinking water										Total	χ^2	df	P
		Own well	Public well	Public tap	Pond	Pipe connection	Own well and pipe connection	Relatives or neighbours well	Borewell	Own well and Borewell	Others				
Vithura	Tribal	63.6	15.2		12.1	3.0		6.1				100.0	25.13	8	0.001*
	Non-tribal	71.2	8.3	2.6		7.1	5.1	3.2	1.9	0.6		100.0			
	Total	69.8	9.5	2.1	2.1	6.3	4.2	3.7	1.6	0.5		100.0			
Thirunelly	Tribal	7.9	32.5	33.3	5.6	4.0		1.6			15.1	100.0	54.00	9	0.000*
	Non-tribal	39.7	9.5	26.7		3.4	0.9	1.7	1.7	1.7	14.7	100.0			
	Total	23.1	21.5	30.2	2.9	3.7	0.4	1.7	0.8	0.8	14.9	100.0			

Source: Primary Survey, 2019
*significant at 5 percent level

In the study area of Vithura, 63.6 percent of tribal population use 'own well' as their source of drinking water. In Thirunelly, less than 10 percent of tribals use water from their well, and 32 percent depends on public well. Twelve percent and 6 percent of tribals use pond water in Vithura and Thirunelly respectively. A few households depend on Kerala Water Authority pipe connection. Some families also use water supply provided through Jalanidhi project introduced by World Bank, through the Kerala Rural Water Supply and Sanitation Agency (KRWSA), which aims to provide quality water supply in rural areas. Apart from this, in Thirunelly panchayat, to solve the water crisis, forest water is tapped to community-level overhead tanks, from where it is distributed to households. Fifteen per cent of households in Thirunelly are dependent on these sources. Chi-square results show that there is significant association between sources of drinking water and social groups in Vithura and Thirunelly (See Table 4.7). Safe drinking water can be ensured if chlorination is done regularly. In both the panchayats, the public health department oversees the process of

chlorination. Ninety-one per cent and 83 per cent of respondents in Vithura and Thirunelly reported that their water sources were regularly chlorinated.

Land is an important economic asset; the extent of land owned or possessed determines the social and economic status of households. Sub-division and fragmentation led to the uneconomic use of land. The viable use of land (mechanisation) presupposes a minimum sizeable unit. The mean extent of land owned among tribals in Vithura is 80 cents compared to 16 cents among non-tribals. In Thirunelly, the mean land owned by tribals and non-tribals is 24 cents and 41 cents respectively. ANOVA results show that there is significant difference in the extent of land owned between tribal and non-tribal households in Vithura (F ratio=49.804; df(1,187);sig=0.000) and also in Thirunelly (F ratio=5. 644; df (1,240);sig=0.018).

Table 4.8: Possession of Land and Ownership of House (In Percent)

Panchayat	Caste	Nature of Possession of land			Ownership of house		
		Title deed	Possession	others	Own	Rent	Staying with relative
Vithura	Tribal	15.2	84.8		97	3	
	Non-tribal	91.7	2.6	5.8	86.5	12.8	0.6
	Total	78.3	16.9	4.8	88.4	11.1	0.5
		χ^2 = 131.192; df = 2; p = 0.000*			χ^2 = 2.897; df = 2; p = 0.235		
Thirunelly	Tribal	47.6	29.4	23	94.4	2.4	3.2
	Non-tribal	90.5	2.6	6.9	96.6	1.7	1.7
	Total	68.2	16.5	15.3	95.5	2.1	2.5
		χ^2 = 52.769; df = 2; p = 0.000*			χ^2 = 0.667; df = 2; p = 0.717		

Source: Primary data, 2019
*significant at 5 percent level

Table 4.8 gives the nature of land possession and house ownership by caste groups across the panchayats. In the vicinity of forest area in Vithura, only 15.2 percent of tribals have title deed, whereas 85 percent have possession right. Non-tribals have title deed to the extent of 92 per cent. In Thirunelly, 48 per cent of tribals possess title deed whereas, for non-STs, it is 90.5 percent. Some of the forest lands have been recently encroached by the tribal community, for which they have neither ownership nor possession. People living in encroached land is more in Thirunelly compared to Vithura. There is significant association in the nature of possession of land between tribal and non-tribal households in both Vithura

and Thirunelly. Possession right is different from title deed. Tribals in Kerala have been living in the forest areas for generations, and the Government has given possession right to them to use this land. Those who possess land without title deed are in a precarious situation, as they are not entitled to mortgage the land in case of a financial crisis. The Government of Kerala is in the unfinished process of conferring ownership rights to tribals.

Table 4.9: Asset Ownership Index

Panchayat	Caste	asset ownership index	ANOVA
Vithura	Tribal	6.2424	F ratio =48.948 df (1,187) p =0.000
	Non-tribal	9.0705	
	Total	8.5767	
Thirunelly	Tribal	4.6746	F ratio =130.241 df (1,240) p =0.000
	Non-tribal	8.5000	
	Total	6.5083	

Source: Primary survey, 2019
*significant at 5 percent level

The more durable assets a household has, the wealthier it is. For the construction of asset ownership index, the household possession of consumer durable assets like TV, refrigerator, mobile phone, dining table, car, scooter etc are considered. As evident from Table 4.9, households in Vithura have higher asset ownership than in Thirunelly. Non-tribal households have higher asset ownership in both the panchayats. ANOVA results show that there is significant difference in asset ownership index between tribal and non-tribal households in Vithura and Thirunelly panchayats.

4.3 CHILD CHARACTERISTICS

This section looks into specific child characteristics like the gender of child, type of delivery and place of birth, and incidence of illness among selected samples of preschool children.

Table 4.10 Percentage Distribution of Children based on Gender

Panchayat	Caste	Gender of Child		χ^2	df	Sig
		Male	Female			
Vithura	Tribal	48.5	51.5	0.129	1	0.720
	Non-tribal	51.9	48.1			
	Total	51.3	48.7			
Thirunelly	Tribal	52.4	47.6	0.010	1	0.919
	Non-tribal	51.7	48.3			
	Total	52.1	47.9			

Source: Primary Survey, 2019

Gender wise analysis in Table 4.10 shows that in Vithura panchayat, 51.5 per cent female children and 48.5 per cent male children are considered for study from the tribal category, whereas 52 per cent male children and 48 per cent female children are from non-tribals. From Thirunelly, a higher percentage of male children (52 percent each) from both tribal and non-tribal communities are included. At 5 percent level of significance, there is no significant association between gender and the caste groups in Vithura and Thirunelly.

Table 4.11 Type of Childbirth and Place of Delivery (in percent)

Panchayat	Caste	Type of childbirth		Place of delivery		
		Normal	Caesarean	Home	Govt hospital	Private hospital
Vithura	Tribal	69.7	30.3		97	3
	Non-tribal	48.1	51.9	1.3	74.4	24.4
	Total	51.9	48.1	1.1	78.3	20.6
		χ^2 = 5.100; df=1, sig = 0.024*		χ^2 = ; 8.206; df=2, sig = 0.017*		
Thirunelly	Tribal	69.0	31.0	4	92.1	4
	Non-tribal	69.8	30.2	1.7	73.3	25
	Total	69.4	30.6	2.9	83.1	14
		χ^2 = 0.017; df=1, sig = 0.895		χ^2 = 22.633; df=2, sig = 0.000*		

Source: Primary Survey, 2019
*significant at 5 percent level

Table 4.11 gives the percentage distribution of children based on type of child birth and place of delivery across the panchayats. An enquiry into the type of childbirth shows that in Vithura, C-section deliveries among non-tribals (52 per cent) are higher than tribals (30 percent). In Thirunelly, C-section deliveries are lower in both tribal and non-tribal communities (around 30 per cent). C-section is a surgical delivery initiated when the doctors fear that normal vaginal delivery will endanger the safety of mother or child. According to WHO (2009), the ratio of C-section to normal delivery is an indicator of the emergency obstetric care. A level as low as 5 percent or less reflects the lack of access to surgical intervention and a percentage higher than 15 is an indicator of overuse of procedure (WHO, 2015). C-section deliveries in India have increased from 8.5 per cent in NFHS 3 to 17.2 per cent in NFHS 4 (IIPS & ICF, 2017). In Kerala, over the same period, the percentage rose from 30.1 per cent to 35.8 percent (IIPS & ICF, 2018). Increase in C-section has become a public health issue. It has both short-run and long-run consequences on the health of mother and child. The C-section percentage is higher than the state average in Vithura, whereas it is lower in Thirunelly panchayat. Chi-square test results show that at five percent level of significance, there is significant association between type of childbirth and social groups in

Vithura panchayat. In Vithura, 1 percent of deliveries happen at home, whereas in Thirunelly it is 3 percent. For delivery, tribals in both Vithura and Thirunelly prefer Government hospitals, whereas services of private health care providers are more utilized by non-tribals. Moreover, C-section deliveries are higher in private hospitals than in public health facilities. At 5 percent level of significance, there is significant association between place of delivery and various social groups in the panchayats.

Birth weight is the weight of the baby taken immediately after the child is born and is an indicator of nutrition the mother and the foetus received during pregnancy. Birth weight of less than 2.5 kg is considered to be low birth weight. In both the panchayats, the mean birth weight of children is less than 2 kg. The mean birth weight for children belonging to tribal category in Vithura is 1.757 kg and mean birth weight is lowest among tribal children of Thirunelly. ANOVA results show that, at 5 percent level of significance, there is significant difference in birth weight of the child as between different caste groups in both the panchayats (Vithura: F ratio=4.627; df(1,187); p=0.033 & Thirunelly: F ratio=12.338; df(1,240); p=0.001).

In 2018, globally, around 6.2 million children under the age of 15 years died, and of these deaths, 5.5 million occurred within the first five years of life (WHO, 2019). The leading causes of death were preterm complications, pneumonia, diarrhoea, malaria etc. If timely interventions like immunization, good nutrition, safe drinking water, environment and access to health care services were provided, more than half of these deaths could have been avoided.

In the study area, the incidence and frequency of illness among children under five were analysed. Frequency of common childhood illness like cold and cough, diarrhoea, fever, Acute Respiratory Infection (ARI), other diseases and also the disease history of the child from birth to date was enquired. Hospitalisation episode and ICU admission were also considered. Frequency of illness was categorised into ‘never’ (indicating that the child never had an incidence of that disease), ‘less frequent’ (or occasionally, say the incidence is once in six months), ‘frequent’ (at least once in three to six months) and ‘more frequently’ (once in two months).

Table 4.12: Percentage Distribution of Illness among Children across Caste Groups

Disease	Panchayat	Tribal				Non-tribal			
		Never	Less frequent	Frequent	More frequent	Never	Less frequent	Frequent	More frequent
Cold and Cough	Vithura	6.1	39.4	42.4	12.1	5.1	35.9	22.2	30.8
	Thirunelly	4	23	51.6	21.4	2.6	31.9	45.7	19.8
Diarrhoea	Vithura	84.8	15.2			86.5	11.5	1.3	0.6
	Thirunelly	69	13.5	11.9	5.6	69	17.2	10.3	3.4
Fever	Vithura	9.1	45.5	27.3	18.2	9	38.5	25.6	26.9
	Thirunelly	16.7	31.7	38.9	12.7	19.8	40.5	28.4	11.2
ARI	Vithura	84.8	12.1	3		91	7.7	1.3	
	Thirunelly	98.4	0.8	0.8		94.8	4.3	0.9	
Others	Vithura	81.8	18.2			86.5	10.3	1.9	1.3
	Thirunelly	96	1.6		2.4	94	5.2		0.9

Source: Primary Survey, 2019

Table 4.12 gives the percentage distribution of illness among children across caste groups. Among tribal children in Vithura, 12.1 percent suffered 'more frequent' episodes of cold and cough, whereas among non-tribal children it was as high as 30.8 percent. Comparison of tribal children as between Vithura and Thirunelly revealed that the percentage was higher among tribal children of Thirunelly (21.4 percent). Diarrhoea is one of the important contributors of malnutrition among preschool children. It results in malnutrition through a reduction in dietary intake, decreased nutrient absorption and loss of vital nutrients from the body (Scrimshaw et al., 1968; Mata et al., 1976). More than 80 percent of children in the study area of Vithura and Thirunelly 'never' had an incidence of diarrhoea. Among tribal children in Thirunelly, 5.6 percent reported 'more frequent' incidence of diarrhoea, whereas it was 3.4 percent among non-tribals. None of the ST children in Vithura reported 'frequent' diarrhoea, whereas 11.9 percent of ST children in Thirunelly had 'frequent' diarrhoea. Among non-tribal children, 1.3 percent in Vithura and 10.3 percent in Thirunelly had 'frequent' diarrhoea. Regarding the treatment for diarrhoea, 6.1 percent and 22 percent of tribal children in Vithura and Thirunelly respectively, sought treatment from hospital or village health worker. Six percent and 8 percent of tribal children in Vithura and Thirunelly respectively took Oral Rehydration Solution (ORS) packet. In Thirunelly, less than one percent of non-tribals relied on homemade fluids like rice soup-'*Kanji vellam'*. Those seeking treatment for diarrhoea from hospital or health worker is more in Thirunelly (21.5 percent) compared to Vithura (4.8 percent). ARI can affect normal breathing. ARI can affect the

upper respiratory system (starting with sinus and ending with vocal cord) or affect the lower respiratory system (starting from vocal cords and ending in the lungs). Causes of upper respiratory infection can be acute pharyngitis, common cold etc. and that of lower respiratory infection can be bronchitis, pneumonia etc. Twelve percent and 0.8 percent of tribal children in Vithura and Thirunelly respectively, had 'less frequent' episode of ARI. Frequency of ARI is lesser among nontribal children of Vithura compared to tribal children. Other diseases include fits, skin disease, asthma, allergy, jaundice, chickenpox, vomiting, sickle cell anaemia, tomato fever, urinary infection, ear infection etc. Among tribal children in Vithura and Thirunelly, 18.2 percent and 1.6 percent respectively had 'less frequent' incidence of other diseases. Sickle cell anaemia is a major cause of 'more frequent' illness among tribal children in Thirunelly. In the study area of Vithura, none of the children had sickle cell anaemia.

Hospitalisation episode was more in Vithura than in Thirunelly. In Vithura, 9 percent each of tribal children were hospitalised due to cold and cough, and ARI. Hospitalisation among ST children of Thirunelly was less. Among tribals, 96 percent of children had not been hospitalised to date, and among those hospitalised, the reason cited was 'others'-allergy, asthma, vomiting, urinary infection etc. Access to health care providers is comparatively more in Vithura than in Thirunelly, a possible reason for more hospitalisation episodes among both tribal and nontribal children in Vithura. A study by Soman et al. (1991) on child morbidity patterns among under 3 in Kerala, found that child morbidity is highest during the first six months and lowest by age three. Environmental quality also affects child morbidity.

Vaccination is an essential precautionary measure to prevent illness. The study enquired the vaccination history of children. Near cent percent of children had been vaccinated for polio and BCG across caste groups and in both the panchayats, except for a child in Thirunelly who missed the vaccination as the mother skipped the stipulated date. Efficient monitoring by ASHA, Anganwadi workers and tribal promoters in the study area, had helped in achieving cent percent vaccination.

4.3.1 Index of Disease Vulnerability

An index of disease vulnerability is constructed, based on the child's illness episode. It is higher in Vithura, compared to Thirunelly panchayat. In Vithura panchayat, index of disease vulnerability is more among non-tribal children, whereas it is more among tribal children in Thirunelly. There is no significant difference between the index of disease vulnerability and

caste in the two panchayats. (Vithura; F value=0.547; df (1,187); p=0.460 and Thirunelly: F value=.0911; df(1,240) ; p=0.341).

Index of disease vulnerability and education of parents are also considered. One would expect the index of disease vulnerability among children to decline as parents climb up the ladder of education. No specific relation can be inferred from Vithura. In Thirunelly, as the educational qualification of parents increases, the index of disease vulnerability declines. There is no significant difference between the index of disease vulnerability and levels of parents' education in Vithura and Thirunelly panchayat.

4.4 Maternal Characteristics

Maternal characteristics considered include mother's demographic characteristics, BMI status, and maternal health care.

The mean age of the mothers in the study area of Vithura and Thirunelly is 28 years and 27 years, respectively. ANOVA results show that at 5 percent level of significance, there is no significant difference in the age of mother as between different social groups in both the panchayats (Vithura: F value=1.437; df(1,187); p=0.232 and Thirunelly: F value=0.026; df(1,240); p=0.872). Mean age at marriage is less in Thirunelly compared to Vithura. It is lower among ST mothers in Thirunelly, and their mean age at marriage is approximately 19.9 years compared to non-ST (20.7 years). In Vithura, the mean age at marriage among ST women is 23 years and among non-ST mothers is 21.7 years. At 5 percent level of significance, there is significant difference in the mean age at marriage as between different social groups in both Vithura and Thirunelly (Vithura; F value=4.537; df(1,187); sig=0.034 and Thirunelly: F value=3.348; df(1,240); sig=0.0069). Mean age at childbirth in Vithura is 25 years and is higher among tribal mothers (26 years), when compared to non-tribals (25 years). In Thirunelly, the mean age of mother at childbirth is 24 years, and there is not much difference in mean age at childbirth as between tribal and non-tribal mothers. At 5 percent level of significance, there is no significant difference in the age at childbirth as between different caste groups in both the panchayats (Vithura; F value=0.987; df(1,187) ; sig=0.322 and Thirunelly: F value=.091; df(1,240) ; sig=0.763).

4.4.1 BMI Status of Mothers

BMI helps to calculate the extent of body fat in adults. It can be used to assess health risk faced by an individual. A healthy mother gives birth to a healthy baby. Mother's nutritional status is vital since a malnourished (underweight) mother is more prone to give birth to a malnourished child, leading to an intergenerational transfer of malnutrition.

Table 4.13 BMI Status of Mothers (in percent)

Panchayat	Caste	BMI status			χ^2	Df	Sig
		Underweight	Normal	Overweight			
Vithura	Tribal	30.3	45.5	24.2	17.937	2	0.000*
	Nontribal	6.4	46.8	46.8			
	Total	10.6	46.6	42.9			
Thirunelly	Tribal	34.9	56.3	8.7	20.062	2	0.000*
	Nontribal	16.4	56.0	27.6			
	Total	26.0	56.2	17.8			

Source: Primary Survey, 2019
*significant at 5 percent level

Table 4.13 shows the BMI status of mothers in the study area. Among tribal mothers, underweight is more in Thirunelly (35 percent) than in Vithura (30.3 percent). Among non-tribals, underweight mothers are significantly lower in Vithura (Vithura: 6.4 percent and Thirunelly:16.4 percent). Mothers having normal BMI are also more in Thirunelly. Overweight mothers are greater in Vithura panchayat, and a comparison of both the panchayats reveal that it is more among non-STs. Chi-square test results show that, at 5 percent level of significance, there is significant association between maternal BMI status and social groups in both Vithura and Thirunelly.

4.4.2 Maternal Health Care

WHO (2019) estimates that 40 percent of pregnant women worldwide are anaemic. Lack of iron during pregnancy adversely affects the health of the mother as well as the development of the foetus. WHO recommends a daily intake of oral iron and folic acid during pregnancy to prevent anaemia and subsequent complications, like preterm and low birth weight babies.

Table 4.14 Intake of Iron-Folic Calcium Tablet and TT Injection (in percent)

Panchayat	Caste	Intake of iron-folic calcium		TT Injection	
		Regular	Irregular	No	Yes
Vithura	ST	93.9	6.1	3	97
	Non ST	95.5	4.5		100
	Total	95.2	4.8	0.5	99.5
		$\chi^2 = 0.149$; df = 1; p = 0.700		$\chi^2 = 4.752$; df = 1; p = 0.029	
Thirunelly	ST	96.8	3.2		100
	Non ST	94.8	5.2		100
	Total	95.9	4.1		100
		$\chi^2 = 0.609$; df = 1; p = 0.435			

Source: Primary survey, 2019

Table 4.14 reveals that 95 percent of mothers were regular in consuming iron-folic and calcium tablets in the study areas. Mothers belonging to the nontribal community in Vithura were more regular in intake of tablets, whereas tribal mothers of Thirunelly were more regular in using these tablets. At 5 percent level of significance, there is no significant association between the intake of iron-folic and calcium tablets and social groups in both the panchayats. All mothers, except 3 percent of them belonging to tribal community in Vithura panchayat, were administered two doses of tetanus toxoid (TT) injections.

4.5 Infant and Child Feeding Characteristics

Optimal IYCF practices are essential for every child to get the best possible start in life. The first 1000 days in the life of a child is very vital and investment in the early years of life by ensuring optimal infant and young child feeding acts as a means to prevent and reduce child malnutrition.

To look into the IYCF practices in the study area, an enquiry is made about the initiation of breastfeeding, whether colostrum (first milk) is given, percentage of children exclusively breastfed for six months, duration of breastfeeding, and initiation of complementary feeding.

Colostrum

In the study area, cent percent of children were breastfed. The first milk produced by mammary glands after childbirth is known as colostrum. It is essential for growth and immunity in children, In Vithura and Thirunelly, 96 percent and 99 percent of children respectively received colostrum.

Initiation of Breastfeeding

Breast milk is the storehouse of vital nutrients, which is essential for a healthy start of life and growth in infants. The study categorises initiation of breastfeeding into 'immediately after birth' (early initiation of breastfeeding), 'within 24 hours' and 'after two days'. WHO recommends early initiation of breastfeeding as it stimulates breast milk production, reduces morbidity among infants, develops mother-child bonding and increases the duration of breastfeeding among children (as cited in MoHFW et al., 2019).

Table 4.15 Initiation of Breastfeeding (in percent)

Panchayat	Caste	Initiation of breastfeeding				$\chi 2$	Df	P
		immediately after birth	within 24 hours	after two days	not applicable			
Vithura	ST	60.6	30.3	9.1		2.231	3	0.526
	Non ST	47.4	42.9	9.0	0.6			
	Total	49.7	40.7	9.0	0.5			
Thirunelly	ST	94.4	5.6			1.280	2	0.527
	Non ST	94.8	4.3	0.9				
	Total	94.6	5.0	0.4				

Source: Primary Survey, 2019

Percentage of infants immediately breastfed after birth, is less in Vithura compared to Thirunelly as seen from Table 4.15. The lag in the initiation of breastfeeding may be due to the delay in the onset of milk production after C-section deliveries. In Thirunelly, 94 percent of infants were put to the breast immediately after delivery. Breastfeeding was initiated in 9 percent of infants in Vithura after two days. At 5 per cent level of significance, there is no significant association between the time of initiation of breastfeeding and social groups in both the panchayats.

Exclusive Breastfeeding

WHO recommends that infants should be exclusively breastfed for the first six months of life for optimal growth, development and health of infants (WHO, 2003). Exclusive breastfeeding will have short run as well as long run benefits on both the child and mother

(Feachem et al., 1984; Victora et al., 1987; Arifeen et al., 2001). Exclusive breastfeeding means that the child is given breast milk only, and no solids or other liquids including water. As seen from Table 4.16, percentage of infants exclusively breastfed for six months were higher in Thirunelly (90 percent) compared to Vithura (76.2 per cent). Percentage of children not solely breastfed are higher among ST compared to non-ST in both the panchayats. At 5 per cent level of significance, there is no significant association between exclusive breastfeeding and social groups in both the panchayats.

Table 4.16 Exclusive Breastfeeding (in percent)

Panchayat	Caste	Exclusive breastfeeding for six months			$\chi 2$	df	P
		No	Yes	Not applicable			
Vithura	ST	18.2	72.7	9.1	0.264	2	0.876
	Non ST	15.4	76.9	7.7			
	Total	15.9	76.2	7.9			
Thirunelly	ST	8.7	87.3	4.0	3.166	2	0.205
	Non ST	6.0	93.1	0.9			
	Total	7.4	90.1	2.5			

Source: Primary Survey, 2019

Initiation of Complementary Feeding

WHO recommends that after six months, to meet the increasing demand for nutrients by infants, they should be given safe and nutritious complementary foods, while continuing breastfeeding for two years or beyond. Dewey and Brown (2003) suggest that complementary feeding is vital for filling the nutrient and energy gap.

More than 80 per cent of infants were introduced complementary feeding after six months in both the panchayats. In Vithura, 6 per cent of tribal children were introduced supplementary feeding at the age of less than three months. None of the children in Thirunelly was initiated supplementary feeding at less than three months. Seven percent and 13.6 per cent of children in Vithura and Thirunelly were given supplementary foods at the age of 3-6 months. Medical conditions like breast engorgement and insufficient quantity of breast milk were cited as reasons for initiating supplementary feeding before six months. There is no significant association between initiation of complementary feeding and social

group in both the panchayats. (χ^2 =6.921; df =3and p=0.074 for Vithura and χ^2 =0.757; df=2 and p=0.685 for Thirunelly).

4.6 Dietary Assessment

4.6.1 Food Frequency Questionnaire (FFQ)

Food frequency questionnaire is used to assess the dietary pattern of tribal and non-tribal families. FFQs are useful to analyse frequency of consumption of specific food items. FFQs are not as accurate as quantitative dietary assessment methods like 24-hour dietary recall method, as one does not take the weight of foods nor quantify the cooking utensils used.

Table 4.17: Frequency of Consumption of Food Items as between Social Groups (in percent)

Items	Panchayat	Tribals						Non- tribals					
		Daily	Weekly	Fortnightly	Monthly	Occasionally	Never	Daily	Weekly	Fortnightly	Monthly	Occasionally	Never
Rice	Vithura	100						100					
	Thirunelly	100						100					
Wheat	Vithura	12.1	63.6	15.2	6.1		3.0	26.3	62.8	3.8	2.6	1.9	1.9
	Thirunelly	10.3	75.4	4.8	1.6	5.6	2.4	20.7	68.1	2.6	2.6	6	
Pulses	Vithura	6.1	84.8	6.1	3.0			17.3	75.6	4.5	1.9		
	Thirunelly	5.6	73.8	3.2	4.1	6.3		19	71.6	1.7	7.8		
Green leafy Vegetables	Vithura	9.1	69.7	12.1		9.1		9.6	43.6	21.2	9.6	15.4	0.6
	Thirunelly	4.8	71.4	7.9	7.1	7.9	0.8	2.6	81.9	6	5.2	4.3	
Vegetables	Vithura	48.5	48.5					62.8	34	2.6		0.6	
	Thirunelly	59.5	31.7	2.4	5.6	0.8		64.7	26.7	5.2	2.6	0.9	
Fruits	Vithura	9.1	42.4	18.2	21.2	6.1	3	21.8	55.1	7.1	9.6	5.1	1.3
	Thirunelly	5.6	35.7	11.9	23.0	20.6	3.2	12.1	39.7	11.2	21.6	15.5	
Fish/ Egg	Vithura	69.7	27.3	3.0				82.7	15.4	0.6	0.6		0.6
	Thirunelly	19.8	68.3	2.4	9.5			31.9	61.2	0.9	3.4	0.9	1.7
Meat	Vithura		12.1	6.1	36.4	39.4	6.1	2.6	13.5	9.6	43.6	23.7	7.7
	Thirunelly	2.4	51.6	4.0	35.7	5.6	0.8	0.9	74.1	3.4	18.1	1.7	1.7
Milk	Vithura	60.6	24.2	3.0	6.1	3.0	3	91.7	6.4	0.6			1.3
	Thirunelly	18.3	16.7	20.6	4.8	19	20.6	58.6	17.2	4.3		10.3	8.6

Source: Primary data, 2019

Table 4.17 gives the frequency of consumption of cereals, pulses, vegetables and non-vegetarian food as between social groups. Rice, being the staple diet of Kerala, irrespective of caste and panchayat differences, everyone consumes it daily. Daily consumption of wheat is more among non-tribals in both the panchayats. Twelve percent and 10.3 per cent of tribal households consume wheat daily in Vithura and Thirunelly respectively. Seventy five and 63.6 percent of tribal households in Thirunelly and Vithura respectively consume wheat products weekly. Majority of the tribals are holders of Antyodaya Anna Yojana (AAY or yellow card) of Kerala Civil Supplies Department. Five kilograms of wheat per card is distributed to yellow cardholders through the Public Distribution System (PDS) free of cost, and the majority of tribals live in joint or extended households. Hence, the wheat distributed is not sufficient for their daily consumption. Pulses consumption daily is more among non-tribals than in tribal households. Consumption of green leafy vegetables is essential as they are the powerhouse of vitamins, especially Vitamin K. Daily consumption of green leafy vegetables is more among non-tribals of Vithura. In contrast, it is more among tribals in Thirunelly. In Vithura and Thirunelly, 69.7 per cent and 71.4 per cent of tribals respectively consume green leafy vegetables weekly; among non-tribals, it is 43.6 per cent in Vithura and 81.9 percent in Thirunelly. Tribals in Thirunelly are in the habit of cooking the leaves of pumpkin (*mathan chappu*), variants of spinach (*cheera chappu*), stem and leaves of elephant foot yam etc. They are referred to as *'chappu'* in local language, which means the leaves of locally available plants. They are rich in nutrients. In Thirunelly, both tribal and non-tribal households consume a variety of *'chappu'*. Almost half of the tribals in Vithura and 60 percent of tribals in Thirunelly consume vegetables daily. More than 60 percent of non-tribals in both Vithura and Thirunelly consume vegetables daily. Fruit consumption among tribals is less. In Vithura and Thirunelly, 9.1 per cent and 5.6 percent of tribals respectively consume fruits daily. It is relatively better among non-tribals in both the panchayats. Fish is an all-time favourite among households in Vithura. Among tribals, 69.7 percent consume fish daily; it is 82.7 percent among non-tribals. In Thirunelly, daily fish consumption by households is lower, and it is much lower among tribals (19.8 percent) compared to non-tribals (31.9 percent). More than 60 per cent of households in Thirunelly consume fish weekly. They prefer to consume dry fish. In Vithura, 2.6 percent of non-tribals consume meat daily; 36.4 percent and 43.6 percent of tribals and non-tribals respectively, consume meat products at least once in a month. In Thirunelly, 51.6 per cent of tribals and 74.1 percent of non-tribals consume meat weekly, in contrast, while in Vithura, it is as low as 12 percent and 13.5 percent among tribals and non-tribals respectively. Daily milk consumption is more

significant among non-tribals (92 percent) compared to tribals (61 percent) in Vithura. In Thirunelly, 18 percent of tribals and 59 percent of non-tribals consume milk daily. Those who never use milk or milk products are more among households in Thirunelly. In rural areas, people prefer to have black tea-'*kattan chaya'*, rather than milk tea. Accessibility to shops are also limited, and people buy milk from households that rear cattle. Moreover, the absence of a refrigeration facility limits the consumption of milk daily.

4.6.2 Twenty Four Hour Dietary Recall

Twenty four hour dietary recall is a structured interview method to capture detailed information regarding the food and beverages consumed by the respondent in the past 24 hours. It is a more appropriate measure of diet intake, and the respondent is asked about the nature and quantity of food consumed. It has a disadvantage of suffering from selection bias and is unable to account for day to day variations in diet intake.

On a sub-sample of 43 child-mother pairs (10 percent of total sample size, from Vithura: 19 (Tribal-5 and nontribal-14 and from Thirunelly: 24(Tribal : 9 and nontribal -15)), 24-hour dietary recall is used to elicit type and quantity of food and beverages consumed in the previous 24 hours. Energy and protein level of child and mother is calculated. It is compared with the Recommended Dietary Allowance level for children and women (Indian Council of Medical Research, 2011), to conclude whether the child/ mother is deficient in energy and protein levels.

Table 4.18. Mean Energy and Protein Levels and its Difference from RDA

Panchayat	Caste	mother energy level	mother protein level	mother energy difference from RDA	mother protein difference from RDA	child energy level	child protein level	child energy difference from RDA	child protein difference from RDA
Vithura	Tribal	1373.90	44.37	-358.10	-10.62	658.34	27.73	-208.98	14.01
	Non tribal	1337.39	49.67	-435.17	-6.53	730.09	42.98	-348.15	5.17
	Total	1346.08	48.41	-416.82	-7.50	713.01	39.34	-315.01	7.28
Thirunelly	Tribal	1837.25	58.70	-180.75	2.76	848.70	37.81	-201.70	17.75
	Non tribal	1538.20	45.95	-361.79	-9.79	721.81	24.49	-434.85	6.59
	Total	1674.13	51.75	-279.50	-4.08	779.48	30.54	-328.87	11.66

Source: Primary Survey, 2019

From Table 4.18, it is evident that in Vithura as well in Thirunelly, the mean energy level of mothers belonging to the tribal category is higher than non-tribal mothers. Mothers in both

the study area are deficient in energy intake, when compared to RDA. Non-tribal mothers have more protein levels compared to tribal mothers in Vithura, whereas tribal mothers in Thirunelly have more protein levels compared to non-tribal counterparts. Tribal mothers in Thirunelly have excess of protein intake- mean of 2.760 g/day. In Vithura, the child energy level is more among non-tribals (730 Kcal/d) compared to tribal children (658 Kcal/d) and, in Thirunelly, it is more among tribal children (848 Kcal/d). A study by Meshram et al.(2012), among tribal children in India, found intakes of all the major nutrients to be below the RDA, whereas intake of protein is similar to RDA. In the present study, child protein difference from RDA, indicates that children in both the panchayats have excess of protein compared to RDA. This is due to the appreciable service rendered by Anganwadis of ICDS. They provide supplementary nutrition to children under three - '*amritampodi*'. Preschooling is offered to children above three years, and they are served with nutritious supplementary foods.

4.7 Nutritional Outcome Analysis- Anthropometric Indicators

To evaluate the nutritional status of preschoolers in the study area, stunting, wasting and underweight are used as outcome variables of nutritional status.

Table 4.19 Percentage of Children Classified based on Anthropometric Indicators

Panchayat	Caste	Height for age				Weight for age				Weight for height					
		Normal	Moderate	Severe	Tall	Normal	Moderate	Severe	Above normal	Normal	MAM	SAM	Risk of overweight	Overweight	Obese
Vithura	ST	33.3	36.4	27.3	3	72.7	18.2	9.1		66.7	6.1	6.1	15.2	3	3
	Non ST	66	21.8	10.9	1.3	75	12.8	4.5	7.7	61.5	9.0	5.1	10.3	8.3	5.8
	Total	60.3	24.3	13.8	1.6	74.6	13.8	5.3	6.3	62.4	8.5	5.3	11.1	7.4	5.3
		χ^2 = 13.036; df = 3; sig = 0.005				χ^2 = 4.218; df = 3; sig = 0.239				χ^2 =2.440; df = 5; sig = 0.785					
Thirunelly	ST	39.7	27.8	32.5		61.9	20.6	13.5	4	50.8	10.3	9.5	14.3	4.8	10.3
	Non ST	56.9	19	24.1		71.6	20.7	4.3	3.4	64.7	8.6	2.6	8.6	7.8	7.8
	Total	47.9	23.6	28.5		66.5	20.7	9.1	3.7	57.4	9.5	6.2	11.6	6.2	9.1
		χ^2 = 7.220; df = 2; sig = 0.027				χ^2 = 6.490; df = 3; sig = 0.090				χ^2 = 9.878; df = 5; sig = 0.079					

Notes: Children whose height/length for age Z score is between ≥-2 to≤3SD (Normal) ,between ≥ -3 to < -2 SD (moderately stunted). Children below -3 SD are severely stunted, greater than +3 SD(tall). Children whose weight for age Z score is between ≥-2 to≤1 (Normal), between ≥ -3 to < -2 SD from the median of the reference population are moderately underweight, Children below -3 SD are severely underweight. Since, we do not use weight for age to determine overweight, here Weight for age Z score between >+1SD&>+3SD are categorised as above normal. Children whose weight for height/length Z score is between ≥-2 to≤1 SD(Normal), between ≥ -3 to < -2 SD from the median of the reference population are moderately wasted(MAM), below -3 SD are severely wasted(SAM) ; >+1to≤+2SD(possible risk of overweight);>+2to≤+3SD(overweight)and>+3SD(obesity). Categories made based on WHO child growth standards classification as given in FANTA Guide https://www.fantaproject.org/sites/default/files/resources/MODULE-2-FANTA-Anthropometry-Guide-May2018.pdf

Source: Primary Survey 2019

Table 4.19 gives the nutritional status of children, in the study area, in terms of anthropometric indicators. In the study area, 60 percent and 48 percent of children in Vithura and Thirunelly respectively are classified as having normal height for age; its percentage is more among non-tribal children in both the panchayats. Moderately stunted children are more among tribal children in Vithura (36 .4 per cent) than in Thirunelly (27.8 per cent). Percentage of children who are severely stunted are higher among tribals in both the panchayats (27.3 per cent and 32.5 percent). In Thirunelly, 24.1 percent of non- tribal children are severely stunted. Chi-square test statistic shows that, there is significant association between height for age and caste. In Vithura, 72.7 percent of tribal children have normal weight for age, whereas in Thirunelly it is 61.9 percent. Children in Thirunelly are moderately underweight than in Vithura. Severely underweight children are more among tribals in both the panchayats. There is no significant association between weight for age and caste in the study area. In Vithura panchayat, tribal children have normal weight for height (66.7 per cent) compared to non-tribals (61.5 per cent). Children with normal weight for height are less in Thirunelly. Percentage of tribal children classified as MAM is 6 per cent and 10.3 percent in Vithura and Thirunelly respectively. The percentage of children classified as MAM in Vithura, is higher among non tribals . Children having the risk of overweight is more among tribals rather than among non-tribals. The above results reveal the double burden of malnutrition that Kerala is facing- SAM/MAM coexisting with danger of overweight and obesity. Majority of tribals spend a sizeable proportion of income buying junk foods. The children are exposed to such unhealthy eating habits at a very young age. Nutritional transition has, on the one hand, increased the number of children with obesity risk and on the other, deprive them of adequate nutrients that are vital for their growth and development.

4.8 Conclusion

Energy deficiency emerged as a serious concern among children and mothers in the study area. FFQ revealed the inadequacy of intake of fruits and green leafy vegetables in diet. Though children are given minimum meal frequency, their diet lacks minimum dietary diversity. The nutritional outcome in terms of anthropometric failure was higher among tribals in both the panchayats and consumption of junk foods is a risk factor.

CHAPTER 5

STUNTING AND WASTING :AT MICRO LEVEL

5.1 Introduction

Cross-sectional analysis is done to assess the pervasiveness of stunting and wasting in two tribal dominated panchayats- Vithura and Thirunelly- of Kerala. The association of child nutritional outcomes by selected background characteristics and the determinants of normal height for age and weight for height among preschoolers are also examined.

5.2 Predictor Variables

The association of child nutritional outcome variables, namely stunting, and wasting, are analysed based on the following predictor variables.

(a) Socio-economic variables: Caste, family members, type of house, total expenditure, asset ownership, and the possibility of another child less than five years.

(b) Parental characteristics: Age of the mother, age at childbirth, parental education, the difference in education levels, mother's height, BMI, occupation of mother, and sector in which father is working.

(c) Utilization of health care services: Number of anti-natal check-ups, type of childbirth, intake of iron calcium tablet during pregnancy and place of delivery.

(d) Child characteristics: Age of the child, the gender of the child, birth weight of the child, birth order, birth interval, whether the child is full-term or not, frequency of diarrhoea, and child vaccination.

(e) Child feeding: Breastfeeding initiation, exclusive breastfeeding for six months or not, duration of breastfeeding, initiation of complementary feeding, and child feeding interval.

Table 5.1 Category Wise Distribution of Children According to Socio-Economic Characteristics

Socio-economic characteristics	Category	Total Number		
		Thirunelly	Vithura	Combined
Caste	ST	126	33	159
	Non ST	116	156	272
Family members	Upto Four members	59	79	138
	Above Four members	183	110	293
Type of house	Kutcha	19	6	25
	Semi pucca	171	53	224
	Pucca	52	130	182
Total Expenditure	Upto Rs 8000	75	31	106
	Rs 80001-10000	74	54	128
	Rs 10,001-Rs 12,000	31	48	79
	Above Rs 12,000	62	56	118
Asset ownership status	Low asset group	169	73	242
	High asset group	73	116	189
Possibility of another child less than 5 years	No	189	171	360
	Yes	53	18	71

Source: Field Survey, 2019

Table 5.1 gives the category wise distribution of children according to socio-economic characteristics. Panchayats together, 37 percent of children belong to the tribal community; 68 percent of children live in households with more than four family members. The proportion of children residing in families with more than four members is greater in Thirunelly (76 percent) compared to Vithura (58 percent). Panchayats combined, close to 6 percent (25) of children live in kutcha houses. Forty-two percent of respondents live in pucca houses. In Vithura panchayat, 3 percent of children live in kutcha houses, 28 and 68 percent live in semi pucca and pucca houses respectively. In Thirunelly too, 70 percent (171) of children were staying in semi pucca houses, 7.8 percent (19) live in kutcha houses. Total outlay includes the monthly expenditure of the household on both food and non-food. Panchayats combined, 30 percent (128) of children lived in households with total monthly expenditure between Rs 8,001 and Rs 10,000. In Vithura, 30 percent of children live in households with monthly spending above Rs 12,000. In Thirunelly, 60 percent each stay in households with a monthly outlay of less than Rs 10,000. Panchayats together, 56 percent of

children live in households with low asset ownership status. Sixteen percent (71) of households had another child less than five years.

Table 5.2 Category Wise Distribution of Children According to Parental Characteristics

Parental characteristics	Category	Total Number		
		Thirunelly	Vithura	Combined
Age of the mother	Upto 25 years	89	62	151
	26-30 years	107	78	185
	Above 30 years	46	49	95
Age at childbirth	<=22 years	100	60	160
	>22 years	142	129	271
Mother's education	Upto 10 th Std	143	36	179
	Higher Secondary	61	98	159
	Graduation &above	38	55	93
Father's Education	Upto 10 th Std	192	107	299
	Higher Secondary	32	61	93
	Graduation &above	18	21	39
Difference in education levels	Education of father< mother	99	103	202
	Education of father= mother	112	77	189
	Education of father> mother	31	9	40
Mother's Height	Short(<155 cm)	174	106	280
	Tall(>155 cm)	68	83	151
BMI of mother	Underweight	63	20	83
	Normal	136	88	224
	Overweight	43	81	124
Occupation of mother	Unemployed	198	163	361
	Employed	44	26	70
Sector in which father is working	Not Applicable	1	9	10
	Formal	20	43	63
	Informal	221	137	358

Source: Field survey, 2019

Table 5.2 reveals the category wise distribution of children according to parental characteristics. Panchayats combined, 43 percent of mothers are in the age group '26 to 30'. Percentage of mothers above 30 years is lesser in Thirunelly (19 percent) compared to Vithura (26 percent). Combined, about 63 percent of mothers have given birth to the child after 22 years. The percentage of mothers whose age at childbirth is '22 years or less' is higher in Thirunelly. In Vithura and Thirunelly together, 41.5 percent of mothers have an education 'up to 10 th', 36.8 percent have education up to 'higher secondary' and 21.5 percent have an education of 'graduation and above'. More than half of mothers in Vithura have an education 'up to higher secondary'. In Thirunelly, close to 60 percent have an education 'up to class 10' and only 15.7 percent have education 'graduation and above'.

Vithura and Thirunelly together, statistics of paternal education shows that majority (69 percent) of fathers have an education 'up to 10 th class', only 9 percent have 'graduation and above'. In Thirunelly, 79 percent of fathers have an education 'upto 10 th class' whereas in Vithura it is 56.6 percent. The percentage of fathers with either 'higher secondary' or 'graduation' is higher in Vithura. The relative difference in the education level of father and mother reveals that 46.8 percent (202) of children have parents whose paternal education are less than maternal education. In Vithura more than half of children have parents whose paternal education are less than maternal education whereas, in Thirunelly, 46 percent of children have parents whose levels of education are similar. Out of 431 samples, 65 percent of mothers have a height of 'less than 155 cm'. The percentage of short mothers are higher in Thirunelly (71 percent) compared to Vithura (56 percent). More than half (221) of the mothers have normal BMI and 28.7 percent are overweight (Combined). Thirunelly panchayat has a higher proportion of underweight mothers (26 percent) compared to Vithura (10.5 percent). Both the panchayats combined, 84 percent (361) of mothers are unemployed. In Vithura and Thirunelly, 86 and 82 percent of mothers respectively are unemployed. In the study areas combined, 2 percent of fathers were either not alive or legally divorced, hence included in 'not applicable category' of 'the sector in which father is working'; 83 percent of children have their fathers working in the informal sector.

Table 5.3 Category Wise Distribution of Children According to the Utilization of Health Care Services

Health care services	Category	Total Number		
		Thirunelly	Vithura	Combined
Number of anti-natal check-ups	Less than 4	116	38	154
	More than 4	126	151	277
Type of childbirth	Normal	168	98	266
	C section	74	91	165
Intake of iron calcium tablet	Never	0	0	0
	Regular	232	180	412
	Irregular	10	9	19
Place of Delivery	Home	7	2	9
	Government Hospital	201	148	349
	Private Hospital	34	39	73
Child Vaccination as per the chart	No	0	1	1
	Yes	242	188	430

Source: Field Survey, 2019

Table 5.3 shows the category wise distribution of children according to the utilization of health care services. Panchayats combined, 35.7 percent of mothers have gone to health care provider for less than four times for anti-natal check-ups. In Thirunelly, less than 50 percent of the mothers received at least four anti-natal check-ups, whereas in Vithura, three fourth of mothers received at least four or more than four anti-natal check-ups. Combined, 38 percent of children delivered through C-section. Deliveries through C-section are relatively higher in Vithura (48 percent) than in Thirunelly (30.5 percent). During their period of pregnancy, 95.5 percent of mothers regularly consumed iron-folic and calcium tablets. Due to various reasons like vomiting and other discomforts associated with the intake of iron-folic and calcium tablets, 4 percent of mothers could not consume the prescribed tablets regularly. Overall, the proportion of institutional deliveries is 98 percent, with 18 percent of deliveries taking place at private hospitals. The percentage of institutional deliveries is more in Vithura panchayat (99 percent) compared to Thirunelly (97 percent). In Thirunelly, 2 percent of deliveries happened at home and majority of the deliveries in both the panchayats happened in Government hospitals.

Table 5.4 Category Wise Distribution of Children According to Child Characteristics

Child characteristics	Category	Total Number		
		Thirunelly	Vithura	Combined
Age of the child	≤12 months	44	30	74
	13-36 months	144	97	241
	37-59 months	54	62	116
Gender of the child	Male	126	97	223
	Female	116	92	208
Birth weight of the child	Upto 2.5 kg	54	35	89
	2.5 to 3.5 kg	168	129	297
	>3.5 kg	20	25	45
Order of birth	First	88	105	193
	Second	101	80	181
	Third	43	4	47
	Above three	10	0	10
Full Term	Yes	232	167	399
	No	10	22	32
Birth Interval	Less than 2 years	40	19	59
	Greater than 2 years	119	66	185
Frequency of diarrhoea	Never &Less frequent	204	186	390
	Frequent	27	2	29
	More frequent	11	1	12

Source: Field Survey, 2019

Table 5.4 provides the category wise distribution of children according to child characteristics. Panchayats combined, 4 percent of children are 'less than six months' of age, 55.9 percent are in the age group '13-36 months' and, 26.9 percent are in the age group '37-59 months'. In the study area, 51 and 59.5 percent of children come in the age group of '13-36 months' in Vithura and Thirunelly respectively. Nearly 52 percent of children are males and 48 percent are females; 20.6 percent of children are born LBW, whereas 10 percent have birth weight of more than 3.5 kg. The percentage of children born LBW is higher in Thirunelly (22 percent) compared to Vithura (18.5 percent), whereas the percentage of children with birth weight more than 3.5 kg are higher in Vithura (13.2 percent) compared to Thirunelly (8 percent). The percentage of children born as the first child is greater in Vithura (55 percent) compared to Thirunelly (36 percent). Four percent of children in Thirunelly are of birth order 'above three'. Thirteen percent of children are born at a birth interval of less than two years. Close to 93 percent of children are born full term. Vithura panchayat has a higher percentage of children born preterm (11 percent) compared to Thirunelly (4 percent). Overall, 90.4 percent (390) of children have 'never and less frequent' diarrhoeal episodes. The proportion of children having 'frequent' and 'more frequent diarrhoea' are greater in Thirunelly.

Table 5.5: Category Wise Distribution of Children According to Child Feeding Characteristics

Child feeding characteristics	Category	Total		
		Thirunelly	Vithura	Combined
Initiation of breastfeeding	Within 24 hours	241	172	413
	More than 24 hours	1	17	18
Exclusive breastfeeding for six months	No	18	30	48
	Yes	218	144	362
Duration of breastfeeding	Less than one year	88	52	140
	1-2 years	52	60	112
	Greater than two years	102	77	179
Initiation of complementary feeding	Less than 3 months	0	9	9
	3 to 6 months	33	13	46
	After 6 months	206	160	366
Child feeding interval	Less than three times	84	9	93
	More than three times	158	180	338

Source: Field Survey, 2019

Table 5.5 shows the category wise distribution of children according to child feeding characteristics. In Vithura, 91 percent of children are put to breast within 24 hours of childbirth whereas; it is near cent percent in Thirunelly. Panchayats combined, 84 percent of children are exclusively breastfed for six months. The percentage of children exclusively breastfed is less in Vithura panchayat (76 percent) compared to Thirunelly (92 percent). Eighty-five percent of children are initiated complementary feeding after six months of age, 2 percent even before three months. None of the children in Thirunelly panchayat is given supplementary feeding before three months and in Vithura panchayat, 4.7 percent of children are given supplementary feeding before three months of age. Combined, 32 percent of children are breastfed for less than one year and 41.5 percent are breastfed for more than two years. The percentage of children breastfed for less than a year is higher in Thirunelly (36 percent) compared to Vithura (27 percent). 78 percent of children are fed with solid or semi-solid foods more than three times in the previous 24 hour period before the interview. Percentage of children receiving food more than three times a day is greater in Vithura (95 percent) compared to Thirunelly (65 percent).

5.3 Stunting

Stunting is a sign of chronic undernutrition. Undernutrition of the mother results in deficient growth in utero. Such children are susceptible to premature mortality (Black et al., 2013). The initial 1,000 days are critical since at this period children are prone to stunting.

5.3.1 Association of Stunting by Socio-Economic Factors

The association of stunting by socio-economic factors are analysed for Vithura and Thirunelly panchayats, combined and separately. The quota sampling procedure is employed, and proportional weightage is assigned for the socio-demographic characteristics such as gender and caste, in the sampling design, as per the respective District Census Handbook 2011.

Table 5.6: **Percentage Distribution of Children Classified based on Stunting by Selected Socio-Economic Characteristics**

Socio-economic characteristics	Category	Stunting (Combined)%		Stunting (Vithura)%		Stunting (Thirunelly)%	
		No	Yes	No	Yes	No	Yes
Caste	ST	39.0	61.0	36.4	63.6	39.7	60.3
	Non ST	62.9	37.1	67.3	32.7	56.9	43.1
	Test Statistic	χ^2 =23.029; df=1, p = 0.000*		χ^2 =11.060; df=1, p = 0.001*		χ^2 =7.171; df=1, p =0.007*	
Family members	Upto 4 members	55.1	44.9	54.4	45.6	55.9	44.1
	Above 4 members	53.6	46.4	67.3	32.7	45.4	54.6
	Test Statistic	χ^2 =.084; df=1, p = 0.772		χ^2 =3.216; df=1, p = 0.073**		χ^2 =2.00; df=1, p = 0.157	
Type of house	Kutcha	60.0	40.0	66.7	33.3	57.9	42.1
	Semi pucca	49.6	50.4	60.4	39.6	46.2	53.8
	Pucca	58.8	41.2	62.3	37.7	50.0	50.0
	Test Statistic	χ^2 =3.827; df=2, p = 0.148		χ^2 =0.119; df=2, p = 0.942		χ^2 =1.051; df=2, p = 0.59	
Total Expenditure	Upto Rs 8000	45.3	54.7	45.2	54.8	45.3	54.7
	Rs 80001-10000	49.2	50.8	51.9	48.1	47.3	52.7
	Rs 10,001-Rs 12,000	60.8	39.2	72.9	27.1	41.9	58.1
	Above Rs 12,000	62.7	37.3	71.4	28.6	54.8	45.2
	Test Statistic	χ^2 =9.480; df=3, p = 0.024*		χ^2 =10.621; df=3, p = 0.014*		χ^2 =1.847; df=3, p = 0.605	
Asset ownership status	Low asset group	45.9	54.1	52.1	47.9	43.2	56.8
	High asset group	64.6	35.4	68.1	31.9	58.9	41.1
	Test Statistic	χ^2 =14.914; df=1, p = 0.000*		χ^2 =4.893 df=1, p = 0.027*		χ^2 =5.041; df=1, p = 0.025*	
Possibility of another child less than 5 years	No	57.8	42.2	63.2	36.8	52.9	47.1
	Yes	35.2	64.8	50.0	50.0	30.2	69.8
	Test Statistic	χ^2 =12.160; df=1, p = 0.000*		χ^2 =1.196; df=1, p = 0.274		χ^2 =8.562; df=1, p = 0.003*	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

As revealed from Table5.6, panchayats combined, 45 percent of children are stunted, 38 percent in Vithura and 52 percent in Thirunelly. Stunting is higher among children of tribal communities. Panchayats combined, 61 percent and 37 percent of tribal and non-tribal children respectively are stunted. Compared to the tribal communities of Thirunelly, tribal children of Vithura are more stunted. Among non-tribals, stunting is higher in Thirunelly. In Thirunelly, stunting is higher (54.6 percent) among children residing in families with more

than four members whereas, in Vithura, it is higher (45.6 percent) among children living in families with four or less members. Panchayats combined, half of the children residing in semi pucca houses are stunted-39.6 percent in Vithura and 53.8 percent in Thirunelly. In each of panchayat as well as combined, above 50 percent of the children are stunted in those families with total monthly spending of less than Rs 8,000. The percentage of stunted children decreases as the total monthly household expenditure increases. More than half of the children from households belonging to 'low asset group' are stunted. In the study, asset ownership is taken as a proxy for wealth status. Children belonging to low asset group are unable to access nutritionally adequate and diverse food. In panchayats combined, there is significant association (at 5 percent level) of stunting with caste, total household expenditure, presence of another child less than five years and asset ownership status. There is a significant relationship of stunting with caste, total expenditure, asset ownership (all at 5 percent level) and number of family members (at 10 percent level) in Vithura. In Thirunelly, it is significantly associated with caste, asset ownership and the possibility of another child below five years.

In the study area, stunting is higher among tribal preschool children. Many studies assert the higher risk of undernutrition among preschool children belonging to the indigenous tribal community, compared to their rural counterparts (Rajaram et al., 2007; Pasricha & Biggs, 2010; Ghosh & Varerkar, 2019). At all India level, the presence of stunting, wasting and underweight among tribal children are 43.8 percent, 27.4 percent and 45.3 percent respectively, whereas the corresponding figures for 'others' (non- marginalised groups) are much lower (31.2 percent stunting, 19.0 percent wasting and 28.8 percent underweight) (IIPS & ICF, 2017). In Kerala, the percentage of stunting is 23.9 percent among tribals, whereas it is 15.9 percent among 'others' (IIPS & ICF, 2018). A study by Fenske et al. (2013) analysing determinants of stunting in India finds no statistically significant effect of number of household members. The present study contradicts this finding. Children from families with more than five members have a greater chance of being stunted (Fikadu, 2014).

5.3.2 Association of Stunting by Parental Characteristics

The association of stunting by maternal age, maternal age at childbirth, parental education, occupation status, mother's BMI etc. are analysed in table 5.7.

Table 5.7: Percentage Distribution of Children Classified based on Stunting by Parental Characteristics

Parental characteristics	Category	Stunting (Combined) in %		Stunting (Vithura) in %		Stunting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Age of the mother	Upto 25 years	50.3	49.7	61.3	38.7	42.7	57.3
	26-30 years	56.8	43.2	66.7	33.3	49.5	50.5
	Above 30 years	54.7	45.3	55.1	44.9	54.3	45.7
	Test statistics	χ^2 =1.405; df=2; p = 0.495		χ^2 =1.721; df=2; p = 0.423		χ^2 = 1.846; df=2, p = 0.397	
Age at childbirth	<=22 years	45.0	55.0	51.7	48.3	41.0	59.0
	>22 years	59.4	40.6	66.7	33.3	52.8	47.2
	Test Statistics	χ^2 =8.411; df=1; p = 0.004*		χ^2 =3.907; df=1; p = 0.048*		χ^2 = 3.283; df=1; p = 0.070**	
Mother's education	Upto 10 th Std	45.8	54.2	50.0	50.0	44.8	55.2
	Higher Secondary	59.1	40.9	63.3	36.7	52.5	47.5
	Graduation &above	61.3	38.7	67.3	32.7	52.6	47.4
	Test statistics	χ^2 = 8.502; df=2; p = 0.014*		χ^2 = 2.912; df=2; p = 0.233		χ^2 = 1.415; df=2; p = 0.493	
Father's Education	Upto 10 th Std	50.2	49.8	57.9	42.1	45.8	54.2
	Higher Secondary	67.7	32.3	72.1	27.9	59.4	40.6
	Graduation &above	51.3	48.7	52.4	47.6	50.0	50.0
	Test statistics	χ^2 = 8.955; df=2; p = 0.011*		χ^2 = 4.255; df=2; p = 0.121		χ^2 = 2.049; df=2; p = 0.359	
Difference in education levels	Education of father< mother	56.9	43.1	63.1	36.9	50.5	49.5
	Education of father= mother	52.4	47.6	61.0	39.0	46.4	53.6
	Education of father> mother	47.5	52.5	55.6	44.4	45.2	54.8
	Test Statistic	χ^2 = 1.578; df=2; p = 0.454		χ^2 = 0.241; df=2; p = 0.886		χ^2 = 0.459; df=2; p = 0.795	
Mother's Height	Short(<155 cm)	47.5	52.5	50.9	49.1	45.4	54.6
	Tall(>155 cm)	66.2	33.8	75.9	24.1	54.4	45.6
	Test statistics	χ^2 = 13.850; df=1; p = 0.000*		χ^2 = 12.298; df=1; p = 0.000*		χ^2 = 1.590; df=1; p = 0.207	
BMI of mother	Underweight	37.3	62.7	45.0	55.0	34.9	65.1
	Normal	55.4	44.6	61.4	38.6	51.5	48.5
	Overweight	62.9	37.1	66.7	33.3	55.8	44.2
	Test statistics	χ^2 = 13.389; df=2; p = 0.001*		χ^2 = 3.213; df=2; p = 0.201		χ^2 = 6.026; df=2; p = 0.049*	
Occupation of mother	Unemployed	55.1	44.9	63.8	36.2	48.0	52.0
	Employed	48.6	51.4	50.0	50.0	47.7	52.3
	Test statistics	χ^2 = 1.014; df=1; p = 0.314		χ^2 = 1.812; df=1; p = 0.178		χ^2 = 0.001; df=1; p = 0.976	
Sector in which father is working	Not Applicable	50.0	50.0	55.6	44.4	0.0	100.0
	Formal	60.3	39.7	62.8	37.2	55.0	45.0
	Informal	53.1	46.9	62.0	38.0	47.5	52.5
	Test Statistic	χ^2 = 1.200; df=2; p = 0.549		χ^2 = 0.169; df=2; p = 0.919		χ^2 = 1.337; df=2; p = 0.513	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

Table 5.7 gives the percentage distribution of children classified based on stunting by parental characteristics. In Vithura panchayat, stunting is highest among children whose mothers' age is 'above 30 years' (44.9 percent) and lowest among children whose mothers' age is between '26 to 30 years' (33.3 percent). In Thirunelly panchayat, the percentage of stunting is highest among children whose mother's age is '25 years or less'. A significantly higher percentage of stunting is observed in children whose maternal age at childbirth is '22 years or below'. A similar trend is observed in Vithura and Thirunelly separately. The proportion of stunted children by education levels of mothers reveal that stunting is lower among children born to mothers having more years of formal education. The association of stunting by father's education shows that in both Vithura and Thirunelly, stunting is lowest among children whose fathers education is 'higher secondary'. At 5 percent level of significance, in panchayats combined, there is significant association of stunting based on the education levels of fathers. A study conducted in Indonesia and Bangladesh found that parental education is a strong determinant of stunting (Semba et al., 2008). The percentage of stunting by the 'difference in education levels' of parents show that the percentage of stunting is lesser among children whose maternal education levels are more in comparison to the education level of father. This highlights the relative importance of maternal education compared to paternal education. Children born to illiterate mothers have double the risk of being stunted compared to children of mothers having secondary education. (Boerma & Bicego, 1992). In our study, stunting is lower among children of mothers with more years of schooling. Studies of Handa (1999) and Mishra and Retherford (2000) showed that children born to illiterate mothers have a low nutritional outcome. Our study conforms to these findings. At 5 percent level of significance, there is no significant relationship between stunting and the relative difference in education levels of parents. Stunting is higher among children whose mothers are short. Among children whose maternal height is 'less than 155 cm', Thirunelly panchayat has a higher percentage of stunting (55 percent) compared to Vithura (49 percent). A study in India by Subramanian et al. (2009) established the relation between maternal height and stunting. Zhang et al. (2007) found that slow foetal growth of short stature mothers can be attributed to composition. Sinha et al. (2018) found that infants born to short mothers had two-fold higher odds of stunting and they concluded that low birth weight infants born to short mothers had a higher chance of stunting. Among children born to underweight mothers, 63 percent are stunted whereas, 44 percent of children born to mothers with normal BMI are also stunted (combined). In Vithura panchayat, more than half (55 percent) of children are

stunted whose mothers are underweight, whereas, in Thirunelly, it is 65 percent. In Vithura, half of the children born to mothers who are working are stunted. In Thirunelly, irrespective of mother's employment status, around 52 percent each are stunted. Though the proportion of stunted is higher among children born to mothers who are working, and whose fathers are working in the informal sector, the association is not statistically significant.

Stunting is significantly associated with mother's age at childbirth, maternal education, maternal height, BMI, and father's education (combined). In Vithura, there is significant association between stunting and mother's age at childbirth and maternal height. In Thirunelly also, stunting is significantly related to maternal BMI, and mother's age at childbirth.

5.3.3 Association of Stunting by Utilization of Health Care Services

The association of stunting by utilization of health care services, namely number of anti-natal check-ups, type of childbirth, intake of iron calcium tablet and place of delivery are analysed.

Table 5.8 Percentage Distribution of Children Classified based on Stunting by Utilization of Health Care Services

Utilization of health care services	Category	Stunting (Combined) in %		Stunting (Vithura) in %		Stunting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Number of anti-natal check-up	Less than 4	54.5	45.5	60.5	39.5	52.6	47.4
	More than 4	53.8	46.2	62.3	37.7	43.7	56.3
	Test Statistic	$\chi^2 = 0.023$; df=1; p = 0.880		$\chi^2 = 0.038$ df=1; p = 0.845		$\chi^2 = 1.932$; df=1; p = 0.165	
Type of childbirth	Normal	53.0	47.0	62.2	37.8	47.6	52.4
	C section	55.8	44.2	61.5	38.5	48.6	51.4
	Test Statistic	$\chi^2 = 0.310$; df=1; p = 0.578		$\chi^2 = .010$; df=1; p = 0.920		$\chi^2 = 0.022$; df=1; p = 0.883	
Intake of iron calcium tablet	Never	0.0	0.0	0.0	0.0	0.0	0.0
	Regular	53.9	46.1	61.7	38.3	47.8	52.2
	Irregular	57.9	42.1	66.7	33.3	50.0	50.0
	Test Statistic	$\chi^2 = 0.118$; df=1; p = 0.732		$\chi^2 = 0.091$; df=1; p = 0.763		$\chi^2 = 0.018$; df=1; p = 0.894	
Place of Delivery	Home	33.3	66.7	50.0	50.0	28.6	71.4
	Government Hospital	51.6	48.4	58.8	41.2	46.3	53.7
	Private Hospital	68.5	31.5	74.4	25.6	61.8	38.2
	Test Statistic	$\chi^2 = 8.547$; df=2; p= 0.014*		$\chi^2 = 3.297$; df=2; p = 0.192		$\chi^2 = 3.881$; df=2; p = 0.144	
Child Vaccination as per chart	No	100	0	100	0	0	0
	Yes	54.0	46.0	61.7	38.3	47.9	52.1
	Test Statistic	$\chi^2 = 0.852$; df=1, p = 0.356		$\chi^2 = 0.619$; df=1, p = 0.432		$\chi^2 =$; df=, p =	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

In Vithura, as seen from Table 5.8, stunting is higher (39.5 percent) among children whose mothers received less than four anti-natal check-ups whereas, in Thirunelly, it is higher (56.3 percent) among children whose mothers received four or more than four anti-natal check-ups. In Thirunelly, irrespective of the type of childbirth, more than half of the children are stunted. Overall as well as in both the panchayats individually, there is no significant association between stunting and number of anti-natal check-ups, type of delivery and intake of iron-folic and calcium tablets. The study by Saaka and Hammond (2020) found association between C-section delivery and stunting. No clear statistical evidence on the relation between stunting and place of delivery is seen in Vithura and Thirunelly separately. Significant association is evident between stunting and place of delivery (combined).

5.3.4 Association of Stunting by Child Characteristics

The percentage distribution of children classified as stunted by selected child characteristics are presented in Table 5.9

Table 5.9 Percentage Distribution of Children Classified based on Stunting by Child Characteristics

Child characteristics	Category	Stunting (Combined) in %		Stunting (Vithura) in %		Stunting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Age of the child	≤12 months	39.2	60.8	56.7	43.3	27.3	72.7
	13-36 months	53.9	46.1	62.9	37.10	47.9	52.1
	37-59 months	63.8	36.2	62.9	37.10	64.8	35.2
	Test statistics	$\chi^2 = 11.105$; df=2, p = 0.004*		$\chi^2 = 0.415$; df=2, p = 0.813		$\chi^2 = 13.692$; df=2, p = 0.001*	
Gender of the child	Male	52.9	47.1	57.7	42.3	49.2	50.8
	Female	55.3	44.7	66.3	33.7	46.6	53.4
	Test Statistics	$\chi^2 = 0.244$; df=1, p = 0.621		$\chi^2 = 1.471$; df=1, p = 0.225		$\chi^2 = 0.171$; df=1, p = 0.680	
Birth weight of the child	Upto 2.5 kg	44.9	55.1	54.3	45.7	38.9	61.1
	2.5 to 3.5 kg	53.2	46.8	61.2	38.8	47.0	53.0
	>3.5 kg	77.8	22.2	76.0	24.0	80.0	20.0
	Test statistics	$\chi^2 = 13.260$; df=2, p = 0.001*		$\chi^2 = 2.992$; df=2, p = 0.224		$\chi^2 = 10.066$; df=2, p = 0.007*	
Order of birth	First	56.5	43.5	62.9	37.1	48.9	51.1
	Second	54.1	45.9	60.0	40.0	49.5	50.5
	Third	48.9	51.1	75.0	25.0	46.5	53.5
	Above three	30.0	70.0	0	0	30.0	70.0
	Test statistics	$\chi^2 = 3.282$; df=3, p = 0.350		$\chi^2 = 0.454$; df=2, p = 0.797		$\chi^2 = 1.454$; df=3, p = 0.693	

Child characteristics	Category	Stunting (Combined) in %		Stunting (Vithura) in %		Stunting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Full Term	Yes	54.6	45.4	64.1	35.9	47.8	52.2
	No	46.9	53.1	45.5	54.5	50.0	50.0
	Test statistic	$\chi^2 = 0.719$; df=1, p = 0.397		$\chi^2 = 2.857$; df=1, p = 0.091**		$\chi^2 = 0.018$; df=1, p = 0.894	
Birth Interval	Less than 2 years	45.8	54.2	52.6	47.4	42.5	57.5
	Greater than 2 years	53.0	47.0	62.1	37.9	47.9	52.1
	Test statistics	$\chi^2 = 0.931$; df=1, p = 0.335		$\chi^2 = 0.554$; df=1, p = 0.457		$\chi^2 = 0.351$; df=1, p = 0.554	
Frequency of diarrhoea	Never &Less frequent	55.6	44.4	62.4	37.6	49.5	50.5
	Frequent	41.4	58.6	50.0	50.0	40.7	59.3
	More frequent	33.3	66.7	0	0	36.4	63.6
	Test statistics	$\chi^2 = 4.346$; df=2, p = 0.114		$\chi^2 = 1.762$; df=2, p = 0.414		$\chi^2 = 1.353$; df=2, p = 0.508	

Source: Field Survey, 2019

Note: *significant at 5%; ** significant at 10 percent

The association of stunting by the age of the child shows that in Vithura and Thirunelly, stunting is least in the group '37-59 months'. In both panchayats combined and in Thirunelly alone, the association between stunting and age of the child is statistically significant. In this study, the prevalence of stunting is highest in the age group 'less than 12 months'. A study by Victora et al. (2010) attempts to analyse worldwide timings of growth faltering in 54 countries. They found that stunting starts close to standards, exceedingly deviates from standard until 24 months and increases slightly after 24 months. A study by Ghosh and Varerkar (2019), on undernutrition among tribal children aged 1 to 6 years in Maharashtra found that older children had a lower risk of stunting. But several studies (Lindtjørn & Alemu, 2002; Thiombiano-Coulibaly, 2004; IIPS & ICF, 2017) assert that stunting is less common among younger infants. High prevalence of stunting in later years suggests a 'weaning crisis', an outcome of poor complementary feeding practices and increased nutritional demand as the child grows (Ricci & Becker, 1996). As the child is weaned, the protective effect of breast milk reduces, leading to an increase in the onslaught of illness. In Vithura, the percentage of stunted is higher among males whereas, in Thirunelly, females are slightly more stunted. Male children usually are more active and hence, the energy they get from food is not sufficient for their optimal growth. They are more vulnerable to early childhood illness. Similar results are obtained from studies by Meshram et al. (2012), Kavosi

et al. (2014), Akombi et al.(2017), and Boah et al.(2019). The percentage of stunted children by birth weight of the child shows that 55 percent of children are stunted among children born LBW (combined). Among children with low birth weight, 45.7 and 61 percent of children are stunted in Vithura and Thirunelly respectively. Stunting is lower among children with a birth weight of more than 3.5 kg-24 percent and 20 percent in Vithura and Thirunelly respectively. The association between stunting and birth weight of the child is statistically significant in panchayats combined and Thirunelly, whereas it is not statistically significant in Vithura (See Table 5.9).

As birth order increases, there is variation in the percentage of stunting. The percentage of stunting among children born as the first child is 43.5 percent, increases to 45.9 percent among children second born and more than half of the children are stunted among children third born (Combined). A study by Jayachandran and Pande (2013), found the disadvantage of stunting more pronounced among later-born Indian children. Birth spacing plays an important role in the nutritional status of children. In the study area too, stunting is higher among children born at a lesser birth interval. Among children born at a birth interval of less than two years, more than 50 percent of them are stunted. Its percentage is higher in Thirunelly (57.5 percent), compared to Vithura (47.4 percent). Shorter birth intervals increase the risk of stunting (Dewey & Cohen, 2007; Gribble et al., 2009; Sobrino et al., 2017). It is not significantly associated with birth interval. Among children born as preterm babies, 53 percent are stunted compared to 45 percent among children born as full-term babies, association is not statistically significant in combined sample and Thirunelly. At liberal level, the association between stunting and child being full term or not is statistically significant in Vithura. Recurrent diarrhoeal episodes tend to increase the extent of stunting. Among children with the incidence of diarrhoea as ‘never and less frequent’, stunting is only 44 percent, whereas 58.6 percent are stunted among children with ‘more frequent diarrhoea’(combined). Though the proportion of stunting increases with more frequent diarrhoeal illness, the association is not statistically significant.

5.3.5 Association of Stunting by Child Feeding

The proportion of children stunted by selected child feeding practices is presented in table 5.10

Table 5.10 Percentage Distribution of Children Classified based on Stunting by Child Feeding Practices

Child feeding Practice	Category	Stunting (Combined) in %		Stunting (Vithura) in %		Stunting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Initiation of breastfeeding	Within 24 hours	53.0	47.0	60.5	39.5	47.7	52,3
	More than 24 hours	77.8	22,2	76.5	23.5	100	0.0
	Test Statistic	χ^2 =4.255; df=1, p = 0.039*		χ^2 =1.681; df=1, p = 0.195		χ^2 =1.091; df=1, p = 0.296	
Exclusive breastfeeding for 6 months	No	56.2	43.8	63.3	36.7	44.4	55.6
	Yes	53.6	46.4	61.1	38.9	48.6	51.4
	Test Statistic	χ^2 =0.121; df=1, p = 0.728		χ^2 =0.052; df=1, p = 0.820		χ^2 =0.116; df=1, p = 0.733	
Duration of breastfeeding	Less than 1 year	50.0	50.0	65.4	34.6	40.9	59.1
	1-2 years	55.4	44.6	60.0	40.0	50.0	50.0
	Greater than 2 years	56.4	43.6	61.0	39.0	52.9	47.1
	Test Statistic	χ^2 =1.408; df=2, p = 0.495		χ^2 =0.384; df=2, p = 0.825		χ^2 =2.854; df=2, p = 0.240	
Initiation of complementary feeding	Less than 3 months	66.70	33.3	66.7	33.3	0.0	0.0
	3 to 6 months	47.80	52.2	61.5	38.5	42.2	57.6
	After 6 months	55.20	44.8	62.5	37.5	49.5	50.5
	Test Statistic	χ^2 =1.432; df=2, p = 0.489		χ^2 =0.070; df=2, p = 0.965		χ^2 =0.572; df=1, p = 0.449	
Child feeding interval	Less than 3 months	39.80	60.2	33.3	66.7	40.5	59.5
	More than 3 times	58.00	42.0	63.3	36.7	51.9	48.1
	Test Statistic	χ^2 =9.731; df=1, p = 0.002*		χ^2 =3.271; df=1, p =0.071*		χ^2 = 2.867; df=1, p =0.090*	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

The proportion of stunting by the time of initiation of breastfeeding shows that out of 413 children put to breast within 24 hours of birth, 194 children (47 percent) are stunted. Except 17 children in Vithura and one child in Thirunelly, others were initiated breastfeeding within 24 hours. Even though for both the panchayats combined, significant association is seen between stunting and commencement of breastfeeding, it is not significant for panchayats separately. Both Vithura and Thirunelly together, out of 368 children in the age group of 6-59 months who are exclusively breastfed, 170 children (46 percent) are stunted. Out of 150 children exclusively breastfed in Vithura, 58 (38.6 percent) are stunted, whereas, in Thirunelly out of 218 children, 112 (51.4percent) are stunted. For calculating the proportion of stunting by the time of initiation of complementary feeding, children in the age group 0-6 months are excluded, as weaning is normally initiated after six months of age. Overall, the proportion of stunting is 33 percent (3) among children given supplementary feeding before three months of age, 52 percent stunting is seen in children who were given supplementary feeding between 3 and 6 months and 44.8 percent were stunted among children given complementary feeding after six months. Delayed introduction of complementary feeding was associated with stunting and severe stunting among infants in India (Dhami et al., 2019). The proportion of stunting is higher among children of Thirunelly (57.6 percent) who were given supplementary feeding between 3 and 6 months, compared to similar children of Vithura (38.5 percent). Stunting by the duration of breastfeeding shows that for both the panchayats combined and for Thirunelly alone, the percentage of stunted children are more among children breastfed for less than a year. In Vithura, the percentage of stunted children is highest (40 percent) among children breastfed for 1- 2 years. In the study area, stunting has no significant association with exclusive breastfeeding, initiation of weaning and duration of breastfeeding. The percentage of stunting is higher among children whose food intake is less than three times a day; the association is statistically significant for the combined sample (5 percent level of significance) as well as for Vithura and Thirunelly separately (10 percent level).

For infants, less than six months, maternal behaviours or child biological characteristics under maternal control say, breastfeeding status and birth weight were the major risk elements for stunting and wasting (Ricci & Becker, 1996).

5.3.6 Determinants of Normal Height for Age

Determinants of normal height for age are analysed in terms of the probability of avoiding stunting. Binary logistic regression is employed to ascertain the empirically significant predictors of normal height for age (dependent variable), from the a priori, identified independent variables based on literature review. The binary dependent variables for the logistic regression model for normal height for age are: (a) stunted children (b) normal height for age children. Stunted children and normal height for age children are represented by zero and one respectively. The variables selected and values assigned to the various categories of these variables are given below.

(1) Caste (V1): ST-0, non-ST-1

(2) Family asset position (V2): low asset group-0, high asset group-1

(3) Mothers' education (with two dummies; V3_1 and V3_2): up to 10^{th} (or SSLC) -0, plus two-1, graduation and above-2

(4) BMI status of mothers (with two dummies; V4_1 and V4_2): underweight-0, normal-1, overweight-2

(5) Age categories of children (with two dummies; V5_1 and V5_2): up to 12 months-0, 13-36 months -1, 37-59 months-2

(6) Birth interval (V6): less than two years -0, more than two years - 1

(7) Duration of breastfeeding (with two dummies; V7_1 and V7_2): less than one year-0, between one and two years-1, more than two years - 2

(8) Initiation of complementary feeding: less than six months-0 (including the case of not applicable), more than six months -1

The category whose assigned value is zero is taken as the "reference category". The study estimates the probability of predicting the possibility of avoiding stunting among children under five. Variations are observed in stunting among children with respect to the study locations (Vithura and Thirunelly). Hence, the analytical tool was run three times; combined, Vithura and Thirunelly. The results are presented accordingly. Table 5.11 depicts the overall estimates of binary logistic regression for normal height for age among children in the study area.

Table 5.11: The Estimates of Logistic Regression of Normal Height for Age (Combined)

Variables	β	S.E.	Wald	Df	p	Exp(β)	95% C.I.for EXP(β)	
							Lower	Upper
(V1) Caste (Non-ST)	.605	.283	4.551	1	.033*	1.831	1.050	3.191
(V2) High asset group	.467	.261	3.196	1	.074**	1.595	.956	2.661
(V3) Mother's education			.213	2	.899			
(V3_1) Mother's education (Plus two)	.042	.280	.022	1	.881	1.043	.602	1.807
(V3_2) Mother's education (graduation and above)	-.091	.353	.066	1	.797	.913	.458	1.823
(V4) BMI status of mothers			3.937	2	.140			
(V4_1) BMI status (normal)	.507	.280	3.272	1	.070**	1.661	.959	2.878
(V4_2) BMI status (overweight)	.589	.322	3.352	1	.067**	1.802	.959	3.385
(V5) Age of child			7.611	2	.022			
(V5_1) Age of child (13-36 months)	.600	.355	2.861	1	.091**	1.822	.909	3.650
(V5_2) Age of child (37 to 59 months)	1.016	.378	7.219	1	.007*	2.763	1.316	5.798
(V6) Birth interval (more than two years)	.038	.215	.031	1	.861	1.038	.681	1.583
(V7) Duration of breastfeeding			.271	2	.873			
(V7_1) Duration of breastfeeding (Between one and two years)	-.139	.316	.194	1	.659	.870	.469	1.615
(V7_2) Duration of breastfeeding (More than two years)	-.018	.289	.004	1	.949	.982	.557	1.730
(V8)Initiation of supplementary feeding (more than 6 months)	.149	.303	.242	1	.623	1.161	.641	2.105
Constant	-1.553	.421	13.599	1	.000	.212		
Chi-square value=41.29;p=0.000								

Source: Field survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

The beta (β) values in the table are the log odds coefficients for building a logistic regression model for predicting the presence or absence of stunting among the children covered under this study. As such, the estimated model is as follows.

$$\text{Log}\left(\frac{P}{1-P}\right)=-1.553+.605*V1+.467*V2+.042*V3\_1-.091*V3\_2+.507*V4\_1+.589*V4\_2+.600*V5\_1+1.016*V5\_2+.038*V6-.139*V7\_1-.018*V7\_2+.149*V8$$

Where:

P = Probability of being normal height for age

V1 = Caste (non-ST)

V2 = High asset group

V3_1 = Mother's education (+2)

V3_2 = Mother's education (graduation & above)

V4_1 = BMI status (normal)

V4_2 = BMI status (over-weight)

V5_1 = Age of child (13 - 36 months)

V5_2 = Age of child (37 - 59 months)

V6 = Birth interval (more than two years)

V7_1 = Duration of breastfeeding (between 1 and 2 years)

V7_2 = Duration of breastfeeding (more than two years)

V8 = Initiation of complementary feeding

The statistically significant value of Chi-square (41.29; $p<.05$) indicates that all the identified predictors, as a group, could theoretically segregate normal height for age (response variable) from stunting, signifying the suitability of the identified variables in predicting the likelihood child being normal. From the result, it can be inferred that the change from tribal to non-tribal community, from 'low asset group' to 'high asset group', improvement in mothers education from 'up to 10 th' to 'plus two', the improvement of BMI status, the change in age of the child, changes in the birth interval from 'less than two years' to 'more than two years', change in the status of complementary feeding from 'less than six months' to 'more than six months', increases the probability to become normal. The predictor variable, caste, in the logit model was found to contribute to normal height for age, with a log-ordered estimate of 0.605, standard error of 0.283, Wald Chi-square value of 4.551 and $p<0.05$. The estimated odds ratio (Exp(β)) indicates a positive relationship of 1.83 fold, at 95% CI (1.050, 3.191), with any favourable change in the reference category of caste. The role of high asset possession in predicting the probability of child being normal height for age was found with a log-ordered estimate of 0.467, standard error of 0.261, Wald Chi-square value of 3.196 and $p>.05$, but $<.1$. The estimated odds ratio (Exp(β)) indicates a positive relationship of 1.595 fold, at 95% CI (.956, 2.661), with any favourable change in the reference category of caste. Similarly, the age group of '37 – 59 months' (V5_2) is also identified as a statistically significant predictor of normal height for age at 5% level of significance.

However, BMI status referred as normal (V4_1) and overweight (V4_2), and age group of child '13 – 36 months' will become statistically significant predictors only at a liberal level,

as their p values are greater than 0.05 (5% level of significance), but less than 0.1 (10% level of significance). The two categories of mother's education (V3_1 and V3_2), birth interval (V6), two categories of duration of breastfeeding (V7_1 and V7_2) and the time of initiation of complementary feeding (V8) were not found to be statistically significant predictors of normal height for age among the children in the study area.

Table 5.12 depicts the estimates of binary logistic regression for normal height for age among children at Vithura. The statistically non-significant value of Chi-square (14.173; p>.05) confirms that the identified predictors generally, as a group, failed, theoretically, to segregate normal height for age children (response variable) from that of stunting, signifying the non-viability of the identified variables in predicting the likelihood of normal height for age. A cursory look at table 2 can corroborate this result.

Table 5.12: The Estimates of Logistic Regression of Normal Height for Age (Vithura)

Variables	β	S.E.	Wald	df	p	Exp(β)	95% C.I.for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	.918	.476	3.712	1	.054**	2.503	.984	6.366
(V2) High asset group	.401	.356	1.272	1	.259	1.494	.744	3.000
(V3)Mother's education			.299	2	.861			
(V3_1) Mother's education (Plus two)	.246	.450	.298	1	.585	1.279	.529	3.092
(V3_2) Mother's education (graduation and above)	.197	.530	.139	1	.710	1.218	.431	3.439
(V4) BMI status of mothers			.414	2	.813			
(V4_1) BMI status (normal)	.183	.549	.111	1	.739	1.200	.410	3.518
(V4_2) BMI status (overweight)	.336	.569	.349	1	.555	1.400	.459	4.271
(V5) Age of child			.988	2	.610			
(V5_1) Age of child (13-36 months)	.552	.659	.702	1	.402	1.737	.478	6.315
(V5_2) Age of child (37 to 59 months)	.661	.665	.987	1	.320	1.937	.526	7.132
(V6) Birth interval (more than two years)	-.007	.344	.000	1	.985	.993	.506	1.949
(V7) Duration of breastfeeding			.676	2	.713			
(V7_1) Duration of breastfeeding (Between one and two years)	-.426	.572	.556	1	.456	.653	.213	2.001
(V7_2) Duration of breastfeeding (More than two years)	-.439	.551	.633	1	.426	.645	.219	1.900
(V8) Initiation of complementary feeding (more than 6 months)	.072	.480	.023	1	.881	1.075	.419	2.756
Constant	-1.155	.749	2.378	1	.123	.315		
Chi-square=14.173; p=0.290								

Source: Field survey, 2019
Note: ** significant at 10 percent.

From the result, it can be inferred that the change from ST to non-ST status, from 'low asset group' to 'high asset group', improvement in mothers education, the improvement of BMI status, the change in age of child, and change in the status of complementary feeding, increases the probability to become normal height for age status. In the case of Vithura, caste is the only statistically significant predictor, which is also on a liberal measure. It was found to contribute to normal height for age, in the logit model, with a log-ordered estimate of 0.918, standard error of 0.476, Wald Chi-square value of 3.712 and $p<0.1$ (.054). The estimated odds ratio (Exp(β)) indicates a positive relationship of 2.503 fold, at 95% CI (.984, 6.366), with any favourable change in the reference category of caste. *'Kanikkar'* of Thiruvananthapuram is generally short in stature. Their genetic predisposition might be a reason for increased levels of stunting. Since no other predictor was found to be significant within the statistical threshold level, the researcher refrained from specifying the logistic regression model.

Table 5.13 depicts the estimates of binary logistic regression for normal height for age among children at Thirunelly. The goodness of fit of the model is revealed from t\he significant value of Chi-square statistics (28.097; $p<.01$).

Table 5.13: The Estimates of Logistic Regression of Normal Height for Age (Thirunelly)

Variables	β	S.E.	Wald	Df	p	Exp(β)	95% C.I.for EXP(β)	
							Lower	Upper
(V1) Caste (Non-ST)	.511	.372	1.887	1	.170	1.666	.804	3.453
(V2) High asset group	.517	.402	1.652	1	.199	1.677	.762	3.687
(V3) Mother's education			.394	2	.821			
(V3_1) Mother's education (Plus two)	-.112	.395	.080	1	.777	.894	.412	1.940
(V3_2) Mother's education (graduation and above)	-.322	.514	.392	1	.531	.725	.265	1.985
(V4) BMI status of mothers			4.294	2	.117			
(V4_1) BMI status (normal)	.705	.342	4.255	1	.039*	2.023	1.036	3.951
(V4_2) BMI status (overweight)	.584	.444	1.728	1	.189	1.793	.751	4.285
(V5) Age of child			9.965	2	.007			
(V5_1) Age of child (13-36 months)	.738	.452	2.665	1	.103	2.093	.862	5.077
(V5_2) Age of child (37 to 59 months)	1.526	.503	9.214	1	.002*	4.599	1.717	12.317
(V6) Birth interval (more than two years)	.149	.284	.277	1	.598	1.161	.666	2.024
(V7) Duration of breastfeeding			.555	2	.758			
(V7_1) Duration of breastfeeding (Between one and two years)	.060	.418	.021	1	.886	1.062	.468	2.411
(V7_2) Duration of breastfeeding (More than two years)	.244	.354	.476	1	.490	1.277	.637	2.558
(V8)Initiation of complementary feeding (more than 6 months)	.259	.411	.397	1	.528	1.295	.579	2.898
Constant	-2.111	.586	12.976	1	.000	.121		
Chi-square=28.097; p=0.005								

Source: Field survey
Note: *significant at 5%; ** significant at 10 percent.

The estimated model is as follows.

$$\text{Log}\left(\frac{P}{1-P}\right) = -2.111 + .511*V1 + .517*V2 - .112*V3\_1 - .322*V3\_2 + .705*V4\_1 + .584*V4\_2 + .738*V5\_1 + 1.526*V5\_2 + .149*V6 + .060*V7\_1 + .244*V7\_2 + .259*V8$$

The results indicate that normal BMI status and age of child between '37 and 59 months' were identified to be the only statistically significant predictors in the model above. The normal BMI status was found to contribute to normal height for age, with a log-ordered

estimate of 0.705, standard error of 0.342, Wald Chi-square value of 4.255 and p<.05. The estimated odds ratio (Exp(β)) indicates a positive relationship of 2.023 times, at 95% CI (1.036, 3.951), with any favourable change in the reference category of BMI status. The other statistically significant predictor of normal height for age is the age of the child between '37 and 59 months', which was found with a log-ordered estimate of 1.526, standard error of .503, Wald Chi-square value of 9.214 and p<.01. The estimated odds ratio (Exp(β)) indicates a positive relationship of 4.599 fold, at 95% CI (1.717, 12.317), with any favourable change in the reference category of age. From the result, it can be inferred that the change from tribal to non-tribal, from 'low asset group' to 'high asset group', the improvement of mother's BMI status, the change in the age of child, change in the birth interval from less than two years to more than two years, change in the duration of breastfeeding to either between one and two years or more than two years, initiation of complementary feeding from less than six months to more than six months, increases the probability to become normal height for age status. However, the other variables in the model were not found to be statistically significant predictors of stunting among the children in Thirunelly. In Thirunelly, around 80 percent of mothers had an education of either elementary or less than secondary education. The marginal benefits of acquiring elementary education by mother confer the highest payoffs in improving the nutritional outcome among children. Maternal nutrition awareness also complements the mother's education.

5.4 Wasting

Wasting, a symptom of acute malnutrition, means that the child is thin for his/her height. It is associated with an immediate increased hazard of onslaught of illness and mortality.

5.4.1 Association of Wasting by Socio-Economic Factors

The percentage of wasting among children by selected socioeconomic factors are shown in Table 5.14

Table 5.14: Percentage Distribution of Children Classified based on Wasting by Selected Socio-Economic Characteristics

Socio-economic characteristics	Category	Wasting (Combined)%		Wasting (Vithura)%		Wasting (Thirunelly)%	
		No	Yes	No	Yes	No	Yes
Caste	Tribal	81.8	18.2	87.9	12.1	80.2	19.8
	Non tribal	87.1	12.9	85.9	14.1	88.8	11.2
	Test Statistic	χ^2 =2.290; df=1, p = 0.130		χ^2 =0.090; df=1, p = 0.764		χ^2 =3.402; df=1, p = 0.065**	
Family members	Upto 4 members	80.4	19.6	83.5	16.5	76.3	23.7
	Above 4 members	87.4	12.6	88.2	11.8	86.9	13.1
	Test Statistic	χ^2 =3.571; df=1, p = 0.059**		χ^2 =0.833; df=1, p = 0.361		χ^2 =3.797; df=1, p = 0.051**	
Type of house	Kutcha	72.0	28.0	50.0	50.0	78.9	21.1
	Semi pucca	83.9	16.1	90.6	9.4	81.9	18.1
	Pucca	88.5	11.5	86.2	13.8	94.2	5.8
	Test Statistic	χ^2 =5.262; df=2, p = 0.072**		χ^2 =7.479; df=2, p = 0.024*		χ^2 =5.047; df=2, p = 0.080**	
Total Expenditure	Upto Rs 8000	83.0	17.0	83.9	16.1	82.7	17.3
	Rs 80001-10000	85.2	14.8	90.7	9.3	81.1	18.9
	Rs 10,001-Rs 12,000	83.5	16.5	79.2	20.8	90.3	9.7
	Above Rs 12,000	88.1	11.9	89.3	10.7	87.1	12.9
	Test Statistic	χ^2 =1.374; df=3, p = 0.712		χ^2 =3.531; df=3, p = 0.317		χ^2 =1.946; df=3, p = 0.584	
Asset ownership status	Low asset group	80.2	19.8	79.5	20.5	80.5	19.5
	High asset group	91.5	8.5	90.5	9.5	93.2	6.8
	Test Statistic	χ^2 =10.848; df=1, p = 0.001*		χ^2 =4.624; df=1, p = 0.032*		χ^2 =6.190; df=1, p = 0.013*	
Possibility of another child less than 5 years	No	84.4	15.6	85.4	14.6	83.6	16.4
	Yes	88.7	11.3	94.4	5.6	86.8	13.2
	Test Statistic	χ^2 =0.862; df=1, p = 0.353		χ^2 =1.128; df=1, p = 0.288		χ^2 =0.319; df=1, p = 0.572	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

As revealed from Table 5.14, Vithura and Thirunelly panchayats together, 14.8 percent of children are wasted. The percentage of wasted children is more among children from tribal community (18.2 percent among tribal and 12.9 percent among non-tribal). Wasting is higher

among tribal children of Thirunelly, whereas it is higher among nontribals of Vithura. In Thirunelly panchayat, one in every five children belonging to tribal community is wasted, which is almost twice the proportion of wasted children among the non-tribal community. In Vithura and Thirunelly, the percentage of wasted children is higher in families with up to 4 members. Percentage of children residing in joint or extended families often receive more psychosocial care from grandparents and other family members, in addition to the care they get from parents. Children are slow eaters, and in nuclear families, the mother who is otherwise engaged in household chores may not get enough time to feed them properly.

Household risk factors also affect the nutritional status of children (Singh et al., 2015). A widely accepted notion is that people living in pucca houses have better household amenities compared to other types of homes. The percentage of wasted children by type of house shows that 28 percent, 16 percent and 11.5 percent of children residing in kutcha, semi pucca and pucca houses respectively are wasted (Combined). In Vithura, out of 6 children staying in kutcha houses, three children are wasted. In Vithura, wasting is least among children residing in semi pucca houses whereas, in Thirunelly it is among children living in pucca houses. The percentage of children wasted is higher among households with lower monthly total expenditure- 17 percent of children are not having normal weight for height in those households with less than Rs 8000 monthly total spending, compared to 12 percent of children in households with total monthly spending above Rs 12,000. In Vithura, the proportion of wasted children is highest in families with total monthly expenditure between Rs 10,001 to 12,000, whereas in Thirunelly, it is in the category of Rs 8,001 to Rs 10,000. In Vithura and Thirunelly, wasting is higher among children belonging to low asset group. It is less among children in families with 'presence of another child less than five years'. In Vithura, out of 18 households having 'another child less than five years', only one household has wasted child (5.6 percent). In Thirunelly, out of 53 households, 7 (13.2 percent) households have wasted children.

In Thirunelly, at liberal level (10 percent level), wasting is significantly associated with caste, number of family members, and type of house. Wasting is also significantly associated with asset ownership (5 percent level). In Vithura, wasting has a significant association with the type of house and asset ownership. For the combined sample, wasting is significantly related to asset ownership; at liberal level, there is an association of wasting with number of family members and type of house.

5.4.2 Association of Wasting by Parental Characteristics

The association of wasting by parental characteristics is given in table 5.15.

Table 5.15: Percentage Distribution of Children Classified based on Wasting by Selected Parental Characteristics

Parental characteristics	Category	Wasting (Combined) in %		Wasting (Vithura) in %		Wasting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Age of the mother	Upto 25 years	86.1	13.9	85.5	14.5	86.5	13.5
	26-30 years	85.4	14.6	87.2	12.8	84.1	15.9
	Above 30 years	83.2	16.8	85.7	14.3	80.4	19.6
	Test statistics	$\chi^2 = 0.414$; df=2; p = 0.813		$\chi^2 = 0.099$; df=2; p = 0.952		$\chi^2 = 0.852$; df=2; p = 0.653	
Age at childbirth	<=22 years	86.9	13.1	83.3	16.7	89.0	11.0
	>22 years	84.1	15.9	87.6	12.4	81.0	19.0
	Test Statistics	$\chi^2 = 0.598$; df=1; p = 0.439		$\chi^2 = 0.627$; df=1; p = 0.428		$\chi^2 = 2.847$; df=1; p = 0.092**	
Mother's education	Upto 10 th Std	82.1	17.9	86.1	13.9	81.1	18.9
	Higher Secondary	86.8	13.2	84.7	15.3	90.2	9.8
	Graduation &above	88.2	11.8	89.1	10.9	86.8	13.2
	Test statistics	$\chi^2 = 2.308$; df=2; p = 0.315		$\chi^2 = 0.575$; df=2; p = 0.750		$\chi^2 = 2.863$; df=2; p = 0.239	
Father's Education	Upto 10 th Std	82.6	17.4	83.2	16.8	82.3	17.7
	Higher Secondary	90.3	9.7	90.2	9.8	90.6	9.4
	Graduation &above	92.3	7.7	90.5	9.5	94.4	5.6
	Test statistics	$\chi^2 = 5.075$; df=2; p = 0.079**		$\chi^2 = 1.955$; df=2; p = 0.376		$\chi^2 = 2.952$; df=2; p = 0.229	
Difference in education levels	Education of father< mother	83.7	16.3	82.5	17.5	84.8	15.2
	Education of father= mother	86.8	13.2	90.9	9.1	83.9	16.1
	Education of father> mother	85.0	15.0	88.9	11.1	83.9	16.1
	Test statistics	$\chi^2 = 0.747$; df=2; p = 0.688		$\chi^2 = 2.667$; df=2; p = 0.264		$\chi^2 = 0.038$; df=2; p = 0.981	
Mother's Height	Short(<155 cm)	84.6	15.4	85.8	14.2	83.9	16.1
	Tall(>155 cm)	86.1	13.9	86.7	13.3	85.3	14.7
	Test statistics	$\chi^2 = 0.163$; df=1; p = 0.686		$\chi^2 = 0.032$; df=1; p = 0.859		$\chi^2 = .071$; df=1; p = 0.790	
BMI of mother	Underweight	81.9	18.1	85.0	15.0	81.0	19.0
	Normal	82.6	17.4	81.8	18.2	83.1	16.9
	Overweight	91.9	8.1	91.4	8.6	93.0	7.0
	Test statistics	$\chi^2 = 6.359$; df=2; p = 0.042*		$\chi^2 = 3.265$; df=2; p = 0.195		$\chi^2 = 3.156$; df=2; p = 0.206	

Parental characteristics	Category	Wasting (Combined) in %		Wasting (Vithura) in %		Wasting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Occupation of mother	Unemployed	83.9	16.1	85.3	14.7	82.8	17.2
	Employed	91.4	8.6	92.3	7.7	90.9	9.1
	Test statistics	$\chi^2 = 2.605$; df=1; p = 0.107		$\chi^2 = 0.934$; df=1; p = 0.334		$\chi^2 = 1.776$; df=1; p = 0.183	
Sector in which father is working	Not Applicable	80.0	20.0	77.8	22.2	100.0	0.0
	Formal	95.2	4.8	93.0	7.0	100.0	0.0
	Informal	83.5	16.5	84.7	15.3	82.8	17.2
	Test statistics	$\chi^2 = 6.033$; df=2; p = 0.049*		$\chi^2 = 2.495$; df=2; p = 0.287		$\chi^2 = 4.283$; df=2; p = 0.117	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

Table 5.15 gives the percentage distribution of children classified based on wasting by selected parental characteristics. In Vithura, the percentage of wasting is high among children whose mothers are in relatively young age group (up to 25 years) and declines with an increase in mother's age. In Thirunelly panchayat, wasting is less among children of young mothers (13.5 percent) and its percentage increases with maternal age. Though the percentage of wasting among children increases with maternal age in both the panchayats combined and Thirunelly, the association is not statistically significant. In Vithura, the percentage of wasted children is higher among mothers whose age at childbirth is '22 years or below' (16.7 percent), whereas, in Thirunelly, the percentage of wasted is higher among mothers whose age at childbirth is 'above 22 years' (19 percent). At liberal level, wasting is significantly associated with the maternal age at childbirth in Thirunelly. The percentage of wasted children is lower among children whose mothers have more years of education. Panchayats combined, and in Vithura, the percentage of wasted children is lowest among children whose mothers' have an education of 'graduation and above'. In Thirunelly, it is lowest among children whose mothers' education is 'higher secondary' (9.8 percent). There is no significant relationship between maternal education and wasting. The percentage of wasted children is lowest among children whose paternal education is 'graduation and above' and is highest among children whose paternal education is 'up to 10 th'. At liberal level, wasting is significantly associated with paternal education for combined sample alone. Panchayats combined as well as in Vithura panchayat, the percentage of wasted children is higher among children whose father's education levels are lower in comparison to the education level of mother. It is least among children whose mothers' education levels are similar to that of their husbands. In Thirunelly, it is least among children whose father's education levels are lower

in comparison to the education level of mother. Association of wasting by the height of the mother reveals that wasting is higher among children whose mothers are short. Among children whose maternal height is 'less than 155 cm', Thirunelly panchayat has a higher proportion of wasted children (16 percent) compared to Vithura (14.2 percent). At 5 percent level of significance, in panchayats combined and separately, there is no significant association between wasting and maternal height. In a study conducted using NFHS 3 data set, a 1cm increase in height decreases the relative risk for wasting (Subramanian et al., 2009).

The percentage of children, who are wasted by BMI status of the mother, shows that wasting is higher among children whose mothers are underweight compared to the rest of the mothers who are either normal or overweight; it is statistically significant for panchayats combined. In Vithura panchayat, wasted children are higher among children of mothers who are having normal BMI. In Thirunelly, close to one in every five children born to underweight mothers are wasted, whereas only 7 percent of children are wasted born to mothers who are overweight. Wasting is double among children whose mothers are employed compared to unemployed. The trend is similar in both panchayats. The percentage of wasted children is higher among children whose fathers work in the informal sector.

5.4.3 Association of Wasting by Utilization of Health Care Services

Table 5.16 shows the percentage distribution of children classified based on wasting by utilization of health care services

Table 5.16: Percentage Distribution of Children Classified based on Wasting by Utilization of Health Care Services

Utilization of Health care services	Category	Wasting (Combined) in %		Wasting (Vithura) in %		Wasting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Number of anti-natal check-ups	Less than 4	83.1	16.9	86.8	13.2	81.9	18.1
	More than 4	86.3	13.7	86.1	13.9	86.5	13.5
	Test statistics	$\chi^2 = 0.784$; df=1; p = 0.376		$\chi^2 = 0.014$; df=1; p = 0.905		$\chi^2 = 0.970$; df=1; p = 0.325	
Type of childbirth	Normal	86.1	13.9	87.8	12.2	85.1	14.9
	C section	83.6	16.4	84.6	15.4	82.4	17.6
	Test statistics	$\chi^2 = 0.485$; df=1; p = 0.486		$\chi^2 = 0.392$; df=1; p = 0.531		$\chi^2 = 0.280$; df=1; p = 0.597	
Intake of iron calcium tablet	Never	0.0	0.0	0.0	0.0	0.0	0.0
	Regular	85.4	14.6	86.7	13.3	84.5	15.5
	Irregular	78.9	21.1	77.8	22.2	80.0	20.0
	Test statistics	$\chi^2 = 0.605$; df=1; p = 0.437		$\chi^2 = 0.571$; df=1; p = 0.450		$\chi^2 = 0.146$; df=1; p = 0.703	
Place of Delivery	Home	100.0	0.0	100.0	0.0	100.0	0.0
	Government Hospital	83.4	16.6	83.8	16.2	83.1	16.9
	Private Hospital	91.8	8.2	94.9	5.1	88.2	11.8
	Test statistics	$\chi^2 = 4.972$; df=2; p = 0.083**		$\chi^2 = 3.521$; df=2; p = 0.172		$\chi^2 = 1.926$; df=2; p = 0.382	
Child Vaccination as per the chart	No	100.0	0.0	100.0	0.0	0.0	0.0
	Yes	85.1	14.9	86.2	13.8	84.3	15.7
	Test Statistic	$\chi^2 = 0.175$; df=1, p = 0.676		$\chi^2 = 0.160$; df=1, p = 0.689		$\chi^2 =$; df=, p =	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

Combined and in Thirunelly, percentage of wasting is less among children whose mothers had at least four anti-natal checkups. Wasting is higher among children born through C-section (16.4 percent); in Vithura and Thirunelly it is 15.4 percent and 17.6 percent respectively. There is no significant association of wasting with the number of anti-natal check-ups and the type of delivery (Table 5.16). Though overall as well as in both panchayats individually, the percentage of wasting is higher among the children whose mothers are irregular in consuming iron-folic and calcium tablets, the association is not statistically significant ($p>0.05$).In Vithura, among children whose mothers were inconsistent in the intake of iron-folic and calcium tablets, the percentage of wasted children is 22.2 percent and

20.0 percent in Vithura and Thirunelly respectively. The proportion of wasted children is higher among children born at Government hospital. In Vithura as well as in Thirunelly panchayat, more than 16 percent of children are wasted among children delivered at a Government hospital. For the combined sample, there is a significant relationship between wasting and place of delivery (10 percent level).

5.4.4 Association of Wasting by Child Characteristics

The percentage distribution of children below five years classified as wasted by selected child characteristics are shown in Table 5.17

Table 5.17: Percentage Distribution of Children Classified based on Wasting by Selected Child Characteristics

Child characteristics	Category	Wasting (Combined) in %		Wasting (Vithura) in %		Wasting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Age of the child	Less than 6 months	88.9	11.1	81.8	18.2	100.0	0.0
	6-12 months	89.3	10.7	73.7	26.3	97.3	2.7
	13-36 months	86.7	13.3	89.7	10.3	84.7	15.3
	37-59 months	79.3	20.7	85.5	14.5	72.2	27.8
	Test statistics	$\chi^2 = 4.556$; df=3, p = 0.207		$\chi^2 = 3.709$; df=3, p = 0.295		$\chi^2 = 11.996$; df=3, p = 0.007*	
Gender of the child	Male	84.3	15.7	85.6	14.4	83.3	16.7
	Female	86.1	13.9	87.0	13.0	85.3	14.7
	Test Statistics	$\chi^2 = 0.261$; df=1, p = 0.609		$\chi^2 = 0.077$; df=1, p = 0.782		$\chi^2 = 4.556$; df=3, p = 0.207	
Birth weight of the child	Upto 2.5 kg	80.9	19.1	80.0	20.0	81.5	18.5
	2.5 to 3.5 kg	85.2	14.8	87.6	12.4	83.3	16.7
	>3.5 kg	93.3	6.7	88.0	12.0	100.0	0.0
	Test statistics	$\chi^2 = 3.656$; df=2, p = 0.161		$\chi^2 = 1.414$; df=2, p = 0.493		$\chi^2 = 4.167$; df=2, p = 0.124	
Order of birth	First	85.0	15.0	83.8	16.2	86.4	13.6
	Second	85.1	14.9	88.8	11.2	82.2	17.8
	Third	85.1	14.9	100.0	0.0	83.7	16.3
	Above three	90.0	10.0	0.0	0.0	90.0	10.0
	Test statistics	$\chi^2 = 0.191$; df=3, p = 0.979		$\chi^2 = 1.586$; df=2, p = 0.452		$\chi^2 = 0.883$; df=3, p = 0.830	
Full Term	Yes	86.5	13.5	87.4	12.6	85.8	14.2
	No	68.8	31.2	77.3	22.7	50	50
	Test statistic	$\chi^2 = 7.353$; df=1, p = 0.007*		$\chi^2 = 1.689$; df=1, p = 0.194		$\chi^2 = 9.270$; df=1, p = 0.002*	
Birth Interval	Less than 2 years	88.1	11.9	100	0.0	82.5	17.5
	Greater than 2 years	84.3	15.7	86.4	13.6	83.2	16.8
	Test statistics	$\chi^2 = 0.517$ df=1, p = 0.472		$\chi^2 = 2.898$; df=1, p = 0.089**		$\chi^2 = 0.010$; df=1, p = 0.920	
Frequency of diarrhoea	Never &Less frequent	86.2	13.8	86.6	13.4	85.8	14.2
	Frequent	72.4	27.6	50.0	50.0	74.1	25.9
	More frequent	83.3	16.7	100.0	0.0	81.8	18.2
	Test statistics	$\chi^2 = 4.063$; df=2, p = 0.131		$\chi^2 = 2.390$; df=2, p = 0.303		$\chi^2 = 2.524$; df=2, p = 0.283	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

The association of wasting by the age of the child shows that in Vithura, wasting is highest among children in the age group of '6-12 months' whereas, in Thirunelly it is in the age group '37-59 months'. In Thirunelly, among children 'less than six months', none is wasted, and it increases as the age of the child advances. But in Vithura, wasting is 18 percent in age group 'less than six months'. There is significant association between wasting and age of the child in Thirunelly panchayat. Older children have greater risk of wasting (Ghosh & Varerkar, 2019). A study by Harding et al.(2018) on risk factors of wasting in South Asian countries observe wasting to be higher among younger children. For combined sample and panchayats separately, wasting is slightly higher among males compared to females. The present study found no significant association between wasting and gender of the child; in contrast some other studies found significant association (Harding et al., 2018; Sinha et al.,2018). At 5 percent level of significance, wasting is not associated with the gender of the child. Overall 19 percent of children are wasted among children born LBW; wasting is higher in Vithura compared to Thirunelly- 20 percent and 18.5 percent respectively. It is lower among children with a birth weight of more than 3.5 kg. In Vithura, among children born as first child, wasting is 16.2 percent; it falls to 11.2 percent among children of 'birth order two'. In Thirunelly panchayat, wasting is highest among children of birth order two. In Vithura, out of 19 children whose birth interval is less than two years, no child is wasted; whereas in Thirunelly out of 40 children whose birth interval is 'less than two years', 7 are wasted (17.5 percent). In Vithura, among children born at birth interval of 'greater than two years', 13.6 percent are wasted while in Thirunelly it is 16.8 percent. In Vithura and Thirunelly combined and separately, there is no significant association of wasting based on birth weight, birth order, and duration of birth interval. Wasting is higher among children born preterm. In Vithura among pre-term born babies, 22.7 percent are wasted while 12.6 percent of full-term babies are wasted. In Thirunelly, half of the children born as pre term are wasted, whereas 14 percent of children are wasted among children born full term. At 5 percent level of significance, overall as well as in Thirunelly, the sample shows significant association between wasting and child being full term or not. Recurrent diarrhoeal episodes tend to increase the extent of wasting. Panchayats combined, twice the percentage of children are wasted (27.6 percent) among children with 'frequent' incidence of diarrhoea, compared to children with 'never and less frequent' diarrhoea incidence (13.8 percent). In Vithura panchayat, among children with 'never and less frequent' diarrhoea, 13.4 percent of children are wasted and out of two children with 'frequent 'diarrhoea, one is wasted. In Thirunelly

also, the percentage of wasting is greater among children with 'frequent diarrhoea'(See Table 5.17).

5.4.5 Association of Wasting by Child Feeding

The proportion of children wasted by selected child feeding practices are analysed in Table 5.18.

Table 5.18: Percentage Distribution of Children Classified based on Wasting by Selected Child Feeding Characteristics

Child feeding characteristics	Category	Wasting (Combined) in %		Wasting (Vithura) in %		Wasting (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Initiation of breastfeeding	Within 24 hours	85.5	14.5	87.2	12.8	84.2	15.8
	More than 24 hours	77.8	22.2	76.5	23.5	100.0	0.0
	Test Statistic	χ^2 =0.808; df=1, p = 0.369		χ^2 =0.1.054; df=1, p = 0.220		χ^2 =0.187; df=1, p = 0.665	
Exclusive Breastfeeding for six months	No	83.3	16.7	86.7	13.3	77.8	22.2
	Yes	85.1	14.9	86.1	13.9	84.4	15.6
	Test Statistic	χ^2 =0.101; df=1, p = 0.751		χ^2 =0.006; df=1, p = 0.936		χ^2 =0.540; df=1, p = 0.462	
Duration of Breastfeeding	Less than 1 year	86.4	13.6	84.6	15.4	87.5	12.5
	1-2 years	86.6	13.4	86.7	13.30%	86.5	13.5
	Greater than 2 years	83.2	16.8	87.0	13.00%	80.4	19.6
	Test Statistic	χ^2 =0.885; df=2, p = 0.642		χ^2 =0.164; df=2, p = 0.921		χ^2 =2.054; df=2, p = 0.358	
Initiation of complementary feeding	Less than 3 months	88.9	11.1	88.9	11.1	0.0	0.0
	3 to 6 months	80.4	19.6	69.2	30.8	84.8	15.2
	After 6 months	85.8	14.2	88.1	11.9	84.0	16.0
	Test Statistic	χ^2 =0.1030; df=2, p = 0.598		χ^2 =0.378; df=2, p = 0.151		χ^2 =0.016; df=1, p = 0.899	
Child feeding interval	Less than 3 times	78.5	21.5	77.8	22.2	78.6	21.4
	More than 3 times	87.0	13.0	86.7	13.3	87.3	12.7
	Test Statistic	χ^2 =4.155; df=1, p = 0.042*		χ^2 =0.571; df=1, p = 0.450		χ^2 =3.187; df=1, p = 0.074**	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

As revealed from Table 5.18, wasting is more among children put to breast after 24 hours of birth. It is lower among children exclusively breastfed for six months. In Vithura, irrespective of the child is exclusively breastfed or not; more than 13 percent of children are wasted in each category. Among children not exclusively breastfed, wasting is higher in Thirunelly compared to Vithura. In Thirunelly, wasting is higher among children, not solely breastfed (22.2 percent) compared to children exclusively breastfed for six months (15.6 percent). Out of the children who are weaned between 3 and 6 months, wasting is 30.8 percent in Vithura and 15.2 percent in Thirunelly. Mishra et al. (2014) found that the significant risk factor for severe acute malnutrition is the consistency of complementary feeding rather than the age of initiation of weaning. Panchayats combined and Thirunelly alone, wasting is higher in children breastfed for more than two years (16.8 percent and 19.6 percent respectively). In contrast, in Vithura it is higher among children breastfed for less than one year (15.4 percent). Wasting is not significantly associated with the time of initiation of breastfeeding, exclusive breastfeeding for six months, duration of breastfeeding, and time of initiation of complementary feeding (combined and separately). Wasting is higher among children whose food intake is less than three times a day. There is significant association between wasting and child feeding interval (combined and Thirunelly). Kumar et al.(2006) also gave similar results confirming that wasting is not significantly associated with infant feeding practices.

5.4.6 Determinants of Normal Weight for Height

Determinants of wasting are analysed in terms of the probability of avoiding wasting. Binary logistic regression was employed to ascertain significant predictors of the child being normal weight for height (dependent variable), from the a priori identified independent variables. The binary dependent variables for the logistic regression model for the normal weight for height are represented by zero and one for wasted and normal children, respectively.

The study estimated the probability of predicting the possibility of avoiding wasting among children under five. Table 5.19 depicts the overall estimates of binary logistic regression for the normal weight for height among children in the study area.

Table 5.19: The Estimates of Logistic Regression of Normal Weight for Height (Combined)

Variables	β	S.E.	Wald	df	P	Exp(β)	95% C.I.for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	-.377	.398	.896	1	.344	.686	.314	1.497
(V2) High asset group	1.138	.384	8.800	1	.003*	3.120	1.471	6.617
(V3)Mother's education			.209	2	.901			
(V3_1) Mother's education (Plus two)	.054	.380	.020	1	.887	1.056	.501	2.222
(V3_2) Mother's education (graduation and above)	-.145	.503	.083	1	.773	.865	.322	2.319
(V4) BMI status of mothers			6.222	2	.045			
(V4_1) BMI status (normal)	-.013	.359	.001	1	.972	.987	.488	1.996
(V4_2) BMI status (overweight)	.971	.488	3.959	1	.047*	2.639	1.015	6.866
(V5) Age of child			5.319	2	.070			
(V5_1) Age of child (13-36 months)	-.349	.508	.473	1	.492	.705	.261	1.908
(V5_2) Age of child (37 to 59 months)	-.957	.520	3.389	1	.066**	.384	.139	1.064
(V6) Birth interval (more than two years)	-.080	.296	.072	1	.788	.923	.517	1.650
(V7) Duration of Breastfeeding			.319	2	.853			
(V7_1) Duration of Breastfeeding (Between one and two years)	.141	.434	.105	1	.746	1.151	.491	2.697
(V7_2) Duration of Breastfeeding (More than two years)	-.066	.379	.030	1	.863	.937	.445	1.969
(V8)Initiation of complementary feeding (more than 6 months)	.591	.393	2.260	1	.133	1.806	.836	3.905
Constant	1.388	.545	6.493	1	.011	4.008		
Chi-square=24.915; p=0.015								

Source: Field survey, 2019; Note: *significant at 5%; ** significant at 10 percent.

The estimated model is as follows.

$$\text{Log}\left(\frac{P}{1-P}\right) = 1.388-.377*V1+1.138*V2+.054*V3\_1-.145*V3\_2-.013*V4\_1+.971*V4\_2-.349*V5\_1-.957*V5\_2-.080*V6+.141*V7\_1-.066*V7\_2+.591*V8$$

Where:

P = Probability of being normal (weight for height)

The variables selected and values assigned to the various categories of these variables are similar to that of stunting. From the result given in Table 5.19, it can be inferred that the change from 'low asset group' to a 'high asset group', improvement in mother's education

from ‘up to SSLC’ to ‘plus two’, the improvement in BMI status of mothers from ‘underweight’ to ‘overweight’, increase in the duration of breastfeeding from ‘less than one year’ to ‘between one and two years’, change in the status of initiation of complementary feeding increases the probability to avoid wasting. The predictor variable, ‘high asset group’, in the logit model was found to contribute to normal weight for height, with a log-ordered estimate of 1.138, standard error of 0.384, Wald Chi-square value of 8.800 and $p<0.05$. The estimated odds ratio indicates a positive relationship of 3.120 times, at 95% CI (1.471, 6.617), with any favourable change in the reference category of family asset position. The change in mother’s BMI status from ‘normal’ to ‘overweight’ decreases the likelihood of wasting, with a log-ordered estimate of 0.971, standard error of 0.488, Wald Chi-square value of 3.959 and $p<0.05$. The estimated odds ratio indicates a positive relationship of 2.639 fold, at 95% CI (1.015, 6.866). Similarly, the age of the child ‘37 – 59’months (V5_2) is also identified as a statistically significant predictor of child being wasted at liberal level (10% level of significance).

Table 5.20 depicts the binary logistic regression estimates for normal weight for height among children in the study area of Vithura.

The estimated model is as follows.

$$\text{Log}\left(\frac{P}{1-P}\right) = .368 - 1.648*V1 + 1.417*V2 + .252*V3\_1 + .457*V3\_2 - .427*V4\_1 + .688*V4\_2 + 2.162*V5\_1 + 1.704*V5\_2 - .065*V6 - 1.036*V7\_1 - 1.153*V7\_2 + 1.341*V8$$

The statistically significant value of Chi-square (20.372; $p<0.1$) attributes that at liberal level, all the identified predictors, as a group, could theoretically segregate normal children from wasted children, signifying the suitability of the identified variables in predicting the likelihood of avoiding the possibility of being wasted.

Table 5.20: The Estimates of Logistic Regression of Normal Weight for Height (Vithura)

Variables	β	S.E.	Wald	Df	p	Exp(β)	95% C.I. for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	-1.648	.829	3.957	1	.047*	.192	.038	.976
(V2) High asset group	1.417	.529	7.179	1	.007*	4.126	1.463	11.636
(V3)Mother's education			.288	2	.866			
(V3_1) Mother's education (Plus two)	.252	.689	.134	1	.715	1.286	.333	4.962
(V3_2) Mother's education (graduation and above)	.457	.852	.287	1	.592	1.579	.297	8.382
(V4) BMI status of mothers			4.321	2	.115			
(V4_1) BMI status (normal)	-.427	.776	.303	1	.582	.652	.143	2.984
(V4_2) BMI status (overweight)	.688	.868	.627	1	.429	1.989	.363	10.909
(V5) Age of child			4.320	2	.115			
(V5_1) Age of child (13-36 months)	2.162	1.043	4.293	1	.038*	8.687	1.124	67.142
(V5_2) Age of child (37 to 59 months)	1.704	1.001	2.900	1	.089**	5.498	.773	39.103
(V6) Birth interval (more than two years)	-.065	.507	.017	1	.898	.937	.347	2.531
(V7) Duration of Breastfeeding			1.424	2	.491			
(V7_1) Duration of breastfeeding (Between one and two years)	-1.036	.981	1.116	1	.291	.355	.052	2.427
(V7_2) Duration of breastfeeding (More than two years)	-1.153	.972	1.409	1	.235	.316	.047	2.120
(V8)Initiation of complementary feeding (more than 6 months)	1.341	.627	4.574	1	.032*	3.824	1.119	13.076
Constant	.368	.982	.141	1	.708	1.445		
Chi-square=20.372; p=0.060								

Source: Field Survey, 2019; Note: *significant at 5%; ** significant at 10 percent.

The change to a 'high asset group', improvement in mother's education, change in BMI status of mothers from underweight to overweight, change in the age of children, change in the initiation of complementary feeding from 'less than six months' to 'more than six months', increases the probability of children to become normal (See Table 5.20). The predictor variable, caste, increases the chance of wasting, with a log-ordered estimate of -1.648, standard error of 0.829, Wald Chi-square value of 3.957 and $p<.05$. The estimated odds ratio indicates 0 .192 fold, for a change from the reference category of caste. The odds of being normal are significantly 4.126 times higher for children belonging to families with high asset possession. As the age of the child increases, the chance of being wasted decreases. A change in the age of the child from the reference category to the age group '13-36 months' shows 8.687-fold increase in the possibility of becoming normal at 5 percent level of

significance. Similarly, a change in the age of the child from reference category to age group '37-59 months' shows 5.498 times increase in the possibility of becoming normal at a liberal level (p <.1). The odds of being normal are significantly 3.824 fold higher, for an improvement in the initiation of complementary feeding from 'less than six months' to 'more than six months'.

Table 5.21 gives the logistic regression estimates for wasting in Thirunelly panchayat. The statistically significant value of Chi-square (27.664; p<.05) signifies the suitability of the identified variables in predicting the likelihood of avoiding the possibility of being wasted.

Table 5.21: The Estimates of Logistic Regression of Normal Weight for Height (Thirunelly)

Variables	β	S.E.	Wald	Df	p	Exp(β)	95% C.I.for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	.053	.549	.009	1	.922	1.055	.360	3.094
(V2) High asset group	1.384	.658	4.422	1	.035*	3.992	1.099	14.504
(V3)Mother's education			1.463	2	.481			
(V3_1) Mother's education (Plus two)	.125	.573	.048	1	.827	1.134	.369	3.487
(V3_2) Mother's education (graduation and above)	-.759	.767	.978	1	.323	.468	.104	2.106
(V4) BMI status of mothers			3.611	2	.164			
(V4_1) BMI status (normal)	.045	.438	.010	1	.919	1.046	.443	2.466
(V4_2) BMI status (overweight)	1.359	.768	3.132	1	.077**	3.893	.864	17.535
(V5) Age of child			10.278	2	.006			
(V5_1) Age of child (13-36 months)	-2.247	1.088	4.268	1	.039*	.106	.013	.891
(V5_2) Age of child (37 to 59 months)	-3.126	1.104	8.019	1	.005*	.044	.005	.382
(V6) Birth interval (more than two years)	-.200	.393	.258	1	.611	.819	.379	1.770
(V7) Duration of breastfeeding			.162	2	.922			
(V7_1) Duration of breastfeeding (Between one and two years)	.206	.580	.126	1	.722	1.229	.395	3.828
(V7_2) Duration of breastfeeding (More than two years)	.012	.462	.001	1	.980	1.012	.409	2.501
(V8)Initiation of complementary feeding (more than 6 months)	.203	.585	.121	1	.728	1.225	.389	3.857
Constant	3.410	1.167	8.540	1	.003	30.273		
Chi-square=27.664; p=0.006								

Source: Field Survey, 2019; Note: *significant at 5%; ** significant at 10 percent.

From the result in Table 5.21, it can be inferred that the change from tribal to non-tribal, low asset group to a high asset group, increase in mothers education from 'up to 10th' to 'plus two', the improvement of BMI status, increase in the duration of breastfeeding, change in the initiation of complementary feeding increases the probability of becoming normal. An improvement in mother's education from 'up to 10th' to 'graduation and above' increases the

probability of becoming wasted. The odds of being normal are significantly 3.992 times higher for children belonging to families with ‘high asset’ possession. The likelihood of the child being normal is significantly 3.893 fold higher at a liberal level ($p<0.1$) when the BMI status of mother changes from ‘underweight’ to ‘overweight’. An increase in the age of the child decreases the chance of being normal. A change in the age of the child from the reference category to the age group ‘13-36 months’ shows 0.106 fold decrease in the possibility of being normal. Similarly, a change in the age of the child from the reference category to age group ‘37-59 months’ shows 0.044 times decrease in the likelihood of becoming normal.

5.5 Conclusion

This chapter enquires into the spatial determinants of child nutritional status, namely height for age and weight for height, in the study area of Vithura and Thirunelly. In Vithura, the likelihood of other social groups to be normal height for age is 2.503 times higher compared to tribal category whereas, in Thirunelly, normal maternal BMI status and age of the child between ‘37 to 59 months’ increases the odds of being normal. The factors contributing to normal weight for height in Vithura are high asset position, age of the child (‘13 to 36 months’ or ‘37 to 59 months’) and initiation of complementary feeding after six months. Caste increases the chance of wasting. In Thirunelly, high asset position, BMI status of mother (overweight) increases the chance of normal weight for height whereas, increase in the age of the child decreases the chance of being normal.

CHAPTER 6

UNDERWEIGHT AND CHILD FEEDING PRACTICES: MICRO ANALYSIS

6.1 Introduction

The chapter looks into the association of underweight with selected child and maternal characteristics. Determinants of normal weight for age in the study area are also analysed. A qualitative investigation of IYCF practices, maternal and child care customs in the study area are also attempted.

6.2 Underweight

Underweight is a composite index of height for age and weight for height. Children whose Z score is below-2 standard deviation are classified as underweight. Underweight is the first indication of protein-energy malnutrition.

6.2.1 Association of Underweight by Socio-Economic Factors

The proportion of underweight children by selected socioeconomic factors are shown in Table 6.1

Table 6.1: Percentage Distribution of Children Classified based on Underweight by Selected Socio-Economic Characteristics

Socio-economic characteristics	Category	Underweight (Combined)%		Underweight (Vithura)%		Underweight (Thirunelly)%	
		No	Yes	No	Yes	No	Yes
Caste	ST	67.3	32.7	72.7	27.3	65.9	34.1
	Non ST	79.4	20.6	82.7	17.3	75.0	25.0
	Test Statistic	χ^2 =7.844; df=1, p = 0.005*		χ^2 =1.754; df=1, p = 0.185		χ^2 =0.2407; df=1, p = 0.121	
Family members	Upto 4 members	73.2	26.8	75.9	24.1	69.5	30.5
	Above 4 members	75.8	24.2	84.5	15.5	70.5	29.5
	Test Statistic	χ^2 =0.332; df=1, p = 0.564		χ^2 =2.203; df=1, p = 0.138		χ^2 =0.021; df=1, p = 0.884	
Type of house	Kutcha	76.0	24.0	83.3	16.7	73.7	26.3
	Semi pucca	72.8	27.2	86.8	13.2	68.4	31.6
	Pucca	77.5	22.5	78.5	21.5	75.0	25.0
	Test Statistic	χ^2 =1.199; df=2, p = 0.549		χ^2 =1.717; df=2, p = 0.424		χ^2 =0.942; df=2, p = 0.624	

Socio-economic characteristics	Category	Underweight (Combined)%		Underweight (Vithura)%		Underweight (Thirunelly)%	
		No	Yes	No	Yes	No	Yes
Total Expenditure	Upto Rs 8000	68.9	31.1	71.0	29.0	68.0	32.0
	Rs 80001-10000	73.4	26.6	77.8	22.2	70.3	29.7
	Rs 10,001-Rs 12,000	77.2	22.8	81.2	18.8	71.0	29.0
	Above Rs 12,000	80.5	19.5	89.3	10.7	72.6	27.4
	Test Statistic	χ^2 =4.401; df=3, p = 0.221		χ^2 =4.882; df=3, p = 0.181		χ^2 =0.350; df=3, p = 0.950	
Asset ownership status	Low asset group	66.9	33.1	65.8	34.2	67.5	32.5
	High asset group	85.2	14.8	90.5	9.5	76.7	23.3
	Test Statistic	χ^2 =18.807; df=1, p = 0.000*		χ^2 =17.819; df=1, p = 0.000*		χ^2 =2.090; df=1, p = 0.148	
Possibility of another child less than 5 years	No	75.6	24.4	80.7	19.3	70.9	29.1
	Yes	71.8	28.2	83.30	16.7	67.9	32.1
	Test Statistic	χ^2 =0.438; df=1, p = 0.508		χ^2 =0.073; df=1, p = 0.787		χ^2 =0.175; df=1, p = 0.675	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

Table 6.1 shows that panchayats combined, underweight children is 25 percent. In Vithura and Thirunelly, it is 19 percent and 29.7 percent respectively. Among tribal children in Vithura, 27 percent are underweight compared to 34 percent in Thirunelly. Among non-tribals, 17 percent and 25 percent of children are underweight in Vithura and Thirunelly respectively. Underweight children are more in families with '4 members or less'. In those families with 'up to four members', in Vithura and Thirunelly 24 percent and 30 percent of children respectively are underweight. In Vithura, underweight children are highest among children living in pucca houses whereas, in Thirunelly it is among children living in semi pucca houses. It is because 69 percent of children live in pucca houses in Vithura whereas 70.7 percent live in semi pucca houses in Thirunelly. The proportion of children who are underweight declines as the household total expenditure increases. Overall, the percentage of underweight children is highest in families with monthly total spending below Rs 8,000 and least in families with total oulay more than Rs 12,000 per month. In Vithura and Thirunelly, among children living in families with monthly total expenditure below Rs 8000, 29 percent and 32 percent respectively are underweight. Percentage of underweight children is more in families with low asset group. Among children living in families with low asset group, 34.2 percent are underweight in Vithura and 32.5 percent in Thirunelly. The percentage of

underweight children is more in families having another child less than five years. Overall, in those families with presence of another child less than five years, 28 percent of children are underweight. In Vithura, in those families with no other child less than five years, the proportion of underweight children are more (19.3 percent), whereas, in Thirunelly, it is higher among families with another child less than five years (32.1 percent).

Underweight is significantly associated with caste and asset ownership (combined). In Vithura, the association is seen only in asset ownership. Underweight is not significantly related to number of family members, type of house, total expenditure and the possibility of another child less than five years for the panchayats combined and separately.

6.2.2 Association of Underweight by Parental Characteristics

The study looks into the association of parental characteristics with the status of underweight among children.

Table 6.2: Percentage Distribution of Children Classified based on Underweight by Selected Parental Characteristics

Parental characteristics	Category	Underweight (Combined) in %		Underweight (Vithura) in %		Underweight (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Age of the mother	Upto 25 years	74.2	25.8	77.4	22.6	71.9	28.1
	25-30 years	75.1	24.9	83.3	16.7	69.2	30.8
	Above 30 years	75.8	24.2	81.6	18.4	69.6	30.4
	Test statistics	$\chi^2 = 0.088$; df=2; p = 0.957		$\chi^2 = 0.803$; df=2; p = 0.669		$\chi^2 = 0.189$; df=2; p = 0.910	
Age at childbirth	<=22 years	75.0	25.0	80.0	20.0	72.0	28.0
	>22 years	74.9	25.1	81.4	18.6	69.0	31.0
	Test Statistics	$\chi^2 = 0.000$; df=1; p = 0.983		$\chi^2 = 0.052$; df=1; p = 0.820		$\chi^2 = 0.250$; df=1; p = 0.617	
Mother's education	Upto 10 th Std	69.8	30.2	80.6	19.4	67.1	32.9
	Higher Secondary	76.1	23.9	78.6	21.4	72.1	27.9
	Graduation &above	82.8	17.2	85.5	14.5	78.9	21.1
	Test statistics	$\chi^2 = 5.657$; df=2; p = 0.059**		$\chi^2 = 1.087$; df=2; p = 0.581		$\chi^2 = 2.143$; df=2; p = 0.342	
Father's Education	Upto 10 th Std	71.6	28.4	77.6	22.40	68.20	31.80
	Higher Secondary	79.6	20.4	83.6	16.40	71.90	28.10
	Graduation &above	89.7	10.3	90.5	9.50	88.90	11.10
	Test	$\chi^2 = 7.419$; df=2;		$\chi^2 = 2.308$; df=2;		$\chi^2 = 3.408$; df=2;	

Parental characteristics	Category	Underweight (Combined) in %		Underweight (Vithura) in %		Underweight (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
	statistics	p = 0.024*		p = 0.315		p = 0.182	
Difference in education levels	Education of father< mother	74.3	25.7	77.7	22.3	70.7	29.3
	Education of father= mother	75.7	24.3	84.4	15.6	69.6	30.4
	Education of father> mother	75.0	25.0	88.9	11.1	71.0	29.0
	Test Statistic	χ^2 = 0.103; df=2; p = 0.950		χ^2 = 1.686; df=2; p = 0.430		χ^2 = 0.037; df=2; p = 0.982	
Mother's Height	Short(<155 cm)	70.4	29.6	76.4	23.6	66.7	33.3
	Tall(>155 cm)	83.4	16.6	86.7	13.3	79.4	20.6
	Test statistics	χ^2 = 8.946; df=1; p = 0.003*		χ^2 = 3.223; df=1; p = 0.073**		χ^2 = 3.800; df=1; p = 0.051**	
BMI of mother	Underweight	67.5	32.5	75.0	25.0	65.1	34.9
	Normal	71.4	28.6	77.3	22.7	67.6	32.4
	Overweight	86.3	13.7	86.4	13.6	86.0	14.0
	Test statistics	χ^2 = 12.444; df=2; p = 0.002*		χ^2 = 2.803; df=2; p = 0.246		χ^2 = 6.381; df=2; p = 0.041*	
Occupation of mother	Unemployed	75.1	24.9	82.2	17.8	69.2	30.8
	Employed	74.3	25.7	73.1	26.9	75.0	25.0
	Test statistics	χ^2 = 0.019; df=1; p = 0.890		χ^2 = 1.213; df=1; p = 0.271		χ^2 = 0.581; df=1; p = 0.446	
Sector in which father is working	Not Applicable	60.0	40.0	55.6	44.4	100.0	0.0
	Formal	92.1	7.9	95.3	4.7	85.0	15.0
	Informal	72.3	27.7	78.1	21.9	68.8	31.2
	Test statistics	χ^2 = 12.308; df=2; p = 0.002*		χ^2 = 10.266; df=2; p = 0.006*		χ^2 = 2.734; df=2; p = 0.255	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

A study by Acquah et al., 2019 found that mothers in their late teens have greater likelihood of having their children being underweight. In the present study, the mean age at childbirth is 25 years in Vithura and 24 years in Thirunelly. Teenage pregnancy is not common in the study area. As evident from Table 6.2, both the panchayats and in Vithura alone, the percentage of underweight children is highest (25.8 percent and 22.6 percent respectively) among children whose mothers are '25 years of age or less' whereas, in Thirunelly, it is among children whose mothers are in the age group '26-30 years' (30.8 percent). In Vithura, the percentage of underweight children is higher among mothers whose

age at childbirth is ‘22 years or below’ (20 percent), whereas, in Thirunelly, it is higher among mothers whose age at childbirth is ‘above 22 years’ (31 percent). The percentage of underweight is least among children whose mothers have more years of schooling. In Vithura panchayat, it is highest (21.4 percent) among children born to mothers having ‘higher secondary’ whereas, in Thirunelly it is among children whose mother’s education is ‘up to 10 th’. In both these places, it is lowest among children whose mothers have ‘graduation and above’. Among children born to illiterate mothers, underweight is twice the percentage compared to those who had completed high school (IIPS & Macro International, 2007). Underweight is the most common form of malnutrition among infants born LBW and mothers with secondary and higher secondary education (Kumar & Ghane, 2017). The association of underweight by the education level of fathers reveal that in panchayats combined and separately, the percentage of underweight children is highest among children whose father’s education is ‘up to 10 th’. There is significant association between underweight among children and paternal education (Combined). In Vithura and Thirunelly together as well as in Vithura alone, the percentage of underweight children is highest among children whose father’s education levels are lower than that of mother, whereas, in Thirunelly, it is among the children whose father’s and mother’s education are equal. The percentage of underweight is higher among children whose maternal height is less than 155 cm. Among children whose maternal height is less than 155 cm, Thirunelly panchayat has a higher percentage of underweight children (33 percent) compared to Vithura (23.6 percent). At 5 percent level of significance, for the panchayats combined and separately, there is significant association between underweight and maternal height. Underweight mothers are more prone to have underweight children. In Vithura panchayat, one in every four children is underweight among children born to underweight mothers, whereas in Thirunelly, around one in every three children are underweight born to underweight mothers. Subramanian et al. (2009) study using NFHS 3 concluded that anthropometric failure among children born to mothers shorter than 145 cm was substantially higher for underweight. A study by Ozaltin et al. (2010) found that maternal height was inversely related to underweight both in infancy and childhood. Percentage of underweight children is higher among children whose mothers are employed. In Thirunelly, it is higher among children born to unemployed mothers. There is no significant relationship between the underweight and maternal occupational. The percentage of underweight children is higher among children whose fathers work in the informal sector. Overall as well as in Vithura panchayat alone, there is significant association between underweight and sector in which the father is working. Underweight is not

significantly associated with maternal age, maternal age at childbirth, difference in parental education levels and occupation of the mother.

6.2.3 Association of Underweight by Utilization of Health Care Services

The association of underweight by utilization of health care services is analysed in Table 6.3.

Table 6.3: Percentage Distribution of Children Classified based on Underweight by Utilization of Health Care Services

Utilization of Health care services	Category	Underweight (Combined) in %		Underweight (Vithura) in %		Underweight (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Number of anti-natal check-ups	Less than 4	70.8	29.2	78.9	21.1	68.1	31.9
	More than 4	77.3	22.7	81.5	18.5	72.2	27.8
	Test statistics	$\chi^2 = 2.211$; df=1; p = 0.137		$\chi^2 = 0.124$; df=1; p = 0.725		$\chi^2 = 0.490$; df=1; p = 0.484	
Type of childbirth	Normal	74.1	25.9	80.6	19.4	70.2	29.8
	C section	76.4	23.6	81.3	18.7	70.3	29.7
	Test statistics	$\chi^2 = 0.288$; df=1; p = 0.592		$\chi^2 = 0.015$; df=1; p = 0.902		$\chi^2 = 0.000$; df=1; p = 0.996	
Intake of iron calcium tablet	Never	0.0	0.0	0.0	0.0	0.0	0.0
	Regular	75.0	25.0	81.1	18.9	70.3	29.7
	Irregular	73.7	26.3	77.8	22.2	70.0	30.0
	Test statistics	$\chi^2 = 0.017$; df=1; p = 0.897		$\chi^2 = 0.062$; df=1; p = 0.804		$\chi^2 = 0.000$; df=1; p = 0.986	
Place of Delivery	Home	77.8	22.2	100.0	0.0	71.4	28.6
	Government Hospital	71.9	28.1	77.0	23.0	68.2	31.8
	Private Hospital	89.0	11.0	94.9	5.1	82.4	17.6
	Test statistics	$\chi^2 = 9.643$; df=2; p = 0.009*		$\chi^2 = 6.850$; df=2; p = 0.033*		$\chi^2 = 2.808$; df=2; p = 0.246	
Child Vaccination as per chart	No	100.0	41.7	100.0	0.0	0	0
	Yes	74.9	0.0	80.9	19.1	70.2	29.8
	Test Statistic	$\chi^2 = 0.335$; df=1, p = 0.563		$\chi^2 = 0.237$; df=1, p = 0.627		$\chi^2 =$; df=, p = -	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

The proportion of underweight by the number of anti-natal check-ups of mothers show that the percentage of underweight children is more among children whose mothers have received less than four anti-natal check-ups. Both the panchayats combined, among children born through normal deliveries, 25.9 percent were underweight; in Vithura and Thirunelly it is 19.4 percent and 29.8 percent respectively. Roy et al. (2004) study on nutritional inequalities in selected states of India across caste and tribe using NFHS 2 found that, apart from socioeconomic conditions, social stratification on the utilization of health care programs aggravates nutritional inequalities. Antenatal care and place of the health care centre influence nutritional outcome. In rural areas, the existence of health provision and health care providers are not statistically significant in deciding the nutritional status of children (Rajaram et al., 2007). Among children born through C-section deliveries, the percentage of underweight children is less. Underweight is not significantly associated with the number of anti-natal check-ups, and type of childbirth. Though overall as well as in panchayats individually, underweight is higher among children whose mothers were irregular in the intake iron-folic and calcium tablets, the association is not statistically significant. One of the reasons cited for the irregular intake of iron-folic acid tablets by the mothers during pregnancy is vomiting. Vomiting reduces nutrient intake of mother-to- be and increases the chance of LBW. A study by Sanghvi et al. (2001) carried out in rural Kerala found that vomiting and nausea during pregnancy is a statistically significant risk factor for child undernutrition. Considering all the samples together as well as both the panchayats individually, the percentage of underweight children is higher among children born at Government hospital. For combined sample and in Vithura alone, underweight is significantly associated with place of delivery. The percentage of underweight among children given timely vaccination is 19.1 percent and 29.8 percent in Vithura and Thirunelly respectively (See Table 6.3).

6.2.4 Association of Underweight by Child Characteristics

The distribution of children classified as underweight by identified child characteristics are presented in Table 6.4

Table 6.4: Percentage Distribution of Children Classified Based on Underweight by Selected Child Characteristics

Child characteristics	Category	Underweight (Combined) in %		Underweight (Vithura) in %		Underweight (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Age of the child	≤12 months	74.3	25.7	76.7	23.3	72.7	27.3
	13-36 months	75.9	24.1	84.5	15.5	70.1	29.9
	37-59 months	73.3	26.7	77.4	22.6	68.5	31.5
	Test statistics	χ^2 = 0.313; df=2, p = 0.855		χ^2 =1.667; df=2, p = 0.434		χ^2 = 0.208; df=2, p = 0.901	
Gender of the child	Male	74.0	26.0	79.40	20.6	69.8	30.2
	Female	76.0	24.0	82.60	17.4	70.7	29.3
	Test Statistics	χ^2 = 0.223; df=1, p = 0.637		χ^2 =0.319 df=1, p = 0.572		χ^2 = 0.021; df=1, p = 0.885	
Birth weight of the child	Upto 2.5 kg	61.8	38.2	74.3	25.7`	53.7	46.3
	2.5 to 3.5 kg	75.8	24.2	80.6	19.4	72.0	28.0
	>3.5 kg	95.6	4.4	92.0	8.0	100.0	0.0
	Test statistics	χ^2 = 18.476; df=2, p = 0.000*		χ^2 = 2.997; df=2, p = 0.223		χ^2 = 15.796; df=2, p = 0.000*	
Order of birth	First	75.6	24.4	77.1	22.9	73.9	26.1
	Second	75.7	24.3	85.0	15.0	68.3	31.7
	Third	66.0	34.0	100.0	0.0	62.8	37.2
	Above three	90.0	10.0	0.0	0.0	90.0	10.0
	Test statistics	χ^2 = 3.333; df=3, p = 0.343		χ^2 = 2.779; df=2, p = 0.249		χ^2 = 3.741; df=3; p = 0.291	
Full Term	Yes	75.7	24.3	82.0	18.0	71.1	28.9
	No	65.6	34.4	72.7	27.3	50.0	50.0
	Test statistic	χ^2 = 1.598; df=1, p = 0.206		χ^2 =1.092 ; df=1, p = 0.296		χ^2 = 2.046; df=1, p = 0.153	
Birth Interval	Less than 2 years	81.4	18.6	89.5	10.5	77.5	22.5
	Greater than 2 years	71.9	28.1	84.8	15.2	64.7	35.3
	Test statistics	χ^2 = 2.092; df=1, p = 0.148		χ^2 = 0.260; df=1, p = 0.610		χ^2 = 2.249; df=1, p = 0.134	
Frequency of diarrhoea	Never &Less frequent	76.4	23.6	81.2	18.8	72.1	27.9
	Frequent	62.1	37.9	50.0	50.0	63.0	37.0
	More frequent	58.3	41.7	100.0	0.0	54.5	45.5
	Test statistics	χ^2 = 4.770; df=2, p = 0.092*		χ^2 = 1.484; df=2, p = 0.476		χ^2 = 2.303; df=2, p = 0.316	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

As given in Table 6.4, in Vithura panchayat, the percentage of underweight children is highest in the age group of '6-12 months' whereas, in Thirunelly, it is highest in the age group '37-59 months'. In Thirunelly, the percentage of underweight children surges as child's age progresses, in conformity with findings of Meshram et al. (2012). No such trend is observed in Vithura panchayat nor both the panchayats combined. In Vithura, the percentage of underweight children is 23.3 percent in the age group 'less than 12 months', and in the age group '13 to 36 months' it falls to 15 percent. Thereafter, increases to 22.6 percent in the age group '37 to 59 months'. A study by Saxena et al. found a higher prevalence of underweight among children in the age group 0-1 year (as cited in Chakraborty et al., 2006). Ramachandran and Gopalan (2011) tried to analyse the pattern of growth of Indian children using WHO child growth standards and found a progressive increase in underweight rates between 3 to 23 months of age. Our findings from Vithura are consistent with these earlier studies. Percentage of underweight children seems to increase in the periods of weaning. The gradual transition from fully breastfed to partial breastfeeding, the reluctance on the part of the child to consume food and suboptimal complementary feeding practices are some of the reasons for the increase in underweight children in this age group. In the study, there is no significant association between underweight and age of the child. The percentage of underweight children is slightly higher among males (26 percent) compared to females (24 percent). Gender-specific characteristics in terms of underweight exhibit the same trend as between the panchayats. This finding shows that there is no gender-specific discrimination. The study by Acquah et al. (2019) found that the chance of being underweight is more among females, whereas the study by Meshram et al. (2012) found the prevalence of underweight to be significantly higher among males. Studies from India by Sen and Sengupta (1983), Benjamin and Zachariah (1993), Banerjee and Mandal (2005) found that females suffer from more protein-energy malnutrition, compared to their male counterparts. All these studies point to sex bias in families that result in nutritional deprivation among girls. Sen and Sengupta (1983) opine that land redistribution and direct nutritional intervention are effective strategies for combating malnutrition. A reversal in this trend can be observed from the latest NFHS 4 (2015-16). The findings from both the panchayats affirm the absence of gender-specific discrimination. High social status of women in Kerala, high levels of literacy and below replacement level fertility has helped Kerala in eliminating the sex bias. In the study area, good nutrition awareness could be observed even among the less educated mothers.

LBW children are likely to become underweight. In Vithura panchayat, 25.7 percent of children are malnourished among children born LBW whereas, among children with birth weight above 3.5 kg, the percentage of underweight children is 8 percent. In Thirunelly panchayat, 46.3 percent of children are underweight among children born LBW. Panchayats combined, and in Thirunelly alone, underweight is significantly associated with child's birth weight. A study by Binkin et al. (1988), using growth data for children less than five from Tennessee Special Supplemental Food Program, found that low birth weight infants were likely to remain shorter and lighter in childhood. As birth order increases, there is slight variation in underweight. In Vithura panchayat, among children born as the first child, the percentage of underweight is 22.9 percent, it decreases to 15 percent among children of birth order two. In Thirunelly panchayat, as birth order increases, the percentage of underweight children rises. The association between underweight and birth order is not statistically significant. Preterm babies are also at a risk of being underweight. Overall, among children born as 'preterm babies', 34.4 percent were underweight compared to 24.3 percent among children born as 'full-term babies'. In Vithura, among children born as 'preterm', 27 percent (6) of children are underweight compared to 18 percent (30) among children born as full-term baby. Fifty percent(5) of children born as preterm are underweight in Thirunelly, whereas 29 percent of children are underweight among children born as full term. Comparing Vithura and Thirunelly, among children born as 'preterm', the percentage of underweight is higher in Thirunelly. There is no significant relation between underweight and whether the child is born 'preterm' or 'full term'. Underweight among children tends to increase as birth interval increases. Among children born at a birth interval of more than two years, 15.2 percent and 35.3 percent of children are underweight in Vithura and Thirunelly respectively. For both the panchayats combined as well as for panchayats individually, there is no statistically significant association between underweight and birth interval. Shorter birth intervals increase the risk of underweight (Gribble et al., 2009). No such finding could be inferred from the present study. Recurrent diarrhoeal episodes tend to increase the extent of underweight. The percentage of underweight is higher in children with 'frequent or 'more frequent' diarrhoea. In Vithura, among children with 'never or less frequent diarrhoea', 18.8 percent (32) were underweight and out of 2 children with 'frequent 'diarrhoea, one is underweight (i.e. 50 percent). In Thirunelly also, the percentage of underweight increases among children with greater frequency of diarrhoea incidence- among children with 'never and less frequent' diarrhoea, the percentage of underweight is 28 percent; it increases to 37

percent and 45.5 percent as the frequency of illness increases from 'frequent' to 'more frequent' respectively. However, there is no significant association.

6.2.5 Association of Underweight by Child Feeding Practices

The proportion of underweight children by selected child feeding practices is shown in table 6.5.

Table 6.5: Percentage Distribution of Children Classified on the Basis of Underweight by Selected Child Feeding Characteristics

Child feeding characteristics	Category	Underweight (Combined) in %		Underweight (Vithura) in %		Underweight (Thirunelly) in %	
		No	Yes	No	Yes	No	Yes
Initiation of breastfeeding	Within 24 hours	74.8	25.2	81.4	18.6	70.1	29.9
	More than 24 hours	77.8	22.2	76.5	23.5	100	0.0
	Test Statistic	χ^2 =0.080; df=1, p = 0.777		χ^2 =0.243; df=1, p = 0.622		χ^2 =0.425; df=1, p = 0.514	
Exclusive breastfeeding for six months	No	75.0	25.0	86.7	13.3	55.6	44.4
	Yes	74.9	25.1	79.2	20.8	72.0	28.0
	Test Statistic	χ^2 =0.000; df=1, p = 0.983		χ^2 =0.888; df=1, p = 0.346		χ^2 =2.178 df=1, p = 0.140	
Duration of breastfeeding	Less than 1 year	77.10	22.9	84.60	15.40	72.70%	27.30%
	1-2 years	77.70	22.3	81.70	18.30	73.10%	26.90%
	Greater than 2 years	71.50	28.5	77.90	22.10	66.70%	33.30%
	Test Statistic	χ^2 =1.932; df=2, p = 0.381		χ^2 =0.931; df=2, p = 0.628		χ^2 =1.084; df=2, p = 0.582	
Initiation of complementary feeding	Less than 3 months	88.9	11.1	88.9	11.1	0.0	0.0
	3 to 6 months	65.2	34.8	76.9	23.1	60.6	39.4
	After 6 months	76.2	23.8	81.2	18.8	72.3	27.7
	Test Statistic	χ^2 =3.578; df=2, p = 0.167		χ^2 =0.505; df=2, p = 0.777		χ^2 =1.888; df=1, p = 0.169	
Child feeding interval	Less than 3 times	63.4	36.6	77.8	22.2	61.9	38.1
	More than 3 times	78.1	21.9	81.1	18.9	74.7	25.3
	Test Statistic	χ^2 =8.353; df=1, p = 0.004*		χ^2 =0.062; df=1, p = 0.804		χ^2 =4.285; df=1, p = 0.038*	

Source: Field Survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

In Vithura panchayat, as shown in Table 6.5, underweight children are more among children put to the breast after 24 hours, whereas in Thirunelly it is higher among children who had been initiated breastfeeding within 24 hours. At 5 percent level of significance, there is no significant association between underweight and commencement of breastfeeding (combined and separately). Overall, one in every four children is underweight irrespective of whether the child is given exclusive breastfeeding for six months or not. The percentage of underweight in Vithura and Thirunelly is 20.8 percent (30) and 28 percent respectively in children exclusively breastfed. In Thirunelly, the percentage of underweight is higher among children not exclusively breastfed (44.4 percent) compared to that of Vithura (13.3 percent). Prolonged breastfeeding increases the chance of being underweight. In Vithura and Thirunelly panchayat, 22 percent and 33 percent of children respectively are underweight among children breastfed for more than two years. In Thirunelly, the percentage of underweight children is least among children who are breastfed for 1-2 years, whereas in Vithura, it is least among children breastfed for less than one year. Prolonged breastfeeding, defined as feeding the child beyond one year of life, was identified as a determining reason for malnutrition (Caulfield et al., 1996). Fawzi et al. (1998) conducted a six-month interval follow up study among North Sudanese children aged 6 to 72 months. An inverse relation between breastfeeding status and weight gain was observed among children 6 to 12 months. Poor complementary feeding practice among breastfed children is one of the reasons contributing to undernutrition. In the present study, the percentage of underweight children is higher among children weaned between 3 and 6 months. The percentage of underweight is higher among children of Thirunelly (39.4 percent) who were given supplementary feeding between 3 and 6 months, compared to Vithura (23.1 percent). There is no significant association of underweight with exclusive breastfeeding, duration of breastfeeding, and initiation of complementary feeding (combined and separately). The percentage of underweight is higher among children whose food intake is less than three times a day. In Vithura, the proportion of underweight among children is 22.2 percent among children who consumed less than three times whereas, in Thirunelly, it is 38.1 percent. Underweight and child feeding interval is significantly associated with the combined sample and Thirunelly. A study by Kumar et al. (2006) conducted in selected areas of urban Allahabad found significant risk factors of underweight to be colostrum deprivation, late initiation of breastfeeding (after six hours), and improper complementary feeding practices.

6.2.6 Determinants of Normal Weight for Age

Determinants of underweight are analysed in terms of the probability of being normal weight for age. Binary logistic regression was employed to ascertain the empirically significant predictors of being normal weight for age (dependent variable). The binary dependent variables for the logistic regression model for normal weight for age are: (a) underweight children (b) normal children. They are represented by zero and one respectively. The variables selected and values assigned to the various categories of these variables are similar to that of stunting and wasting.

The study estimated the probability of predicting normal weight for age among children under five. Based on observed variations in underweight among children with respect to Vithura and Thirunelly, separate logistic regression models for panchayats combined, Vithura and Thirunelly are run. Table 6.6 depicts the overall estimates of binary logistic regression for the probability of being normal weight for age among children in the study areas.

Table 6.6: The Estimates of Logistic Regression of Normal Weight for Age (Combined)

Variables	β	S.E.	Wald	df	P	Exp(β)	95% C.I.for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	-.138	.327	.179	1	.672	.871	.458	1.654
(V2) High asset group	1.016	.310	10.715	1	.001*	2.763	1.504	5.078
(V3)Mother's education			.212	2	.899			
(V3_1) Mother's education (Plus two)	-.123	.312	.155	1	.694	.884	.479	1.632
(V3_2) Mother's education (graduation and above)	-.006	.421	.000	1	.988	.994	.435	2.269
(V4) BMI status of mothers			8.916	2	.012			
(V4_1) BMI status (normal)	.016	.298	.003	1	.958	1.016	.567	1.822
(V4_2) BMI status (overweight)	.945	.390	5.857	1	.016*	2.572	1.197	5.529
(V5) Age of child			.482	2	.786			
(V5_1) Age of child (13-36 months)	.146	.403	.132	1	.717	1.158	.525	2.551
(V5_2) Age of child (37 to 59 months)	-.037	.425	.008	1	.931	.964	.419	2.218
(V6) Birth interval (more than two years)	-.218	.244	.796	1	.372	.804	.498	1.298
(V7) Duration of breastfeeding			2.099	2	.350			
(V7_1) Duration of breastfeeding (Between one and two years)	-.093	.372	.062	1	.803	.911	.439	1.891
(V7_2) Duration of breastfeeding (More than two years)	-.417	.331	1.589	1	.207	.659	.345	1.260
(V8)Initiation of complementary feeding (more than 6 months)	.660	.331	3.979	1	.046*	1.935	1.012	3.703
Constant	.292	.434	.454	1	.501	1.340		
Chi-square=36.604; p=0.000								

Source: Field Survey, 2019; Note: *significant at 5%; ** significant at 10 percent.

The estimated model is as follows.

$$\text{Log}\left(\frac{P}{1-P}\right)=0.292-.138*V1+1.1016*V2-.123*V3\_1-$$
$$0.006.*V3\_2+.016*V4\_1+.945*V4\_2+.146*V5\_1-.037*V5\_2-.218*V6 -$$
$$.093 * V7\_1-.417*V7\_2+.660*V8$$

Where:

P = Probability of being normal weight for age

The statistically significant value of Chi-square (36.604; p<.05) indicates that all the identified predictors, as a group, could theoretically segregate normal weight for age (response variable) from underweight, signifying the suitability of the identified variables in predicting the likelihood of the child being normal weight for age. From the result shown in Table 6.6, it can be inferred that the change from low asset position to high asset position, change in mother's BMI, change in the age of the child from 'up to 12 months' to age '13 to 36 months', and change in the time of initiation of complementary feeding from 'less than six months' to 'more than six months', increases the probability to become normal weight for age. The predictor variable, high asset group, in the logit model was found to contribute to a child being normal weight for age, with a log-ordered estimate of 1.016, standard error of 0.310, Wald Chi-square value of 10.715 and p<.05. The estimated odds ratio indicates a positive relationship of 2.763 fold, at 95% CI (1.504, 5.078), with any favourable change in the reference category of asset group. Change in BMI status of mother from underweight to overweight in predicting the probability of child being normal weight for age was found with a log-ordered estimate of 0.945, standard error of 0.390, Wald Chi-square value of 5.857 and p<.05. The estimated odds ratio indicates a positive relationship of 2.572 fold, at 95% CI (1.197, 5.529), with any favourable change in the reference category of mother's BMI status. Similarly, initiation of complementary feeding (V8) is also identified as a statistically significant predictor of child being not underweight at 5% level of significance. The estimated odds ratio indicates a positive relationship of 1.935 fold, at 95% CI (1.012, 3.703), with any favourable change in the reference category of initiation of complementary feeding. Caste(V1), two categories of mother's education (V3_1 and V3_2), age of the child(V5_2), birth interval (V6), two categories of duration of breastfeeding (V7_1 and V7_2) were not found to be statistically significant predictors of child being underweight among the children generally in the areas of study.

Table 6.7 depicts the estimates of binary logistic regression for the likelihood of being not underweight at Vithura. The goodness of fit of the model is revealed from the significant value of Chi-square statistics (27.525; p<.05).

Table 6.7: The Estimates of Logistic Regression of Normal Weight for Age (Vithura)

Variables	β	S.E.	Wald	df	P	Exp(β)	95% C.I.for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	-.260	.603	.186	1	.666	.771	.236	2.516
(V2) High asset group	1.888	.485	15.173	1	.000*	6.603	2.554	17.070
(V3)Mother's education			.364	2	.834			
(V3_1) Mother's education (Plus two)	-.360	.606	.352	1	.553	.698	.213	2.290
(V3_2) Mother's education (graduation and above)	-.374	.748	.249	1	.617	.688	.159	2.983
(V4) BMI status of mothers			2.314	2	.314			
(V4_1) BMI status (normal)	-.528	.663	.634	1	.426	.590	.161	2.162
(V4_2) BMI status (overweight)	.139	.713	.038	1	.845	1.149	.284	4.653
(V5) Age of child			3.913	2	.141			
(V5_1) Age of child (13-36 months)	1.849	.958	3.727	1	.054**	6.354	.972	41.522
(V5_2) Age of child (37 to 59 months)	1.409	.943	2.232	1	.135	4.093	.644	25.991
(V6) Birth interval (more than two years)	.468	.460	1.039	1	.308	1.598	.649	3.932
(V7) Duration of breastfeeding			2.188	2	.335			
(V7_1) Duration of breastfeeding (Between one and two years)	-.996	.892	1.245	1	.265	.370	.064	2.124
(V7_2) Duration of breastfeeding (More than two years)	-1.286	.879	2.141	1	.143	.276	.049	1.548
(V8)Initiation of complementary feeding (more than 6 months)	.332	.605	.301	1	.583	1.394	.426	4.560
Constant	.301	.875	.119	1	.731	1.352		
Chi-square=27.525; p=0.006								

Source: Field survey, 2019
Note: *significant at 5%; ** significant at 10 percent.

The estimated model is as follows.

$$\text{Log}\left(\frac{P}{1-P}\right)=0.301-.260*V1+1.888*V2-.360*V3\_1-.374*V3\_2-.528*V4\_1+.139*V4\_2+1.849*V5\_1+1.409*V5\_2+.468*V6-.996*V7\_1-1.286*V7\_2+.332*V8$$

From the result, in Table 6.7, it can be inferred that the change from low asset position to high asset position, change in BMI status of the mother from underweight to overweight, change in age of the child from 'up to 12 months' to either age '13 to 36 months' or '37 to 59 months', the birth interval from less than two years to more than two years and change in the time of initiation of complementary feeding increases the probability to become normal

weight for age. Change in caste, two categories of mother's education, BMI status from underweight to normal, two categories of duration of breastfeeding reduces the chance of being normal weight for age. Among these, the predictor variable high asset group, in the logit model was found to contribute to a child being normal weight for age, with a log-ordered estimate of 1.888, standard error of 0.485, Wald Chi-square value of 15.173 and p<.05. The estimated odds ratio indicates a positive relationship of 6.603 fold, at 95% CI (2.554, 17.070), with any favourable change in the reference category of the asset group. Age of the child '13 to 36 months' was found to predict the probability of the child being normal weight for age, with a log-ordered estimate of 1.849, standard error of 0.958, Wald Chi-square value of 3.727 and p>05, but <.1. The estimated odds ratio indicates a positive relationship of 6.354 fold, at 95% CI (.972, 41.522), with any favourable change in the reference category.

Table 6.8 depicts the estimates of binary logistic regression for underweight among children at Thirunelly. The statistically non-significant value of Chi-square (17.401; p>.05) confirms that the identified predictors generally, as a group, failed theoretically, to segregate normal weight for age (response variable) from that of underweight, signifying the non-viability of the identified variables in predicting the likelihood of the child being normal.

Table 6.8: The Estimates of Logistic Regression of Normal Weight for Age (Thirunelly)

Variables	B	S.E.	Wald	df	P	Exp(β)	95% C.I.for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	-.003	.418	.000	1	.994	.997	.440	2.261
(V2) High asset group	.207	.449	.214	1	.644	1.230	.511	2.964
(V3)Mother's education			.239	2	.887			
(V3_1) Mother's education (Plus two)	.003	.417	.000	1	.994	1.003	.443	2.269
(V3_2) Mother's education (graduation and above)	.252	.575	.192	1	.661	1.287	.417	3.974
(V4) BMI status			5.110	2	.078			
(V4_1) BMI status (normal)	.083	.342	.060	1	.807	1.087	.556	2.125
(V4_2) BMI status (overweight)	1.172	.553	4.492	1	.034*	3.228	1.092	9.541
(V5) Age of child			.648	2	.723			
(V5_1) Age of child (13-36 months)	-.289	.475	.369	1	.544	.749	.295	1.902
(V5_2) Age of child (37 to 59 months)	-.422	.524	.648	1	.421	.656	.235	1.832
(V6) Birth interval (more than two years)	-.554	.306	3.276	1	.070**	.575	.316	1.047
(V7) Duration of breastfeeding			.882	2	.643			
(V7_1) Duration of breastfeeding (Between one and two years)	-.048	.462	.011	1	.917	.953	.385	2.356
(V7_2) Duration of breastfeeding (More than two years)	-.317	.378	.704	1	.402	.728	.347	1.528
(V8)Initiation of complementary feeding (more than 6 months)	.867	.411	4.441	1	.035*	2.380	1.063	5.330
Constant	.528	.542	.952	1	.329	1.696		
Chi-square=17.401; p=0.135								

Source: Field Survey, 2019; Note: *significant at 5%; ** significant at 10 percent.

It can be inferred that the change from low asset group to a high asset group, improvement in mother's education, the improvement of BMI status, change in the status of complementary feeding, decreases the probability to become underweight (Table 6.8). Change in BMI status of mother from underweight to overweight was found to increase the likelihood of child being normal weight for age. The estimated odds ratio indicates a positive relationship of 3.228 fold, at 95% CI. Increase in birth interval from less than one year to greater than two years, increases the likelihood of being underweight at a liberal level, with a log-ordered estimate of -.554, standard error of 0.306, Wald Chi-square value of 3.276 and $p<.1$. The estimated odds ratio indicates a negative relationship of 0.575 fold, at 95% CI (0.316,1.047). The predictor variable, initiation of complementary feeding (V8), in the logit model, was found to contribute to a child being not underweight, with a log-ordered estimate of 0.867, standard error of 0 .411, Wald Chi-square value of 4.441 and $p<.05$. The estimated odds ratio indicates a positive relationship of 2.380 fold, at 95% CI (1.063, 5.330), with any favourable change in the reference category. Since no other predictor was found to be significant within the statistical threshold level, the researcher refrained from specifying the logistic regression model.

6.3 IYCF Practices, Maternal and Child Care in the Study Area: A Qualitative Investigation

An exploratory qualitative investigation is attempted to analyse the IYCF practices, maternal care and child care practices in Vithura and Thirunelly. Using a semi-structured interview schedule, telephonic in-depth interviews were conducted in the local language (Malayalam) among mothers of children under 5 years, to elicit information on four categories namely, pregnancy and post-pregnancy care, infant and young child feeding practices, maternal awareness (maternal nutrition knowledge and vaccination), and care of children during illness. Twenty mothers were randomly chosen for an in-depth interview, from the previously chosen 431 samples for quantitative analysis. In-depth, interviews were tape-recorded after getting the prior consent of the participants. Recorded interviews were then transcribed and coding categories were created. Using the methodology of Krippendorf (2004), data inference and analysis were done using ethnographic content analysis. Manifest and latent content were employed for content analysis. Manifest content is analysed using countable objects, say frequencies, food etc. Latent content tries to provide interpretation for following a particular practice, nutrition knowledge, and beliefs.

Qualitative results

Data exploration resulted in formation of various categories and inferences were sorted based on the content. Inferences depicting the opinion of majority are given, supported by relevant statements from participants.

6.3.1 Pregnancy and Post Pregnancy Care

Table 6.9: Prenatal and Antenatal Care of Mothers in the Study Area

Category	Content Analysis	Ethnography
Food Quantity	During pregnancy, they either increased frequency of food intake or increased the quantity (81%). Reduced intake of rice deliberately (due to excessive weight gain), or due to pregnancy issues (vomiting, late pregnancy discomfort)(18.7%).	*'Weight gain during pregnancy.'* *'craving for Kanji (rice soup) and pickle.'*
Food Diversity	Included fruits, green leafy vegetables, tubers, fish and meat products in the diet (100%). Consumed locally available as well as market purchased fruits and vegetables. Avoided certain fruits like pineapple, papaya as it may lead to miscarriage (87.5%). Leaves of pumpkin results in lines on the skin of foetus (10 %)	*'A variety of chappu (green leafy vegetables) is available in our neighbourhood.'* *'I live in Tholpetty area and Kodagu oranges are available in plenty.'* *'I don't know the scientific reason behind avoiding certain fruits. I cannot take any risk.'* *'I love pineapple, I ate it in the late pregnancy.'*
Antenatal care: Ease of delivery	Used to do all household chores, walking (100%).Majority, regularly consumed iron-folic acid. Irregular intake of Iron-folic acid tablets among some as it triggers vomiting (18%).	*'Delay in delivery can be avoided and more will be the chances of normal delivery if you do household work.'*
Post Natal care	Local herbs (43%), Ayurvedic medicines (56%), oil massage (40%) and medicated hot water bath (100%) or a combination of any of these (100%).	*'Necessary for quick healing of vaginal cuts during delivery.'* *'Can get rid of future health issues.'*

Source: Field Survey, 2019

Food intake of mother is an important factor determining the growth and development of the foetus. Mothers were asked about their eating pattern- in terms of food quantity, food frequency and food diversity. As revealed from Table 6.9, majority of the participants either

increased the frequency of food intake by including healthy snacks between meals or at least tried to maintain the same level of food intake. Weight gain among mothers during pregnancy varied between 6 kg to 15 kg. Pregnancy-related vomiting and late pregnancy issues resulted in less food intake. Some participants reduced rice as it may further increase weight gain. They substituted it with less starchy, high nutrient foods. Locally available fruits (like jackfruit, guava, banana, and mango) and tubers (like tapioca, elephant foot yam, sweet potato), green leafy vegetables (Spinach, ash gourd leaf) were popularly used. A variety of green leafy vegetables grown in the neighbourhood are called as *chappu* in Thirunelly and a variety of *chappu- cheera chappu, Kumbilanga ela, mathan chappu, chena chappu* (Spinach, ashgourd leaf, pumpkin leaf, elephant foot yam leaf respectively) are cooked and consumed by both tribals as well as non-tribals. Market purchased fruits and vegetables were also consumed once in a while, but not on regular basis. They are usually bought by husbands when they go to purchase other provisions. Overall, intake of fruits was less among the participants. Vegetable consumption was more prominent. Majority of the participants increased intake of fish- sardine being the most popular. Pregnant ladies had an understanding of fruits to be avoided during pregnancy, as the awareness had been passed on from elder mothers. Tribal mothers avoided eating *mathan chappu* (pumpkin leaf) during pregnancy as they believed that it will develop a line on the skin of the newborn. Mothers have relatively less awareness of avoiding high mercury-containing fish variety during pregnancy.

Majority of pregnant women did no specific exercises or ayurvedic medicines for ease of delivery. All household works were done by them. As postnatal care treatment, only hot water bath is commonly used among tribals in Thirunelly. In addition to hot water bath, herbal medicines and ayurvedic medicines are usually used by non-tribals in Thirunelly and by both tribals and non-tribals in Vithura.

6.3.2 Infant and Young Child Feeding

Table 6.10: Infant And Young child Feeding Practices in the Study Area

Category	Content Analysis	Ethnography
Breast milk	Breast milk is the perfect food (100%) since it improves healthiness(66 %), immunity and general health (33%), brain development (20%) of the infant.	*'Giving colostrum enhances immunity.'* *'Breast milk is better than any other fluid and is the best.'*
Introduction and duration of breastfeeding	Breastfeeding initiated as early as within one hour or mostly within half a day after birth. Six months of exclusive breastfeeding (75%).	*'Nurses in Government hospitals are strict. They ask you to get up and feed the baby within one hour after delivery'.* *'Eating fruits in days immediately after delivery, will enhance milk production.'*
Infant Formula	Formula milk was rarely given- given only when mother had to go out (12.5 %), low milk production (18.75%), for weight gain (8%). Cow milk preferred.	*'Child does not like the taste of powder milk.'* *'Diluted cow milk- half a glass cow milk mixed with half a glass water.'*
First Weaning foods	The first foods given as complementary feeds are cereals like Ragi, health mix, 'Amrutham Nutri Mix', Banana powder, broken wheat etc., fruit and vegetable purees. Commercial products (Cerelac) are not popular.	*'From six months onwards, breast milk is not enough.'* *'For making cereal purees, I usually use jaggery or palm sugar as they are more nutritive than white sugar.'* *'Commercial products have substances not good for children.'*
Food Preparation	Children prefer lukewarm food. Children want variety foods, and snacks are prepared at home.	*'They get easily bored, if given same food. I make a variety of snacks using Amrutham Nutri Mix.'*
Food intake	Foods were given at regular intervals (responsive feeding). Frequent meals- three main meals and three or four snacks. Older children were encouraged to eat finger food (self-feeding) Children are persuaded to eat by taking them outside home to show birds, butterflies etc.; Television and phones or by forcefully feeding them	*'Sometimes, my son says – Amma.. I am hungry.'* *'I ensure that the child's stomach is not empty.'* *'He is reluctant to eat. I sometimes play a cartoon on my phone. I know it is bad. At least I can fill his stomach.'*

Source: Field Survey, 2019

All the respondents unanimously opined that breast milk is the perfect food for the newborn, as it confers both short term and long term benefits to the child (See Table 6.10). Sixty six percent of respondents believe that breast milk improves healthiness. Tribal mothers of Thirunelly have a lesser understanding of the importance of exclusive breastfeeding, and many of them started giving complementary foods as early as three months. All mothers, irrespective of their place of residence, unequivocally opined that breastfeeding is beneficial for the health of the baby and was aware that 'colostrum' or the 'yellow milk' was the first feed to be given. Of the all mothers interviewed, mother of Athira (name changed), belonging to Scheduled Caste community residing in Vithura panchayat, said that her family gave *swarnam urach* (feeding gold) to both of her children, immediately after birth. Raw gold is rubbed on a stone (*ura kalu*), then it is churned with honey and is given to the child for licking. In spite of concerted efforts by ICDS, ASHA workers and health personnel in disseminating awareness on the benefits of administering breast milk alone to infants, the traditional practices are still followed by some families.

Initiation of breastfeeding was started based on the instruction received from health personnel. Children were put to breast as early as within one hour of childbirth in case of normal childbirth or the mostly within half a day in case of C section. In spite of delivery related health issues, mothers were asked to sit and give breast milk. Mothers felt that even though the quantity of breast milk is less in the initial days, eating fruits, vegetables and regularly feeding the infant will enhance milk production. Majority of children were exclusively breastfed but is relatively less among tribal children of Thirunelly.

Formula milk was given for both justifiable (breast illness like abscess or engorgement, child's reluctance to drink breast milk, the doctor prescribing formula milk for weight gain) and unjustifiable reasons (self-perceived low milk production, going outside the home). Cow milk was frequently used compared to powdered milk. Diluted cow milk was given to avoid stomach upsets as well as for ease of digestion. A minority of mothers refrained from giving cow milk to their children till three years, due to its unsuitable nutritional composition- they felt that cow milk is for the calf. Participants in both the panchayats had a similar understanding of the first weaning foods. Varieties of cereals were preferred to tin foods. Rather than using sugar as a sweetening agent, majority used palm jaggery (*Karupatti*) or palm sugar candy (*panam kalkandam*) due to its nutritive content. Social welfare department of Government of Kerala, in collaboration with Kudumbashree (a women empowerment and poverty eradication initiative of Kerala State Poverty Eradication Mission) supplies through

its Anganwadi centres, Amritham Nutri mix - a health supplement - to be given to children in the age group six months to three years in the form of take-home ration (THR). Around 3.5 kg of nutrimix per month is given to each child. Apart from porridge, *amrutham podi* can be used to make a variety of snacks, and Anganwadi teachers give classes on it to mothers. Children get easily bored if they are given the same food. So, mothers try to bring variety in foods prepared. Ghee, coconut oil, coconut milk etc. are added to porridges to enhance the taste as well as nutrition. In both, the study areas, commercial products like Cerelac are not much popular due to their notion of harmful ingredients in commercial foods. Majority serve lukewarm food to children. Mother/Caretaker of the child takes the responsibility of feeding him at regular intervals.

Children at this age are more engaged in play and they often forget hunger.

Older children were given food in a plate. Mothers felt that self-feeding is the best feeding strategy. If the food is not finished by the child himself, then mother's feed them. Children were given frequent meals- three main meals and three or four snacking daily. In between snacking were identified and it reduced appetite resulting in less intake of the main meal. Mothers try to provide nutritious snacks to children. Rather than buying snacks from the bakery, they are made at home. Majority of the mothers practiced responsive feeding. Responsive feeding is considered to be the best feeding strategy applying the principle of psychosocial care. Optimal complementary feeding depends not just on the quantity and quality of food, but also on how, where and by whom the child is fed (Engle et al., 2000; WHO, 2009, Tariku et al., 2017). More than 50 percent of mothers admitted that they feed the children by distracting them with television, phone, telling stories, taking them outside home etc.

6.3.3 Awareness

Table 6.11: Nutrition and Vaccination Awareness among Mothers

Category	Content Analysis	Ethnography
Nutrition Awareness	Participants had an overall understanding of the need to feed children with diverse foods. Their understanding varied with levels of education. ASHA workers, Anganwadi teachers and tribal promoters played a significant role in disseminating the need to include a variety of foods in the diet. Knowledge regarding exact nutrient content and uses of foods were absent. Mothers used nutrition terminology (protein, vitamins) unaware of the correct parlance. Misconceptions regarding the intake of certain foods	*'Banana for weight gain.'* *'Orange is rich in Vitamin C; it hydrates the body, gives immunity power, and is good to avoid constipation.'* *'Beetroot for blood.'* *'Orange causes Phlegm.'* *'Egg causes phlegm.'*
Vaccination Awareness	To get immunity against various illness, and to prevent disability. The participants listed a number of illness that can be prevented.	*'Vaccination to prevent deadly diseases.'*

Source: Field Survey, 2019

It is evident from Table 6.11 that nutrition awareness among mothers varied based on the social groups to which they belong and their education. Mothers of children from the tribal community of Thirunelly were ignorant of the benefits of breast milk and the nutrient content in foods. Mothers of both panchayats used nutrition terminologies like protein, vitamins, minerals etc without knowing the correct usage. Though they were less aware of the exact benefit of various foods normally consumed, they were convinced of the need to include diverse foods in their diet. Certain misconceptions based on own experience and traditional beliefs prevailed regarding the intake of certain foods. Anganwadi workers regularly (once in a month) take weight of children enrolled in their Anganwadi. Mothers of underweight children are advised by Anganwadi workers to provide special care. Mothers recognised the

importance of administering timely vaccination to children. All the children were administered their age-specific vaccines.

6.3.4 Care of Children During Illness

Table 6.12: Care of Children and Mode of Treatment

Category	Content Analysis	Ethnography
Treatment for Illness during Infancy and Childhood	For colic related issues among infants, participants gave some of the following herbal home remedies: *Uramarunnu* (a mix of herbs, usually bought from Ayurvedic stores), *palkayam* (asafetida), *Vayambu* (sweet flag) and *Jathikka* (nutmeg). They are usually diluted in mother's breast milk and given to the baby.	*'From 28 th day onwards, after bath Uramarunnu is given. We eat a variety of foods and babies drink our milk. It is good for proper digestion and to avoid stomach upset.'*
	For cold, popularly used home remedies are Tulsi, *Pani Koorka* (Indian Rock-Foil). Medicated coconut oil prepared using Tulsi, and pepper is used as hair oil; *Rasnadi powder* is applied on the scalp to prevent cold.	
	For cold and mild fever, older children are given *Karipetti kappi* (Palm sugar coffee), kashayam or herbal juice prepared using Tulsi leaf, palm jaggery, dried ginger and pepper.	*'Normally, children get illness like cold and cough at around 7-8 months.'* *'Hair oil made using panikoorka is good for cooling head. Cold never occurs.'*
Mode of treatment	Children are administered home remedies initially (35%), immediately taken to the doctor (35%), start medicines previously given by the doctor (28 percent).	*'If fever shoots up at night, it will be difficult to take him to the doctor'.*
	For not so severe cold or fever, parents wait to see if the cold or fever subsides. Majority try to reduce fever by giving sponge bath.	*'The doctor may be giving the same medicines which I have at home, but it is a great relief if I take the kid to the doctor'.*
	After the onset of COVID-19, not much illness.	

Source: Field Survey, 2019

Children are more prone to illness and it entails a lot of tension to parents. Some of the parents initially try to treat the illness by administering home remedies. For colic related issues, a popular herbal remedy is *uramarunnu*. Medicated hair oil is applied to hair, to prevent cold and fever. For older children, to treat mild cold and fever, herbal juice prepared using a variety of medicinal herbs are administered. Even though the disease condition of the child is mild, the majority of the parents prefer to take the child to the doctor, because of the limited availability of transportation facilities during the night. Majority of mothers had an understanding of the first aid treatments to be given to the ailing child. After the onset of COVID-19, illness episodes are relatively less among children (See Table 6.12). Since formal classes are suspended, there is no interaction between peers and hence transmission of illness has been arrested. Moreover, increase in personal hygiene, frequent hand washing, social distancing, care and less interaction with outsiders have reduced the onslaught of illness among children.

From the qualitative analysis, the following are the strengths and challenges with regard to IYCF practices in the study area:

Strengths

Mothers are aware of increased energy and protein requirements during pregnancy and they alter their dietary patterns, incorporating veggies, fruits and non-vegetarian foods to their consumption basket.

Breastfeeding is initiated immediately after delivery. The effort of health service providers is laudable.

Infants are not given honey or gold, after delivery.

Complementary foods initially introduced are cereal-based porridge, and they are preferred to commercial foods. Nutrient content of the food is enhanced by adding ghee, healthy sweetening agents etc.

Responsive feeding strategy.

Challenges

Self-perceived less milk production by mother and infant cues result in early introduction of complementary feeding.

Financial constraints result in less intake of market purchased fruits, vegetable and non-vegetarian foods.

Traditional beliefs led to abstinence from consuming certain fruits and vegetables during pregnancy.

Misconception prevails with respect to giving certain foods to children.

Early introduction of complementary feeding by tribals in Thirunelly is a challenge.

6.4 Risk Factors Leading to Anthropometric Failure: A Qualitative Investigation

Telephonic in-depth interviews were conducted, specifically among 15 randomly selected mothers of children who suffered from any one of the anthropometric failures (as revealed from quantitative analysis). It was conducted to elicit the risk factors faced those children. Based on the inputs from the interview, the risk factors identified are given in Table 6.13.

Table 6.13: Probable Risk Factors Leading to Anthropometric Failure

Vithura	Thirunelly
Preterm babies (Medical conditions like leaking amniotic fluid, amniotic fluid level dropping to below normal, early water break etc.) as well as full-term babies	Preterm babies as well as full-term babies
Low birth weight	Low birth weight
Pregnancy complications	Pregnancy complications
C-section	Early marriage and early pregnancy
Low Maternal nutrition , BMI and height	Low Maternal nutrition , BMI and height
Extending duration of breastfeeding beyond two years	Extending duration of breastfeeding beyond two years
Familial discord	Familial discord
Frequent illness	Frequent illness
	Filthy environment (Tribals)
	Betel nut chewing among mothers(Tribals)
	Lack of nutrition awareness(Tribals)
	Alcohol intake among father of children(Tribals)
	Very early (3 months) as well as late introduction of complementary feeding
	Less media exposure

Vithura	Thirunelly
	Less Education: Dropout of parents from schools due to familial financial stress
	Parents are first-generation learners
	Genetic predisposition
	Less care towards children
	Unwillingness to send children to Anganwadi
	Less food diversity (Indigenous food) among tribals
	The average number of family members are more
	Less access to tertiary care
	Frequent illness
	Twins

Source: Primary Survey, 2020

6. 5 Traditional Customs and Practices

Two elderly women belonging to tribal communities in each of the panchayats were interviewed, to analyse the traditional customs and practices followed by tribal community in the past concerning pregnancy, infant and child care.

A few excerpts from the interview.

6.5.1 Thirunelly

Rajani (name changed), mother of three-year-old male twins, resides at Kappomkolly settlement of Thirunelly panchayat, Wayanad district. She belongs to the Adiyar tribe. She has four children. The eldest son is in 8 th standard and the second son is in LKG. The twins are the youngest. Her mother in law lives along with them. Her husband has not attended any school. He works as a masonry helper. Rajani has studied till 4 th standard and her family's financial situation forced her to discontinue her studies.

> *I have 5 siblings. I had to discontinue my studies because at that time my parents had no job. We had no money to buy books and uniform. My parents were struggling to make both ends meet.*

She was married at a very young age of 14 years. Her eldest son was born when she was 15 years old. Though the twins were full-term babies, their birth weight was low – 1.600 kg and 1.450 kg respectively. She is in the habit of chewing betel leaves. Though her husband drinks alcohol, he doesn't create problems at home.

Rajani did not face any health issues during her last pregnancy. She included in her diet fruits, vegetables and leafy vegetables that were easily available in the neighbourhood. She used to do all the household chores. As postnatal care, she only had hot water bath and ate hot foods.

Regarding their religious customs during pregnancy, from fifth month of pregnancy one is not allowed to enter the temple. Starting from seventh month, they are not allowed to go to the temple.

Breast milk was the first feed given to the infants. She was unaware of the benefits of breast milk as well as the nutrient content and health benefits of commonly consumed fruits, vegetables, egg, fish etc. Children were given complementary foods from third month onwards. Cow milk was considered as thick milk and hence not given. Mostly, they drank black tea.

> *The twins have no special demands. Whatever I make, they eat. They usually ask for food when they are hungry. They are awake by the time I get up in the morning. By 8: 30 am, I give them breakfast..Wheat dosa, puttu etc. By noon, I give them kanji (rice soup). Usually, I prepare one side dish. In the evening, I prepare snacks using Amritham podi. For dinner, we usually have rice.*

The intake of fruits is less. In the interview conducted in October 2019, the mother had said that children had frequent incidence of fever. Of late, after the onslaught of COVID 19 and subsequent lockdown, the children haven't had any illness.

> *I had enrolled my kids in Anganawadi in March beginning. Then corona came. Now Anganwadi is closed. The Anganwadi teacher brought for them a kit from Anganwadi (some workbooks and food for children).*
>
> *Covid 19 locks down days are still a nightmare for us. My husband didn't have any job then. We didn't starve as we got enough provisions supplied by the Government through ration shops. Right now, I have 30 kg of rice in my kitchen. Children very promptly got their share of raw foods from Anganwadi.*

Girija, the grandmother of twins, recollected her childbirth experience and post-pregnancy care she received.

I don't know my age. I gave birth to my four children at my home. My delivery was attended by my father's elder sister. I haven't given gold, or honey to my children.

Post-natal care

After delivery, it is our custom to bath twice. Four to five days after delivery a kashayam (ayurvedic formulation) is given. A mixture of kattu jeera (wild cumin), another variety of jeera (mustard like cumin collected from the forest), black pepper, and garlic are initially fried in a pan. Then the mixture is powdered well. Two glasses of water are poured into this mixture and boiled with lids closed, till it becomes one glass. In the evening, it is given to drink after bath and in the morning before bath. We drink this for a week. My mother had said that it is for reducing the size of tummy after delivery. Kanji (broken rice soup) is given after drinking this kashayam. Pepper and garlic are added to kanji. I haven't eaten any other medicines. For lunch, we are given rice, some green leafy vegetable (chappu), and mullan fish (dry fish). The fish is fire-roasted and not fried. At that time we didn't have any means to buy vegetables from outside. It is believed that if mother eats sardine and mackerel it will lead to itching and appearance of rashes in the skin of the child. Hot water bath is usually given under the supervision of an elder woman, usually mother or mother in law.

Girija (name changed) did not administer their traditional post-pregnancy treatment for her daughter in law as her delivery was in the hospital and she was taking medicines given from the hospital. She said that she was afraid to provide their traditional postpartum care to her daughter in law.

We should not eat Papaya during pregnancy. Till two months of pregnancy, you can eat pumpkin leaves, but not afterwards. Since pumpkin leaves have thin thorns on it, it is believed eating them will develop lines on the skin of the baby.

Care of child during illness

Earlier, for an illness like cold, they used to drink *kashayam* made using dried ginger, and pepper.

In the event of an illness, persons in our community who are well versed in providing traditional methods of treatment would visit the houses and demonstrate as to how to prepare the medicine. We later prepare it, as directed. Nowadays, traditional herbal preparations are not very effective as before. Every time we go to the hospital, doctor

gives us a number of medicines and injections. The doctor has asked me to take medicines for blood pressure and diabetes every day without fail. Hence, I am afraid to take our traditional medicines. At those times, my mother was afraid to go to the hospital. Not many hospitals and no medicines. Now things have changed.

Regarding the introduction of complementary feeding to children

After two months, we start giving ragi prepared using palm sugar candy. After 90 days or so, some children show interest to eat rice. While sitting in our lap, they may take a handful of rice from our plate. After a few days, we start giving them rice..

Traditional food habits

In olden days we got paddy in lieu of money wage (cash in kind). We prepare rice from paddy (Nellukuttu). For lunch and dinner, we eat rice. The leftover broken rice is used to prepare rice soup, and we have it in the morning. For the curry, we make one dish made from green leafy vegetables. Sometimes, we used to catch crab from the river and make a crab jackfruit nut curry or crab chutney. Now, there is no food scarcity. We get all kinds of foodstuffs from the shop-rice, vegetables, fish- and we prepare our meals. We make at least three curries daily. Still, is there any dearth of diseases?

6.5.2 Vithura

To understand the maternal and child care practices of Kani tribals in Vithura panchayat, an untrained midwife, 90 years old, belonging to Kani tribe of Thiruvananthapuram is interviewed. She has attended almost 50 deliveries. Kani tribals were helpers of Travancore Kings. By King's decree, they were given the right to settle anywhere in the forest.

Based on our place of residence, we are addressed as Malakani (living in the interior forest), Nattukani (living in the mainland) and Kani. Our forefathers were nomads and they practised slash and burn cultivation. They would clear the forest land and cultivate there for some time. Then they would move to some other place. When ministerial rule came into being, they confined us to a particular place, forbidding from entering the interiors of the forest.

They have no title deed but only possession certificate for the land owned. Kani tribals live in clusters known as a settlement area. Settlement areas are demarcated with a stone

called *janda*. The land belongs to the forest department, and they need to get prior sanction even to plant a sapling or to cut tree for their own use. From the traditional food crop cultivation (paddy, a variety of tubers), they are moving to cash crops (rubber). One reason is the destruction of food crops by wild animals.

Care of child immediately after delivery

Umbilical cord is cut using a sharpened piece of bamboo (*eera poli)*. After the umbilical cord stump of the child falls, a mixture of turmeric and ash (pukayira) is applied every day to the navel, till it is healed. It is pressed down with the thumb to prevent a bulge in the navel area. Ash is made by burning a piece of old cloth. In Kani community, the first feed is breast milk *(panchipal*). On the same day itself, newborn is given to lick *swarnam urach.* Pregnant women wear blouse and lungi to expose their tummy to early morning and evening sunrays, to prevent jaundice in infants after birth. Men belonging to Kani tribe hunt monitor lizards (*udumbu/vali)* from forest and the processed fat is stored. A minuscule quantity of such fat is given to the infant to rule out any chance of jaundice.

Postnatal care

As delivery pain progress, stomach of the pregnant lady is massaged by applying coconut oil to correctly position the child to ease delivery. Immediately after childbirth, for preserving mother's health, a small quantity of neem oil is given to drink. Mother is given rice to eat along with chutney. It is prepared using sun-dried bird's eye chilli (*kanthari mulaku*), turmeric (*manjal)* and pot tamarind (*Kudam pulli*). They are grinded using masala grinding stone to make a smooth paste. Without adding oil, it is cooked in a pot. Like this, it is given for nine days. For preparing another side dish, sun-dried pot tamarind is soaked in water and is grinded to make a smooth paste. Ginger, pepper, garlic, jeera are also grinded and added to this tamarind paste. It is cooked without adding oil or mustard seed. Usually, oil is not added while preparing foods because they believe it will quickly heal wound inside the stomach. Banana and brinjal have stains and hence are not given to the mother.

A variety of porridges are given to the mother after delivery, from fifth day onwards till 16 th day.

Porridge prepared using coconut flower, raw rice and jaggery.

Porridge prepared using little tree plant (*mukkutti)*, raw rice and jaggery.

Porridge prepared using Ceylon slitwort *(thumbapoo)* juice and jaggery

Tonic and ayurvedic formulation is purchased from raw herb sellers (*angadikada*)

Starting from the next day of delivery till 16th day, hot water bath is given to the mother. Days are also considered while deciding when to start the bath. It is not started on Wednesday and Saturday. Once the pot for preparing hot water bath is placed in the pottery kiln, it is taken off the kiln after 16th day. The water is drawn from the pot carefully, as they believed that if water drips and falls into the furnace, it will cause burns on the skin of the infant. Different kinds of locally available herbs and creepers are used to prepare hot water.

Culture

After delivery, there is a custom known as *Muunu kuli*. On Fridays and Tuesdays, Mountain God (*Mala daivam*) is given offering of betel leaf, areca nut, puffed rice, flattened rice, incense sticks, banana, and alcohol (*Padukka*) in a special place designated in their settlement (*kallam*). The child is applied kajol on the ninth day (*onpathamkulli*). Thread ceremony (*noolukettu*) is done on the 28 th day after child is born. On that day, early morning, an offering (pongala) is made to God. The thread which is to be tied around the waist of the child is dipped in turmeric water before it is tied. Pregnant women are not allowed to go to the temple from first month of pregnancy as they are considered unclean (*Thodakuu/theendal*). After six months, for child's rice giving ceremony (child's solid food giving ceremony), they go to the temple. First complementary feed is rice (*echil*). Most popular complementary feed is ragi porridge, prepared using jaggery.

Traditional Food habits

> *In the past, we ate a variety of tubers (neduvanam, tapioca, elephant foot yam, sweet potato, Taro (chembu)) collected from forest as well as cultivated in their neighbourhood. It ripens in the Malayalam month of Karthika (July- August) and is collected and stored for use throughout the year. Diverse preparations (charcoal cooked tapioca, mashed tapioca etc) were made using these tubers and it was the staple diet. Tubers, along with cooked green leafy vegetable preparations (drumstick leaf, pumpkin leaf) are mostly eaten for breakfast and lunch. We eat rice only for dinner. We used to cultivate vegetables (brinjal, bitter gourd, ladies finger, pumpkin) in our homestead and catch fish from rivulets. But nowadays, our traditional eating patterns have been, to a large extent, replaced by market purchased produces.*

It is believed that if papaya, pineapple, kanam, a variety of river fish (elameen), mukkizhangu are eaten by a pregnant woman, it will lead to abortion. Unwed mothers used to eat these kinds of foods to terminate pregnancy. Now also, pregnant women in their settlement avoid such kind of foods.

Care of children during illness

Medicated oil is prepared using champak flower and coconut oil, for curing skin disease like Eczema (*Karappan*). For cold, medicated oil is prepared using Indian Rock-Foil *(Panikoorka),* pepper, and Tulsi. For mild cold and fever, palm sugar coffee is given to older children. Stomach related ailments, *uramarunnu* is given.

There has been a change over the years in the dietary pattern of tribals. Janani Janmaraksha scheme by Government of Kerala provides financial assistance of Rs 2000 per month to pregnant tribal and breast-feeding mothers from the third month of pregnancy till the child turns one. The main aim of the scheme is to enable pregnant and lactating women to access nutritious food through direct cash transfer. The indirect benefit of the scheme has been a spurt in the number of institutional deliveries. The traditional medicines are not used widely, because they are afraid to administer their indigenous treatments along with English medicine (allopathy).

6.6 Conclusion

The determinants of normal weight for age in Vithura were asset position and age of the child (‘13 to 36 months’) whereas in Thirunelly, it was influenced by maternal BMI status, birth interval and time of initiation of complementary feeding. Qualitative analysis could effectively capture the elements hidden in quantitative methods. The major risk factors of anthropometric failures emerging from qualitative analysis were familial discord, filthy environment, pregnancy complications, late or early introduction of complementary feeding etc. High level of nutrition awareness was visible among mothers in general.

CHAPTER 7
FINDINGS AND CONCLUSION

7.1 Introduction

Malnutrition among children under five is a public health concern and it impedes the rapid development of a nation. Nutritional security is a multi-dimensional aspect that needs involvements in gaining access to sufficient food, health services, maternal care, along with optimal child feeding practices, improved sanitary environment and knowledgeable care resources. Micronutrient deficiencies and nutritional transition, has led to the triple burden of malnutrition and rising toll of NCDs, the result of which is enormous costs to the economy.

7.2 Issues, Research Gap

Most of the studies at micro-level focused on the high burden malnutrition states in India. Though Kerala is far ahead of other states concerning health and nutritional indices, the triple burden of malnutrition is an emerging issue of concern, and the nutritional outcome of marginalized groups in Kerala is far behind that of other social groups. Even within districts with a considerable size of tribal population, there are wide inter-district variations in nutritional status. Several existing micro-level studies have either focused on studying the nutritional outcome of either children of tribal communities or children of 'other communities' separately, and majority of them were confined to a specific district, area or a sect of tribal population. The present study is undertaken in two tribal dominated panchayats of two districts in Kerala. The study gains relevance as no inter district comparison of nutritional outcome of preschool children (0-5 years) as between tribal and nontribal population and their mothers have been undertaken so far.

7.3 Objectives

(1) To study the changing context of the nutritional status of children under five and women across the states of India.
(2) To analyse the IYCF practices and maternal health care indicators across the selected states.
(3) To look into the panchayat specific determinants of nutritional outcome among preschoolers in the study area.

(4) To explore the community-specific child care and maternal care customs and traditions practised in the study area.

7.4 Methodology

Using secondary data sources, the trends and patterns in child nutritional outcome at national and state level are analysed . Certain indicators related to IYCF are assessed across states and group of states. Rank correlation matrix, coefficient of variation, and averages are used.

For primary data collection, the study employs multi-stage sampling technique. From the Kerala average of stunting, wasting and underweight, mean absolute deviation of anthropometric indicators, scaled by state average, are calculated for the six districts. In this backdrop, a cross-sectional analysis is conducted among 189 and 242 preschoolers in tribal-dominated panchayats of Vithura and Thirunelly respectively. Quota sampling procedure is employed, and proportional weightage is assigned for the socio-demographic characteristics such as gender and caste, in the sampling design, as revealed from respective District Census Handbook, 2011. Samples were randomly selected with the assistance of ASHA workers, Anganwadi teachers and tribal promoters. The study uses a mixed-method for data analysis. Quantitative led qualitative method has been employed. For primary data collection, a pretested structured interview schedule is used to elicit information regarding socio-economic, household, child, maternal characteristics and child feeding practices, and the respondents were the mothers of the children. Anthropometric assessment is done using WHO child growth standards. The study explores, using ethnographic content analysis, pregnancy and post-pregnancy care to mothers, IYCF practices, nutrition awareness and care of children during illness in the study area. The traditional practices and customs followed specifically by tribals for preserving and maintaining maternal health, and child health are also assessed. Univariate, bivariate analysis and logistic regression are employed. Statistical techniques used are mean, standard deviation, Z score, chi-square, and ANOVA.

Chapter 1 deals with introduction, statement of the problem, need for the study, objectives, data source, methodology and limitations.

Chapter 2 discusses issue wise review of literature.

Chapter 3 looks into trends in nutritional status of children under five and women in India and Kerala, IYCF practices, maternal health care indicators across the selected states of India using NFHS data, child and maternal care indicators for selected districts of Kerala.

Chapter 4 gives an overview of the socio-economic demographic profile, child characteristics, health and nutritional profile, and dietary assessment of preschoolers and their mothers in the study area.

Chapter 5 deals with the association of anthropometric failures, namely stunting and wasting, by selected characteristics, namely socioeconomic, parental, utilization of health care services, child and child feeding variables. Determinants of nutritional status are also ascertained.

Chapter 6 focusses on determinants of weight for age. A qualtitative analysis of infant and young child feeding practices, child and maternal care customs in the study area are also analysed.

Chapter 7 discusses the major findings and suggestions from the study.

7.5 Limitation of the Study

(1) Clinical assessment of nutritional status is not attempted.

(2) Assessing nutritional status using anthropometric methods reflect only the current nutritional outcome.

(3) Head of the household were not the primary respondents.

(4) The study is confined to two tribal dominated panchayats.

7.6 Major Findings

7.6.1 Macro Level Findings

- Rural-urban differential in nutritional outcome remains unaltered over the last ten years.
- The marginalised groups are at a disadvantage with respect to health and nutritional status indicators.

- In NFHS 3, coefficient of variation among states is largest in case of wasting whereas, in NFHS 4, it is for underweight.
- As compared to wasting, the rank correlation coefficient of stunting and underweight are very high and positive.
- Despite overall improvements in stunting, wasting and underweight across the country, the relative status of states remain the same.
- The prevalence of nutritional indices indicates that the majority of North Eastern states performed better.
- The relative better performance of Kerala and Tamil Nadu is due to the strong political will, successful implementation of PDS, and efficient working of Anganwadis.
- States with the lowest percentage of underweight children may not be good performers.
- The percentage of children receiving MMF is higher compared to the percentage of children receiving MDD and MAD. Though the children are provided with minimum meal frequency, the diet is not diverse.
- Though the group of low vulnerable states perform relatively better in terms of indicators pertaining to IYCF, its percentage is very low. Inadequate IYCF are responsible for poor nutritional outcome, but improvements in feeding practices can undoubtedly address the problem and can break the chain of malnutrition.

7.6.2 Micro Level Findings

- In Vithura, C Section deliveries among non-tribals are higher compared to tribals. In Thirunelly, C Section deliveries are lower in both categories. Tribals in both Vithura and Thirunelly prefer Government hospital whereas services of private health care providers are more utilized by non-tribals for delivery.
- Hospitalisation episode was more in Vithura than in Thirunelly.
- In Thirunelly, as the educational qualification of parents increases, the index of disease vulnerability declines.
- More than 80 per cent of infants were introduced complementary feeding after six months in both the panchayats.
- Mothers in both the study area are deficient in energy intake when compared with RDA. Non-tribal mothers have more protein levels compared to tribals in Vithura,

whereas tribal mothers in Thirunelly have more protein levels compared to their nontribal counterparts.

- Child protein difference from RDA indicates that children in both the panchayats have an excess of protein when compared with RDA.
- Panchayats combined, 45 percent of children are stunted- 38 percent in Vithura and 52 percent in Thirunelly.
- Stunting is higher among tribals.
- In panchayats combined, there is significant association of stunting with caste, total household expenditure, presence of another child less than 5 years and asset ownership status. There is significant relationship of stunting with caste, total expenditure, asset ownership (all at 5 percent level) and number of family members (at 10 percent level) in Vithura. Whereas in Thirunelly, it is significantly associated with caste, asset ownership and possibility of another child below five years.
- Stunting is lower among children whose mothers have more schooling, association is not statistically significant overall as well as in two panchayats separately.
- Panchayats combined, there is significant association of stunting based on the education levels of father. There is no significant relationship between stunting and relative difference in education levels of parents.
- Stunting is significantly associated with maternal age at time of childbirth, education, height, BMI, and father's education (combined). In Vithura, there is significant association between stunting and mother's age at childbirth and maternal height. In Thirunelly also, stunting is significantly related to maternal BMI, and mother's age at childbirth.
- At 5 percent level of significance, overall as well as in both the panchayats individually, there is no significant relation between stunting and number of anti-natal check-ups, type of delivery and intake of iron-folic and calcium tablets. No clear statistical evidence on relation between stunting and place of delivery is seen in Vithura and Thirunelly separately.
- When combined, there is significant association between stunting and place of delivery.
- The association between stunting and birth weight of child is statistically significant in panchayats combined and Thirunelly, whereas it is not statistically significant in Vithura.

- The proportion of stunting increases among children, as the birth order increases, but the association is not significant.
- At liberal level, the association between stunting and child being full term or not is statistically significant in Vithura.
- The association between stunting and frequency of food intake is statistically significant for the combined sample (5 percent level) as well as for Vithura and Thirunelly separately (10 percent level).
- Though for both the panchayats combined, there is significant difference in the proportion of stunted children on the basis of the time of initiation of breastfeeding, the difference is not statistically significant for each of the panchayats individually.
- The proportion of stunting is higher among children of Thirunelly (57.6 percent) who were given supplementary feeding between 3 and 6 months, compared to similar children of Vithura (38.5 percent).
- Logistic regression analysis show that non-tribal children are 1.83 times more likely to be normal height for age. Children belonging to families with high asset possession are 1.59 times more likely to be normal (at liberal level). Children in the age group '37-59 months' are 2.763 times likely to become normal. A change in BMI status to normal and overweight and age group of children '13 – 36 months' are statistically significant predictors only at a liberal level.
- In the case of Vithura, caste (OR=2.503, p=0.054, 95% C.I:0.984, 6.366) is the only statistically significant predictor.
- Normal BMI status (OR=2. 023, p=0.039, 95% CI =1.036, 3.951), and age of child between 37 and 59 months (OR=4. 599, p=0.002, 95% CI =1.717, 12.317), were identified to be the only statistically significant predictors of normal height for age in Thirunelly.
- For the combined sample, wasting is significantly related to asset ownership; at liberal level there is association of wasting with number of family members and type of house.
- In Vithura, wasting has significant association with type of house and asset ownership.
- In Thirunelly, at liberal level (10 percent level), wasting is significantly associated with caste, number of family members, and type of house. Wasting is also significantly associated with asset ownership (5 percent level).

- Wasting is significantly associated with maternal BMI and paternal education for combined sample alone.
- In panchayats combined and separately, there is no significant association of wasting with age of mother, maternal education, relative difference in parental education levels, maternal height, and occupation of mother.
- At liberal level, wasting is significantly associated with age of mother at childbirth in Thirunelly.
- The percentage of wasting is higher among the children whose mothers are irregular in taking iron folic and calcium tablets, the association is not statistically significant for panchayats combined and separately.
- For the combined sample, there is significant relation between wasting and place of delivery.
- Only in Thirunelly panchayat, there is significant association between wasting and age of the child.
- For combined sample and panchayats separately, wasting is not associated with the gender of child.
- In Vithura and Thirunelly combined and separately, there is no significant association of wasting based on birth weight, birth order, and duration of birth interval.
- There is significant association between wasting and child feeding interval (combined and Thirunelly.
- For the combined sample, high asset group was found to contribute to normal weight for height. Any change in reference category from low asset group to high asset position results in 3.120 fold increase in child being normal. The change in mother's BMI status from normal to overweight decreases the likelihood of wasting. Similarly, age of the child '37 – 59'months is also identified as a statistically significant predictor of wasting at liberal level.
- In Vithura, caste increases the chance of wasting. A change in asset position, age of the child from reference category to either '13-36 months' or '37 to 59 months', and improvement in initiation of supplementary feeding from 'less than six months' to 'more than six months' increases the possibility to become normal.
- In Thirunelly, the odds of being normal are significantly higher for children belonging to families with high asset possession. A change in BMI status of mother from reference category to overweight increases the odds of being normal. A change in the

age of the child from reference category to the age group of either ‘13-36 months’ or ‘37 to 59 months’ decreases the likelihood of being normal.

- Underweight is significantly associated with caste and asset ownership (combined). In Vithura, association is seen only in asset ownership.
- Underweight is not significantly associated with number of family members, type of house, total expenditure and possibility of another child less than five years for the panchayats combined and panchayats separately.
- There is significant association between underweight among children and paternal education (Combined).
- At 5 percent level of significance, for both the panchayats combined and separately, there is significant association between underweight and maternal height.
- Overall as well as in Vithura panchayat alone, there is significant association between underweight and sector in which the father is working. Underweight is not significantly associated with age of mother, age of mother at childbirth, difference in parental education levels and occupation of mother.
- Overall as well as in both panchayats individually, underweight is higher among children whose mothers were irregular in the intake iron-folic and calcium tablets, the association is not statistically significant.
- For combined sample and in Vithura alone, underweight is significantly associated with place of child delivery.
- In Thirunelly, the percentage of underweight children increases as the age of the child progresses.
- For panchayats combined, there is significant association of underweight with birth weight of the child and frequency of diarrhoea. In Thirunelly, significant relation is found between underweight and birth weight of the child.
- Underweight and child feeding interval is significantly associated with combined sample and Thirunelly.
- In the logit model, a change in reference category of asset position, BMI status (overweight), and initiation of complementary feeding increases the odds of being normal weight for age (combined).
- In Vithura, a change in the reference category of asset position and age of the child ‘13 to 36 months’ are significant predictors of normal weight for age.

- In Thirunelly, a change in the reference category of BMI status (overweight), birth interval (more than two years) and initiation of complementary feeding significantly increases the likelihood of being normal weight for age.
- Nutrition awareness was less among tribal mothers of Thirunelly.
- Irrespective of caste and panchayat differences, breastfeeding is initiated immediately after delivery.
- In Thirunelly, mothers prefer to include in their diet locally available to market purchased fruits.

7.7 Policy Suggestions

- Anganwadis, while monitoring nutritional status of children, assign more importance to weight for age. To get a comprehensive picture of a child's nutritional status, all three indicators of nutritional outcomes need to be considered simultaneously.
- Region and ethnicity-specific child growth standards can better monitor the nutritional status of children.
- Caste is a reality, but improvements in socio-economic status of marginalized communities should focus on strengthening their asset position, land ownership, education, status of women, utilisation of health care and government nutrition interventions.
- Macro-level data is collected once in ten years. Monitoring surveillance should be done periodically, with the assistance of local self-governments. Targeted interventions in high risk groups.
- Familial discord is a risk factor for undernutrition. Anganwadi teachers are in a better position to know the happenings in a family, as it may be disclosed to them by the children. Anganwadi teachers should be given basic training in counselling parents.
- Mother's should be encouraged to maintain a kitchen garden so that it can complement the intake of locally available fruits and vegetables.
- Access to tertiary care needs to be enhanced.
- Nutrition awareness can complement formal education and should be made an integral part of academic curriculum.

7.8 Concluding Remarks

In spite of progressive social and health policies followed by Kerala, anthropometric failures are rampant among tribal children. The levels of utilization of Anganwadi services are relatively less among tribals, and the need of the hour is to increase its utilization rate. Maternal education, nutrition awareness, optimal infant and young child feeding practices, improving health care access, water, sanitation and hygiene practices, and all-inclusive social protection system can help reduce the burden of malnutrition.

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AIR POLLUTION AND NUTRITIONAL TRANSITION AS RISK FACTORS FOR NON-COMMUNICABLE DISEASES : THE EMERGING TRENDS IN HEALTH SCENARIO OF KERALA, INDIA

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Abstract

India is confronted with the challenge of tackling the twin burden of communicable and non-communicable diseases (NCDs). Combined effects of air pollution and changes in dietary pattern have accentuated the problem of NCDs and over nutrition(obesity). The paper uses secondary data sources, National Family Health Survey, 4(2015-16), Kerala Economic Reviews, and India: Health of the Nation's states report, 2017 to review the risk factors and the incidence of major non-communicable diseases in India and Kerala. India has a disproportionately high burden of cardio vascular diseases, followed by chronic respiratory diseases, cancer and diabetes. In Kerala, the sharp rise in prevalence of NCDs were associated with gradual process of urbanization, the phenomenal reduction in the cultivated area of paddy and all pulses and the enormous increase in poultry and meat consumption, access to labour saving techniques ,the rise of various non-farm sectors, and especially the emergence of service sector. Though demographic dividend provides us a window of opportunity, the same would act as a double-edged sword as both the younger and the older people are equally prone to NCDs. The problem of increased burden of NCDs will remain unresolved until and unless both behavioural modifications at micro level and environmental protection at macro level are intensively addressed.

Keywords: Non Communicable Diseases, double burden, nutritional transition, air pollution.

Introduction

Close link between environmental pollution and non-communicable disease burden is widely recognised (India: Health of the Nation's states report 2017). Rapid industrialisation and economic growth brought to the forefront the risk of environmental degradation. Environmental issues and loss of biodiversity affects agriculture, food production, health and nutrition. Now, the focus has shifted to achieve the dual objectives of growth with sustainable development. Sustainable development looks into the aspirations of the present generation, without compromising the needs of the future generations (Brundtland Report 1987). Sustainable development without environmental protection would endanger not only the eco-system but also the health parameters of the population. The India State Level Disease Burden Initiative Report, conducted as a part of the Global Burden of Diseases, Injuries and Risk Factors Study (GBD) 2016, found that air pollution emerged as the second largest risk factor in India, the first being malnutrition (as cited in India State Level Disease Burden Initiative Air Pollution Collaborators 2019). In India, out of 1.24 million mortality in 2017, 12.5 percent of the deaths were due to air pollution (India State Level Disease Burden Initiative Air Pollution Collaborators 2019). Studies from across the globe established links between air pollution and noncommunicable diseases, particularly chronic obstructive pulmonary disease (COPD) and cardio vascular diseases (Cohen *et al*., 2017). Improved air quality in high income countries resulting from stringent legislative measures implemented by them led to a decline in the world wide mortality rates due to $PM_{2.5}$ as between 1990 and 2015, whereas mortality and Disability Adjusted Life Years (DALYs) due to NCDs have accentuated in India and China (Cohen *et al*. 2017).

Nutritional transition and air pollution

Epidemiological and nutritional transition along with air pollution have increased morbidity and mortality due to NCDs. Rapid revolution in health sector led to an epidemiological transition, resulting in a demographic dividend and high incidence of NCDs, namely cardiac ailments, hyper tension, diabetes and cancer (Omran 2005; McKeown 2009). NCDs have taken precedence over communicable diseases (Wahdan 1996) and it results in morbidity and premature deaths leading to a loss of productivity and human capital. More recently, across the globe there have been onslaught of new communicable diseases like SARS, Nipah, COVID 19 etc and the resurgence of diseases in mutated or drug resistant variants which had been eradicated earlier (Wahdan, 1996).

Nutritional transition refers to the shift in dietary and physical activity patterns, accompanied by demographic, and socio-economic changes (Popkin 2006). It has brought changes in the nutritional outcome, a major factor for the high incidence of obesity and a rising tide of NCDs. Globally, there has been a shift in dietary patterns-Western diet, replacing the traditional pattern of food (Kennedy 2008). Increasing urbanization, shift in consumption pattern from a higher proportion of carbohydrate based foods to one with lower carbohydrates, along with diversified foods like animal products, fat and excessive use of sugar, resulted in nutritional transition (Hawkes 2006; Popkin 2006). The role of mechanisation, labour saving device, block chain and artificial intelligence entail less physical activity, affecting the entire life styles and is precipitated by changes in energy expenditure (Popkin 2006). These emerging issues stress the need to address the problem of tackling obesity and NCDs. Countries are grappling to simultaneously address the issue of overweight and obesity on one hand and under nutrition on the other. 'South Asian enigma' is still a puzzle that economic growth did not result in improved nutritional

outcome (The World Bank in India 2009). Malnutrition is cited as one of the major causes of child mortality (The World Bank in India 2009). In the fifth assessment report of the Inter-Governmental Panel on Climate Change (IPCC), 2014, malnutrition is treated as one of the five largest adverse health impact of climate change.

Materials and Methods

The paper makes use of secondary data sources, like National Family Health Survey 4 (NFHS), Comprehensive National Nutrition Survey 2019, Kerala Economic Reviews, Global burden of disease study 1990-2016 and 2017, and India: Health of the Nation's states report to review the risk factors and the incidence of major non-communicable diseases in India and Kerala.

Non-communicable diseases in India

Non communicable diseases (NCDs) are chronic in nature, a result of genetic, physiological, environmental and behavioural factors. Air pollution was identified as a risk factor for NCDs, along with other risk factors like tobacco use, physical inactivity, harmful use of alcohol and unhealthy diets (WHO European High Level Conference on Non Communicable Diseases 2019). Globally, a healthier environment could have averted twenty three percentage of all deaths (WHO 2017). Metabolic risk factors are high blood pressure, overweight, hyperglycaemia etc. The poverty alleviation measures of less developed countries are often hampered due to increased out of pocket spending on NCDs, as most of these diseases require continuous medication and treatments.

Results and Discussion

The report 'India: Health of the Nation's states – The India State Level Disease Burden Initiative', 2017 gives a comprehensive picture of non communicable disease burden across the states of India. The Global Burden of Disease Study 2017, tried to assess the impact of air pollution on deaths, disease burden and life expectancy across states of India (India State Level Disease Burden Initiative Air Pollution Collaborators 2019).

In 2017, the annual population-weighted mean exposure to ambient particulate matter in India was 89·9 μg/m³ and 76·8% of the population were exposed to annual population-weighted mean exposure above the limit recommended by the National Ambient Air Quality Standards in India (40 μg/m³)(India State - Level Disease Burden Initiative Air Pollution Collaborators 2019). 1·24 million deaths in India in 2017, which were 12·5% of the total deaths, were attributable to air pollution and had 26·2% of the global air pollution DALYs in 2017.

Table 1 gives the total deaths (in absolute number and percentage) due to major NCDs in India as between 1990 and 2016 India has a disproportionately high burden of chronic respiratory diseases. In India, chronic respiratory diseases caused 10.9 per cent of the total deaths and 6.4 per cent of the total DALYS in 2016 (India State - Level Disease Burden Initiative CRD Collaborators 2018). Two prominent chronic respiratory illness were COPD and asthma and they were responsible for 75·6% and 20 per cent respectively of the total DALYs due to chronic respiratory diseases in India in 2016. Air pollution was the leading risk factor for COPD .Cardiovascular diseases contributed to 28·1% of the total deaths and 14·1% of the total DALYs in India in 2016, compared with 15·2% and 6·9% respectively, in 1990. The overlapping risk factors for cardiovascular diseases in 2016 included dietary risks, high systolic blood pressure, air pollution, high total cholesterol, tobacco use, high fasting plasma glucose, and high bodymass index (India State - Level Disease Burden Initiative CVD Collaborators 2018).

Health loss resulting from diabetes, is the highest among major noncommunicable diseases. The number of people with diabetes in India increased from 26·0 million in 1990 to 65·0 million in 2016. Its prevalence in 2016 was highest in Tamil Nadu and Kerala (India State - Level Disease Burden Initiative Diabetes Collaborators 2018). The most important risk factor for diabetes in India was overweight. Between 1990 and 2016, number of new cases and deaths due to cancer has doubled in India. In 2016, 8·3% of the total deaths and 5·0% of the total DALYs were due to cancer. Crude cancer incidence rate in 2016 was highest in Kerala (135.3), compared to 74.1 in 1990 (India State - Level Disease Burden Initiative Cancer Collaborators 2018).

Table1 : Total deaths(in absolute number and percentage) due to major NCDs in India as between 1990 and 2016.

NCDs	2016	1990
Cardio Vascular	54.5 Million(28.1)	25.7 Million(15.2)
COPD	55 Million(10.9)	28 Million(9.6)
Cancer	1.06 Million (8.31)	0.55 Million
Diabetes	65 Million (3.1)	26 Million

Source: India State-Level disease burden initiative CRD collaborators; India State-Level disease burden initiative CVD collaborators; India State-Level disease burden initiative cancer collaborators, India State-Level disease burden initiative diabetes collaborators

Emerging health scenario of Kerala

Kerala model of health- good health at low cost – had started to face crisis as early as 1980s (Ekbal 2017). Panikkar and Soman(1985) pointed out that while mortality was low in Kerala, the prevalence of morbidity was found to be quite high; more people perceive themselves to be sick compared to other states in India (as cited in Ramankutty 2012). Rampant modernisation and urbanisation, drastic lifestyle changes, high alcohol and tobacco consumption, affinity for white collar jobs, unhealthy eating patterns, and less physical exercise, increase in stress levels contribute to the high prevalence of non-communicable diseases in the state (Kerala Economic Review 2017). In India 42 per cent of total deaths are due to NCDs, where as in Kerala, more than 52 per cent of the total deaths in the productive age group of 30 and 59 are due to NCDs (Kerala Economic Review 2017). Twenty seven per cent of Kerala adult males have diabetes compared to 15 per cent at national level and 19 per cent of adult female population is diabetic compared to 11 per cent in India. Genetic predisposition, dietary habits and sedentary lifestyle are considered to be the reason for this phenomenon (Kerala Economic Review 2017).In spite of Kerala's striking achievements in the health parameters (NFHS 4), Kerala is the most morbid state. Morbidity in Kerala is more than three times the all India average. The percentage of persons that responded as ailing (PPRA) in a 15-day period, in India was 7.5 percentage, this was 24.5 percentage in the state. PPRA in other states ranged between 6 percentage and 9 percentage (National Sample Survey 75th Round 2019).Comprehensive National Nutrition Survey (CNNS) reports that one in every five children (20.5%) are stunted (CNNS 2019). The

corresponding figures was 15.5% in Jammu and Kashmir. Kerala is behind J&K, Goa and Tamil Nadu. Around 9.5 per cent of adolescents are overweight, compared to 4.8 per cent in all India level, 32.2 percent in the age group 10-19 years are in pre diabetic condition and the prevalence of high total cholesterol is 13.9 percent (CNNS 2019).

Risk factors of NCDs

National Family Health Survey 4 (NFHS) 2015-16, fourth in the series of NFHS surveys initiated in 1990s , provides nation wide data on maternal, child health , other health issues and provides estimates of blood glucose levels and blood pressure levels among women (aged 15-49 years) and men(15-54 years) for all India, state level and district level. Blood glucose levels and elevated blood pressure are metabolic risk factors for NCDs.

NFHS 4(2015-16) data on the percentage of underweight children and prevalence of Acute Respiratory Infection among children in the last two weeks preceding the survey, nutritional status of adults whose BMI is below normal and who are overweight, blood sugar levels and hyper tension among adults at all India and state levels are used to assess the risk factors for NCDs. A comparison of the above said indicators, as between India and Kerala, reveal that in terms of child nutritional indicators, Kerala fares better compared to all India average. The prevalence of high levels of child under nutrition is to be viewed as an opportunity to approach this menace in a wider perspective. Apart from anthropometric failures, other indicators of child health and well being are to be looked into. Children in Kerala are doing better in terms of health parameters like infant mortality rate and child mortality rate (Kerala Economic Review 2019). The percentage of underweight children in Kerala is only 16.1 per cent compared to 35.8 per cent at all India. Anaemia incidence among children in the age group 6-59 months in Kerala(35.7 per cent) is lower than the national average (58.6 per cent), still the incidence of anaemia is worrisome. In addition to other factors, outdoor air pollution is associated with paediatric acute respiratory infection (ARI) (Romieu *et al.,* 2002). The air quality index of Kerala is better, hence the percentage of children with ARI is less compared to all India. In Kerala, the percentage of overweight or obese men and women (28.5 per cent and 32.4 per cent) far exceeds the all India average. Females are more prone to obesity compared to males in both India and Kerala. The incidence of both diabetics and hyper tension are higher in Kerala.

Table 2: Comparison of Child and Adult Nutritional Indicators and metabolic risk factors for NCDs as between India and Kerala (in percentage)

	Kerala	India
Child Nutritional indicators		
((a) Under weight	16.1	35.8
(b) Children aged 6-59 months who are anaemic	35.7	58.6
Nutritional status of adults		
(a) Women whose BMI is below normal (BMI<18.5 Kg/m^2)	9.7	22.9
(b)All women age 15-49 years who are anaemic	34.3	53.1
(c) Women who are overweight/obese	32.4	20.6
(d) Men whose BMI is below normal (BMI<18.5 Kg/m^2)	8.5	20.2
(b) Men age 15-49 years who are anaemic	11.7	22.7
(c) Men who are overweight/obese	28.5	18.9
Childhood illness		
Prevalence of ARI in the last two weeks preceding the survey	0.8	2.7
Blood sugar level among adults		
High blood sugar level(Women)	8.7	5.8
High blood sugar level(Men)	13.1	8.0
Hyper tension among adults		
Moderately high (women)	0.8	1.4
Moderately high (men)	1.3	2.3

Source : NFHS 4

The disaggregated analysis of 'Kerala: Disease Burden Profile 1990-2016' rings a wake up call to revamp the health sector of Kerala. Among the leading causes of DALYs, in 1990 ischaemic heart disease was 7.1 per cent, rose to 12.2 per cent in 2016; COPD caused DALY was 3.7 per cent in 1990, increased to 4.4 percent in 2016 (India: Health of the Nation's states report 2017). Table 3 gives the top five risk factors leading to death and disability combined as between 1990 and 2016 in Kerala. In 1990, malnutrition was the dominant risk factor driving most death and disability combined, whereas in 2016 high blood pressure is the leading risk factor. Malnutrition resulted in 17.4 per cent of DALY, out of total DALYs in 1990. In 1990, behavioural categories were prominent compared to environmental and metabolic category. Whereas in 2016, out of five risk factors, four were from metabolic category. This clearly indicates that the risk factors for NCDs are high in Kerala.

Table 3: Risk factors of Kerala as between 1990 and 2016.

Risk factor 1990	Risk category (1990)	Risk factor 2016	Risk category (2016)
Malnutrition (17.4 %)	Behavioural	High Blood Pressure (13.4 percent)	Metabolic
Air pollution (9.3 %)	Environmental	Dietary risk (11.2 %)	Behavioural
Dietary risk (8.1 %)	Behavioural	High fasting plasma glucose (11.1 %)	Metabolic
High Blood Pressure (7.9 %)	Metabolic	High Body Mass Index (7.6 %)	Metabolic
Tobacco use (6.5 %)	Behavioural	High total cholesterol	Metabolic

Source: India: Health of the Nation's states- The India State Level Disease Burden Initiative report, 2017
Note: The percentage in bracket is DALYs from that risk out of the total DALYs.

In Kerala, the nutritional transition is associated with gradual process of urbanization, the phenomenal reduction in the cultivated area of paddy (779000 Ha in 1960-61 to 198000 Ha in 2018-19) and all pulses (44000Ha in 1960-61 to 950 Ha in 2018-19) and the enormous increase in poultry (152(in lakhs) in 1982 to 298 (in lakhs) in 2019) and meat consumption (Kerala Economic Survey 2019), access to labour saving techniques, the rise of various non-farm sectors, and emergence of service sector reduced the extent of physical activity, resulting in a sharp rise in the prevalence of NCDs. The NRI remittances to Kerala to the tune of Rs 85,092 crores (Rajan and Zachariah 2019) has made a dent in the pattern of consumption. A study by Gill *et al.* (2015) analysed the environmental impact of dietary changes due to nutritional transition in Brazil, China and India, using supply data from FAOSTAT. The increase in cereal supply in China and India had a major impact on nitrogen and phosphorous cycle and increase in beef supply had impact on green house gas emissions.

Conclusion

To tackle the problem of the rapid increase in NCDs, an imperative approach and cross cutting policies at national and regional levels are required. The assessment of the impact of dietary changes and the leading causes for high incidence of non communicable disease is a rather complex task. India still remains home to the world's largest percentage of under nourished population, along with high incidence of NCDs. The Kerala model of development is debatable, in the context of ever-increasing burden of NCDs. Nutritional transition along with lower environmental pollution is expected to have better health outcome. Similarly, changes in dietary pattern culminates in a drift in the type of foods produced, thereby impacting the environment. The shift from cereal consumption to meat, dairy products, emergence of eating out and subsequent intake of junk foods have added fuel to the burden of non communicable diseases. This situation calls for comprehensive studies and evaluation to make our population healthier and more productive.

Objectives

(1) To review the risk factors of non communicable diseases in India

(2) To look into the emerging health crisis of Kerala

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Paper Presentation Certificate

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INDIAN HEALTH ECONOMICS AND POLICY ASSOCIATION (IHEPA)

on

SOCIAL DETERMINANTS OF HEALTH

IHEPA | NISER | IIPS | Indian Council of Social Science Research | Azim Premji University

Certificate of Participation

This is to certify that

Mr/Ms/Dr Anju Susan Thomas

presented a paper entitled **Nutritional Outcome among Women and Pre School Children in India, with Particular Reference to Kerala: Evidence from NFHS** *in the 8th Annual Conference of IHEPA held at National Institute of Science Education and Research (NISER) Bhubaneswar during January 23-24, 2020.*

Secretary
IHEPA

President
IHEPA

Local Organising Secretary
NISER

Paper Presentation Certificate

UNIVERSITY OF MALAYA

PENA

INTERNATIONAL CONFERENCE ON RESEARCH INSIGHTS ON SOCIAL SCIENCE, LITERATURE, SCIENCE AND LAW

20 & 21 FEBRUARY 2020

ST. THOMAS COLLEGE, KOZHENCHERRY, PATHANAMTHITTA, KERALA, INDIA

(Affilated to M.G. University, Kottayam, Kerala)

Certificate of Appreciation

This certificate is awarded to Prof./Dr./Mr./Ms. Anju Susan Thomas

of Govt college for Women, Trivandrum for having been **Attended/Presented a paper** ~~**(In absentia)**~~

titled Indicators of Nutritional Status among Children under 5 and Mothers among Indian States: Evidence from NFHS

at the International Conference on Research Insights on Social Science, Literarture, Science and Law held during 20 & 21 February 2020.

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APPENDIX

Appendix 1: Interview Schedule

A Research study on health and determinants of nutritional status of Pre- school children and their mothers

Note: All the information collected will be kept confidential and will be used only for research purposes

Date:

Phone Number:

1.Name of the panchayat:	
2.Ward no. House No.	
3.Caste Religion Name of the tribe:	
4. Name of the Head of the Household	Head of the household: M/F

5.Type of family: (1) Nuclear; (2) Joint; (3) Extended

6.Total number of family members living in the household

7. Type of house: (1) Kutcha (2) Semipucca (3)Pucca

8.Type of flooring: (1) Cow dung (2) Cement(3) Tiles

9. How many rooms are there in the house excluding the kitchen

10. Whether the house is electrified or not? (1)Y (2) N

11.Extent of land owned

12.Nature of possession of land owned? (1) Title deed(2) Possession (3) Others, specify

13. Source of drinking water: (1)Own well (2) Public well(3) Public tap (4)Pond (5) Others

14.Chlorination? (1) Yes (2) No

15. Distance to the source of drinking water (1 km=half hour walking distance)

16 .Do you boil water before drinking?(1) Y(2)N

17.How often do you clean the house? (1)Daily (2) Weekly

18.Fuel for cooking (1) Kerosene(2) twigs (3) Gas (4) electricity

19.What kind of toilet facility do you have in your house? (1)Own flush toilet(2) Public flush toilet (3)others

20. Drainage facility (1)Open drain (2)Closed drain

21. Ownership of assets

Asset	1=Yes; 2=No
Cycle	
Scooter	
Auto	
Car	
TV	
Iron	
Refrigerator	
Microwave Oven	
Mixie/ Grinder	
Mobile	
AC	
Dining Table	

Cot	
Livestock	
Bank deposit	
Gold	

22. Child Details

Name	
Gender (1=Male, 2=female)	
Age of the child(in months)	
Was the child a **full term** baby?1= Yes,2=No	
Order of birth of the child: 1/2/3	
Type of child birth (1) Normal (2) C-section	
Where did the delivery take place? (1) Home (2) Government (3) Private hospital	
Financial assistance under Janani Suraksha Yojana? 1= Yes,2=No	
Child's weight(kg)	
Child's height(cm)	
Weight of the mother (in Kg)	
Height of the mother (in Cm)	

23.Child care: (1) Biological parents (2) Relatives

24.Birth weight of the baby: (1) Less than 2.5 kg (2) 2.5kg to 3.5 kg (3) 3.5 kg and above

25. What is the birth interval between the previous child and the present child

26 . Maternal Information

Age of the mother	
Age at marriage:	
Age at childbirth	
Marital status (1) Married (2) Divorce(3) Widow	

27.Parents education and occupation

	Father	Mother
Educational qualification		
Occupation		
No. of days employed in a week		
Wage per day		
MGNREGA (1=Yes, 2=No)		
Kudumbasree (1=Yes, 2=No)		

Codes: **Educational qualification**: (1) Illiterate (2) Primary (up to class VII) (3) Up to SSLC (4) +2 (5) Graduation (6) PG and above

Occupation code: (1) Agriculture (2) Forest produce gatherers; (3) Wage labourer (4) Government Job;(5)- Private Sector job, (6) Business (7) Self-employed(8)Others including part time like house maid

28.Are you in the habit of taking:

Alcohol

Drugs

Smoking

29.Your source of information about happenings in the world? (1) Radio (2) Newspaper (3) TV (4) Internet (5) Others

30. Details of children

Child Details	Number	Reason, Age	What age
Alive children			
Miscarriage			
Still Birth			
Death of children			

Health Status of Child

(31) Incidence of illness from birth to date

Type of illness	Frequency	Hospitalized	ICU
Cold and cough			
Diarrhoea			
Fever			
Acute Respiratory Infection			
Others, Specify			

32.In case of diarrhoea, type of treatment administered? (1) Treatment from hospital/ village health worker (2) Gave ORS packet solution (3) Homemade fluids (4) Did not do anything

Immunisation

33.Has the child been given vaccination as per the vaccination chart ?1 Yes;2No

34.Has the child taken vaccination for (to be recorded as per vaccination card details)

BCG	
Polio 1 OPV1	
Polio 2 OPV2	
Polio 3 OPV3	
DPT1	
DPT2	
DPT3	
OPV/DPT	
Measles	
Vitamin A	

OR If **immunization card not available**, ask the following questions

Immunization	1= Yes; 2=No
BCG (Injection in the left arm or shoulder that caused a scar)	
Polio (vaccination drops in the mouth)	
DPT vaccination- an injection in the thigh or buttocks (usually given at the same time as polio)	
Measles vaccination (an injection in the left arm at the age of 9 months or older)	

35.If not given vaccination, what is the reason:

(1) In accessibility to hospital (2) Lack of knowledge (3) Against spiritual/ cultural belief

36.Infant Feeding Practice

Did you breastfeed (1=Yes; 2=No)	
First milk(colostrum) immediately after delivery (1=Yes; 2=No)	
Initiation of breastfeeding: (1) Just after birth (2) Within 24 hours after child birth, (3) after 2 days	
Was the child **exclusively breast fed for 6** months (1=Yes; 2=No)	
If not, **reason**: (1) Insufficient quantity of breast milk, (2) Medical conditions like engorgement, (3) Need to go for work	
Duration of breastfeeding:(1) Up to 6 months, (2) 6-12 months,(3) till 24 months and above	
Initiation of supplementary feed(weaning) (1) less than 3 months, (2) 3-6 months, (3) After 6 months	
Do you wash hands before feeding the child (1=Yes; 2=No)	

37.Since this time yesterday, how many times did the child eat solid or semisolid foods other than liquids?

(1) Less than 3 times, (2) More than 3 times

38. Maternal Health Status

During pregnancy, were you regular in taking **iron-folic tablets and calcium tablets** (1) Regular (2) Irregular (3) never	
2 doses of TT injection? (1=Yes; 2=No)	
antenatal checkup (1) Less than 4;(2) More than 4	
post-natal checkup? (1=Yes; 2=No)	

39.Did you face any complication during delivery: (1) High BP (2) Diabetes (3) Prolonged labour (4) Foetal distress

40.Before or after delivery did you suffer from any complications or health issues ?

Type of complication	Nature of treatmentcodes:1: Allopathy,2: Ayurveda 3: Homeo ,4: Home Remedy)
Excessive bleeding	
Irregular periods	
Back pain	
Blood pressure	
Diabetes	
Hormonal imbalance (Thyroid)	
Heart problem	
Asthma	
Depression	
Others(specify)	

Food Security

41.Type of card held: (1) Anthyodhaya Anna Yojana (AAY), (2) Priority(3)Annapoorna (4) Non Priority state subsidy(5) Non Priority non subsidy (State the colour of the card)

42.Distance to the nearest PDS (ration shop): (1) Less than 2 km, (2) 2-5 km, (3) More than 5 km

43.Items availed through PDS

Item	Kg
Rice	

Sugar	
Gram	
Wheat/ Atta	
Kerosene	
Others, Specify	

44. Diet chart- Food Frequency chart

	Frequency of use						
Food	Daily	Weekly	Fortnightly	Monthly	Occasionally	Never	Expenditure (Weekly or monthly)
Cereals Rice/ Rice flour wheat / wheat flour							
Pulses and legumes Bengal Gram(kadala) Green gram (cherupayar) Black gram(uzhunnu) Others, Specify							
Green Leafy vegetables and other vegetables							

Cabbage Spinach (Cheera) Bitter Gourd (Pavakka) Padavalam							
Roots and Tuber (Ask and then write frequency)							
Fruits (Ask and then write frequency)							
Non-Veg Fish / egg Chicken Mutton/Beef							
Milk **Curd**							
Bakery items/Junk foods							
Tea/ coffee							

45.What kind of fish you generally eat? (1) Fresh water (2) marine (3) dry fish

46.What is the name of the fish that you generally prefer?

47.From where do you generally buy fish? (1) local market (2) local shop (3) any other place

48.How you make fish? (1) curry (2) fry (3) any other preparation, specify

49.Who in the household get larger share of fish preparation? (1) Children (2) adult male (3) adult female (4) elderly

50. Expenditure Pattern

Non food ***Yearly expenditure*** on: (a)Education (b) Medical expenditure (c) Clothing/ Foot wear ***Monthly expenditure*** **on:** Rent Gas/ Kerosene/ Firewood Electricity Beedi/ Tobacco/ Alcohol Diesel/ Petrol/ Travel Telephone/ Mobile/ internet	

51.**24-hour dietary recall**

Time	` Food item		Quantity	
	Child	Mother	Child	Mother
Breakfast				
Lunch				
Dinner				

52. Food insecurity experience scale (Answer Yes/ No)

During the last 12 months, was there a time when, because of lack of money or other resources, you or others in the household

(1) did not have enough food to eat

(2) had to reduce the consumption of the quantity of food

Accessibility to PHC and Anganwadi

53.Nearest health facility(specify):

54.In the event of illness, what is the type of medical treatment preferred? (1) Allopathy (2) Homeo (3) Ayurveda (4) indigenous medicine.

55.Where do you prefer to get treatment? (1) PHC (2) Government District hospital (3) Government Medical College (4) Private

56.Reason for the above preference: (1) Ease of accessibility (2) Low treatment cost, (3) Availability of Doctors, (4) Others, specify

57.Facilities availed through PHC (1) Doctor care (2) Medicines (3) In patient care (4) Laboratory services

58.Distance to nearest PHC? (1 km=half hour walking time) 1) < 1 km,2) 1-3 km,3) > 3 km

59. Do you have health card for availing treatment Y/N

60.Do you avail Anganwadi facility? Y/N

61.Distance to the nearest Anganwadi? (1 km=half hour walking time) 1) < 1 km,2) 1-3 km,3) > 3 km

62.What services do they provide? a) Pre schooling(b) Supplementary nutrition for children(c) Supplementary nutrition for pregnant and lactating women.

Appendix 2: Permission Order for Visiting Anganwadis

ICDS A3/8633/2019

Directorate of Women & Child Development
Poojappura, Thiruvananthapuram
Dated: 27 .04.2019

The Director
Women and Child Development

Dr.G.Sridevi,
Associate Proffessor,
School of Economics,
University of Hyderabad.

Sir,

Sub: Women & Child Development Department: Integrated Child Development Scheme: Permission for visitng Anganawadis for Ph.D Programme reg:-

Ref: 1.Your Letter dated 15.04.2019
2. Application of Anju Susan Thomas dated 6.04.2019

As part of Ph.D Programme, Anju Susan Thomas, Research Scholar of your institution is granted permission for visiting Anganawadis at ICDS Projects of Thiruvananthapuam, Wayanad and Palakkad Districts for the study regarding Health, Nurtrition & Poverty among Children aged 0-59 months from 29th April 2019 to 31st July 2019. Before starting the field work they have to seek permission from the CDPO concerned and should strictly adhere to the following instructions.

1. Field work should be conducted without interrupting the daily activities of Anganawadis.
2. Photography/Video recordings in the Anganawadis are not allowed.
3. Data collected during field work should be used only for study purposes.
4. A copy of the report should be submitted to this office

Yours faithfully

Director of Women & Child Development

Copy to Programme Officer, Thiruvaananthapuram,Wayanad, Palakkad
CDPO Concerned

Appendix 3: Permission Order from Tribal Department

OFFICE OF THE DIRECTOR OF SCHEDULED TRIBE DEV. DEPARTMENT
4th Floor Vikas Bhavan, Thiruvananthapuram Pin:695033

Ph:0471-2303229,0471-2304594.Fax:0471-2302990.E-mail:keralatribes@gmail.com

D3-6521/19 22.06.2019

The Director

To

Anju Susan Thomas,
Assistant Professor in Economics,
Govt. College for Women, Tvpm

Sir,

Sub:- STDD- Permission to visit Tribal settlements in Wayanad, Palakkad and Thiruvananthapuram districts of Kerala
Ref: Your Ltr. Dated 06/06/19 &11/06/19

With reference to above, consent of the Scheduled Tribes Development Department ,Government of Kerala is granted for research about "HEALTH. NUTRITIONAL SECURITY AND POVERTY AMONG WOMEN AND CHILDREN: A CASE OF KERALA" at tribal settlements in the districts of Wayanad. Palakkad and Thiruvananthapuram for a period of 21/06/2019 to 30/09/2019 subject to the following conditions.

1. The proposed visit should only be conducted as a part of the Research work and thus obtained data, knowledge and reports should not in any way be used for purposes other than the study of the scholar.
2. The visit should be conducted with the knowledge of PO Kalpetta,TDO Mananthavady , TDO Sulthan Bathery, TDO Palakkad, PO Attappady & PO Nedumangad.
3. The visit should not in any way hurt the cultural and habitual life of the tribal people lay in the settlement.
4. A copy of the thesis/study report should be furnished to the Director of Scheduled Tribes Development Department, Vikas Bhavan, IVth Floor, Thiruvananthapurm 33.
5. An agreement should be executed before PO Kalpetta,TDO Mananthavady , TDO Sulthan Bathery, TDO Palakkad, PO Attappady & PO Nedumangad.

6. Permission of the Forest Department Should also be obtained for entering in the tribal settlements amidst the forest.
7. Any infringement on the rights of the people lay in the settlement attract penal proceedings under Prevention of Atrocities Act 1989.
8. Special instruction:- Objection if any from the concerned tribal people should be duly considered; the research stopped and be reported to the Director
9. This sanction will cease at the written notice of PO Kalpetta,TDO Mananthavady , TDO Sulthan Bathery, TDO Palakkad, PO Attappady & PO Nedumangad.
10. The applicant should leave the settlement by 5 pm. You are not permitted to stay overnight in the colony

Yours faithfully,
Sd/
DIRECTOR

Approved for Issue

V.SASEENDRAN
Deputy Director (Education)

COPY:The Principal Chief Conservator of Forest
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Appendix 4: Permission Order from Forest Department

Permission for Field Work in Forest Areas for Scientific Research.

KFDHQ- 3802/2019-CWW/WL10 **Dated.04.07.2019**

Title of the Project	:	***"Health Nutritional Security and Poverty Among Women and Children: A Case of Kerala"***
Researchers	:	**Ms. Anju Susan Thomas, Assistant Professor in Economics**
Institution	:	**Government College for Women ,Thiruvananthapuram**
Duration of the project	:	**01.07.2019 to 30.09.2019**
Funding Agency	:	**Nil**

Subject to the provisions of the Wildlife (Protection) Act, 1972, and the Kerala Forest Act, 1961, and the Rules made there under, **Ms. Anju Susan Thomas, Assistant Professor in Economics, Government College for Women, Thiruvananthapuram is granted permission to enter the tribal settlement of Wayanad, Palakkdu and Thiruvananthapuram from 01.07.2019 to 30.09.2019 for** the purpose of scientific research on the above project, on following conditions.

1. **The researcher shall not collect any samples from the Forest Area.**
2. **The Researcher should abide by the conditions laid down in the order no D3/6521/2019 Dated 22.06.2019 of the Director, Scheduled Tribes Development Department (copy enclosed)**
3. None of the faunal elements belonging to endangered/threatened/rare categories and included in the Scheduled lists of Indian Wildlife (Protection) Act, 1972 will be collected or disturbed, and the survey shall not entail any clearing of forests or flora in the area.
4. The researcher should produce Identity Proof before the competent authority on demand.
5. The Researcher and his team, if any, shall be bound to act in accordance with the existing Acts, Rules and directions of the concerned officers.
6. The field programmes and visits of the research team shall be intimated to the concerned Assistant Conservator of Forests/ Wildlife Warden / Divisional Forest Officer / Asst. Wildlife Warden / Range Officer in advance as per the schedule attached on such dates / time mutually agreed by the researcher and the Divisional Forest Officer/Wildlife Warden having jurisdiction over the area and the collection shall be made in the presence of local Forest Department Staff only.
7. If photography is involved during the course of collection of biological resources, copies of the photographs with identity of plants / animals shall be sent to the concerned DFO/WLW, who shall maintain a register for such cases.
8. A minimum of three hard copies and one soft copy of the published and one hard and one soft copy of the Final Research Report shall be given free of cost to the Chief Wildlife Warden, on expiry of the period of research. Progress report of the study should be submitted every six months of the period of research, failure of which will lead to withdrawal of permission.
9. The Institution shall be held liable for any damage or loss caused due to the action of negligence or otherwise of the members of the research team. The research team shall make good to Government in Forest Department for any loss caused and for the destruction or damage to any forest produce, wildlife, forests or environment. The loss will be assessed by the Chief Wildlife Warden and his decision shall be final.

10. The Chief Wildlife Warden has the full discretionary powers to grant, suspend or reject permission to regulate the field works related to the research project with respect to time and space in view of the protection and management problems in the Protected Areas / Forest areas.

11. Being an institution under the Central/State Government/ autonomous body under the Central/State Government it is exempted from payment of the Security Deposit.

12. Any vehicle, vessel, weapon, trap or tool that has been used for violation of the conditions specified herein shall be forfeited to the State Government and the offender will be proceeded against as per provisions of the laws in operation in forest area /Wildlife Sanctuary / National Park / Closed area of the State.

13. The study team shall be permitted to enter into the forest area only with proper accompaniment of Forest Guides / Staff as the case may be. Suitable amount as fixed by the Chief Wildlife Warden from time to time will have to be remitted by the study team for such services rendered by the Forest Department.

14. The Chief Wildlife Warden shall take appropriate action on the researcher/organization for non-submission of final report on time as per Terms and Conditions stipulated in the letter granting permission for the project.

15. A researcher will not be required to pay entry fee in the park. If researcher needs to use a vehicle for his research activities inside the park no entry fee for the vehicle will be charged. Other facilities when availed will be charged at the rate applicable to Government officials on duty.

16. Movements of the researcher and or his assistants in the Protected Area shall be recorded in a log book to be maintained by him which will be submitted to the park management every month.

17. Movement at night shall not be allowed.

18. The Chief Wildlife Warden or any competent authority shall have the powers to suspend, withdraw or cancel the permission granted, for violation of any of the conditions of permission, or if it is subsequently found that any particulars furnished by the applicant in the application are not true or for any other just and valid reasons to be recorded in writing and, the Government or Department or any Forest Officer shall not be liable to pay any compensation for loss or damages or inconveniences caused due to the suspension, withdrawal or cancellation of the permit.

Chief Wildlife Warden,
Kerala.

To

Ms. Anju Susan Thomas, Assistant Professor in Economics, Government College for Women, Thiruvananthapuram

Copy to: The Divisional Forest Officer Wayanad /Palakkad/Thiruvananthapuram for information

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