Nutritional Status of Children In Tribal Communities of Wayanad

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Certificate

This is to certify that the dissertation titled **"Nutritional Status of Children in Tribal Communities of Wayanad"** submitted by **Dr.Ladish Krishnan** of Achutha Menon Centre for Health Science Studies, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram is a bonafide work carried out by him.

Guide

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Declaration

I hereby declare that the work embodied in this dissertation entitled "**Nutritional Status of Children In Tribal Communities of Wayanad**" is the result of original research and has not been submitted in any other university or Institution.

Dr.Ladish Krishnan

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Contents

Abstract

Background

Malnutrition remains among the most devastating problems facing the majority of the world's poor and needy. Tribal populations in India are considered to be socio-economically the most disadvantaged group and tribal children have very poor health indicators when compared to the rest of the population.

Objectives

The objective of the present study was to ascertain the proportion of malnourished children (6-60 months) by anthropometric evaluation and to determine the sociodemographic and environmental factors associated with malnutrition.

Methods and Results

A cross sectional survey of 297 children (162 male and 135 female) in the age group of 6-60 months was undertaken in Noolpuzha Panchayat, Wayanad, Kerala. Length/ Height and weight were measured by the investigator using standard measuring boards and electronic weighing machine (SECA 881). Univariate and bivariate analysis were used to examine sociodemographic and environmental factors associated with malnutrition. The overall prevalence of stunting and underweight in our sample was 40% and 54% respectively. The factors associated with increased prevalence of malnutrition were socioeconomic status, educational status of mothers, birth order, type of tribe and hygienic practices.

Conclusion

These observations reemphasize the need for education and awareness programmes targeting the mothers. Overall improvement in living standards of tribal population is warranted to improve the nutritional status of the children. We also have to improve the functioning of public facilities like health centres, Anganwadies in the tribal area.

Chapter 1. Introduction

1.1 Background

Malnutrition is a nutritional disorder or condition resulting from faulty or inadequate nutrition. It results from an imbalance between the body's needs and the intake of nutrients, which can lead to syndromes of deficiency or obesity. It includes under-nutrition, in which nutrients are undersupplied, and over-nutrition, in which nutrients are oversupplied. Because of the high demand for energy and essential nutrients, infants and children are at particular risk of undernutrition. Malnutrition in early childhood has serious, long-term consequences because it impedes motor, sensory, cognitive, social and emotional development

Malnutrition kills, maims, cripples and blinds on a massive scale worldwide. It affects one in every three people worldwide, afflicting all age groups and populations, especially the poor and vulnerable. It plays a major role in half of the 10.4 million annual child deaths in the developing world; it continues to be a cause and consequence of disease and disability in the children who survive. Malnutrition is not only medical; it is also a social disorder rooted in poverty and discrimination. It has economic ripple effects that can jeopardize development.[1]

The increased recognition of the relevance of nutrition as a basic pillar for social and economic development placed childhood undernutrition among the targets of the first Millennium Development goal to "eradicate extreme poverty and hunger.[2]

Worldwide malnutrition is one of the leading causes of mortality and morbidity in childhood. According The World Health Report 2005[3], most deaths among children under five years are still attributable to just a handful of conditions and are avoidable through existing interventions. Six conditions account for 70 percent to over 90 percent of all these

deaths. These are: acute lower respiratory infections, mostly pneumonia (19 percent), diarrhea (18 percent), malaria (eight percent), measles (four percent), HIV/AIDS (three percent), and neonatal conditions, mainly preterm birth, birth asphyxia, and infections (37 percent). Malnutrition increases the risk of dying from these diseases. Over half of all child deaths occur in children who are underweight.

Hunger and malnutrition remain among the most devastating problems facing the majority of the world's poor and needy. Nearly 30 percent of humanity—infants, children, adolescents, adults and older persons in the developing world—are currently suffering from one or more of the multiple forms of malnutrition. Some 49 percent of the 10.7 million deaths among under-five children each year in the developing world are associated with malnutrition. In the year 2000 an estimated 149.6 million children under five years of age, of which 26.7 percent of the world's children in this age group, are still malnourished when measured in terms of weight for age.[4]

Malnutrition is implicated in more than half of all child deaths worldwide. Half of all malnourished children live in South Asia. India, China and Bangladesh, make up half of all malnourished children in the developing world.[5]

Malnutrition plagues a disproportionately large number of children in India compared with most other countries. The results of the National Family Health Survey-2[6] (1998-1999) show that 46 percent of all children below age four are stunted (as measured by height-for-age), 47 percent are underweight (as measured by weight-for-age), and 17 percent wasted (as measured by weight-for-height). Twenty-three percent of the children are severely stunted, 18 percent severely underweight, and 3 percent severely wasted, according to internationally accepted definitions. The lower prevalence of wasting than stunting or underweight indicates

that chronic malnutrition is more prevalent in India than acute malnutrition. The prevalence of underweight by gender was shown to be 45 percent for males and 49 percent for females. In India 56 percent of children belonging to Schedule tribes were underweight (weight-for-age), 53 percent were stunted (height- for- age) and 22 percent were wasted (weight-for-height).

There is considerable variation in the prevalence of malnutrition by state. Among the states, Bihar and Kerala have the highest and lowest prevalence of undernutrition, respectively. Though the Health indicators of Kerala are higher, compared to other states in India, the situation of nutrition in critical sectors and areas of population does not portray a good picture. The data presented by the National Nutrition Monitoring Bureau (NNMB) 2003, shows that 40.7 percent of children are underweight, 30 percent stunted and 33.8 percent wasted. [7] According to the National Family Health Survey-2 Kerala report, 27 percent children under three years of age in the general population were underweight, 22 percent were stunted and 11 percent wasted. Among children aged 12-23 months 35 percent underweight, 28 percent stunted, 19 percent wasted. The prevalence of underweight by gender was shown to be 26.2 percent for male and 27.6 percent for females.

1.2 Literature review

Nutritional status is the physiological state of an individual that results from the relationship between nutrient intake and requirements and from the body's ability to digest, absorb and use these nutrients.[8]

There are various ways of assessing the nutritional status of under-five children. It can be assessed using clinical signs, biochemical indicators, assessment of dietary intakes and anthropometry.

i) Clinical signs: clinical criteria for diagnosis of undernutrition are not precise and difficult to interpret accurately. Clinical manifestations of undernutrition depend on the severity and duration of nutritional deprivation, the age of undernourished subject, relative lack of different proximate principles of food and the presence or absence of associated infections. Therefore it is difficult for assessment of nutritional status in a population.

ii) Biochemical indicators: there are several biochemical tests to assess the nutritional status. Biochemical abnormalities begin to show up as the severity of malnutrition increases and they might require a series of tests to assess the nutritional status. They cannot be applied on a population basis as they are time consuming, expensive and unethical as it needs invasive procedures.

iii) Assessment of dietary intake: involves dietary surveys like household inquiries or individual food consumption surveys .In this method one can categorize people as being well -nourished or undernourished based on whether their intake of food matches their food energy needs or nutrient requirements. It is difficult to solely judge the nutritional status by assessing the quantity of food consumed by an individual in the recent past, because the human body has a remarkable capacity to adjust its metabolism to meet the variations in the daily intake of food. Therefore short term deficit do not produce any physiological changes. Also, in our study population, majority are believed to have no education and belong to a low socioeconomic background. So it was considered unsuitable to conduct diet surveys as it requires weighment of food and measure the quantity of food eaten.

iv) Anthropometry

Anthropometry has an important advantage over other nutritional indicators for the following reasons: normally if there is a deficiency in dietary intake for a short period the body adapts itself to compensate for the deficit to some extent. If the deficiency of food persists for a longer period the malnourished child conserves energy by curtailing physical activity and growth rates are affected. If nutrition deficit continue longer physical activity is severely curtailed, clinical signs of malnutrition starts appearing or to get noticeable and there will be a marked deficit in the growth of child. Anthropometry does have an important advantage as body measurements are sensitive over the full spectrum of malnutrition where as biochemical tests and clinical signs useful only in the extreme.

Anthropometry can be used to verify the existence of a nutritional problem in a population and to assess the magnitude. It provides an indication of risks as well as that of socioeconomic devcelopment. But is used primarily as an indicator of benefit for selecting those communities that is likely to gain most from a proposed intervention.[9,10]

The measures that are normally used to undertake anthropometric assessment are age, sex, length/height and weight. Each of these variables provides one piece of information about a person. When they are used together they can provide important information about a person's nutritional status. When two of these variables are used together they are called an *index*. Three indices are commonly used in assessing the nutritional status of children: Weight-for-age, Length-for-age or Height-for-age, Weight-for-length or Weight-for-height.[9]

These measurements need to be compared to standard references. So as to standardize a child's measurement by comparing the child's measurement with the median or average measure for children at the same age and sex. The reference standards used in this study to

standardize measurements, was the one developed by the United States National Center for Health Statistics (NCHS). This is recommended for international use for the first five year of life by the World Health Organization.

The reference population chosen by NCHS was a statistically valid random population of healthy infants and children.

Questions have frequently been raised about the validity of the US-based NCHS reference standards for populations from other ethnic backgrounds. Available evidence suggests that until the age of approximately 10 years, children from well nourished and healthy families throughout the world grow at approximately the same rate and attain the same height and weight as children from industrialized countries. Moreover disparities in growth between developed and developing countries reflect nutritional rather than genetic differences.[11]

Another question that arises is that, are these standards suitable for Indian children?

Gopalan C in his paper[12] states that though NCHS standards are, in fact, applicable to Indian population segments of children and adolescents belonging to the affluent sections. This is because growth pattern of the affluent sections, unlike the growth patterns of the poor sections of the Indian population covered by the National Nutrition Monitoring Bureau (NNMB) correspond closely to International Standards. The appropriate standard against which to estimate stunting could be derived from measurements on local populations belonging to the country's middle-class groups who do not suffer from scarcity of basic necessities of food, clothing, shelter, and health care, and who enjoy good health and nutrition. It is likely that such a yardstick for Indian populations may nearly correspond to –1 SD of the International Standard. This, however, needs to be confirmed.

The anthropometric indices chosen in this study are height-for-age (stunting) and weight-for- age (underweight). Weight-for height (wasting) was not chosen, as it is often associated with acute starvation or severe disease.

a) Height-for-age (Stunting)

On a population basis, high levels of stunting are associated with poor socioeconomic conditions and increased risk of frequent and early exposure to adverse conditions such as illness and/or inappropriate feeding practices. The inverse relationship between stunting and household's socioeconomic status is the reason for the world Health Organization recommending stunting as a measure of social deprivation and as one of the indicators to monitor equity in health. In less developed areas, where the prevalence of low height-for-age is substantial, it may be safely assumed that most short children are stunted.[9]

b) Weight-for age (Underweight)

The advantage of this index is that it reflects both past (chronic) and/or present (acute) undernutrition (although it is unable to distinguish between the two). In the absence of significant wasting in a community, similar information is provided by weight-for-age and height-for-age, in that both reflect the long term health and nutritional experience of the population.[9]

There are number of factors that affect the nutritional status of a child. The most commonly cited factors are food availability and dietary intake, breastfeeding, prevalence of infectious diseases, access to health care, immunization against major childhood diseases, maternal care during pregnancy, water supply and sanitation, socioeconomic. Demographic characteristics such as the child’s age and sex, birth intervals and birth order.

Some of the socioeconomic, demographic and environmental factors affecting child nutrition according to studies done earlier in different places are reviewed below.

1.2.1 Household economic status

The commonest cause of malnutrition among the poor is inability to buy food of the desired quality and quantity for them and their family's nutritional requirements. This in turn adversely affects their capacity to work, therefore earning less and poverty. It is vicious cycle of poverty- diminished work capacity- low earning and poverty.[13]

Several studies done in different parts of the world showed, higher the level of economic status of the household, lower the level of child malnutrition. A study done by Jeyaseelan[14] showed that household economic status has a strong effect on chronic child malnutrition. Another study Bangladesh showed malnutrition rate was two times higher among the poorest than that of the richest.[15] A study by Anne Katahoire et al in Uganda[16] states, as one moves up the income ladder, a remarkable drop in the rate of stunting is observed. Improved household income levels are associated with a dramatic drop in the probability of stunting of children.

1.2.2 Education of mother

Educational status of parents is an important determinant of children's growth and development, because it is one of the most important resources that enable women to provide appropriate care for their children. Children whose mothers have some education, but have not completed middle school are much less likely to be stunted, wasted, or underweight than are children whose mothers are illiterate[17]. Children whose mothers have little or no education tend to have a lower nutritional status, than children of more-educated mothers.[14] Findings of a study showed that mothers' education was a robust predictor for inequalities of

child health and nutrition[18]. Maternal education was significantly and independently associated with children's nutritional status, whereas father's education was unrelated to children's nutritional status.[19] Children born to unschooled mothers were at a significantly higher risk of dying before their fifth birthday than those born to mothers with some schooling. There was a greater risk of children not completing immunization if their mothers had not been to school.[20]

1.2.3 Employment status of mothers

Women's employment may enhance the household's income but it may also have negative effects on the nutritional status of children, as it reduces a mother's time for childcare. Some studies have revealed that there is a positive association between mothers' employment and nutrition of the child.[21, 22]

1.2.4 Environmental factors

Environmental conditions like inadequate water and sanitation can indirectly cause certain types of malnutrition. In a study by Vella et al in northwestern Uganda, showed children whose families used water from unprotected sources were more underweight than their counterparts.[23] Families who had alternative sources of fuel in addition to firewood, had fewer children underweight.[24] The poor nutritional status beyond six months age increases risk for morbidity due to poor environmental conditions in urban slums.[25, 26, 27]

1.2.5 Child morbidity

Infections like malaria, tuberculosis, and measles precipitate acute malnutrition. Recurrent diarrhea in under five children has proved to be a major contributory factor for malnutrition[13]. During infections, children have less appetite. The body catabolizes its own tissues, to produce additional heat energy. Therefore these children loose weight.

Malnutrition adversely affects the immune status and therefore malnourished children become vulnerable to infections. Thus setting up a vicious cycle of malnutrition-infection-malnutrition.

The persisting high burdens of diarrhoeal disorders and acute respiratory infections in South Asia reflect the poor state of basic public health services, especially clean water and sanitation, and a general lack of hygiene awareness. Indoor air pollution due to poor housing, overcrowding, and use of organic fuels in confined spaces greatly contributes to respiratory infections among women and children in rural populations.[28] Diarrhea and other infectious diseases affect both dietary intake and utilization, which may have a negative effect on the nutritional status. A comparative study on children's nutritional status indicated that stunting was highest among children with recent diarrhea.[29] Another study showed that there was strong relation between malnutrition and an increased risk of death was observed for diarrhea and acute respiratory infection[30].

1.2.6 Birth order

It is expected that parents give less attention to older children when they give birth to a new child who needs more care and attention. Moreover poverty adds to this, less food is available in poor households and even this is distributed unequally among different members of the family. Children with three or older siblings are more likely to suffer chronic malnutrition than are children from smaller families.[17] One study showed that, higher birth order (5+) is positively associated with child malnutrition.[14]

1.2.7 Birth interval of the child

Higher birth spacing is likely to improve child nutrition, since the mother gets enough time for proper childcare and feeding. Studies in developing countries showed that children born after a birth interval of 24 months have lower levels of stunting.[31]

1.2.8 Gender

Given widespread evidence of discrimination against girls in India, the proportions stunted and underweight are identical for boys and for girls.[17] A study by Jeyaseelan showed that proportions stunted and underweight are identical for boys and for girls.[14] Mishra et al found that boys and girls were about equally likely to be stunted and underweight, but boys were slightly more likely than girls to be wasted.[32]

1.2.9 Breast feeding

Optimal breastfeeding begins with exclusive breastfeeding, starting at the time of birth and continuing for up to six months. This gives a nutritional advantage to the babies during the first few months of life. A number of studies have shown association between breastfeeding and nutritional status of children. Significant association of breast-feeding and higher prevalence of underweight and stunting among non breast fed children were noted. Long duration of breast-feeding has a positive effect on linear growth in the second and third years of life.[33] Timing of weaning is significantly associated with stunting among children in India.[34] A study has shown that, at the community level, incidence of gastrointestinal and respiratory illness decline after effective promotion of breastfeeding. It supports a causal association, indicating that breast milk itself or the process of breastfeeding provides protection against infant illness[35]. Although there are studies which showed duration of

breast-feeding had indirect relation to the nutritional status, longer the duration of breast feeding higher the prevalence and the severity of malnutrition.[36]

1.3 Rationale of the study

Tribal populations in India are considered to be socio-economically the most disadvantaged group. They cannot be grouped as homogeneous, as they belong to different ethno-lingual groups, have diverse faith and are at different levels of development-economically, educationally and culturally. The problems of tribal communities differ from area to area. For this, there should be a proper need for understanding their problems, specific to place. So that relevant development programmes can be made and implemented. There is a greater need for undertaking a region-specific study of the nutritional status of tribal children, which can provide data to decision-makers and health workers with the baseline information necessary to plan, implement, monitor and evaluate nutrition and public health intervention programmes aimed at promoting healthy growth and development.

Several studies conducted in the past among various tribal groups revealed wide variation in their health and nutritional status characterized by their individual socio-economic, socio- biological conditions as well as socio-cultural practices. The environmental factors in which the tribes live, their health care facilities and their utilization also significantly determine the overall health status of the group[15]. Tribal children are a neglected section of society and have very poor health indicators when compared to the rest of the population.

The nutritional status of children under the age of five years is considered to provide a good reflection of the nutritional well being of the community. This is because children are the most vulnerable to problems of inadequate food intake and disease, the major underlying

causes of malnutrition. Malnutrition is not merely a result of too little food, but of a combination of factors like insufficient protein, energy and micronutrients, frequent infections or disease, poor care and feeding practices, inadequate health services and unsafe water and sanitation. These conditions in turn are closely linked to the standard of living and whether a population can meet its basic needs, such as access to food, housing and health care. Growth assessment not only serves as a means for evaluating the health and nutritional status of children but also provides an indirect measurement of the quality of life of an entire population. Child malnutrition is internationally recognized as an important public health indicator for monitoring nutritional status and health in populations.[37]

Not many studies have been done to assess the nutritional status among the children of these tribal communities. The present study will attempt to reveal the nutritional status of tribal children (6-60 months) living in rural areas of Wayanad, in Kerala.

1.4 Objectives

General

To study the nutritional status and its associated factors of children in tribal communities of Wayanad**.**

Specific

a) To ascertain the proportion of malnourished children (6-60 months) by anthropometric evaluation.
b) To determine the sociodemographic and environmental factors associated with malnutrition among the proposed target group.

Chapter 2. Methodology

2.1 Study type

Descriptive cross-sectional survey.

2.2 Study setting

The study area was in Wayanad district, Kerala**.** The name "Wayanad" is believed to have been derived from the word, Vayalnadu, meaning the land of paddy fields. The native tribals locally known as "*Adivasi"* mainly consist of various sects like *Paniyas, Kurumas, Adiyars, Kurichyas, Ooralis, Kattunaikkans*, etc. The Scheduled Tribes population of Noolpuzha Panchayat according to Census Kerala, 2001 was 10,288. Wayanad's geographical position is peculiar and unique. It is a land of forest, which account for 38 percent of the total area of the district. The difference in altitudes of each locality within the district presents a variation of climatic conditions. Wayanad has an agricultural economy and it has no major industry. No religion can be said to be predominant in this district. It is located along the borders of Karnataka and Tamilnadu.

Wayanad district stands first in the case of Adivasi Population (about 36 percent) among other districts in the state. They form 17.1 percent of the total population of the district and the highest in the state**.**

Noolpuzha Panchayat in Sulthan Bathery block, Wayanad district was chosen for the study. Again this Panchayat was chosen, as it has one of the highest populations of tribal communities in the district.

2.3 Study Population

Children in tribal colonies falling within the age group of 6-60 months and all the tribal colonies in Noolpuzha Panchayat are the study population for the present study. The

subjects of study were children between 6 and 60 months of age. Children older than six months were included, assuming that this is the minimum amount of time the child is exposed to family-related factors and also, this is the average age in which children are weaned. These children are relatively more exposed to environmental causes of malnutrition. Only one child from each family was included in the study. If there was more than one eligible child, then any one child was selected by lottery method.

2.4 Sample Size:

According to the NFHS-2 India report, 56 percent of children belonging to Schedule tribes were underweight (weight-for- age), 53 percent were stunted (height- for- age) and 22 percent were wasted (weight-for-height). The National Family Health Survey-2 Kerala reports, 27 percent children under three years of age were underweight, 22 percent were stunted and 11 percent wasted. Assuming the prevalence of malnutrition among the tribal population to be 40 percent and with the design effect of two, the sample size required for estimating the true prevalence of malnutrition with a 95 percent confidence interval was calculated to be approximately 300.

Sample size was calculated using the formula[38]

$$N = \frac{(Z^2 * PQ)}{\Delta^2}$$

Where,

N= sample size

Z= confidence limit factor (this is taken as 1.96 for 95 percent confidence interval)

P= assumed proportion of stunting (in our case it was taken as 40 percent based on previous studies and after a series of discussions with the faculty)

Q = 1-P = 1-0.4=0.6

Δ = precision factor (This is the difference between the assumed prevalence and lowest expected prevalence). The lowest expected prevalence was taken to as 32 percent. So Δ=0.40 - 0.32 = 0.08

As tribal was selected for data collection, for which cluster sampling was adopted. The estimated sample size was multiplied by a design effect of 2 to obtain the final estimate.

The calculated sample was

$N= \{(1.96)^2\ 0.4 * 0.6\} * 2 / (0.08)^2 = 288$

Considering the chance for non response and non availability of study subjects during the survey, a sample size of 300 was finalized for the study.

2.5 Sample selection procedures

Tribal populations in Wayanad district are spread out into numerous tribal hamlets or colonies. Cluster sampling was used to select children, taking colonies as the cluster units. Details regarding the number of colonies and population of each colony were available from the government of Kerala's, tribal welfare office. It was collected as a part a socioeconomic survey being conducted three years back, by the tribal welfare office. As per this survey, a total of 140 tribal colonies were registered in Noolpuzha Grama Panchayat.

There was no dependable estimate of the number of children in each of these colonies available. So taking estimates from the Census 2001 report, we assumed that 8 percent of the Tribal population would be children 6-60 months. All the 140 colonies were listed in order of the official list. The number of children in the age group of 6-60 months was calculated for each colony. The cumulative total of this population of children in the Panchayat was estimated to be 711. The cumulative total (711) was divided by the number of clusters (140)

to estimate the average number of children per colony, which was calculated to be 5. The sample size (300) was divided by the average number of children per colony (5) to estimate the number of colonies to be selected. This was estimated to be 60. The total number of colonies (140) was divided by the estimated number of colonies (60), to get a cluster interval of 2. Therefore every other colony was selected from the list of tribal colonies. Finally a total of 65 colonies were surveyed to get a sample size of 300. All the children in the age group of 6-60 in the selected colony (cluster) satisfying the inclusion criteria were included in the study. Children who were ill during the survey were not included in the study. We got the required number of children by surveying 65 colonies.

2.6 Data collection techniques

The survey was performed by house visits. The principal investigator with the help of Tribal promoters conducted the survey from 25 June 2005 to 25 August 2005. Tribal promoters are voluntary part time workers being appointed by the governmental tribal welfare office, to look into the welfare of Tribal populations. There were twenty five tribal promoters under the Noolpuzha Panchayat tribal extension office, each of them were assigned to work in a particular area. Many of the colonies were difficult to reach, as they were located in the forests. Access into the tribal colonies was made easy for the investigator with the help of tribal promoters, who were familiar with the areas. The survey was mostly performed in the early mornings and late evening to facilitate the participation of employed caregivers. It had two components: a semi structured interview schedule and anthropometry.

2.6.1 Interview schedule

Was conducted using a pre-tested semi structured questionnaire so as to obtain the following information

a) Demographic characteristics: age, sex, birth order, previous birth interval.

b) Background characteristics**:** type of tribe, mothers and fathers educational status, occupational status and personal habits of parents.

c) Housing characteristics: type of house, electricity, sanitation facility, type of fuel for cooking, source of drinking water, method of drinking water purification.

d) Breastfeeding practices: time of initiation, duration of breast feeding and weaning practice.

e) Morbidity: diarrhea, fever and cough within last two weeks as described by the mother and where treatment was received. A question regarding any history of diarrhea, fever and cough in the last two weeks of the survey was asked (diarrhea is determined as perceived by mother or caretaker or as three or more loose watery stools per day, or blood in stool)

f) Immunization status: Information on immunization was obtained from the immunization cards of the children whose mothers had them. The dates when the child received vaccinations was noted down by the investigator. For those who did not have the card, information was obtained from the mothers. Immunization status for children 12 months and older (by which age they should have completed the immunization schedule) was considered to be adequate for age, if the child had received BCG, Measles, three doses each of DPT and Polio. The children 12 months and older was chosen for analysis because Government of India guidelines specify that children should be adequately immunized by the time they complete the first year of life.

g) Information was collected about the mother's visit to the antenatal clinic during pregnancy and the number of times visited.

h) Age: Special attention was paid to determine the age of children, using official documents whenever possible. Even if the mother or caregiver knew the birth date or age of the child, cross-checking with the documentary evidence such as from Anganwadi, Panchayat office or junior public health nurse was done as errors in recall are common.

i) Distance from the health facility and Anganwadi was estimated by asking the respondent, the approximate walking time taken to cover the distance. One kilometer was approximately assumed to be half hour walking time.

j) j) Socioeconomic status: The format of Standard Living Index used in the National Family Health Survey -2 was modified to suit the tribal circumstances and used to assess the standard of living. (Appendix- 4) This was based on household ownership of assets and possessions.

k) Details regarding the availability of Anganwadis and schools for the preschool children established under the government of Kerala were collected.

2.6.2 Anthropometry

In this study malnutrition is synonymous with protein-energy malnutrition, which signifies an imbalance between the supply of protein and energy and the body's demand for them to ensure optimal growth and development. This imbalance includes both inadequate and excessive energy intake. The former leading to malnutrition in the form of wasting (as measured by low weight-for-height), stunting (as measured by low height-for-age) and underweight (as measured by low weight-for-age), as measured against the age-sex

standardized values and the latter resulting in overweight and obesity. In our study only the inadequate energy intake malnutrition is considered, as majority of the tribal populations are socioeconomically disadvantaged.

2.7 Interpretation of nutritional indices

Anthropometric indices can be interpreted as follows

i) Weight-for-height Index : used to compare a child's weight with the expected value of a normal(NCHS/WHO reference) child of the same height. Low weight-for-height is a measure of Wasting.

ii) Height-for-age Index: used to compare a child's height with the expected value of a normal(NCHS/WHO reference) child of the same age from a reference population. Low height-for –age is a measure of Stunting.

iii) Weight-for-age Index: used to compare a child's weight with the expected value of a normal(NCHS/WHO reference) child of the same age. Low weight-for-age is a measure of underweight.

iv) Low weight-for-height (**Wasting or thinness**): indicates in most cases a recent and severe process of weight loss, which is often associated with acute starvation and/or severe disease. However, wasting may also be the result of a chronic unfavorable condition. Provided there is no severe food shortage.

v) Low height-for-age (**Stunted growth):** reflects a process of failure to reach linear growth potential as a result of suboptimal health and/or nutritional conditions

vi) Low weight-for-age (**underweight):** is influenced by both the height of the child (height-for-age) and weight (weight-for-height).

vii) Mid upper arm circumference is a good predictor of immediate risk of death. It is used for rapid screening of acute malnutrition.

2.8 Taking measurements

Measurements were taken using standardized methods.

i) Height was measured for children (24-60 months). The child was made to stand on the measuring board which was kept vertical. Shoulder blades and buttocks of the child were placed against the board. With the right hand, the headpiece on top of the child's head was lowered down and pushed through the child's hair. Once the position was achieved the measurement was made to the nearest 0.1cm.

ii) Length was measured for children (6 - 23 months). The child was made to lie flat, on the center of the board. The investigator then placed his left hand on the child's knees and pressed them firmly against the board. With the right hand, the foot piece was placed firmly against the child's sole. The measurement was made to the nearest 0.1cm.

iii) Weight was measured after minimizing clothing on the child using standard electronic weighing machine (SECA 881). The mother was asked to stand on the scale, and after the display of weight is retained, the mother and baby key on the machine is pressed to activate the function. The child was passed to the mother onto the scale. After the value was stable for about 3 seconds, the weight of the child was recorded.

iv) Mid upper arm circumference (MUAC) was measured using a non stretchable tape. The circumference was measured at the mid point of the left arm. After measuring the distance between lateral tip of the acromion and the tip olecranon process of ulna, mid point was located by dividing the distance by two. Circumference was measured without compressing soft tissues and recorded to the nearest 0.1 cm.

a) Weighing and measuring equipment

i) Weight of the child was measured using mother and child portable digital weighing machine (SECA 881). This scale enables the weight of the child to be determined in their mother's arms. (Provided by AMCHSS, SCTIMST, Trivandrum)

ii) The height / length were measured to the nearest 0.1 cm using wooden measuring boards (Shorr board) with a sliding head piece. This standardized measuring board was previously used in the National Family Health Survey-2. The board was provided by the Indian Institute of Population Sciences, Mumbai, to another investigator, for a similar study, who in turn provided it to us.

2.9 Reference standards

According to the NCHS /WHO standards Wasting, stunting, and underweight is defined as low weight for height, height for age and weight for age respectively. For reporting of these indices, Z-scores (standard deviation scores) are used.

The **Z-score** or **standard deviation unit (SD)** 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.

This can be written in equation form as:

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

2.10 Cut-Offs

Cut -off based prevalence for the indicators were used in this study. The use of cut-off enables the different individual measurements to be converted into prevalence statistics. The cut-off used in this study with Z-scores is minus two standard deviations. This means

children with a Z-score for underweight, stunting or wasting below minus two standard deviation are considered moderately malnourished, and those below minus three severely malnourished. The cut-off points for WHO classification (Z-Scores) was adopted for this study (Table 1). Broadly children are considered normal if the Z-Scores are above -2 and malnourished if Z-Scores below -2.

Table 1. **WHO classification (Z-Scores**)

Cut-off	**Nutrition classification**
<2 to > -1 Z score	Normal
< -1 to > -2 Z score	Mild undernutrition
< -2 to > - 3 Z score	Moderate undernutrition
< -3 Z- score	Severe undernutrition

Mid upper arm circumference cut-offs are somewhat arbitrary due to its lack of precision as a measure of malnutrition. A cut-off of 11.0 cm is used for severely malnourished children. Those children below 12.5 cm are classified as moderate and severe.

2.11 Data Analysis

The data generated from the study was entered into SPSS and Epi info software. Assessment of the children's nutritional status was done using the Nutritional Anthropometry software (Epi Info 2002 system) from the division of Nutrition, CDC, Atlanta. Univariate, bivariate and multivariate analyses were done to infer from the study data. .

Exclusion range

For anthropometric analysis, records with Z score values less than or more than 4 Z-score units from the observed mean are likely to be errors and was excluded or treated as missing values and were excluded as per the guidelines stated in the WHO Technical Report Series No 854.

Chapter 3. Results

3.1 Characteristics of the study sample

The total study sample size to be surveyed was 300. Four children were excluded because they were just below the minimum age group. Three more children were excluded as the Z scores obtained were out of the inclusion range. Finally a total 293 children in the age group of 6-60 months, were surveyed, of which 159 (54.3 percent) were males and 134 (45.7 percent) were females.

Age was grouped according to the recommendations by the WHO and divided into six groups, as shown in the table 2.

i) Age – Sex distribution of study population

Table 2.	**Age and Sex distribution of the study population, Wayanad, 2005**		
	Sex		
	Male	**Female**	**Total**
	N (%)	**N (%)**	**N (%)**
Age group			
6-11	12(7.5)	14(10.5)	26 (8.9)
12-17	24(15.1)	20(15.0)	44 (15.1)
18-23	15(9.4)	9(6.7)	24 (8.2)
24-35	33(20.8)	25(18.7)	58 (19.8)
36-47	50(31.4)	44(32.8)	94 (32.0)
48-59	25(15.8)	22(16.3)	47 (16.0)
Total	**159 (100)**	**134 (100)**	**293 (100)**

It was noted that the majority of the children in the study population were in the age group of 24- 60 months.

ii) Type of tribals

Table 3 Type of tribals in the study population, Wayanad, 2005		
Variable	**Number**	**Percent (%)**
Name of the tribe		
Katunayaka	76	26.0
Kurma	66	22.5
Paniya	151	51.5
Total	**293**	**100**

It our study population, 51 percent belonged to the paniya tribe, 26 percent belonged to katunayaka tribe and 22 percent belonged to kurma tribe.

iii) Standard of living

Standard of living index was computed with the necessary modifications made to that of NFHS-2 data (Appendix-4)

Table 4. Percent distribution of children by standard of living index, Wayanad, 2005		
Variable	**Number**	**Percent (%)**
Standard of living		
Low	231	78.8
Middle	54	18.4
High	8	2.8
Total	**293**	**100**

iv) Type of house

Table 5 Percent distribution of type of house in study population, Wayanad, 2005		
Variable	**Number**	**Percent (%)**
Type of house		
Kachha	32	10.9
Semi Pucca	132	45.1
Pucca	129	44.0
Total	**293**	**100.0**

Among the study population 44 percent of the children lived in *pucca* houses, 45 percent in *semi pucca* and 11 percent lived in *kachha* houses.

Table 6.Percent distribution of population by Housing characteristics,Wayanad,2005		
Variable	**Number**	**Percent (%)**
Toilet facility		
No facility	226	77.1
Pit toilet	26	8.9
Flush toilet	41	14.0
Total	**293**	**100.0**
Electricity in household		
Yes	253	85.2
No	44	14.8
Total	**293**	**100.0**
Source of drinking water		
Dug well	217	74.1
Surface water	54	18.4

Tube well/bore well	8	2.7
Piped	14	4.8
Total	293	100.0
Purification of drinking water		
Strain by cloth	126	43.0
Boiling	141	48.1
Do not purify	26	8.9
Total	**293**	**100.0**

v) Housing characteristics

Almost 45 percent of the houses had a separate room for cooking and 96 percent used firewood as the main fuel for cooking. It was found that 86 percent of the households had electricity. Majority in study population did not have any toilet facility in their household. Hygienic practices followed, like the method used in purification of water. It revealed that 43 percent drinking water after straining by cloth, 48 percent boiled water and only 9 percent used water without following any method of purification. Considering the distance to the source of drinking water. It was found that 37 percent of the households had the source of drinking water within the yard, 43 percent was at a distance of less than five minutes of walking time from the source and 19 percent was more than 15 minutes walking time.

vi) Parental Education

Table 7.Percent distribution of parental education of study population, Wayanad, 2005

Variable	Number	Percent (%)
Education of mother		
No education	126	43.0
Primary (up to class VII)	80	27.3
Secondary (up to class X)	65	22.2
Higher (above class X)	22	7.5
Total	**293**	**100.0**

Education of father		
No education	122	41.6
Primary (up to class VII)	89	30.4
Secondary (up to class X)	69	23.5
Higher (above class X)	13	4.5
Total	**293**	**100.0**

Educational status of mothers and fathers were equally poor. Nearly 45 percent of mothers and fathers had no education. It was found that 7.5 percent of the mothers had education above secondary level, whereas only 4.4 percent of the fathers had education above secondary level.

vii) Parental Occupation

Table 8. Distribution of parental occupation of study population ,Wayanad, 2005 (N=293)

Variable	Number	Percent (%)
Employment status of mother		
Regular job	4	1.4
No job	93	31.7
Agricultural worker	196	66.9
Total	293	100.0
Employment status of fathers		
Regular job13	4.4	
No job	30	10.2
Agricultural worker	250	85.4
Total	**293**	**100.0**

Majority of the parents were engaged in agriculture. Almost 70 percent of the mothers and 85 percent of the fathers were involved in agriculture. Of which only 5.1 percent of mothers and 4.8 percent of fathers, were working in their own land and the rest were working for daily wages.

viii) Parental habits

Table9. Parental habits of study population ,Wayanad, 2005

Variable	Number	Percent (%)
Tobacco chewing habit of mothers		
Yes	177	60.4\
No	116	39.6
Total	**293**	**100.0**
Tobacco chewing habit of fathers		
Yes	168	57.3
No	125	42.7
Total	293	100.0
Tobacco smoking habit of fathers		
Yes	161	54.9
No	132	45.1
Total	**293**	**100.0**
Alcohol consumption habit of fathers		
Yes	201	68.6
No	92	31.4
Total	**293**	**100.0**

Tobacco chewing was found to be prevalent among 60.4 percent of mothers and 57.3 percent of fathers. Among fathers 55 percent of fathers smoke and 67 percent of them consume alcohol

ix) Distance to health facility

Table 10. Percent distribution of children by distance to health facility from the colonies, Wayanad,2005		
Variable (distance in Kilometers) (%)	**Number**	**Percent**
Less than 1 km	38	13.0
1-3 km	120	41.0
More than 1km	135	46.0
Total	**293**	**100**

Almost half the population has no health facility within a distance of three kilometers. Of the available health facilities Primary Health Centers were the majority (85 percent).

A functioning Anganwadi or school for pre school children was present near the colonies of 56 percent of study subjects. Of which only 32 percent were within 3 kilometers range. The details regarding the services available in the Anganwadi showed that nearly 50 percent provided supplementary nutrition for the children.

It was found from our study that 263(89.8 percent) of the children had documented date of birth, either in the Anganwadi, Sub Centres or Panchayat office. The birth registration among the tribal population is increasing as the government of Kerala, has made it mandatory during admission of the children in schools.

x) Antenatal care

Table11. Antenatal care of mothers in study population ,Wayanad,2005)		
Variable	**Number**	**Percent (%)**
Number of antenatal visits		
One	19	6.5
Two	51	17.4
Three	66	22.5
More than three	103	35.2
No antenatal care at all	54	18.4
Total	**293**	**100.0**

It was found that 81.6 percent of the mothers had gone to hospitals for antenatal checkups while their were pregnant, and 57.7 percent of the mothers had gone for checkups three times or more.

xi) Birth order of child

Table 12. Distribution of birth order of children ,Wayanad, 2005 (N=293)		
Variable	**Number**	**Percent (%)**
Birth order		
First	92	31.4
Second	101	34.5
Third	62	21.2
More than three	38	12.9
Total	**293**	**100.0**

It was found that children with birth order of three and more comprised 34 percent of the study population.

xii) Child Morbidity

Table 13. Acute morbidity in the study population		
Variable	**Number**	**Percent (%)**
Diarrhea (2 weeks prior to survey)		
Yes	70	23.9
No	223	76.1
Total	**293**	**100**
Treatment taken for diarrhea	**Number**	**Percent (%)**
From hospital	53	75.7
Gave ORS	6	8.6
Home made fluids	5	7.1
Did nothing	6	8.6
Total	**70**	**100**

Regarding respiratory morbidity, it was found that 23.9 percent had diarrhea and 57.3 percent had fever and cough in the previous two weeks of the survey. Of the children who had a history of fever and cough, nearly 50 percent of them had received treatment; majority had taken treatment from the Primary Health centre.

xiii) Pattern of breastfeeding

Table 14. Pattern of breastfeeding in the study population,Wayanad,2005)		
Variable	**Number**	**Percent (%)**
Breastfed		
Yes	290	99.0
No	3	1.0
Total	**293**	**100.0**

Duration of exclusive breastfeeding		
< 3 months	8	2.7
3-6 months	46	15.7
>6months	236	80.6
Not breastfed	3	1.0
Total	**293**	**100.0**
Initiation of breastfeeding		
Just after birth	230	78.5
Within 24 hours	50	17.1
After 24 hours	7	2.4
Don't know	3	1.0
Not breastfed	3	1.0
Total	**293**	**100**

The tribal population had very good breastfeeding practices, as 99 percent of the mothers had breastfed their children. Only three children were not breastfed and even after repeated enquires, they were no firm answers as to why they were not breastfed. Out of which 78.5 percent of mothers had breastfed their children just after birth. One significant finding is that more than 80 percent of the mothers had exclusively breastfed their children for more than six months.

xiv) Immunization status

Table 15. Percent distribution of children in the age group of 12-60 months by immunization status,Wayanad,2005

Variable	Number	Percent (%)
Adequacy of immunization		
Adequate for age	173	59.0
Inadequate for age	120	41.0
Total	**293**	**100.0**

BCG vaccination		
Received	210	71.7
Not received	83	28.3
Total	**293**	**100.0**
OPV 3 doses		
Received	267	91.1
Not received	26	8.9
Total	**293**	**100.0**
DPT 3 doses		
Received	209	71.3
Not received	84	28.7
Total	**293**	**100.0**
Measles vaccination		
Received	152	55.6
Not received	121	44.4
Total	**273***	**100.0**

* Children below 10 months were excluded

It was found that 62.4 percent had immunization cards. In case of others who did have a card, the children were considered vaccinated, if the mother or care giver confidently confirmed that they were vaccinated. It was found that 71.7 percent of children had received BCG. The coverage of OPV among the tribal population was high, as 91.1 percent received polio vaccination. Three doses of DPT vaccine were received only by 71.3 percent of the children. The coverage of measles vaccination was the least; only 51.9 percent had received the vaccination.

3.2 Prevalence of malnutrition

In this study, the World Health Organization recommended classification using the United States National Center for Health Statistics reference population was adopted. That is a Z-score for underweight, stunting or wasting below minus two standard deviation are considered moderately malnourished, and below minus three as severely malnourished.

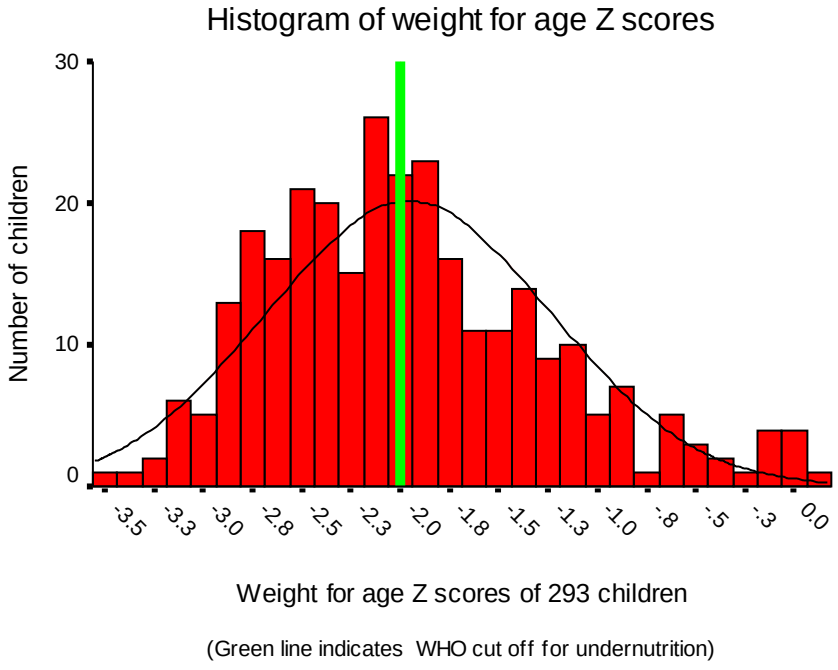
3.2.1 Underweight

Almost 50 percent of the children in the study sample were underweight and four percent were severely underweight. Figure 3 shows the prevalence of underweight and figure 4 the distribution of Z scores. Only children with moderate and severe malnutrition are considered as malnourished (underweight) in this study.

Table 16.Distribution of underweight (weight-for-age) among the study population,Wayanad, 2005

Type of malnutrition (underweight)	Number	Percent (%)
Normal	30	10.2
Mild	106	36.1
Moderate	146	49.8
Severe	11	3.9
Total	**293**	**100.0**

Figure 1

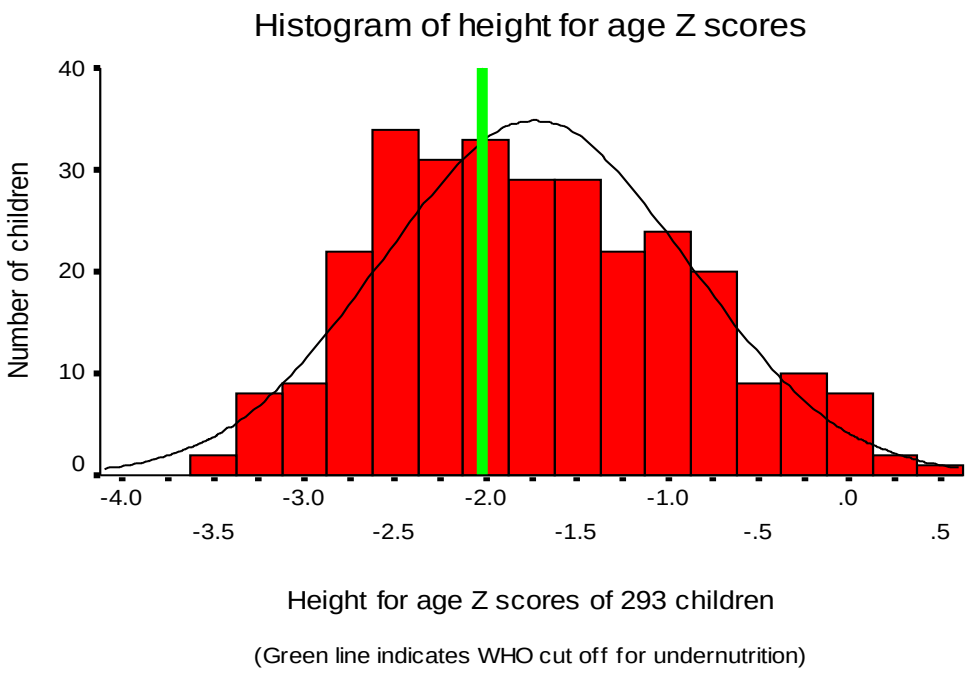


3.2.2 Stunting

In our study 36.7 percent of the children were short for age and 4.4 percent were severely stunted. According to the cut-off (< - 2 SD) used in our study, only children with moderate and severe malnutrition are considered as malnourished.

Table17. Distribution of stunting (height-for-age) among the study population,Wayanad, 2005		
Type of malnutrition (stunting)	**Number**	**Percent (%)**
Normal	63	21.5
Mild	109	37.2
Moderate	109	37.2
Severe	12	4.1
Total	**293**	**100.0**

Figure 2



3.2.3 Wasting

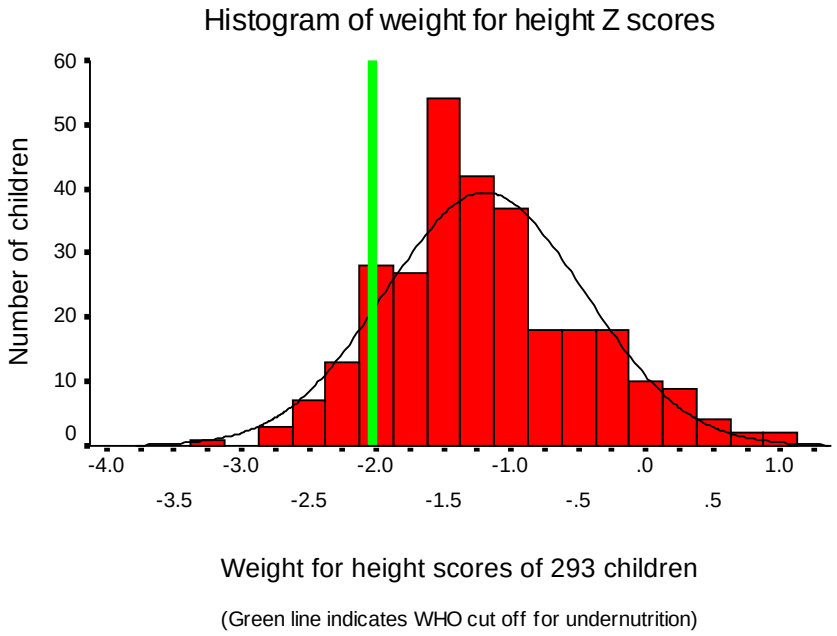
Similarly in our study 10.7 percent were wasted and 0.7 percent was severely wasted, according to the cut-off (<-2 SD).The lower prevalence of wasting than stunting or underweight indicates that chronic malnutrition is more prevalent in this community than acute malnutrition.

One child in the study sample was severely malnourished with reference to the Cut-off for mid upper arm circumference less than 12.5 cm.

Table18. Distribution of wasting (weight-for-height) among the study population,Wayanad, 2005

Type of malnutrition (wasting)	Number	Percent (%)
Normal	104	35.6
Mild	158	53.9
Moderate	30	10.2
Severe	1	0.3
Total	**293**	**100.0**

Figure 3



3.3 Factors influencing Underweight and Stunting

Bivariate analyses by cross tabulations were done using number of factors. For bivariate analyses, Z scores of less than -2 were taken as underweight or stunted, and more than or equal to -2 was taken as normal. The results of this analysis are given below.

3.3.1 Influence of socioeconomic and demographic factors on underweight

i) Age and sex vs underweight (low weight for age)

Table19 Percentage of children aged 6-60 months classified as undernourished (underweight), according to age and sex,Wayanad,2005

Variable	Normal N(%)	Underweight N(%)	Total N(%)
Age of child			
6-11	19(14.0)	7(4.5)	26(8.9)
12-17	18(13.2)	26(16.6)	44(15.0)
18-23	12(8.8)	12(7.6)	24(8.2)
24-35	21(15.5)	37(23.6)	58(19.8)
36-47	44(32.3)	50(31.8)	94(32.1)
48-59	22(16.2)	25(15.9)	47(16.0)
Total	**136(100)**	**157(100)**	**293(100)**
Sex			
Male	71(52.2)	88(56.1)	159(54.3)
Female	65(47.8)	69(43.9)	134(45.7)
Total	**136(100)**	**157(100)**	**293(100)**

There was no significant difference in underweight across age groups. However older children showed a higher percent of underweight. Boys showed a higher percent of underweight that was statistically not significant.

ii) Educational status of parents vs underweight (low weight for age)

Malnutrition was divided into mild, moderate and severe based on the WHO classification (Table 1). Only moderate and severe malnutrition were considered as undernourished for analysis.

Table 20. Percentage of children by educational status of mother and type of undernutrition (underweight), Wayanad, 2005.

Undernutrition (underweight),	Normal n (%)	Mild n (%)	Moderate n (%)	Severe n (%)
Education of mother				
No education	8(26.7)	44(41.5)	68(46.5)	6(54.5)
Primary (up to class VII)	3(10.0)	25(23.6)	48(32.9)	4(36.4)
Secondary (up to class X)	9(30.0)	28(26.4)	27(18.5)	1(9.1)
Higher (above class X)	10(33.3)	9(8.5)	3(2.1)	0(0.0)
Total	**30(100)**	**106(100)**	**146(100)**	**11(100)**

Table 21. Percentage of children by educational status of father and type of undernutrition (underweight), Wayanad, 2005.

	Undernutrition (underweight),			
	Normal n (%)	**Mild** n (%)	**Moderate** n (%)	**Severe** n (%)
Education of father				
No education	3(10.0)	48 (45.2)	66 (45.2)	5(45.5)
Primary (up to class VII)	9(30.0)	27 (25.5)	47 (32.2)	6(54.5)
Secondary (up to class X	11(37.7)	29(27.4)	29 (19.9)	0(0)
Higher (above class X)	7(22.3)	2(1.9)	4 (2.7)	0(0)
Total	**30 (100)**	**106(100)**	**146(100)**	**11(100)**

Educational status of the parents had a significant influence on underweight. It was found that, as the educational status of the parents increased the proportion of underweight decreased. It showed a significant trend.

iii) Standard of living vs underweight (low weight for age)

Table22. Percentage of children by standard of living and underweight , Wayanad, 2005

Variable	Normal N(%)	Underweight N(%)	Total N(%)
Standard of living			**p= .000**
Low	90(66.2)	141(90)	231(79)
Middle	38(28.0)	16(10)	54(18.4)
High	8(5.8)	0(0.0)	8(2.6)
Total	**136(100)**	**157(100)**	**293(100)**

Children in the low standard of living families had more number of underweight children, than those from medium and high standard of living.

iv)Type of tribe vs underweight (low weight for age)

Table 23. Percentage of children by type of tribe and undernutrition (underweight), Wayanad, 2005

Variable	Normal N(%)	Underweight N(%)	Total N(%)
Name of the tribe			**p= .000**
Katunayaka	38(28.0)	38(24.2)	76(26)
Kurma	46(33.9)	20(12.7)	66(22.5)
Paniya	52(38.1)	99(63.1)	151(51.5)
Total	**136(100)**	**157(100)**	**293(100)**

Children belonging to Paniya and katunayaka tribes had the highest percent of underweight

v) Personal habits of parents vs underweight (low weight for age)

Table 24. Percentage of children by tobacco chewing habit of mother and underweight, Wayanad, 2005			
Variable	**Normal N(%)**	**Underweight N(%)**	**Total N(%)**
Tobacco chewing habit of mother			**p= .001**
Yes	68(50.0)	109(69.4)	177(60.4)
No	68(50.0)	48(30.6)	116(39.6)
Total	**136(100)**	**157(100)**	**293(100)**

Mothers' tobacco chewing habit had a significant effect on the nutritional status of the children. It was found that, of the 177 children whose mothers had tobacco chewing habit, 60 percent of their children were underweight. Whereas fathers personal habits like tobacco chewing, smoking and alcohol consumption had no effect on underweight.

vi) Hygienic practices vs underweight (low weight for age)

Table 25. Percentage of children by source of water and underweight , Wayanad, 2005			
Variable	**Normal N(%)**	**Underweight N(%)**	**Total N(%)**
Source of drinking water			**p= .06**
Dug well	106(78.0)	111(71.0)	217(74.1)
Surface water	21(15.4)	33(21.0)	54(18.4)
Tube well/piped	9(6.6)	13(8.0)	22(7.5)
Total	**136(100)**	**157(100)**	**293(100)**
Purification of drinking water			**p= .001**
Boiling	91(53.0)	50(41.3)	141(48.1)
Strain by cloth	81(47.0)	71(58.7)	152(51.9)
Total	**172(100)**	**121(100)**	**293(100)**

Children whose families used drinking water without adopting any purification method had higher percent of underweight, than the children whose households used water after boiling. However, the source of water had no effect on underweight of children.

vii)Housing characteristics vs underweight (low weight for age)

Table 26. Percentage of children aged 6-60 months classified as undernourished (underweight) according to selected housing characteristics,Wayanad,2005

Variable	Normal N(%)	Underweight N(%)	Total N(%)
Toilet facility			**p= .004**
No faci	130(75.6)	96(79.3)	226(77.1)
Pit toilet	13(7.6)	13(10.7)	26(8.8)
ESP Latrine	4(2.3)	5(4.1)	9(3.0)
Flush toilet	25(14.5)	7(5.9)	32(11.1)
Total	**172(100)**	**121(100)**	**293(100)**
Type of house			**p= .016**
Kachha	21(12.2)	11(9.1)	32(10.9)
Semi Pucca	63(36.6)	69(57.0)	132(45.1)
Pucca	88(51.2)	41(33.9)	129(44)
Total	**172(100)**	**121(100)**	**293(100)**
Electricity			
Yes	113(83.1)	138(87.9)	251(85.7)
No	23(16.9)	19(12.1)	42(14.3)
Total	**136(100)**	**157(100)**	**293(100)**

It showed children, whose households had no toilet facility or have pit toilet had a higher percent of underweight. Children who lived in Kachha and semi Pucca houses had a higher percent of underweight.

viii) Immunization status vs underweight (low weight for age)

Table 27. Percentage of children aged 6-60 months by immunization status and undernutrition (underweight),Wayanad,2005			
Immunization status	**Normal N(%)**	**Underweight N(%)**	**Total N(%)**
Adequate vaccination	81(59.6)	92(58.6)	173(59.0)
Not adequate vaccination	55(40.4)	65(41.4)	120(41.0)
Total	**136(100)**	**157(100)**	**293(100)**

Immunization status of the children did not show any significant effect on underweight

ix) Breastfeeding practices vs underweight (low weight for age)

Table 28. Percentage of children by duration of exclusive breastfeeding and undernutrition (underweight), Wayanad, 2005.			
Variable	**Normal N(%)**	**Stunted N(%)**	**Total N(%)**
Duration of exclusive breastfeeding			
< 3 months	4(3.0)	4(2.6)	8(2.8)
3-6 months	23(17.2)	23(14.7)	46(15.8)
>6months	107(79.8)	129(82.7)	236(81.4)
Total	**134(100)**	**156(100)**	**290(100)**

Though there was no significant influence of duration of exclusive breastfeeding on underweight. It was seen that the percent of underweight was higher in children who were breastfed for more than six months

x) Birth order vs underweight (low weight for age)

Table 29. Percentage of children by birth order and undernutrition (underweight), Wayanad, 2005.			
Variable	**Normal N(%)**	**underweight N(%)**	**Total N(%)**
Birth order			
First	49(36.0)	43(27.4)	92(31.4)
Second	52(38.2)	49(31.2)	101(34.5)
Third	19(14.0)	43(27.4)	62(21.2)
More than three	16(11.8)	22(14.0)	38(12.9)
Total	**136(100)**	**157(100)**	**293(100)**

It was found that children with a higher birth order (three and above) had higher percent of underweight.

xi) Distance of health facility vs underweight(low weight for age)

Table 30. Percentage of children by distance from the health facility and undernutrition (underweight), Wayanad, 2005			
Variable	**Normal N(%)**	**underweight N(%)**	**Total N(%)**
Distance to health facility			
Less than 1 km	14(10.3)	24(15.3)	38(13.0)
1-3 km	55(40.4)	65 (41.4)	120(41.0)
more than 3 km	67(49.3)	68(43.3)	135(46.0)
Total	**136(100)**	**157(100)**	**293(100)**

Children living in colonies, where the distance from the health facilities to the colony was more than three kilometers had higher percent of underweight.

3.3.2 Influence of socioeconomic and demographic factors on Stunting

i) **Age and sex vs Stunting (low height-for-age)**

Table31. Percentage of children aged 6-60 months classified as undernourished(stunting), according to age and sex, Wayanad, 2005

Variable	Normal N(%)	Stunted N(%)	Total N(%)
Age of child			
6-11	19(11.0)	7(5.8)	26(8.9)
12-17	26(15.1)	18(14.9)	44(15.0)
18-23	11(6.4)	13(10.7)	24(8.2)
24-35	40(23.3)	18(14.9)	58(19.8)
36-47	56(32.6)	38(31.4)	94(32.1)
48-59	20(11.6)	27(22.3)	47(16.0)
total	**172(100)**	**121(100)**	**293(100)**
Sex			
Male	86(50.0)	73(60.0)	159(54.2)
Female	86(50.0)	48(40.0)	134(45.8)
Total	**172(100)**	**121(100)**	**293(100)**

There is no significant difference in stunting across age groups. However older children showed a higher percent of stunting. Although boys showed a higher percent of stunting, that was not statistically significant.

ii) Educational status of parents vs Stunting (low height-for-age)

Undernutrition was divided into mild, moderate and severe based on the WHO classification (Table 1). Only moderate and severe malnutrition were considered as undernourished for analysis.

Table 32. Percentage of children by educational status of mother and type of Undernutrition (Stunting), Wayanad, 2005				
			Undernutrition (Stunting)	
	Normal	**Mild**	**Moderate**	**Severe**
	n (%)	n (%)	n (%)	n (%)
Education of mother				
No education	25(39.7)	41(37.6)	51(46.8)	9(75.0)
primary (up to class VII)	9(14.3)	34(31.2)	35 (32.1)	2(16.7)
secondary (up to class X)	17(27.0)	26(23.9)	21(19.3)	1(8.3)
higher (above class X)	2(19.0)	8(7.3)	2(1.8)	0(0.0)
Total	**63(100)**	**109(100)**	**109(100)**	**12(100)**

Table 33. Percentage of children by educational status of father and type of Undernutrition (Stunting), Wayanad, 2005.				
			Undernutriton (Stunting)	
	Normal	**Mild**	**Moderate**	**Severe**
	n (%)	n (%)	n (%)	n (%)
Education of father				
No education	26 (41.3)	40 (36.7)	48 (44.0)	8 (66.7)
primary (up to class VII)	13 (20.6)	36 (33.0)	37(33.9)	3(25.0)
secondary (up to class X)	18 (28.6)	28 (25.7)	22(20.2)	1 (8.3)
higher (above class X)	6 (9.5)	5 (4.6)	2 (1.8)	0(0.0)
Total	**63 (100)**	**109(100)**	**109(100)**	**12(100)**

Educational status of the parents had a significant influence on stunting. It was found that as the educational status of the parents increased the proportion of stunting decreased. It showed a significant chi- square for trend.

iii) Standard of living vs Stunting (low height-for-age)

Table 34. Percentage of children by standard of living and undernutrition (Stunting), Wayanad, 2005.			
Variable	**Normal N(%)**	**Stunted N(%)**	**Total N(%)**
Standard of living		**p= .003**	
Low	125(72.3)	106(87.6)	231(78.9)
Middle	39(22.3)	15(12.4)	54(18.4)
High	8 (5.4)	0 (0)	8(2.7)
Total	**172(100)**	**121(100)**	**293(100)**

iv) Type of tribe vs stunting (low height-for-age)

Table 35. Percentage of children by type of tribe and undernutrition (Stunting), Wayanad, 2005. (N= 293)			
Variable	**Normal N(%)**	**Stunted N(%)**	**Total N(%)**
Name of the tribe			**p= .004**
Katunayaka	47(27.3)	29(24.0)	76(26.0)
Kurma	49(28.5)	17(14.0)	66(22.5)
Paniya	76(44.2)	75(62.0)	51(51.5)
Total	**172(100)**	**121(100)**	**293(100)**

Cross tabulations of standard of living groups and stunting showed the highest percent of stunting in the low standard of living group, than the medium and high. Paniya tribe had the highest percent of stunting in the study population.

v) Personal habits of parents' vs Stunting (low height for age)

Table 36. Percentage of children by undernutrition(Stunting) and tobacco chewing habit of mother, Wayanad, 2005			
Variable	**Normal N(%)**	**Stunted N(%)**	**Total N(%)**
Tobacco chewing habit of mother a			**p= .031**
Yes	95(55.2)	82(67.8)	7(60.4)
No	77(44.8)	39(32.2)	116(39.6)
Total	**172(100)**	**121(100)**	**293(100)**

Mothers' tobacco chewing habit had no significant effect on stunting of the children. Although it was found that 46.3 percent of the children, whose mothers had tobacco chewing habit were stunted. Fathers personal habits like tobacco chewing, smoking and alcohol consumption had no significant influence on stunting of the children.

vi) Hygienic practices vs Stunting (low height-for-age)

Table 37. Percentage of children by source of water & undernutrition (Stunting), Wayanad, 2005			
Variable	**Normal N(%)**	**Stunted N(%)**	**Total N(%)**
Source of drinking water			**p= .06**
Dug well	135(78.5)	82(67.8)	217(74.1)
Surface water	23(13.4)	31(25.6)	54(18.4)
Tube well/piped	14(8.1)	8 (6.6)	22(7.5)
Total	**172(100)**	**121(100)**	**293(100)**
Purification of drinking water			**p= .051**
Strain by cloth	81(47.0)	71(58.7)	152(51.9)
Boiling	91(53.0)	50(41.3)	141(48.1)
Total	**172(100)**	**121(100)**	**293(100)**

Children whose families used water without adopting any purification method were more stunted than the children whose households used water after boiling. It was seen that almost 48 percent of children, whose households used to strain the water with a cloth were stunted. Stunting was higher among children whose households use surface water for drinking.

vii) Housing characteristics vs Stunting (low height-for-age)

Table 38. Percentage of children aged 6-60 months classified as undernourished (stunted) according to selected housing characteristics,Wayanad,2005

Variable	Normal N(%)	Stunted N(%)	Total N(%)
Toilet facility			**p= .083**
No facility	130(57.5)	96(79.4)	226(77.1)
Pit toilet	13(7.6)	13(10.7)	26(8.9)
E.S.P Latrine	4(2.3)	5(4.1)	9(3.0)
Flush toilet	25(32.6)	7(5.8)	32(11.0)
Total	**72(100)**	**121(100)**	**293(100)**
Type of house			**p= .002**
Kachha	21(12.2)	11(9.1)	34(11.6)
Semi Pucca 63(36.6)	69(57.0)	132(45.1)	
Pucca	88(51.2)	41(33.9)	129(43.3)
Total	**72(100)**	**121(100)**	**293(100)**
Electricity			
Yes	141(82.0)	110(91.0)	251(86.0)
No	31(18.0)	11(9.0)	42(14.0)
Total	**172(100)**	**121(100)**	**293(100)**

It showed children from households who had no toilet facility or have pit toilet had a higher percent of stunting. Children who lived in Kachha and semi Pucca houses had a higher percent of stunting.

viii) Immunization status vs stunting (low height-for-age)

Table 39. Percentage of children aged 6-60 months by immunization status and undernutrition (stunting),Wayanad,2005

Immunization status	Normal N(%)	Stunted N(%)	Total N(%)
Adequate vaccination	99(57.6)	74(61.2)	173(59.0)
Not adequate vaccination	73(42.4)	47(38.8)	120(41.0)
Total	**172(100)**	**121(100)**	**293(100)**

Immunization status of the children did not show any significant effect on stunting.

ix) Breastfeeding practices vs Stunting (Height-for-age)

Table 40. Percentage of children by duration of exclusive breastfeeding and undernutrition (Stunting), Wayanad, 2005.

Variable	Normal N(%)	Stunted N(%)	Total N(%)
Duration of exclusive breastfeeding			
< 3 months	5(3.0)	3(2.5)	8(2.8)
3-6 months	28(16.6)	18(14.9)	46(15.9)
>6months	136(80.4)	100(82.6)	236(81.3)
Did not breast feed	3(1.7)		3(1.0)
Total	**172(100)**	**121(100)**	**293(100)**

Neither duration of exclusive breastfeeding nor the age of weaning had any influence on stunting.

x) Birth order vs Stunting(height for age)

Table 41.Percentage of children by birth order and undernutrition (Stunting), Wayanad, 2005.			
Variable	**Normal N(%)**	**Stunted N(%)**	**Total N(%)**
Birth order			
First	56(32.6)	36(29.8)	92(31.4)
second	69(40.1)	32(26.4)	101(34.5)
Third	26(15.1)	36(29.8)	62(21.2)
More than three	21(12.2)	17(14.0)	38(12.9)
Total	**172(100)**	**121(100)**	**293(100)**

Children in the birth order of three and above had higher percent of stunting.

xi) Distance of health facility vs stunting (low height for age)

Table 42. Percentage of children by distance from the health facility and undernutrition (stunting), Wayanad, 2005			
Variable	**Normal N(%)**	**Stunting N(%)**	**Total N(%)**
Distance to health facility			
Less than 1 km	17(9.9)	21(17.4)	38(13.0)
1-3 km	66 (38.4)	59 (48.8)	120(41.0)
more than 3 km	89(51.7)	46(33.8)	135(46.0)
Total	**172(100)**	**121(100)**	**293(100)**

Children living in colonies , where the distance from the health facilities to the colony was more than three kilometers had higher percent of children who were underweight.

Antenatal visits (used as a proxy for access to health services), also had no significant influence on stunting. Also, other variables like distance from Anganwadi and health centre had no relation with stunting

Chapter 4. Discussion

The present study examines the nutritional status of under- five children in an effort to estimate the prevalence of malnutrition. In our study it was observed that the nutritional status of children was generally poor, over 40 percent of the children were short for age, nearly 50 percent of the children in the study sample were underweight and 11 percent were wasted The overall prevalence of underweight, stunting and wasting was consistent, in comparison to the NFHS-2 India report and a study done in Kerala by National Nutrition Monitoring Bureau (NNMB) in 2003. NFHS-2 report showed that 56 percent of children belonging to Schedule tribes were underweight (weight-for- age), 53 percent were stunted (height- for- age) and 22 percent were wasted (weight-for-height). NNMB surveys largely pertain to poor rural populations and do not generally capture the upper-middle-class and the affluent sections. It showed that 40.7 percent of children are underweight, 30 percent stunted and 33.8 percent wasted.

Several studies have been done in different settings around the world, to study the role of mothers' education in child malnutrition. A study by Gupta MC et al[19] among urban slum dwellers in India, identified that maternal education level and knowledge, attitudes and practices was significantly and independently associated with children's nutritional status. In this study Knowledge, attitudes and practices significantly associated with nutritional status pertained to nutritional requirements of children, nutritional value of foods, immunization, hygiene, oral rehydration and diarrhea. Whereas fathers education was unrelated to the child's nutritional status in the study. Another study in Uganda by Henry Wamani et al showed Children belonging to mother with no formal education or to mothers who stopped in primary school were significantly more likely to be stunted compared to their counterparts

with mothers who were educated beyond primary school.[18] According to a WHO report it was found that, children whose mothers have some primary education were 1.9 times more likely to be stunted compared to children whose mothers had secondary or higher education.[1]

In our study also we found similar association of underweight and stunting with mothers education. Mothers' education showed an inverse relationship to malnutrition (underweight and stunting) of the child. It was found that, with increasing educational status of the mother, the corresponding number of malnourished children declined. The fathers education and nutritional status of children also had a similar trend. Although mothers education did not have any significant association after multivariate analysis.

The immunization status did not have any influence with nutritional status is our study. The immunization coverage among our study population was lower compared to NFHS-2 Kerala reports. According to the NFHS-2, Kerala reports 95 percent of children aged 12 to 23 months are fully vaccinated. 100 percent for BCG, 98 percent for third dose of DPT vaccine, 98 percent for third dose of polio vaccine and 95 percent for measles vaccine. Whereas in our study it was found that 72.1 percent received BCG. This could be due to the still existing higher number of home deliveries in the community. 91.2 percent received polio, 71.7 percent had received three doses of DPT vaccine. The coverage of measles vaccination was the least; only 51.9 percent had received the vaccination.

The other important factor that showed significant influence on underweight and stunting was Standard of living (socio economic status). A study conducted in South Africa[16] showed, that the household's economic position is seen to have a highly significant impact on the probability of a child being stunted and underweight. A study in Uganda by Joyce K. Kikafunda et al showed children from households with a low or very low socioeconomic

status had two and one-half times the risk of being underweight relative to children who came from households with middle to upper socioeconomic status[24]. From a study in Ethiopia, that states household economic status is also another important variable explaining child stunting. As compared with children residing in households with medium or higher economic status, children residing in very poor and poor households was two times more likely to be stunted[1]. A study done by Jeyaseelan[14] showed that household economic status has a strong effect on chronic child malnutrition. Another study in Bangladesh[15] showed malnutrition rate was two times higher among the poorest than that of the richest.

The most striking result in our study was the significant relation between socioeconomic status and malnutrition, in accordance to the above mentioned studies. It is noteworthy that the variables used in computing the Standard of living, reflect the permanent living conditions of the households. A low standard of living level thus indicates long-term poverty. It is notable that the association of standard of living with underweight and stunting was highly significant even after multivariate analysis.

Birth order is another factor that had a significant influence on underweight and stunting. A NFHS bulletin by Vinod K Mishra and Robert D Rutherford showed that children in small families are less likely to suffer chronic malnutrition than are children with three or more older siblings[17]. Also Jayseelan in his study found, birth order of five and more is positively associated with child malnutrition.[14] From our study it was found that children with lower birth order (< 3) had lower risk of being malnourished, as compared to those with higher birth order. This was consistent with the findings of the study by Vinod K Mishra and Robert D Rutherford. Children with three or more older siblings are more likely to suffer chronic malnutrition than are children from smaller families, probably because competition

for food increases with family size. However, when adjusted for other factors in multivariate analysis it showed significant relation with both underweight and stunting.

Method used to purify water, that was used as a proxy for hygienic practices in our study had significant influence on underweight. Our study found, Children from household's not using boiled water for drinking, had a higher risk for underweight and stunting. This could be due to lack of awareness regarding hygienic practices, lack of education, and lack of resources or poverty. This result was consistent with a previous study by Vella et al in northwestern Uganda, showing children whose families used water from unprotected sources were more underweight than their counterparts.[23] Another study by V. G. Rao et al showed ,poor environmental sanitation and unhygienic personal habits appear to predispose the children to the risk of infections, leading to malnutrition[39]. The children whose homes used water from protected sources had a lower risk of underweight relative to children whose homes used water from unprotected sources[24].

This study found that among the children whose parents are habituated to chewing tobacco 40 percent were underweight and 60 percent children were stunted. Significant association of breast-feeding and higher prevalence of underweight and stunting among non breastfed children was found from several studies around the world. Long duration of breast-feeding has a positive effect on linear growth in the second and third years of life.[33] Although there are studies which showed duration of breast-feeding had indirect relation to the nutritional status, longer the duration of breast feeding higher the prevalence and the severity of malnutrition.[36] One study found that undernourished children were more likely to be breastfed for longer durations compared with normally nourished children[40]. Although in our study there was no significant influence of breast feeding to stunting and underweight, it was

found that underweight was higher among children who were exclusively breastfed for longer than six months duration.

Our study does not show any influence of employment status of mother to underweight and stunting, in contrast to a study by Bamji M and Thimayamma.[21] Source of water and toilet facility had no influence on the nutritional status of children unlike other studies done earlier by Vella V et al[23] and by Raman L.[27] One of the reasons may be that, most of the households in the study population do not have a toilet facility as they live in forests.

It is seen that the *Paniya* population which had the highest prevalence of stunting and underweight, and also had the higher percentage of families living within the lower standard of living group. This may be due to food insecurity in these households that negatively affect the nutritional status of children, also may be due to poor standard of living.

4.1 Strengths and limitations of the study

The anthropometric measurements were done by going to the individual households with the necessary equipments by the investigator who has served the population as a medical doctor for a long time and very familiar with the area. This adds to the credibility of the study.

The major limitations of the study is the inability of the study explore further into the qualitative details of many aspects like reasons for not giving breast milk to the kids by a few mothers. Another concern is the use of western standards as reference. However WHO has standardized this reference for children under five for both developing and developed countries. Obtaining the correct age of the children was another major limitation in the study. Some children may have reported as older or as younger, than they really were. This might

have affected the under nutrition estimates. However documented evidence for date of birth were obtained for majority of the children

4.2 Conclusions and Recommendations

This study found that undernutrition in the tribal children is quite high compared to the estimates for other communities in the region The lower levels of wasting, compared with stunting and underweight, indicate that chronic (long-term) malnutrition is more common than acute (severe but short-term) malnutrition in the study population. The high prevalence of underweight and stunting in the study population and the low levels of education and standard of living, identify an important public health problem in the area.

Degree of malnutrition was significantly related to standard of living, parents education and birth order. However with multivariate analysis standard of living was found to be most significant correlate to both underweight and stunting. There was no relation found with the distance of the colonies to the nutritional status. . Antenatal checkup and immunization coverage which were the proxy variables used to asses the utilization of health services had no significance. This may be due to the selective health seeking behavior of parents; probably they take the children to the hospital only if they are sick.

The study revealed children of very poor (low standard of living index) households and children belonging to the *Paniya* tribe had the highest prevalence of malnutrition. This study shows that education of parents is one of the important determinants of children's nutritional status. Children of educated parents are at a lower risk of malnutrition. Although malnutrition is high among children of women with no education, more than 40 percent of children, whose mothers have completed secondary school or higher education, also suffer from chronic malnutrition. This suggests that efforts to improve women's education need to

be combined with more specific programmes to improve child-feeding practices. Opportunities should be given to adult women and men to take part in non-formal education. Health and nutrition education should also be an integral part of the education process.

Study revealed strong correlation with the economic status and malnutrition. Overall socio economic upliftment in the region will improve the standard of living of the population, bringing down the eternal problems of malnutrition. Similarly public facilities like health centres and Anganwadi should be made functional. At present they are not in real sense that is why there is no positive correlation of these parameters and malnutrition. Similarly advancing the literacy status especially female education would have a positive impact on the overall health of the children including their nutritional status.

4.3 Ethical consideration:

The study was done as a part of the mandatory dissertation and was approved by the Institutional Ethics committee (IEC) and Technical Advisory committee (TAC) (Sree Chitra Tirunal Institute for Medical Sciences and Technology). Necessary permission from tribal leaders, local leaders and the community were obtained. The purpose and contents of the survey was clearly explained to the caregiver in a non threatening and culturally appropriate manner. Care givers were given ample opportunity to ask questions and decline participation if necessary. Verbal assent from each caregiver and consent from children older than 3years was sought prior to interview or undertaking any measurements.

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Appendix-1

Glossary

Nutritional status The physiological state of an individual that results from the relationship between nutrient intake and requirements and from the body's ability to digest, absorb and use these nutrients

Malnutrition A nutritional disorder or condition resulting from faulty or inadequate nutrition

Anthropometry: Use of human body measurements to obtain information about nutritional status.

Anthropometric index: Use of weight and height in conjunction with each other or with reference to age.

Nutrition indicator A measure used at the individual and population level to determine nutritional status.

Exclusive breastfeeding An infant is given no food or drink, including water, other than breast milk (except any medicinal drops or syrups which may be indicated).

Over nutrition: A situation caused by an excessive, unbalanced intake of nutritional substances.

Prevalence The proportion of the population that has a condition of interest (e.g. wasting or stunting) at a specific point in time.

Stunting Refers to shortness that is a deficit of linear growth which has failed to reach genetic potential as a result of poor diet and disease. Stunting is defined as <-2 standard deviations (SD) of the height-forage median value of the National Center for Health Statistics/World Health Organization (NCHS/ WHO) international reference data.

Undernourishment Food intake that is continuously inadequate to meet dietary energy requirement.

Undernutrition The result of undernourishment, poor absorption or poor biological use of nutrients consumed.

Weight-for-age Index used to compare a child's weight with the expected value of a child of the same age. A measure of underweight.

Weight-for-height Index used to compare a child's weight with the expected value of a child of the same height. A measure of wasting.

Kachha houses: made from mud, thatch, or other low-quality materials.

Pucca houses: (made from high-quality materials such as bricks, tiles, cement, and concrete) throughout, including roof, walls, and floor.

Semi-pucca houses: made from partly low-quality materials and partly high-quality materials

Weaning: this is defined as the time when mothers begin to introduce food other than milk into the child's diet

Cut-off point - Predetermined risk levels used to differentiate between malnourished and adequately nourished segments of a population.

Design effect - The loss of sampling efficiency resulting from the use of cluster sampling instead of random sampling (a design effect of 2.0 is commonly used for anthropometric and immunization surveys).

Distribution - A display that shows the number of observations (or measurements) and how often they occur.

Morbidity - A condition resulting from or pertaining to disease; illness.

NCHS reference standards – Growth percentiles developed by the National Center for Health Statistics in the US that provide standards for weight-for-age, length-for-age and weight-for-length.

Protein-energy malnutrition – Undernutrition that results in an individual not receiving adequate protein or calories for normal growth, body maintenance, and the energy necessary for ordinary human activities.

Stunting - A slowing of skeletal growth that results in reduced stature or length; a condition that usually results from extended periods of inadequate food intake and infection, especially during the years of greatest growth for children.

Underweight - A condition measured by weight-for-age; a condition that can also act as a composite measure of stunting and wasting.

Wasting - A condition measured by weight-for-height; a condition that results from the loss of both body tissue and fat in a body; a condition that usually reflects severely inadequate food intake and infection happening at present.

Z-score - A statistical measure of the distance, in units of standard deviations, of a value from the mean; the standardized value for an item based on the mean and standard deviation of a data set; a standardized value computed by subtracting the mean from the data value and then dividing the results by the standard deviation.

Appendix-2

Interview and Examination Schedule

A. General information

A.1 Grama Panchayat… **A.2 Day of interview:** …….

A.3 Name of the Colony… **A.4 Cluster number**…

A.5 Tribe…

B.Colony details

B.1 Nearest health facility (specify):……

B.2 Distance of the nearest health facility from the colony (1 km = half hour walking time) 1) <1 km 2) 1-3 km 3) > 3 km

B.3 Is there a functioning Anganwadi near your colony: 1) Yes 2) No

B. 4. If yes, do they have?
1) Pre-school education 2) supplementary nutrition for children
3) supplementary nutrition for mothers (including pregnant and lactating women)

B.5 Distance of the nearest Anganwadi from the colony (1 km = half hour walking time) 1) <1 km 2) 1-3 km 3) > 3 km

C. Details of the child

C.1 Name…

C. 2. Sex: 1) Male 2) Female

C. 3 The child is taken care of by:
1) Biological parents 2) Mother alone 3) Mother & step father
4) Father & step mother 5) Relatives 6) others specify…

C. 4 Age (as mentioned by mother / respondent)
1) Day/Month/Year… 2) Don't Know

C. 5 Age (as recorded by Anganwadi / JPHN / Panchayat office / Hospital)
1) Day/Month/Year: 2) Don't Know

C. 6 Age (clinical estimate by the investigator) 1) Month/Year:…

C.7 Place of delivery 1) Home 2) Hospital

C.8 Birth order 1) First 2) Second 3) Third 4) Other (specify):

C.9 Previous birth interval: 1) First 2) < 24 months 3) 24-47 months 4)>48 months

C.10 Did you Breastfeed: 1) Yes 2) No

C.11 If Yes, When did you initiate breast feeding?
1) Just after birth 2) within 24 hours 3) After 24 hours 4) don't know

C.12 How long did you exclusively breastfeed
1) < 3months 2) 3- 6months 3) > 6months

C. 13 When did you start weaning: 1) < 3months 2) 3- 6months 3) > 6months

C. 14. Since this time yesterday, how many times did the child eat solid or semisolid foods other than liquids? 1) Number of times: …. 2) Don't know

C. 15. Did the child have diarrhea in the last two weeks? 1) Yes 2) No
(Diarrhea is determined as perceived by mother or caretaker, or as three or more loose or watery stools per day, or blood in stool)

C. 16. If yes, what did you do?
1) Treatment from hospital / Village health worker 2) Gave ORS packet solution
3) Home made fluids 4) Did not do anything

C. 17. Did the child have fever or cough in the last two weeks 1) Yes 2) No

C. 18. Did you seek advice or treatment for the illness? 1) Yes 2) No

C. 19. If yes, from where did you seek care: … (Specify)

C.20. Is there a vaccination Card for the child?
1) Yes seen 2) Yes, not seen 3) No

If immunization card is available, copy each type of immunization recorded on the card

Date of birth:

Birth weight:

BCG	
Polio1 OPV1	
Polio2 OPV2	
Polio3 OPV3	
DPT 1	
DPT 2	
DPT 3	
OPV/ DPT	
Measles	
Vitamin A	

(Questions **C.21- C.25** to be asked if immunization card not available)

C.21. **Was the child ever been given a BCG vaccination against tuberculosis, that is a injection in the left arm or shoulder that caused a scar**

1) Yes 2) No 3) Don't Know

C.22 Was the child ever been given any vaccination drops in the mouth – that is Polio? 1) Yes 2) No 3) Don't Know

C.23 Did the child ever been given DPT Vaccination – that is an injection in the thigh or buttocks (usually given at the same time as Polio)

1) Yes 2) No 3) Don't Know

C.24 If yes, how many times: 1) Number (specify) 2) don't remember

C.25 Has the child been given Measles vaccination? (that is an injection in the arm at the age of 9 months or older) 1) Yes 2) No 3) Don't Know

D. Details of mother

D. 1 a**) Mothers name……..**

b) Fathers name…….

D.2 Did you go for antenatal check ups: 1) Yes 2) No

D. 3 If yes, how many times: 1) One 2) Two 3) Three 4) > 3

D. 4 If you ever attended school, up to which level?
1) Nil 2) Primary (up to class VII) 3) Secondary (up to class X)
4) Higher (above class X)

D. 5 If your husband ever attended school, up to which level?
1) Nil 2) Primary (up to class VII) 3) Secondary (up to class X) 4) Higher (above class X)

D. 6 Employment status of mother:
1) Regular income generating activity (specify) 2) No income generating activity
3) Engaged in Agriculture: a) Own b) Labour

D. 7 Personal habits of mother:
1) Chew tobacco 2) smoking tobacco 3) consume alcohol 4) other (specify)…….

D. 8 Employment status of father:
1) Regular income generating activity (specify) 2) No income generating activity
3) Engaged in Agriculture: a) Own b) Labor

D.9 Personal habits of father
1) chew tobacco 2) smoking tobacco 3) consume alcohol 4) other (specify) …….

E. <u>Household details</u>

E. 1 Name of head of household: …….

E. 2 Name of the Respondent and relationship with the child: …….

E. 3 Type of family: 1) Nuclear 2) Joint

E .4 Numbers of members in the family: …….

E. 5 Type of house: 1) Kachha 2) Semi Pucca 3) Pucca

E .6 How many rooms are there in your household? .....

E .7 Is there a separate room for cooking in your household? 1) Yes 2) No

E .8 Main fuel for cooking in your household
1) Electricity/LPG/ Biogas 2) kerosene/charcoal/coal 3) firewood / cow dung cake

E .9 Do you have electricity in your household: 1) Yes 2) No

E.10 What is the main source of drinking water?
1) Dug well 2) Surface water 3) Tube well/borehole 4) Piped 5) Rain water

E .11 How far is the source of drinking water from your household?
1) In the residence / yard /plot 2) < 5 minutes walking time
3) > 15 minutes walking time

E .12 What do you do to purify drinking water?
1) Strain by cloth 2) boiling 3) nothing 4) other (specify):

E .13 What kind of toilet facility does your household have?
1) No facility 2) Pit toilet/latrine 3) E. S. P latrine 4) flush toilet

E .14 Do you own?
1) Buffalos 2) Cow 3) Goat 4) Poultry 5) Rabbits 6) Pigs 7) other (specify)

E. 15 Do you own any of these?
1) Car / tractor 2) Moped/ Scooter /Motorcycle 3) Telephone
4) Refrigerator 5) Color TV 6) Bicycle 7) Fan 8) Radio 9) Sewing machine
10) Black & white TV 11) Cot 12) Mattress 13) Table 14) Chair
15) Clock/ watch

E .16 Does **your household own any irrigated land:** 1) yes 2) No

E .17 If Yes, how many acres
1) <2 acres 2) 2 – 4 acres 3) >4 acres 4) Don't Know.

F. <u>Anthropometry</u>

F .1 Child's weight (kg)	
F .2 Child's length or height. Child under 2 years old. **Measure length** (Lying down). Child age 2 or more years. **Measure height**(Standing up).	Length (cm) Lying down_____ Height (cm) Standing up_____
F. 3 Mid-upper arm circumference (cm)	

Appendix -3

List of Tribal Colonies

	Name of colonies	Population	8% of population
1	Kottankara	46	3.68
2	Pilakavu	301	24.08
3	Putur	107	8.56
4	Vellaktte	17	1.36
5	Thendankara	24	1.92
6	Manimundu	158	12.64
7	Puliyadi	16	1.28
8	Rampalli	86	6.88
9	Vettipura	35	2.8
10	Narakakolly	25	2
11	Mandankura	20	1.6
12	Poolakura	38	3.04
13	Ambadi	11	0.88
14	Anacamp	145	11.6
15	Puthanmoola	6	0.48
16	Kuzhimoola	51	4.08
17	Manalvayal	29	2.32
18	Marod	378	30.24
19	Kaottanode	179	14.32
20	Kadamkally	82	6.56
21	Kuzhiyad	99	7.92
22	Moodankunnu	32	2.56
23	Mathamangalam	245	19.6
24	Ponkuzhi	223	17.84
25	Theenoor	99	7.92
26	Panayambam	89	7.12
27	Chundapadi	92	7.36
28	Chiramoola	11	0.88
29	Thervayal	61	4.88
30	Odakuni	61	4.88
31	Nagaramkunnu	39	3.12
32	Karnal	104	8.32
33	Chirakamp	18	1.44
34	Karipur	96	7.68
35	Kunnilpura	17	1.36
36	Thiruvanoor	120	9.6
37	Kottanadutalapura	67	5.36
38	Chundakara	23	1.84
39	Malapura	103	8.24
40	Kollymoola	23	1.84
41	Kolayodu	65	5.2
42	Kalurkunu	113	9.04
43	Parivarath	12	0.96
44	Kakkamala	55	4.4
45	Erathukally	16	1.28
46	Adakamanga	22	1.76

47	Kappad	8	0.64
48	Kayapura	40	3.2
49	Aavayal	4	0.32
50	Kolipali	50	4
51	Kadamkolly	33	2.64
52	Annimula	23	1.84
53	Urankunnu	40	3.2
54	Vellakode	48	3.84
55	Kodangapura	8	0.64
56	Bicharam	81	6.48
57	Kundur	32	2.56
58	Pallivayal	38	3.04
59	Panthankolly	24	1.92
60	Manalimula	58	4.64
61	Kottakunnu	42	3.36
62	Athikunni	40	3.2
63	Kathanga	4	0.32
64	Manmadamula	174	13.92
65	Pachadi	33	2.64
66	Chiramula	50	4
67	Choyimoola	125	10
68	Karzhery	49	3.92
69	Ambalakunnu	60	4.8
70	Kakkathodu	83	6.64
71	Mannurkunnu	82	6.56
78	Kariampadi	52	4.16
73	Valluvadi	136	10.88
74	Kotur	176	14.08
75	Thoramangalam	102	8.16
76	Karaputhadi	94	7.52
77	Thanikunnu	28	2.24
78	Odakolli	40	3.2
79	Odapalam	120	9.6
80	Mulanchira	15	1.2
81	Madakunnu	41	3.28
82	Koyalipura	58	4.64
83	Kulathurkunnu	13	1.04
84	Cherukunnu	31	2.48
85	Anapanthi	65	5.2
86	Kakkavayal	19	1.52
87	Kodangapura	13	1.04
88	Mykara	117	9.36
89	Thottamula	32	2.56
90	Kanal	63	5.04
91	Pattayad	3	0.24
92	Chadakapura	31	2.48
93	Kundanamkunnu	22	1.76
94	Kumizhi	94	7.52
95	Manaladi	12	0.96
96	Thakarapadi	115	9.2

97	Kalankandy	23	1.84
98	Chukalikunnu	139	11.12
99	Panapadi	149	11.92
100	Ambadekar	214	17.12
101	Malakapu	47	3.76
102	Kallumuku	17	1.36
103	Manmadanpali	33	2.64
104	Alathur	19	1.52
105	Edathara	25	2
106	Eadakalle	41	3.28
107	Ochilimoola	39	3.12
108	Purandikunni	42	3.36
109	Kurakapalli	134	10.72
110	Kanur	4	0.32
111	Kulukunnu	26	2.08
112	Karagapadi	39	3.12
113	Karakara	15	1.2
114	Kanatikunne	44	3.52
115	Ullilam	63	5.04
116	Kather	4	0.32
117	Karakapura	6	0.48
118	Kotanod	144	11.52
119	Mulankavu	37	2.96
120	Kovur	7	0.56
121	Kolipura	26	2.08
122	Kundanamkunnu	35	2.8
123	Eralode	45	3.6
124	Lakshenvedu	21	1.68
125	Malapura	13	1.04
126	Madhamangalam	13	1.04
127	Thekumpeta	12	0.96
128	Manmadakollui	8	0.64
129	Malankappu	195	15.6
130	Mellemoola	55	4.4
131	Pulathuki	59	4.72
132	Pambankolli	30	2.4
133	Kanankode	31	2.48
134	Kottanadutalapura	77	6.16
135	Kolur	240	19.2
136	Thotumula	66	5.28
137	Karadimad	122	9.76
138	Panapadi	28	2.24
139	Kalichira	37	2.96
140	Pankalam	80	6.4
	Cumulative Total	**8884**	**710.72**

.

Appendix-4
Standard of living index (SLI)

1. House type

4 for pucca

2 for semi –pucca

1 for katcha

2. Toilet facility

4 for own flush toilet

2 ESP latrines

1 for pit toilet/ latrine

0 for no facility

3. Source of lighting

2 for electricity

1 for kerosene, gas or oil

0 for other source of lighting

4. Main fuel for cooking

2 for electricity, liquid petroleum gas or biogas

1 for kerosene/charcoal/coal

5. Source of drinking water

2 for tube well/bore hole

1 for dug well

0 for surface water

6. Separate room for cooking

1 for yes

0 for no

7. Ownership of agricultural land

4 for less than 5 acres

3 for 2 acres- 4 acres

2 for less than 2 acres

0 for no agricultural land

8. Ownership of live stock

2 if owns livestock

0 if does not own live stock

9. Ownership of durable goods

4 for tractor/car

3 for mopped/scooter, telephone, refrigerator, colour television

2 for bicycle, fan, radio, sewing machine, black and white television

1 for cot mattress, table, chair, clock/watch

Index score ranges from

0-14 for a low SLI

15-24 for a medium SLI

25-67 for a high SLI