NUTRIENT ADEQUACY AND BACTERIOLOGICAL QUALITY OF COMPLEMENTARY DIETS AND THEIR IMPACT ON THE NUTRITIONAL STATUS OF CHILDREN (6-24 Months old) IN THE SLUM AREAS OF ADDIS ABABA, ETHIOPIA

BY SENAIT ZEWDIE (BSc. Biology)

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR MASTER OF SCIENCE DEGREE IN APPLIED HUMAN NUTRITION AT THE UNIVERSITY OF NAIROBI, KENYA.

November, 2001

DECLARATION

I, Senait Zewdie hereby declare that this thesis is my original work and has not been presented for degree in any other university

Senait Zewdie

Date 28/11/2001

This thesis has been submitted for examination with our approval as university supervisors

1. Prof. S. K. Mbugua

Date 28/11/2001

2. Prof. N .M. Muroki

Date 28/11/01

Department of Food Technology and Nutrition

DEDICATION

This work is dedicated to my mother **Tejitu Butta** who passed away while I was applying for this course. I will not forget her love and care during those days, when she brought me up.

ACKNOWLEDGEMENTS

I am very much grateful to God my Lord and Saviour whose constant grace and strength sustained me during my work.

I thank the United Nation University (UNU) for sponsoring my MSc studies and making funds available.

I express my special thank to my supervisors Prof. S. K. Mbugua and Prof. N. M Muroki for their advice and support throughout the study. The supervision, comments and suggestion they provided throughout the work were worthwhile.

I express my gratitude to the Applied Nutrition Programme staff for their assistance during the course and research work.

I thank the Ethiopian Health and Nutrition Institute (EHNRI) for providing me with all required support during the data collection and allowing me to pursue this programme. Special thanks to Infectious and Other Diseases Department for their assistance during the data collection. In addition I thank Mr. Tekellel Beza and Mr. Bisrat H/mariam from public health laboratory for analysing the food samples.

I am extremely grateful to my beloved husband Argaw Boggale, our children Rediet, Mussie Sharon and Eyassu Argaw for their support, encouragement and patience throughout the whole course without which I would not have done this work. I appreciate my husband's commitment responsibilities and sacrifice in caring of our children and accepted all the difficulties of life without me; and may God bless you.

I will not forget my father Zewdie Belayneh and my brother Tariku Seifu for their love and encouragement through out my life.

I thank the Integrated Holistic Approach (IHA) project that granted me permission to carry out the study and all the necessary support during pre-testing and implementation of the data collection

I thank all Christian friends who supported me and my family through prayers and may God bless all of you.

ABSTRACT

A cross-sectional study was carried out between October 2000 and February 2001 in three randomly selected slum *kebeles* of Addis Ababa, Ethiopia. It aimed at providing information on the nutrient adequacy, bacteriological quality of complementary diets and their impact on the nutritional status of children aged 6-24 months. The study covered a total of 350 children. Systematic random sampling was used to select the study subjects. A structured questionnaire for demographic and socio-economic information was used for all the study subjects.

The dietary intake of the children was analysed by collecting data based on 24- hour dietary recall and food intake frequency. Sub samples of the complementary foods taken randomly from the study households was analysed for possible microbiological contamination. The study showed that the average income of the household was 250 Birr (29 USD) per month. The proportion of illiterate mothers was found to be 27.3%. Complementary foods were introduced to the majority (83.4%) of the children at the age of 4-6 months. Breast-feeding was extended up to the age of 24 months for more than two thirds (67.5%) of the household children.

The overall rate of malnutrition based on –2SD Z score cut- off point was 26.6%, 38.6% and 9.4% for underweight, stunting and wasting respectively. There was significant difference ($p<0.01$) prevalence of malnutrition in different age groups for underweight and stunting respectively. The total calorie intake of the children was low with (15.8%) of male and (19.2%) of female children in the age group 13-24 months, who met their calorie Recommended Daily Allowance (RDA). A significant difference ($p<0.01$) in energy intake was observed within female and male children.

More than 70% of the children had their protein intake meeting the RDA. Iron and calcium intake for the children was lower than the recommended intake. The pattern of nutrient intake got worse as the children grew older.

Coughing and diarrhoea were the major illnesses affecting 28.8% of male and 26.7% female household children respectively. There was significant difference ($p<0.01$) in the prevalence of the diseases among the three *kebeles* Complementary foods were contaminated by Gram-positive spore formers bacteria (*Bacillus subtilis*) Gram-negative organisms, (*Klebsiella* species, *Enterobacter* species, *E.coli*) and molds.

From the review observed in the study it is concluded that the inadequacy of nutrient intake among the children was due to low intake of essential nutrients and low diversified diet. The presence of spoilage and indicator organisms showed the unhygienic condition for preparation of the complementary foods, which can lead to infections and worsen the health status of the children.

It is therefore recommended that appropriate use of locally available foods, mixing cereals and legume to balance protein requirement and boost the nutrient intake of the children. Also income generating activities, appropriate nutrition and health education for mothers should be promoted. This would improve the nutritional status of the children and enhance the preparation of microbiological safe foods.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

ACC/SCN: Administrative committee on co-ordination sub committee on nutrition of United Nations

CSA: Central Statistics Authority

EHNRI: Ethiopian Health and Nutrition Institute

MUAC: Mid Upper Arm Circumference

NCHS: National Centre for Health Statistics Nutrition of the United Nations

PEM: Protein energy malnutrition

RDA: Recommended daily Allowance

SPSS: Statistical Package for Social Scientists

UNDP: United Nations Development Programme

UNICEF: United Nations Children's Fund

WFA: Weight-for-Age

WFH: Weight -for -Height

WHO: World Health Organisation

DEFINITION OF TERMINOLOGY

Adequacy of nutrient: Daily intake of the nutrient expressed as percentage of the recommended dietary allowance or intake.

Atmit: A thin porridge made from mixture of cereals and legume.

BMI: It is explained as weight in kg over height in meter square

Cfu/ml: It is the number of microbial colony forming unit per millilitre of the analysed sample

Child care: It is the activity given for the child by the mother or the care giver in the household like providing and feeding available foods, breast feeding, washing the child, teaching and taking to clinic for immunisation against vaccine preventable disease.

Complementary feeding: The period during which other foods or liquids are provided along with breast milk.

Complementary foods: Food or liquids other than breast milk given to the young child when the mother decides to take the child off the breast.

Dietary recall: A survey instrument in which the respondent is asked to recall the actual food and drink on specific days usually the immediate past 24 hour.

Energy requirement: The amount of energy taken from food that will balance energy expenditure when the individual is in good health and of a given body size composition with constant activity.

Gender: Identifies the social differences between man and women that learned or changeable over times and has wide variations with in and between cultures.

Household: A person or group of people living in the same house sharing common source of food.

Injera: A pancake like leavened bread and a common staple food made from cereal flour teff (Eragrostis abyssinacae)

K/Cal: Kilocalories (10^3 or 1000 calories). A unit used to measure energy value of food.

***Kebele*:** It is the lowest administrative unit of urban dweller association in Ethiopia.

Morbidity: The number of sick persons or disease in relationship to a specific population

MUAC: Mid upper arm circumference measured at the mid point between the tip of the acromial process and the tip of the olecrano.

Protein requirement: The minimum amount of dietary protein intake that will balance the loss of nitrogen from the body in the minimum level of physical activity.

Slum: Location in city or town characterised by low socio-economic status, crowding of dwelling buildings and poor environmental sanitation and hygiene.

Stunting: Malnutrition status indicated by anthropometric measurement height -for – age, when the height of the child is below -SD Z score of the expected height of a reference child of the same age.

Twenty-four hour recall: Method used at individual level to find out by using interview the actual food intake of an individual in the last 24 hours. Food quantities are usually assessed by using household measures.

Underweight: Malnutrition status indicated by anthropometric measurement weight-for – age, when the weight of the child is below -2SD Z score of the expected weight of reference child of the same age.

Wasting: Malnutrition status indicated by anthropometric measurement weight-for-height, when weight of the child is below -2 SD Z score of the expected weight of a reference child of the same height.

Wet: Sauce/stew made from legume flour or meat

Woreda: An administrative unit in Ethiopia equivalent to district

Z -Score: The deviation of the value for an individual child from the median value of the reference population National Centre for Health Static's (NCHS) divided by the standard deviation for the reference population.

CHAPTER ONE: INTRODUCTION

1.1 Statement of the problem

Childhood malnutrition is a major public health problem throughout the developing countries .It is the underlying principle cause of death for many of the world's children. The complementary feeding period is the time in a child's life when life is most vulnerable to malnutrition, morbidity and mortality. An infant over six months of age is vulnerable to micronutrient deficiencies like iron, vitamin A, and calcium. Children consuming an average of 500 ml of breast milk a day from six months onward would barely cover 10% of their iron needs and less than one third of their vitamins and calcium requirements. Also the composition that contains mixture of cereals or tubers and pulses, which are poor meals in micronutrient and may cause nutritional deficiency (WHO, 1999).

A study in Ethiopia (Tessema and Hailu, 1997) showed that 52.8% of the children initiated complementary food beyond their six months of life, and among these 16% had their complementary diet beyond first year of life. In addition, 27% of the children did not have any of the animals or vegetable sources of diet, respectively indicating the quantitative deficiency of the diet, which predisposes them to a number of micronutrients deficiencies. Malnutrition problems often can be related to quality, acceptance of the food and inappropriateness of how it is used. The lack of diversity and quantity of the food usually inadequate to meet the nutrient and energy requirement of the children, therefore, monotony of the food supply can result in low intake of calorie and micronutrient.

A study in Addis Ababa slum area reported high level of malnutrition with prevalence of 46.9%, 56% and 3.4% underweight, stunting and wasting, respectively (Abate, 1998). A severe undernourishment was reported in the urban slum of Bangladesh, which was characterised by poor sanitary, overcrowded condition, and extreme poverty. The slum poor residents own few or no production assets and no saving and are, therefore, vulnerable to any crises. Infants were given complementary diet very early from birth up to two months of age consisting of low energy dense gruel. Environmental and nutrition related diseases were prevalent. About 11% of the study, population had third degree of malnutrition (under 60% of expected weight for age).

The high proportion of young people, low-income group, lack of service like refuse disposal, sewerage connection, electricity and pure water supply were the manifestation of urban slum. Previous study (Zeleke and Aschalew, 1997) conducted in Ethiopia showed bacteriological contamination of some selected Ethiopian weaning diets containing pathogenic, spoilage and indicator organisms. A similar study conducted in Ethiopia showed that most of the food samples tested had very high number of bacterial contamination with lowest count $1.6x10^5$ and highest count $9.9x10^8$ Cfu/ml. *Bacillus* species was mainly dominated by *B.ceures*. These high bacterial contaminations signify the public health significance related to weaning diets in Ethiopia (Erku and Ashenafi, 1998). In addition to this high prevalence of malnutrition in urban slum compared to a rural village in Thailand, where severe protein -calorie malnutrition for children under six month was reported (Harpham, 1988).

WHO, (1997) reported that 70% diarrhoea episodes in developing countries could be due to pathogens transmitted through food and food handlers. Since food contamination is one of the major contributions to diarrhoea diseases, the principle of food safety should be recognised as important strategy for the prevention of diarrhoea diseases.

Improvement in child nutrition is very important aspect for positive impact on its physical growth and reduction of the risk of complication of infections, and to maximise psychomotor development performance (WHO, 1998). However, information on nutrient adequacy, bacteriological quality and the impact of these parameters on the nutritional status of children is very limited. Therefore, the current study was designed to fulfil the following general objectives.

1.2. General objectives

a: To investigate the dietary adequacy of complementary foods consumed by children (6-24 months of age)in relation to their nutritional status in the slum area of Addis Ababa Ethiopia.

b: To describe the microbiological contaminants in the complementary diet during feeding time.

The above general objectives were addressed under the following specific objectives

1.3 Specific objectives

To Determine

a. Dietary energy, protein, calcium and iron intake of complementary foods.

b. Adequacy level of energy and nutrient intake in relation with RDA.

c. The microbiological quality to establish the health risk in the complementary foods.

d. The nutritional status of the children in the slum area of Addis Ababa as influenced by the complementary diet.

1.4 Research questions

The present study was designed to answer the following questions

1. Do the children in the study households meet their energy, protein, calcium and iron requirement?
2. What is the impact of dietary adequacy and microbiological quality of complementary foods on the nutritional status of the children?

1.5 Expected benefits

There is no adequate data for nutrition and policy planners on the current field of study. This study is, therefore, expected to provide baseline information for nutritionist, nutrition planners and other interested groups for the development of intervention programmes in children dietary intake and reduce the rate of food contamination to enhance their nutritional status. The information from the study also can be used in reducing prevalence of malnutrition, which has positive impact on the child physical growth, psychomotor development and school performance.

CHAPTER TWO: LITERATURE REVIEW

2.1 General over view

Malnutrition is a worldwide problem and its persistence has negative effects on children, society and the future of mankind. Childhood malnutrition remains a common problem in much of the developing world (WHO, 1998). The state of the world children malnutrition is the result of a combination of inadequate dietary intake and infection. Global estimation of child malnutrition showed that 220 million are stunted, 67 million are wasted and 183 million were underweight, and that malnutrition was associated with the overall situation causing child death that occur in developing countries (UNICEF, 1998). This leads to physical, mental and physiological deficits expressed in anthropometrical data among children in the less developed countries (UNDP, 1997).

Protein energy malnutrition,(PEM) iron deficiency (anaemia), vitamin A deficiency and iodine deficiency disorder are the main forms of malnutrition in the developing countries including Africa. 28.9% of the under-five in Sub-Saharan Africa are malnourished, and PEM contributes up to 40% of death of young children .In addition inadequate feeding practice combined with disease are major causes of PEM (OAU/UNICEF, 1992).

In the global situation, 150 million children are underweight, over 20 million are low birth weight and 40 million children estimated to be vitamin A deficient (Gillespie and Mason, 1991).

More than half of the world malnourished people live in South Asia. From the five million deaths each year in South Asia, 3 million are indirectly associated with malnutrition (UNICEF, 1997). Inadequate nutrition in infancy and childhood has serious consequences. Underweight children tend to have severe illnesses and are exposed to diarrhoea and respiratory infection diseases. This shows that there is a strong association between underweight, mortality and morbidity (ACC/SCN, 2000).

The nutritional status of Miskito Indians in Northeast Nicaragua indicated that stunting (low height- for -age) was the major form of malnutrition in children less than five years of age. Weight for age was also affected and dietary data revealed a primary deficit of energy as well as low level of vitamin A, calcium and iron (Horner et al., 1981). Malnourished children have impaired immune function and high rate of enteric and other infection as well as high risk of premature death. Besides this risk, delayed motor development and impaired cognitive function and school performance are associated with the process of early nutritional stunting (WHO, 1998).

Energy consumption by young children in developing countries during the period of complementary feeding appears to be less than current international recommendations (Brown,1997). This may be attributed to the high rate of infection, poor quality diet and caregivers feeding behaviours. Attention during this critical period of time should be taken by prevention and appropriate treatment of infection. Also improvement in dietary quality to assure minimal adequate energy, nutrient content, palatability and instruction of caregivers in appropriate frequency of feeding.

Of all infection which cause death among children aged 0-5 years in developing countries, diarrhoea is among the most important, and accounts 10 -20 % of all deaths during the first few years of life (Tomkins et al., 1993).

In developing countries 70% of the complementary diet are contaminated with enteric pathogenic such as *E.coli* (Motarjemi et al., 1994). Polluted water, flies and pests, domestic animals, dirty utensils, unwashed hand, raw foods and insufficient cooking time are common predisposing factors for infection with enteric pathogens. A study in Guatemala (Barrell and Rowlad, 1979) showed that food was a significant source of weanling diarrhoea. Also a microbiological study of foods and water in El Salvador revealed *E. coil* (enteric pathogen) due to the source of faecal contamination.

2.2 General state of malnutrition in Ethiopia

Childhood mortality is among the most serious problems in Ethiopia. According to a 1994 National rural survey in Ethiopia, 64% of all the children in rural Ethiopia aged 6-59 months were chronically malnourished (Yemer, 2000). This figure is among the highest in the world. Inappropriate and inadequate dietary intake and infectious diseases are the immediate and direct causes of malnutrition that are affected by socio- economic, demographic, childcare and environmental factors

The report by the Central Statistics Authority showed that the percentage of underweight, stunted and wasted among pre-school children in Addis Ababa were 33.3%, 55.5% and 5.1%, respectively (CSA, 1992).

Jember (1985) similarly reported a low level of health status in *Kebele* 41 *Woreda* 3 that is located in one of the poorest and congested parts of Addis Ababa. This was one of the areas picked for this study.

According to Zewdie, (1993) the problem of vitamin A deficiency was 20 % as manifested by Bitots's spot. Gebre, et al., (1999) reported that Ethiopia has the poorest health status in the world. The under five mortality was reported as nearly 50% of all deaths. In addition, the common causes of under five morbidity include acute respiratory infections, diarrhoea and malnutrition. The study in Gamo-gofa western region of Ethiopia showed that among partially weaned infants, 40% had diarrhoea (Ketsela et al., 1990). A base line survey on vitamin A deficiency in Southern Ethiopia from randomly selected 4123 children showed that 51 (1.2%) of them had night blindness and 8 (0.2 %) had Bitots spots (Demisse et al., 1998). Besides this, a study reported by Yonas et al., (1996) showed that the prevalence of night blindness, Bitot's spot, corneal ulceration and corneal scar were 17%, 26,5%, 2.7% and 0.7%, respectively. Deficiency of micronutrients contributes to the morbidity, growth retardation and lower physical activity. Like in other developing countries, the introduction of modern technology like food, fortification in Ethiopia is not feasible among majority of the people (Genebo and Gelaw, 2000).

During complementary feeding infants are at risk of getting diarrhoea due to food borne pathogens and this consequently reduce food intake and loss of nutrients through vomiting, fever, malabsorption and diarrhoea. A community based microbiological study of weaning foods in Jimma zone Ethiopia showed that fifty percent of the examined weaning foods

harboured bacterial counts over 2x 10^6 cfu/ ml and coliforms were isolated from one- half of the samples (W.Tenssay and Mengistu, 1997). The incidence of diarrhoea disease is high during the first two years of life especially when weaning has commenced. A study in Addis Ababa on bottle-feeding infant revealed that out of 270 bacterial isolates, 63(23.3%) were *E.coli* and from these 9(14.2%) were recognised as Entero- pathogenic *E.col*, 9(3.3%) *Staphylococcus aures*, 66(22.4%) *Enterobacter* species, 50(18.55%) *Klebsiella* spp and 31(11.5%) *Citrobacter* spp (W/Tensay and Tesfaye, 1992).

2.3 Determinants of malnutrition

More than one billion people in the world live in extreme poverty (ACC/SCN/ WHO, 1997). Most go hungry every day with serious consequences to the mother and their children. Special attention should, therefore, be given to people living in poverty and the needs of vulnerable and disadvantaged groups be addressed. At the international and national level, resources for care are influenced by policies and ideologies, which support poor families. Spending priority frequently, favour military investment or urban industry rather than social sector funding.

Policies in government which allocate few resources to investment in social programs or which exclude some groups from full enjoyment of rights to social services contribute to the persistence of malnutrition. The low status of women in many countries has been linked to malnutrition. When women do not have access to the means of production, their control over the resources is limited, thus undermining the nutritional status of the children (UNICEF, 1997).

A study in Malawi indicated that socio-economic conditions together with feeding practice are important determinant of malnutrition. Inadequate quality and quantity of food cause high prevalence of fevers and diarrhoea disease (Madise and Mpoma, 1997).

2.3.1.Income:

The World Bank (1996) underscored the importance of income as a critical determinant of nutrition in developing countries. Therefore, there is a positive relationship between income and dietary adequacy of households. Inadequate dietary intake during the period of gestation and the first few years of life, impair physical and mental development as well as the general nutritional status of children. Household income is one of the major factors to be considered in determining children's nutritional status (Yemer, 2000).

2.3.2 Education

Education is associated with greater awareness of nutrition. Better-educated parents are, therefore, able to provide more nutritious diet at even different income levels due to their nutrition awareness in utilisation of food materials with appropriate nutrition value (Ahmed et al., 1994). Mothers and caregivers with understanding of sanitation can apply food hygiene and good food handling practices during preparation. A significant positive correlation between mother's education and hygienic score has been reported.

2.3.3 Family Household Size

Family size may affect the nutritional status of every member of the household. This is because of reduced resources allocation to members in large households (Yemer, 2000).

The allocation of food per member is likely to decrease with the increase in the number of household members, which in turn has negative effect on per capita nutrient intake. Maternal education in this regard is a very important factor in determining how much food intake in quantity and quality that is allocated to the children; to cater for their nutritional status Household size has a positive association with children nutritional status indicators like weight- for-age and weight- for- height. In large households seasonal food availability and food distribution is very much affected.

2.3.4 Gender

Gender is a set of social and cultural norms hat influence the lives of women and men in every society. In every society the roles of women is less privileged, and is offered less opportunities in any socio economic interaction (Nancy, 1997). The World Bank, (1996) has shown a considerable evidence that the male children receive more and better health care at an earlier age than female children.

Like female children, adult women are disadvantaged with respect to health care and education. A household survey report also showed more incidence of illness for female than male. The survey reported that a female child was likely to breastfed less often and for shorter periods than her male sibling. In general, the gender effect include a strong preference for sons, arranged marriage for young girls, inequitable allocation of resources for food, healthcare, education income, and discrimination against widows.

2.3.5 Culture and habit

Cultural factors include habits, belief, preferences, customs and ideals that legitimise action in the society. Malnutrition is likely to increase when these factors do not support

care for women and children (UNICEF, 1997). Culture is a major determinant of what we eat. Food intake is a response to both biological and cultural stimuli that fulfils both biological and social needs. Food habits are dynamic norms and behaviour in a particular culture that helps sustain any community.

Food habit is part of cultural change. In some cultures, the food accepted as good may be less dense with low nutritional quality, while the unaccepted food may have better nutritional quality (Fieldhouse, 1986).

2.3.6 Dietary adequacy:

The nutritional status of the child can be affected by low intake of essential nutrients (Takyi, 1999). Energy and other nutrients are essential for the growth and normal development of infant as well as young children. The amount of energy needed for the body varies depending on age, sex, body size and environmental conditions. Like energy, the concentration of protein in the food must be enough in order to satisfy body requirement for maintaining body structure and function of the entire cell in the body. Besides energy and protein, nutrient concentration in the diet should be considered to minimise growth faltering in children (Cameron and Hofvander, 1983).

2.3.7 Hygiene and sanitation

The food we eat and the water we drink must be clean and safe. Harmful micro organisms, parasites, toxins and harmful chemicals easily contaminate food and drinks. Contaminated food and water cause diarrhoea and vomiting thus aggravating malnutrition in infant and young children (King, and Burgess, 1993).

2.3.8 Infection and Immunity:

Immune system can be impaired by nutritional deficiencies. During PEM, the deficiency of specific nutrients such as iron and zinc causes consistent changes in immunological responses, which have been reversed with nutritional repletion. (Lee and Nieman 1996).

Malnutrition not only predisposes children to infection but also, at the same time infection will tend to affect the nutrition of the host. In niacin deficiency, there is marked atrophy and inflammatory changes in the oral mucous membrane. Vitamin A deficiency results in metaplasia and keratinization of various epithelial tissues mostly seen in conjunctiva and cornea of the eye (McLaren, 1981).

2.4 Complementary and breast feeding:

Complementary feeding is the process of introducing other foods than breast-milk to the child. In the first stage the child gets all nutrients from the breast milk but starts other foods during the second stage, when the child get the same amount of milk but eats increasing amount of other foods. Finally, the child takes decreasing amount of breast milk coupled with increasing amount of other foods. By the age of four- six months, many children can't get enough nutrients from breast milk alone. During this period, they have grown two or more times the size that they were borne and become more active. Good complementary foods need to be rich in energy and nutrients, safe and soft as well as easy to eat and affordable by the family (King and Burgess, 1993). The complementary feeding period is the critical time, which often results in malnutrition and diseases. This results if the complementary food is inadequate in quantity and quality, unhygienically prepared as well as culturally unacceptable (David, 2000).

Complementary foods should be prepared based on their palatability, taste and acceptability. The energy and nutrient quality has to be denser than milk to supply essential nutrients to improve the nutritional status of the child. During the time of initiation of complementary feeding the quality and quantity of the complementary food has a great effect on the child health (WHO, 1999).

A study in Jimma town Ethiopia showed that median age for introducing the first complementary food and terminating breast-feeding was 7.1 and 25.3,, months respectively

(Gethaneh et al., 1997). Breast-feeding should continue up to the age of two or more years. Breast milk as a source of nutrient can provide one- third of the nutrient that a child needs up to the age of two years (King and Burgess, 1993).

2.5 Introduction of complementary foods

In most developing countries, the average growth of infants in weight and height is satisfactory until the age of three months. Growth faltering occurs during the time complementary foods are introduced. This flattering is as a result of combination of quality of complementary foods and timing of their introduction. Therefore, it is important to consider appropriate introduction of complementary feeding time and the quality of complementary foods. During and after breast-feeding appropriate feeding is a very important measure in order to reduce nutritional inadequacy and malnutrition among the young children (Tontisirin and Yambourist, 1995).

WHO recommends breast milk as adequate for meeting the nutritional needs of the child within the age of 4-6 months. The appropriateness of the feeding practice is affected by the type of food, economic, cultural background and family size (Piechulek et al., 2000).

2.6 Manifestation of protein energy malnutrition (PEM)

In developing countries, the majority of young children pass through mild moderate or severe form of PEM during the complementary feeding period (Cameron and Hofvander, 1983). Some of the infants develop a more severe type of malnutrition manifested as marasmus, kwashiorkor or marasmic kwashiorkor, particularly when malnutrition is confounded with infection The prevalence of energy malnutrition in children under five years of age in developing countries was 34.6%. Among world's malnourished children, 79% live in Asia (Southern Asia) 17% in Africa and 3% in Latin (WHO, 1995).

2.7 Urbanization and child malnutrition and care

Living conditions in least developing countries are made worse by combination of the health problems and particularly respiratory and enteric infections, with poor quality housing due to poverty (UNICEF, 1997). The urban poor are often at risk of getting diseases due to poor sanitation, unsafe drinking water, polluted air and toxic wastes. In developing countries, infant mortality is four or more times higher in poorer segments of the urban populations than in richer segments.

Urbanisation has tremendous consequences for childcare. In urban area, the mothers need to spend time outside the home and less time to look after their children. The urban environment is less secure for the children with its crowding, accidents and pollution

Rapid rate of population growth, pressing on limited lands available for farming, push landless labour into cities. In addition, the relative better economic opportunities in cities are factors leading to urbanisation. The residents of the slums and shantytowns are in the shadow of the rest of the city in terms of quality of life and services. Most of the women and children in developing countries live in the slums where they do not benefit from the facilities, services and economic opportunities that urban areas have to offer (Harpham et al., 1988). The most vulnerable population is found where population density is highest. The population density in slum area of Calcutta and Manila is four or five times higher than the average for the entire city. In Bangkok, the average number of people per room is 3.5, which is far above the city average.

Although salaries are higher in the cities, the cost of food is expensive, resulting in the poor having a smaller proportion of their income available for food. Women are forced to work in full-time or par-time jobs to complement the family income. Under such circumstances women may typically have less time for food preparation and may expose their child to early complementary feeding or often no breast-feeding at all (Harpham et al., 1988).

The vulnerability of poor people increases due to high level of unemployment and poverty. Poverty is the most important predictor of environmental health risk, deprivation from physical assets, political influence, and access to basic service and social capital (WHO, 2000).

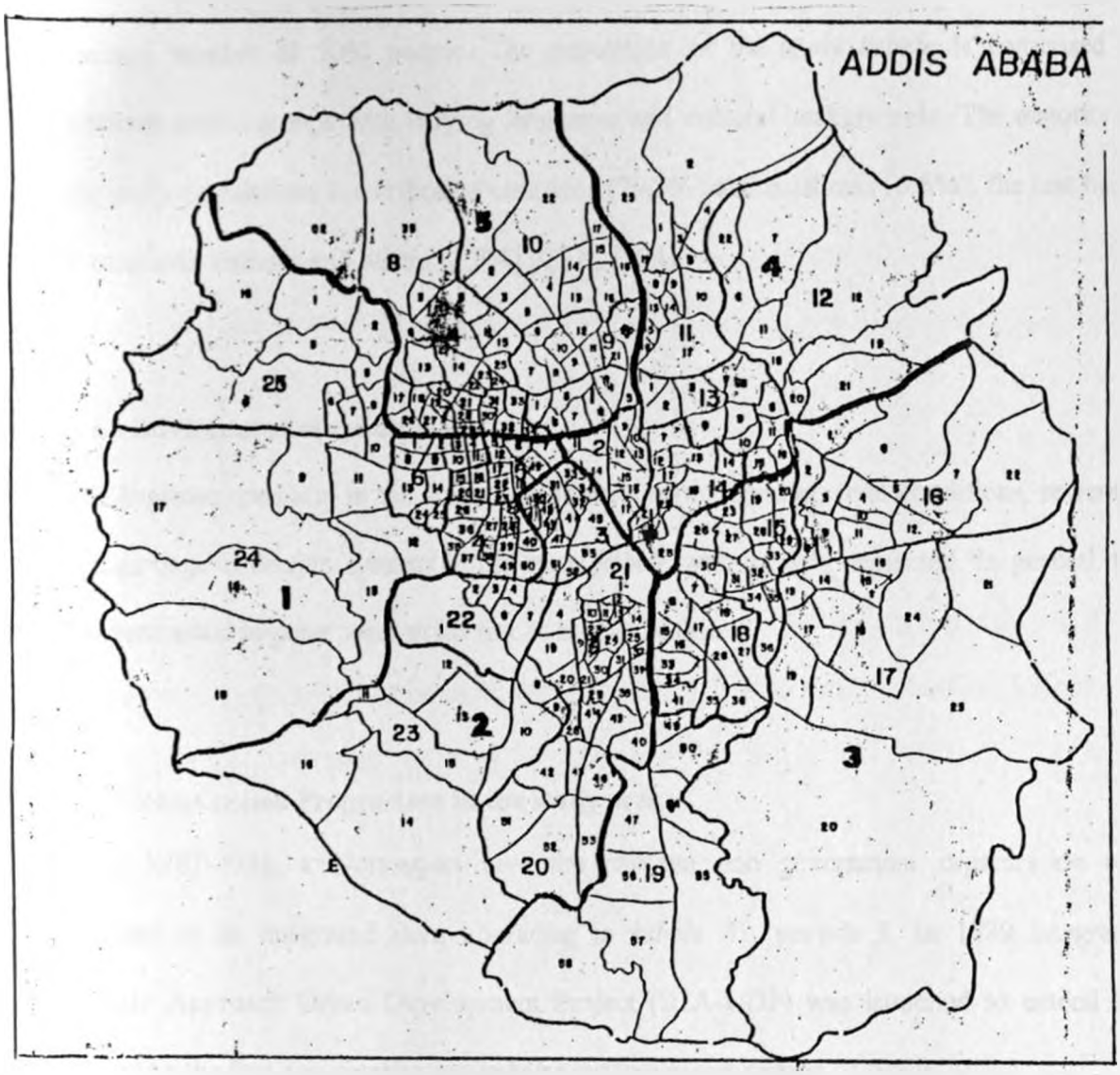
CHAPTER THREE: STUDY DESIGN AND METHODOLOGY

3.1 Description of the Study Area

Addis Ababa is the capital city of Ethiopia with a current population of over two and half million, of which, according to the 1994 census, 48.4% are males and 51.6% females. There are 305 Urban Dwellers Associations *(kebele)* with an average population of 5000 each, which are grouped into 28 higher *kebele* (*woredas),* categorised into six zones. There are city councils, which supervise the affairs of the city at the *Zonal, Woredas* and *Kebeles* levesl. According to the World Bank survey, the majority of the population in Addis Ababa (79%) live in low economic cadre and congested settlement where conditions are unfit for human habitation (Jembere, 1985). Houses are made of wood covered with mud. This survey identified seven *kebeles* as typical slums and the most congested parts of Addis Ababa.

Urban slums are areas where the poor, deprived, and oppressed live and houses are badly built and crowded. The heavy rain gradually washes away the mud plaster thereby needing continuous repair. Road conditions are bad particularly for low-income areas, which are accessed through narrow rugged pathways and inaccessible by vehicles. Services such as sanitation and refuse collection are lacking. *Kebele* 41, one of the present study areas was the poorest and most congested parts of Addis Ababa. There are five neighbouring *kebeles* where have certain things in common. All had particularly very poor people living in them, who are unable to support themselves. From the health, point of view hygiene and environmental sanitation problems in neighbouring *kebeles* are almost identical to those in *kebele* 41(Harpham, 1988).

Figure 1: Map of Addis Ababa showing the study site



Scale 1:75,000

SOURCE: SCO. (1987)
The study site
Woreda 3 kebele 41• and 43•
Woreda 4 kebele 40•

3.1.1 Study population

According to the 1994 survey, the population of each *kebeles* is estimated to have an average number of 5000 people. The population of the study *kebele* is composed of different ethnic groups with varying languages and cultural backgrounds. The majority of the study populations are orthodox christians (79.8%) and muslims (16.5%), the rest being Protestants, catholic and others (3.7%) (CSA, 1994).

3.1.2 Environmental condition

The hygienic condition in the study area is very poor. Housing, road conditions, sewerage and garbage collection systems in the study *kebele* were grossly neglected. In general, the environmental hygiene poses great risk to human health.

3.1.3 Intervention Programme in the study area

From 1981-1986, a Norwegian save the children non government organization was involved in an integrated slum upgrading in *kebele* 41, *woreda* 3. In 1989 Integrated Holistic Approach Urban Development Project (IHA-UDP) was launched to extend the project to the five was neighboring *kebeles* in the poorest section of Addis Ababa.

The target groups for the project were the most disadvantaged of the community: These were female household heads, children, the elderly, the disabled, unemployed and households with low income.

The project set up nutrition rehabilitation centre due to the poor nutritional status of the population and high mortality rates. It targets children under five, pregnant mothers and some socio- medical cases (Stuckey, 1997).

3.1.4. Nutritional status in the area

The impact assessment for the intervention programme still found 8%, 20% and 29% of children were wasted, stunted and underweight, respectively (Stuckey, 1997). The nutritional status of the mothers was, however, within normal limit where the average BMI was 18.6

3.1.5 Morbidity in the study area

From 1997 evaluation programme in the study area diarrhea accounted for 40%, respiratory infection 21%, fever 19% vomiting 6% and others (14%), which includes eye, skin and infection (Stukey, 1997).

3.1.6 House hold income and occupation

The average household income was 134 Birr (16.2 dollars) per month. Occupation data for the mothers showed that 57% were not employed, 6% had regular jobs, 15% selling foods 13% daily laborers and 9% were other jobs in informal sector (Stukey, 1997).

3.2 Methodology

A cross sectional survey of descriptive and analytical nature was carried out in the three slum *kebeles* of Addis Ababa, Ethiopia from October 2000-February 2001.

3.2.1 The study population and sample size

The sampling frame included all households in the study area with children aged 6-24 months old. A systematic random sampling was applied in their selection. Since the beneficiaries were children between 6-24 months of age the following formula was used to determine the sample size of the study as suggested by (Fisher, et al .1991).

$$n=\frac{z^2.p.q}{d^2}$$

Where:

n= The desired sample size for each populations

z= Standard normal deviation, set at 1.96 which corresponds to 95% confidence interval.

p= Proportion to malnutrition prevalence recorded in child care practice in households with malnourished children and those well nourished children in slum area of Addis Ababa ,Ethiopia (Abate, 1998)

q= Prevalence of non malnourished which is 1-p

d= the acceptable range of error which is 0.05

Substituting the above figure in the above formula gave the following sample size.

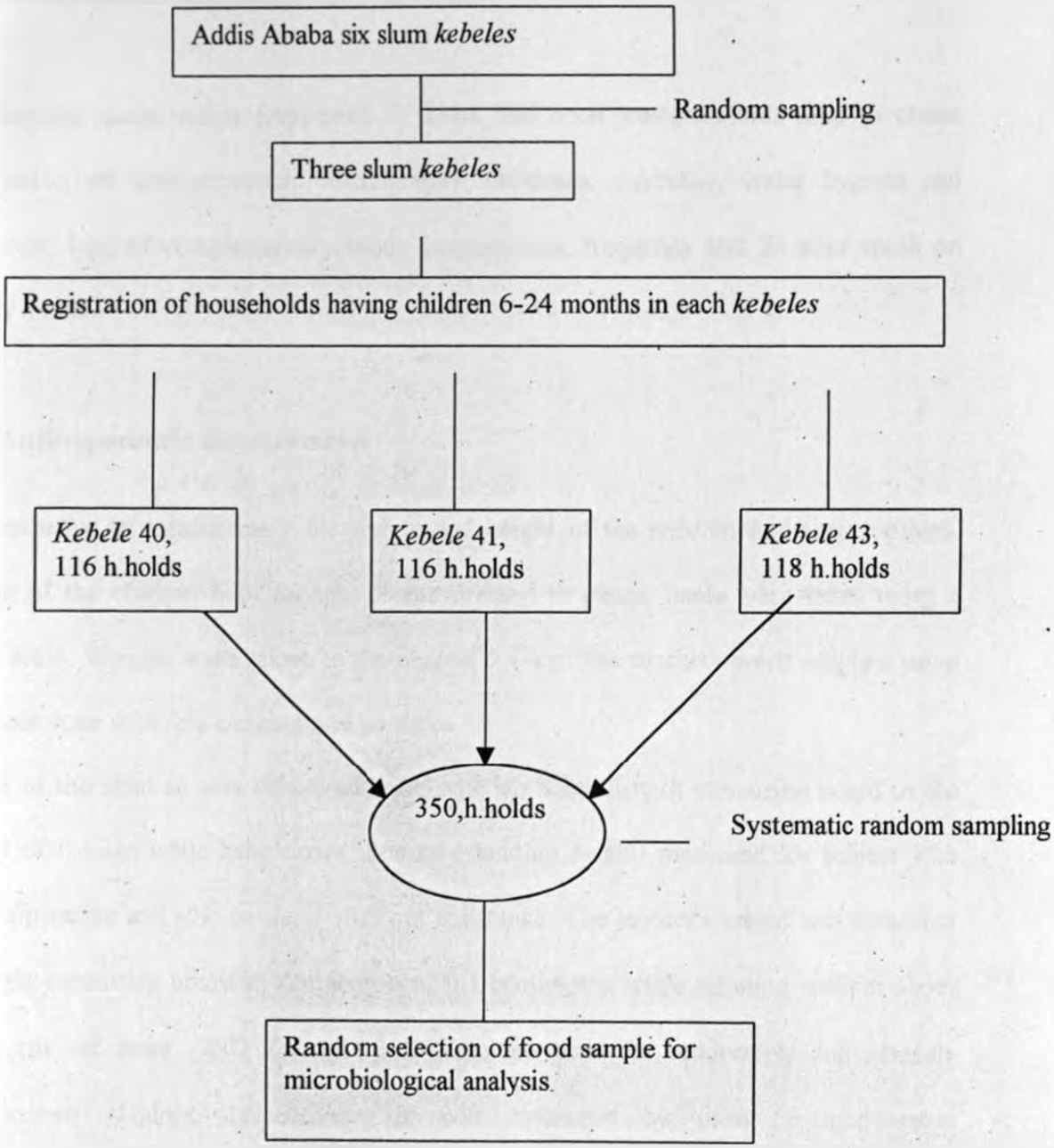
$$n = \frac{1.96^2 \times 0.35 \times 0.65}{0.05^2} = 350$$

3.2.2 Sampling procedure

There were six *Kebeles* in the area where the socio economic and environmental sanitation and other conditions were more or less the same. The study was carried out in the randomly chosen three *Kebeles* namely *Kebele* 40, 41 and 43. *Kebele* 41 and 43 are located in *Woreda* three and *kebele* 40 located in *Woreda* four. Preliminary survey was done in the three *kebeles* to identfy all households with children 6-24 months of age.

The total number of households, which were eligible in the study, were 450. According to this sample frame, the desired sample size was selected by applying systematic random sampling method. There was no drop out and all the households', which participated in the study. In all households the questionnaire was administered to the mothers /caregivers. Anthropometric measurement for all the index children and for the mothers/caregivers were taken and recorded. Where there was more than one child aged 6-24 months in a household, only one child was selected randomly and enlisted for the study.

Figure 2: Flow chart on the sampling scheme



3.3. Data collection technique

3.3.1 Questionnaire administered to the mothers/ caregivers

A structured questionnaire (Appendix 1) which had been pre-tested was used to obtain information on socio-economic, demography, childcare, morbidity, water hygiene and sanitation, type of complementary foods consumption, frequency and 24-hour recall on dietary intake.

3.3.2 Anthropometric measurements

This consisted of measurement for weight and height of the children and their mothers. Weight of the children 6-24 months of age dressed in plastic pants were taken using a Salter scale. Weights were taken to the nearest 0.1-kg. The mothers were weighed using bathroom scale with few clothing and no shoes.

Length of the children was measured using wooden height/length measuring board to the nearest of 0.1 cm while lying down. Stature (standing height) measured for subject who was cooperative and able to stand with out assistance. The mother's height was measured by height measuring board to the nearest of 0.1 centimetre, while standing without shoes on. A cut off point -2SD Zs and -3SD Zs were used for moderately and severely malnourished children, respectively. It was measured by using anthropometric measurements namely; weight-for-age (underweight), height-for-age (stunted) and weight-for-height (wasted) according to Z Score from NCHS reference standards.

3.3.3. 24-hour dietary recall

A 24-hour questionnaire (Appendix 1) was administered to all households. The respondents were asked to show the amount of each ingredient used to prepare the meal using households' measures. Measuring cylinders and kitchen scale were used to measure food and drinks consumed by the index children in the households. The Ethiopian food composition table was used to calculate the amount of calorie, protein and micronutrients derived from all the ingredients consumed by the index child (EHNRI and FAO,1998).

Household food frequency consumption on daily and weekly basis was carried out by asking the respondents the type of food and drink the child consumed and how often they had taken them.

From the amounts of food taken by the children the energy, protein, carbohydrate and other nutrients were calculated using Nutri-Survey program for window, 1995. Since the food taken was complementary to the breast milk, the energy, protein, carbohydrate and nutrient intake was calculated by using secondary data from poorly nourished mothers in developing countries (Cameron and Hofvander, 1983).

3.4 Study instruments

-A locally made wooden height/ length measuring board was used for children weight / height measurements.

- A Salter spring balance weighing scale, which could take a maximum of 25 kg and with a precision of 0.1 kg has used to take children's weight.

Beam balance or bathroom scale was used to measure the weight of the mother/ caregiver.

A poyear kitchen scale PS-68 was used to weigh cooked and raw food (with maximum capacity of 1 kg).

Glassware like petri-dishs (disposable), measuring cylinder, test tubes, bottles etc. were used for sample collection and sampling.

Incubators, autoclaves and colony counters were used for microbiological analytical exercises.

3.5 The study planning activities

3.5.1 Selection of research assistant and training

Three research assistants with secondary level education were recruited and trained thoroughly on measurement of dietary intake, measuring height and weight of the children and mothers.

All the three assistant were recruited from the study area on the basis of their experience since they were community health attendants. Each *kebele* had community health attendant who visited the households for family planning, sanitation and other clinical issues. They were held in high esteem in the society and could easily convince the mothers/caregivers. The principal investigator gave training about the objective and purpose of the study.

The necessary precautions during data collection were highlighted including the need to communicate and how care should be taken during data collection including communication with the subjects in respectful manner.

3.5.2 Pre-testing

Pre testing of the study instruments was done to check the effectiveness and fitness of the study instruments. These were questionnaire, height/length measuring board, Beam balance scale, and Salter scale etc. The questionnaire was administered to 15 mothers with children 6-24 months of age and modification was done accordingly.

3.6 Microbiological sampling and analysis

3.6.1 Sampling

Food and water quality analyses were carried out to identify the microbiological load of complementary diet of the children and water used by the households. Based on the category of the food items consumed by the children, representative samples were taken. Seven types of commonly used complementary foods were collected for microbiological analysis.

From 350 sample 49 food samples were randomly taken to run food microbiological analysis. To get the representative sample the seven food samples were divided by the total households' (350) and. the square root was used to determine the number of sampling. According to this procedure, each food sample was taken seven times to get the representative sample. Complementary foods for the index child were collected using sterile screw capped glassware. The food was transported to EHNRI laboratory within two hours and kept in 0° C-adjusted refrigerators before the analysis was done.

3.6.2. Microbial isolation and identification

Samples were serially diluted using sterile peptone water (0.1% peptone and 0.9% NaCl) and pour plated on to different agar media. All plates were incubated at 37°C. Sampling was done for the enumeration of total count and identification of *B.subtilis*, *Klebsiella spp* *Enterobcter* spp , *E.coli* ,enteropathogenic E.coil and molds

The media used included Blood Agar for Gram-positive organisms, MacConkey Agar (BBL) for Enterobactereacea, Slanetz and Bartley (Oxoid CM 377) medium for Streptococci and Enterococci, Potato Dextrose Agar (PDA Oxoid CM 139)) for mold and yeast count, and Plate Count Agar (PCA Oxoid CM 139)) for total aerobic count.

For identification of the isolated colonies, enrichment media Tryptose soy yeast broth (Tsy Oxoid 129), Thioglycollate and Cooked meat medium (Difico) were used. For the identification of Gram-negative organisms biochemical media like Kligler Iron Agar (Difico 0086-01), Simmons Citrate Agar (0xoid CM 155), Lysine agar (Difico), Urea agar base (Oxoid CM53), Motility test medium (Difico), Manitol Broth (Difico) and Glucose Broth with Durham tubes were used.

Simultaneously for the identification of Gram-positive organisms, different types of sugars like Glucose, Arabinose Starch, and Manitol were used. Besides these, the isolates were characterized and identified using Bergeys Manual of Systematic Bacteriology (Claus and Berkeley, 1984; Noeland, 1984).

3.7 Data entry, cleaning and method of analysis

The data was entered, cleaned and analyzed in SPSS-PC Version 8 Software. The energy, protein, carbohydrates and nutrients taken by the index child during the past twenty-four hour were analyzed using Nutri -Survey software

The amount of each food ingredients was calculated using Ethiopian Food Composition Table. Dietary adequacy level was analyzed using the average intake of the child and compared with the recommended daily allowance appropriate to the sex and age of the child (Appendix 2x3). Descriptive statistics was calculated on the average and percentage for demographic, socioeconomic factors

3.8 Methods used for project monitoring and evaluation

Method for project monitoring and evaluation included;

1. Interviewers were trained carefully and close supervision during pre-testing and the actual survey was taken.

2. Households were revisited when there was need for more clarification and completion of missing information.

3.Every questionnaire was checked every day after the fieldwork in case of any error.

CHAPTER FOUR: RESULTS

4.1 Demographic characteristics

4.1.1 Distribution of religion in the study area

The total population of the households was 1870 from which 45.6% and 54.4% were male and female respectively (Appendix 4). The major types of religion in the study area were orthodox, and muslim. Distribution of religion in the households was such that majority (85.1%) were orthodox christian, 13.1% muslims, 1.7% protestant and others 0.2% (Table 1). The proportion (31.9%) of orthodox in *kebele* 43 and muslims (6.9%) in *kebele* 41 were significantly ($p<0.01$) higher than the other *kebeles.* There was no significant difference ($p>0.05$) in the proportion of protestant.

Table 1: Distribution of religion in the study households

Religion	The study area N=1870			Total	P-value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Orthodox	502(26.9)	490(26.3)	596(31.9)	1589(85.1)	0.000
Muslims	55(2.9)	129(6.9)	61(3.3)	244(13.1)	0.000
Protestant	11(0.6)	8(0.26)	15(0.8)	34(1.7)	0.155
Others	3(0.2)	-	-	3(0.2)	-
Total	571(30.6)	627(33.5)	672(36)	1870(100)	-

Figures in parenthesis are percentages, Chi square test, Significant at $p<0.01$

Table 2 shows the marital status of mothers in the study population. The proportion of mothers who were married was significantly ($p<0.05$) higher (64.2%) than the proportion (35.8%) of single mothers. 23.8%, 38.9%, and 35.8% in *keble* 40, 41 and 43 were single respectively.

Table 2: Distribution of mothers by marital status

Marital status	The study area n=350			Total	P-value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Single	30(23.8)	49(38.9)	46(37.3)	125(35.8)	0.026
Married	86(37.6)	67(29.6)	73(32.7)	225(64.2)	0.026
Total	116(33)	116(33)	118(34)	350(100)	-

Figures in parenthesis are percentages

Chi square test, significance at $p<0.05$ levels

4.1.3 Type of ethnic groups in the study households

Table 3 shows four major types of ethnic groups in the study area namely *Amhara, Oromo, Gurage* and *Tigre*. The dominant ethnic group was *Amhara*, which constituted 35.3%. Slightly more than a quarter (27.5%) were *Gurage*, slightly less than a quarter (22%) *Oromo*, and close to ten percent (9.0%) *Tigre*, while others (*Wolaita* and *Kembata*) constituted 6%. The proportion (14.1%) of *Amhara* was higher in *kebele* 43, while more (11.4%) *Gurage* residents were found in *kebele* 41. There was significant difference at (P<0.01 and <0.05) level in the distribution of different ethnic groups among the three *kebeles*).

Table 3: Distribution of population by ethnic groups

Ethnic group	The study area N=1870			Total	P-value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Amhara	223(11.9)	175(9.4)	263(14.1)	660(35.4)	0.000
Oromo	116(6.2)	151(8.1)	144(7.7)	411(22)	0.257
Tigre	40(2.1)	70(3.7)	58(3.1)	176(8.9)	0.038
Gurage	177(9.5)	213(11.4)	125(6.7)	513(27.6)	0.000
Others	15(2.6)-	17(2.6)	82(12.2)	110(6)	0.000
Total	571(30.5)	627(33.4)	672(36)	1870(100)	-

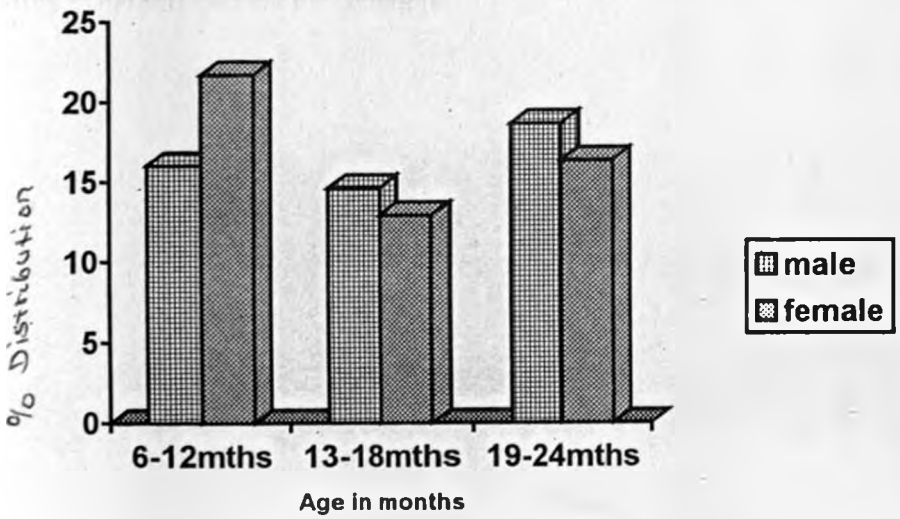
Figures in parenthesis are percentages

Chi square test, significant at p< 0.01 and< 0.05

4.1.4 Age and sex composition of the study children

Out of 350 children from the surveyed households, 49.1% and 50.9% were male and female respectively (Figure 2). The higher category was females aged 6-12 months, which was near to a quarter (21.7%). The next higher category was that of male 19-24 months of age, which constituted 18.6%.

Figure 3: Distribution of the study household children by age and sex



4.1.5 Information on the age of the children

More than three-quarters (83.5%) of the information on the age for the children in the study population was obtained from the growth-monitoring card, 2.9% from mothers and a small number (0.9%) from clinical events (Table 4).

Table 4: Sources of information on children age

Age of children recorded from n=350	Proportion of children
Growth monitoring card	292 (83.5)
From mothers	55(2.9)
Clinical events	3(0.9)

Figures in parenthesis are percentages

4.1.6. The age distribution in the study population

A table 5 summarises the overall age group distribution in the study households. The proportions of people below 15 and above 65 years were 42.9% and 1.8% respectively, while those between 15 and 65 years was 55.5%. The dependent age groups, which are those less than 15 and above 65 years, constituted 44.7% of the study population. There was no significant difference (P>0.05) in the age group distribution among the three *kebeles.* The dependency ratio, which is the ratio of persons in the "dependent", ages (under 15 and over 65 years) to the economically productive group, was 0.8.

Table 5: Distribution of the study population by age groups

Age groups	The study area N=1870			Total
	Kebele 40	*Kebele* 41	*Kebele* 43	
<15 years	244(42.7)	262(41.9)	295(43.9)	801(42.9)
Between 15-64 years	316(55.3)	352(56.2)	367(54.6)	1035(55.4)
>64 years	11(1.9)	12(1.9	10(1.5)	34(1.8)

P>0.05, Chi square test

Figures in parenthesis are percentages

4.2. Socio economic characteristics of the surveyed households

4.2.1. Monthly income of the household

The income earned by the households in the three *kebeles* is presented in Table 6. The monthly income of the household ranged from 30- 1500 *Birr*. The mean income was 250 *Birr*, which was equivalent to (28 USD). Majority (77.1%) of the population in *kebele* 41 earned monthly income less than 250 Ethiopian *Birr*, and a small number (14.4%) earned between 251 and 500 Birr. Only few (8.5%) of the population earned more than 501 *Birr*. In *kebele* 40 about two third (60.9) earned monthly incomes below 250 *Birr* while 27% and 12.2% got between 251-500 Birr and above501Birr respectively. The income distribution was better in *kebele* 40 than the other two *kebeles*. There was no significant difference in monthly income among the three *kebeles* ($p>0.05$).

Table 6: Income distribution

Income/month (Birr)	The study area n=350			Total	P-value
	Kebele 40	*Kebele* 41	*Kebele* 43		
< 250	70(60.9)	91(77.1)	77(32.4)	238(67.8)	0.231
251-500	31(27)	17(14.4)	28(23.7)	76(21.7)	0.059
501-1500	14(12.2)	10(8.5)	13(11)	37(10.5)	0.567
Total	116(33.1)	116(33.1)	118(34.3)	350(100)	-

Chi square tests, Figures in parenthesis are percentage

4.2.2 Household Assets

Table 7 shows the household assets distribution in the study area as a measure of affluence. Majority (73.4%) of the households owned radio. Television was found in slightly more than a third (26.5%) of the households in *kebele* 40 while small number 8.7% and 16.1% in *kebele* 41 and 43, respectively had this item. Electric clay stove was found in 30% of the households in *kebele* 40, respectively. There were no households with bathroom facilities in *kebele* 41 and 43, while only a small number (2.6%) of the households in *kebele* 40 had this facility. *Kebele* 41 had the highest number (24.3%) of households with private houses, compared to *Kebele* 40 and 43. The difference in the owning of household assets in the three *kebeles* was statistically significant ($p<0.01$) for radio, television, refrigerator and electric stove. There was no significant difference ($p>0.05$) in owning private house between the three *kebeles*

Table 7: Percentage distribution of household assets as a measure of affluence.

Household asset	The study area			Total	P- Value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Radio	91(77.8)	73(63.5)	93(78.8)	257(73.4)	0.013
Television	31(26.5)	10(8.7)	19(16.1)	60(17.1)	0.001
Fridge	8(6.8)	-	1(0.8)	9(2.6)	-
Bathroom	3(2.6)	-	-	3(0.9)	-
Electric stove	35(30)	10(8.8)	35(30.5)	81(23.2)	0.001
Private house	21(17.9)	28(24.3)	17(14.4)	66(18.9)	0.145

Figures in parenthesis are percentages Significant at $p<0.01$, Chi square test

4.2.3 House construction materials

Table 8 shows the house construction materials in the study area. Almost all (98.6%) houses in the three *kebeles* were roofed using corrugated iron sheets and had mud walls (98.9%). There was almost equal number of households in *kebele* 40 (12.9%) and *kebele* 43 (12%) had their floor made of mud. A higher proportion (24.6%) in *kebele* 41 had mud floor. More households (17.4%) in *kebele* 41 had cemented floor. The difference in the type of floor in the three *kebeles* was statistically significant ($p<0.01$). However, there was no significant difference ($p>0.05$) for the type of wall and roof in the three *kebeles*.

Table 8: Distribution of houses construction materials

Type of houses and construction	The study area n=350				P-value
	Kebele 40	*Kebele* 41	*Kebele* 43	Total	
House roof					
Corrugated iron sheets	115(32.9)	115(32.9)	115(32.9)	343(98.6)	0.250
Grass	2(0.4)	3(0.9)	2(0.4)	7(1.4)	
House floor					
Mud	45(12.9)	42(12)	86(24.6)	173(49.4)	
Cement	48(13.3)	61(17.4)	25(7.1)	135(38.6)	
Wood	24(6.9)	14(4)	4(1.1)	42(12)	0.000
House wall					
Mud	117(33.4)	116(33.1)	114(32.5)	348(98.9)	0.537
Wood	-	-	2(0.4)	2(0.4)	

Figures in parenthesis are percentages

Chi square test, significant at $p<0.01$ (house floor)

4.2.4 Occupational status of members in the study households

Table 9 summarizes the occupational status of members of the households in the study areas. It was found that children under five and students were (25.25 and 24.4%) these with some form employment (10+18.4% and 5.6%) had some business. Hose wives and dependents were 11.4% and 5% respectively. *Kebele* 40 had a high proportion house wives (14.7%) and those employed (12.3%). *Kebele* 43 had more students (26.4%) and dependents 5%. While *kebele* 41 had more retailers (9.75%) and causal laborers (25.4%). There was significant difference ($p< 0.01$) within the occupational distribution among the three *kebeles*

Table 9: Distribution of study household by occupation

Occupation	The study area N=1870			Total	P- value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Under five	153(26.8)	154(24.6)	164(24.4)	471(25.2)	0.573
Housewife	84(14.7)	55(8.8)	75(11.2)	214(11.4)	0.005
Salary employed	70(12.3)	42(6.7)	75(11.2)	187(10)	0.003
Student	145(25.4)	131(20.9)	180(26.8)	456(24.4)	0.039
Retailer	29(5.1)	61(9.7)	15(2.2)	105(5.6)	0.000
Causal laborer	75(13.1)	159(25.4)	109(16.2)	343(18.4)	0.000
Dependent	15(2.6)	24(3.8)	54(8)	93(5)	0.004
Total	576(30.6)	626(33.5)	672(36)	1870(100)	_

Chi square test Figures in parenthesis are percentages, significant at $p<0.01$

4.2.5 Education level of mothers

Table 10 shows the distribution of mothers by level of education in the study area. A third (30.8%) had primary education, (40.7%) reached secondary school, while slightly more than a quarter (27.5%) were illiterate. There was no significance difference ($p>0.05$) in educational level of mothers among the three *kebeles.* The number of illiterate mothers in *kebele* 40 was highest (37.1%) compared to the others, whereas *kebele* 41 had highest number (39%) of mothers with primary education. The number of mothers with secondary school enrolment was about the same in the three-study areas.

Table 10: Distribution of mother's education level.

Educational Level	Study area, n=350			Total	P-value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Illiterate	37(37.1)	35(37)	23(23.9)	97(27.5)	0.077
Primary	30(27.6)	36(33.3)	42(39)	111(30.8)	0.147
Secondary	49(31.9)	47(32.6)	51(35.5)	142(40.7)	0.202

P>0.05, Chi square test, Figures in parenthesis are percentages

4.3 Child feeding and adequacy of complementary foods

4.3.1 Child feeding

Child feeding in the present study includes breast-feeding, complementary foods, which vary in nutrient adequacy. Complementary foods were feed by the caregiver in the absence of the mother.

4.3.1.1 Breast Feeding

Table 11 shows the duration the duration of breast-feeding in children among the three *kebeles*. Breast-feeding extended up to 24 months. Higher proportion (62.9%), about a third (29.7%) and a small number (7.7%) of the children were breast-fed for the period of 13-24, 7-12 and 0-6 months, respectively. More of the children (71.6%) in *kebele* 40 were breast fed beyond one year than the other two *kebeles*. In *kebele* 43 37.3% of the children breast-fed up to one year. There was significant difference ($p<0.05$) in the duration of breast-feeding for 7- 12 months of age among the three *kebeles*. There was no significance difference($p>0.05$) for the age group 0-6 and 13-24 months.

Table 11: Duration of Breast-feeding

Age group	The study area n=350			Total	p-value
in months	*Kebele* 40	*Kebele* 41	*Kebele* 43		
0-6	9(7.8)	11(9.5)	7(5.9	27(7.7)	0.596
7-12	24(20.7)	36(31)	44(37.3)	104(29.7)	0.027
13-24	83(71.6)	69(59.5)	67(56.8)	219(62.9)	0.046

Figures in parenthesis are percentages Chi square test Significant at $p<0.05$

4.3.1.2 Type of caregiver in the absence of the mother

Table 12 lists types of caregivers in the absence of the mother in the study area. In most of the households, siblings (31.1%) took care of the children in the absence of their mothers. 26% of children were take care of by their grandmothers in the absence of their mothers. In 26% of the households, there was no one to look after the children and they either were usually abandoned to a neighbor or accompanied their mothers. There was significance difference ($p<0.01$) in the type of caregivers (for sibling and others) in the absence of the mother among the three *kebeles* but there was no significant difference ($p>0.05$) for other types of caregiver in the three *kebeles*

High proportions (43.6%) and 30.8% of the children in *kebele* 40 were taken care of by the sibling and grandmothers, respectively in the absence of their mothers. Fathers *took* care of few children in the three *kebeles*. Small proportions (12%, 9.5% and 16.2%) of the children in the three *kebeles* were taken care of by the maids. In majority of the households, the meal for the children was prepared and fed by the mothers.

Table 12: Distribution of children caregivers in the absence of their mother

Person taking care of the	The study area n=350			Total	p-value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Father	3(2.6)	6(5.1)		15(4.3)	0.563
Sibling	51(43.6)	34(29.3)	24(20.5)	109(31.1)	0.005
Maid	14(12)	11(9.5)	19(16.2)	44(12.6)	0.280
Grand mother	36(30.8)	22(19)	33(28.2)	91(26)	0.198
Others	13(11.1)	43(37.1)	35(29.9)	91(26)	0.000
Total	116(33.1)	116(33.1)	118(33.7)	350(100)	

Figures in parenthesis are percentages

Significant at $p<0.01$, Chi square test

4.3.1.3 Introduction of complementary foods

Table 13 summarizes the introduction of complementary food in the surveyed households; majority (83.4 %) of the children started complementary feeding between 4-6 months. High proportion (90.6%) of the children in *kebele* 40 and 13.8% of the children from *kebele* 41 started complementary food at the ages of 4-6 and 7-9 months, respectively. Small number (6%) and (5.1%) of the children in *kebele* 40 and 43 started complementary food at the age 10-12 months respectively. Few (2.6%) in *kebele* 40 started complementary food at the age of above 12 months. There was significant difference ($p<0.01$) with in the time of complementary food introduction between the three *kebeles*.

Table 13: Time of complementary food introduction

Time of complementary food	The study area n=350			Total	P-value
	Kebele 40	*Kebele* 41	*Kebele* 43		
1-3months	3(2.6)	3(2.6)	8(6.8)	14(4)	0.164
4-6 months	106(90.6)	90(77.6)	97(82.2)	293(83.4)	0.025
7-9 months	5(4.3)	16(13.8)	7(5.9)	27(7.7)	0.009
10-12 months	-	7(6)	6(5.1)	13(3.7)	-
Above 12 months	3(2.6)	-	-	3(0.9)	-
Total	117(33.3)	116(33)	118(33.6)	350(100)	-

Figures in parenthesis are percentages

Significant at $p<0.01$,Chi square test

4.3.2 Type of complementary foods and methods of feeding

Table 14 shows the type of complementary foods consumed by the study children. *Cerifam*, bread and tea, potato, cow milk and porridge were the main foods used by the households' children. Slightly more than half (52.5%) and more than a third (34.4%) of the children in *kebele* 40 and 43 used *cerifam* as introduction of complementary diet while a small number (13%) used *cerifam* in *kebele* 41. Majority (83%) and 47.1% of the children in *kebele* 41 used bread and cow milk respectively while few number (1.8%) used *faffa* for the introduction of complementary diet. There was significant difference ($P<0.01$) in the type of complementary diets (*cerifam*, porrige and bread) used among the three *kebeles*. However, but there was no significant difference ($p>0.05$) in potato, *injera* and cow milk use among the three *kebeles*

Table 14: Type of food used for introducing complementary food

Type of complementary diet	The study area n=350			Total	P-value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Cerifam	64(52.2)	17(13.1)	42(34.4)	124(35.4)	0.000
Potato	20(38.5)	14(25)	20(36.5)	55(15.7)	0.324
Porridge	9(16)	13(26)	29(58)	52(15.7)	0.003
Injera	6(33.3)	4(26.7)	6(40)	17(4.6)	0.853
Bread/tea	5(5.1)	50(83.1)	9(11.9)	65(18.6)	0.000
Cow milk	12(35.3)	16(47.1)	6(17.6)	35(10)	0.068
Faffa	-	2(1.8)		2(0.6)	-
Total	118(33.7)	116(33.1)	116(33.1)	350(100)	-

Figures in parenthesis are percentages Significant at $P<0.01$, Chi square test

4.3. 2.1 Method of feeding

Table 15 shows the distribution of methods of feeding in the study household children. The major method of feeding was spoon, bottle, hand and cup feeding. About forty percent (39.6%) in *kebele* 40, more than quarter (28.1) in *kebele* 41 and a third (32.3) in *kebele* 43 used spoon as method for feeding. More than a third (36.7%) and (38.3%) of children in *kebele* 41 and 43 used bottle-feeding, respectively. A half (50%) of the children in *kebele* 41 and about quarter (23%, 27%) of the children in *kebele* 40 and 43 used hand method of feeding respectively. Cup feeding was exercised in 45.2%. 41.9% and 12.9% of the children in *kebele* 41,43 and 40 respectively. There was significance difference ($p<0.01$and $p<0.05$) in spoon and cup method of feeding respectively but there was no significant difference ($p>0.05$) in hand and bottle method of feeding

Table 15: Method of feeding complementary foods

Method of feeding	The study area n= 350			Total	P- value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Spoon	93(39.6)	66(28.1)	76(32.3)	235(67.1)	0.002
Bottle	15(25)	22(36.7)	23(38.3)	60(17.1)	0.299
Hand feeding	5(22.7)	11(50)	6(27.3)	22(6.3)	0.187
Cup	4(12.9)	14(45.2)	13(41.9)	33(9.4)	0.035

Figures in parenthesis are percentages significant at $p<0.01$ and $p<0.05$

Chi square test

4.3.3 Dietary adequacy of complementary diet

4.3.3.1 Calorie intake

Table 16a summarizes the proportion of children who met their calorie requirement according to the age groups. About the same number (18.4%, 11.8% and 14.3%) of children from the age group of 4-6 months met their calorie requirement in the three *kebeles.* High proportion 43.1%, 35.3 and 31.4% of the children met their calorie requirement from *kebele* 41 and 43. There was significant difference ($p<0.01$) between those meeting RDA and those who didn't met in the three *kebeles*

Table 16 a: Proportion of children meeting calorie RDA by age group

Age groups (months)		Proportion of children meeting RDA		
		Kebele 40	*Kebele* 41	*Kebele* 43
4-6	n=27	7(18.4)	6(11.8)	5(14.3)
7-9	n=37	8(21.1)	5(9.8)	11(31.4)
10-12	n=67	11(28.9)	22(43.1)	11(31.4)
13-24	n=219	12(31.6)	18(35.3)	8(22.9)

Figures in parenthesis are percentages Significant at $p<0.01$

The mean calorie intake was lower than RDA in the age group 13-24 months for both male and female children (Table 16 b). In the age group, 4-6 months, about three-quarter (73%) of male and more than a half (58%) of female met the RDA, while 52.9% of male and 75% of female in the age group 7-9 months met their RDA. Small proportion (15.8% and 19.2%) of male and female children in the age group 13-24 months met their RDA. The mean energy intake K/Cal for the male children was higher than the female children. The energy intake among the female children was significantly different at ($p<0.01$) and within male children ($P< 0.01$) but there was no significant difference ($P>0.05$) between male and female children among the study households.

Table 16 b: Calorie intake by the children

Age group in months	Sex	RDA	Mean Calorie intake	Proportion of children meeting their RDA
4-6	M	690	864±221	73.3
	F	645	743±204	58.3
7-9	M	825	952±350	52.9
	F	765	956±238	75
10-12	M	920	1000±234	64
	F	865	996±222	66.7
13-24	M	1230	1008±253	15.8
	F	1165	977±236	19.2

$P<0.01$ for male, $P<0.01$ for female M= male, F= female

4.3.3.2 Protein intake

Table 17 summarises the proportion of children who met their protein requirement based on the age groups. A high proportion (73%) in *kebele* 40, 60% in *kebele* 41 and a half (57.1%) of children age 13-24 months in *kebele* 43 met their required protein intake. A small proportion (8%) in *kebele* 43 and 7% in *kebele* 41 received the required protein intake for that age respectively. Higher proportion of children in the age of 6 months met their protein RDA than for the other age groups (Appendix 8). There was significant difference ($p<0.05$) in meeting protein RDA for the age group among the three *kebeles*

Table 17: Protein intake, by the children

Age groups (months)	Proportion of children meeting their protein RDA		
	Kebele 40	Kebele 41	Kebele 43
4-6 n=27	9(9)	9(10.5)	7(8)
7-9 n=37	10(10)	6(7)	14(15.9)
10-12 n=67	8(8)	19(22)	17(19.3)
13-24 n=219	73(73)	52(60)	50(57.1))

Figures in parenthesis are percentage p>0.05

4.3.3.3 Calcium and iron intake

Table 18 shows the proportion of children who met the required calcium and iron intake for their age. A small proportions (6.7,6.1% and 13%) of children met their RDA for their age in *kebele* 40,41 and 43, respectively while in the age group 13-24 months 83.3% in *kebele* 40 and 69.7% in *kebele* 41 met their RDA.

There was significant difference (P<0.01) for calcium RDA met for the age groups in the three *kebeles* .The proportion of children who met their iron RDA was highest for the age group 13-24 and lowest for the age group six months in the three *kebeles.* The mean intake of calcium was low compared with the RDA but the mean intake of iron higher than RDA, but 40.7% of the children at the age 6 months received below RDA (Appendix, 9). There was significant difference (p<0.01) in iron intake among children in the three *kebeles.*

Table 18: Distribution of children by Calcium and Iron intake

Age groups (months)	Proportion of children meeting calcium RDA			Proportion of children meeting iron RDA		
	Kebele 40	*Kebele* 41	*Kebele* 43	*Kebele* 40	*Kebele* 41	*Kebele* 43
6 n=27	2(6.7)	2(6.1)	3(13)	6(5.6)	7(6.5)	3(2.7)
7-12 n=104	3(10)	8(24.2)	3(13)	19(17.6)	33(30.8)	42(37.5)
13-24 n=219	25(83.3)	23(69.7)	17(73.9)	83(76.9)	67(62.6)	67(59.8)

P<0.05 for calcium **P<0.01 for iron**

4.4. Frequency consumption of complementary foods

Table 19 shows frequency of consumption of complementary diets in the study children. Bread, *injera, porridge faffa* and milk were most commonly consumed foods on daily basis by (63.2%, 53.4%, 32.2%, 36.3% and 29.6%) of the children respectively.

Only 1% of the children ate meat daily. Small number of the households that is (11.2%, 4.6% and 2.9%) ate orange, banana and vegetables on daily basis, respectively.

Bulla was also eaten daily by a small number of the children (9.8%) *injera,* milk bread, porridge potato and *faffa* were eaten more than once daily by the study households children. Vegetable, *bulla* and fruit were consumed by small proportions 2%, 2.5% and 5.3% of the children more than once pr day.

The proportion of those who had never eaten protein rich foods was relatively high. Meat, milk and *faffa* were reported as never having been eaten by 55%, 37.1% and 35.5% of the households, respectively. A third (36.5%) had never consumed porridge. A small proportion had not consumed starchy foods that are 19.5% for *injera,* 21% for potato and 12.1% for bread.

A high proportion 75.5% had never consumed vegetables while slightly more than a half 54.6% had never consumed banana. More than two thirds 68.8% had never consumed *bulla* in the study households.

Table 19: Frequency of consumption of different complementary diets

Food items	Proportion of children consuming the diet n= 350						
	More than once per day	Once per Day	3-6 x per wk	2x per wk	1x per month	During holiday	Never
Beef	-	5(1)	23(6.6)	29(8.3)	46(13.2)	55(15.8)	192(55.2)
Milk	50(14)	102(29.3)	35(10.1)	22(6.3)	10(2.9)	2(0.6)	129(37.1)
Faffa	36(10)	128(36.8)	47(13.5)	9(2.6)	2(0.6)	5(1.4)	123(35.3)
Porridge/atmit	37(10.3)	112(32.2)	44(12.6)	25(7.2)	4(1.1)	1(0.3)	127(36.5)
Injera	57(16)	186(53.4)	27(7.8)	8(2.3)	5(1.4)	1(0.3)	66(19)
Potato	38(10.5)	101(29)	98(28.2)	25(7.2)	10(2.9)	3(.9)	75(21.6)
Bread	46(12.8)	220(63.2)	31(8.9)	9(2.6)	1(0.3)	1(0.3)	42(12.1)
Bulla	10(2.5)	34(9.8)	23(6.6)	24(6.7)	15(4.3)	6(1.7)	238(68.8)
Vegetables	8(2)	10(2.9)	21(6)	33(9.5)	13(3.7)	1(0.3)	264(75.9)
Orange	14(3.8)	39(11.2)	101(29)	66(19)	29(8.3)	3(.9)	98(28.2)
Banana	6(1.5)	16(4.6)	53(15.2)	51(14.7)	30(8.6)	4(1.1)	190(54.6)

Figures in parenthesis are percentages

Wk= week

4.5 Nutritional status in the study area

4.5.1 Nutritional status of the children in the selected households

Table 20(a) summarizes the nutritional status of the children in the study households. The overall nutritional status was 26.6%, 38.6% and 9.4% for underweight, stunting and wasting respectively in the study area. There was no significant difference ($p>0.05$) in distribution of malnutrition in the three *kebels*.

Table 20(a) Malnutrition in the three *kebeles*

Nutritional status	The study area			Total
	Kebele 40	*Kebele* 41	*Kebele* 43	
Wasted	11(9.5)	14(12.1)	8(6.8)	33(9.4)
Underweight	29(25)	37(31)	27(22.1)	93(26.6)
Stunted	40(34.8)	49(42.2)	47(38.8)	136(38.6)

Figures in parenthesis are percentages

As showed in Table 20 (b) they were grouped as normal, moderately malnourished and severely malnourished using the cut- off points recommended by the WHO (1983). Those less than –2SD Z score were grouped as moderately malnourished and those less than-3SD Z score were grouped as severely malnourished.

Within the age groups 6-11,12-17 and 18-24 months 10%, 35% and 54% were moderately underweight while 8.7%, 34.8% and 56.5% were severely underweight, respectively. The prevalence of stunting among the same age groups was 15.5%, 31% and 53.6% while those severely malnourished were 11.8%, 25.5% and 62.7%, respectively.

The prevalence for wasting was high (50%) in the age group 18-24 months. The level of malnutrition increased with increasing the age of the children. The number of stunted, wasted and underweight children was highest in the age group 18-24 months of age. There was significant difference ($p<0.01$) in stunting and underweight between age groups but there was no significance difference ($P>0.05$) in wasting among the age groups.

Table 20 b: Distribution of malnutrition on the age groups

Age group	Rate of malnutrition					
	Underweight		Stunted		Wasted	
	<-2 z-score	<-3 z-score	<-2 z-score	<-3 z-score	<-2 z-score	<-3 z-score
6-11 months	7(10)	2(8.7)	13(15.5)	6(11.8)	2(8)	2(25)
12-17 months	25(35.7	8(34.8))	26(31)	13(25.5)	9(36)	2(25)
18-24 months	38(54.3)	13(56.5)	45(53.6)	32(62.7)	14(56)	4(50)
Total	70(19.6)	23(6.4)	84(23.5)	51(14.3)	25(7)	8(2.2)

P<0.01 for stunted

P< 0.01 for underweight

P>0.05 for wasted

4.5.2 Nutritional status of children by mid upper arm circumference (MUAC)

Table 21 shows the proportion of malnourished and normal children based on mid upper arm circumference (MUAC) measurement. About 23% of the children were malnourished (below the cut off point 12.5cm) in the three *kebeles* .

A third (30.2%) in *kebele* 41, about quarter (25.4%) in *kebele* 43 and a small number (12.9%) in *kebele* 40 were malnourished. There was significant difference ($P<0.05$) in the prevalence of malnutrition based on MUAC measurement among the three *kebeles.*

Table 21: MUAC measurement of the children

Nutritional status	The study area n=350			Total
	Kebele 40	*Kebele* 41	*Kebele* 43	
Malnourished<12.5 cm	15(12.9)	35(30.2)	30(25.4)	80(22.9)
Normal>12.51 cm	101(87.1)	81(69.8)	88(74.6)	270(77.1)

Figure in parenthesis are percentages, significant at $P<0.05$, Chi square test

4.5.3 Nutritional status of the mothers by body mass index (BMI)

Using the BMI 18.4% of the mothers in the study population were to be malnourished, this 23.5 % were in kebele 40, 34.4% in kebele 41 and 42.3% in kebele 43. However there was no significant difference ($p>0.05$) in the nutritional status of the mothers in the three *kebeles* as assessed by BMI.

Table 22: Maternal nutritional status

Nutritional status	The study area		n= 350	Total
	Kebele	*Kebele* 41	*Kebele* 43	
Malnourished	16(23.5)	22(34.4)	28(42.3)	64(18.4)

Figures in parenthesis are percentage $p>0.05$

4.5.4 Calorie intake and the nutritional status of the children

Table 23 shows the association of RDA with the nutritional status of the children in the study area. More than forty five percent (46.7%), slightly less than a third (32.2%) and 11.1 % of the study children who did not meet their RDA were stunted, underweight and wasted, respectively.

The proportions of underweight and stunted that met RDA and did not were significantly different (P<0.01) but, for wasting there was no significant difference (P>0.05). Those children who did not meet their RDA were 1.4 times at risk to be underweight and stunted.

Table 23: Association of RDA and nutritional status of the children

Nutritional status	Number and proportion of children meting	Number and proportion of children don't meeting their RDA*	P-value	CI	Odds ratio
Wasting	8(6.5)	25(11.1)	0.05	0.968-1.474	1.195
Underweight	18(14.5)	75(32.2)	0.000	1.190-1.583	1.373
Stunting	30(24.2)	105(46.7)	0.000	1.195-1.610	1.387

Figures in parenthesis are percentages
Chi square test
Significance at p<0.01
CI= Confidence interval

4.6 Immunization and morbidity

4.6.1 Child immunization

Immunization had been carried out successfully in the study area. The data showed that 83.6 % of the children were fully immunized for their appropriate age (Table 24). High proportion (89.5%) of the children in *kebele* 41 was immunized, while 21.2 % in *kebele* 43 were not fully immunized because of factors like their age, family separation etc. However there was no significant difference ($p>0.05$) in immunization of the children in the three *kebeles.*

Table 24: Pattern of immunization in the children

Immunisation	Study area n=350			Total
	Kebele 40	*Kebele* 41	*Kebele*43	
Immunised	96(82.8)	103(89.5)	93(78.8)	293(83.6)
Not fully immunised	20(17.2)	13(10.5)	25(21.2)	57(16.4)

Figures in parenthesis are percentages,

Chi square test, $p>0.05$

4.6.2 Child morbidity

Table 25 summarizes the major types of illnesses in the study household children. Diarrhea, fever, coughing and vomiting were the diseases the children suffered from most. At the time of data collection, 42.1% and 42.9%) of the children suffered from diarrhea and coughing, respectively. Only small numbers (7.1% and 3.6%) suffered from fever and vomiting. The prevalence of diarrhea was high (54.2%) in *kebele* 41. In *kebele* 40 and 43 coughing was highly prevalent 38.3% and 41.7%, respectively (Table 22). There was significant difference ($p<0.01$) in the prevalence of diarrhea and coughing among the children of the households but there was no significance ($p>0.05$) in the prevalence for fever.

Table 25: Prevalence of diseases among the children

Type of illness	The study area			Total	P-value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Diarrhea	11(18.6)	32(54.2)	16(27.1)	59(42.1)	0.00
Fever	4(30)	3(20)	5(50)	10(7.1)	0.504
Cough	23(38.3)	12(20)	25(41.7)	60(42.9)	0.002
Vomiting	1(20)	2(40)	2(40)	5(3.6)	-
Others	5(83.3)	1(16.7)	-	6(4.3)	-

Figures in parentheses are percentages Significance at $P< 0.01$, Chi square test

4.6.3 Morbidity among the mothers

Table 26 shows the prevalence of fever, diarrhea, coughing and vomiting among the mothers in the study populations. The prevalence of coughing was highest at 44.6% followed by fever (41.3). Diarrhoea and vomiting was prevalent in small proportion (10.9% and 3.3%) of the mothers. There was significant difference ($p<0.05$) in the prevalence of disease among the three *kebles*.

Table 26: Prevalence of diseases in the mothers

Type of disease	The study area			Total
	Kebele 40	*Kebele* 41	*Kebele* 43	
Fever	6(30)	20(64.5)	12(29.3)	38(41.3)
Diarrhea	3(15.3)	2(6.5)	5(12.2)	10(10.9)
Coughing	11(55)	8(25.8)	22(53.7)	41(44.6)
Vomiting	-	1(3.2)	2(4.9)	3(3.3)

Figures in parenthesis are percentages, Chi square test, $p<0.05$

4.7 Water sanitation and Hygiene

4.7.1 Water availability

Table 27 shows the sources of water in the study area. The sources of water were private, communal and water purchased from neighbors. The percentage of households obtaining water from the different sources within the three *kebeles* was significantly different ($p<0.01$) although the quality was the same. Almost all the study households (99.4%) in the study area used chemically treated tap water. Almost nearly a half (48.2%) of the households in *kebele* 40 had own water supply compared to approximately 23% and 30% in *kebele* 41 and 43, respectively.

About two third (61.1%) in *kebele* 41 and a quarter (25.7%) in *kebele* 43 had access to communal tap water source compared to 13.3% in *kebele* 40. About forty percent (41.7% and 39.7%) in *kebele* 43 and 40, respectively purchased water from neighbors, while small number (18.6%) in *kebele* 41 had this facility. The average amount of water used by the households within 24 hours was 63±32.7 liters.

Table 27: Water sources in the study area

Water Source	The study area n=350			Total	P value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Private	40(48.2)	19(22.9)	24(28.9)	83(23.6)	0.002
Communal	15(13.3)	69(61.1)	29(25.7)	113(32.1)	0.000
Purchased from neighbor	62(39.7)	29(86)	65(41.7)	156(44.3)	0.000

Figures in parenthesis are percentage, significance at $P< 0.01$, Chi square test

4.7.2 Toilet accessibility

Table 28 shows distribution of latrines in the surveyed households. The major types of latrine in the study area were private and communal. The distribution of latrine was significantly different P<0.01) among the three *kebeles*. More than a half (56.4%) in *kebele* 40 and 28.2% in *kebele* 43 had private latrines while a small numbers (15.4%) in *kebele* 41 had this facility. About the same number (35.7% and 34.7%) in *kebele* 41 and 43 respectively had communal latrines. Only 29.7% in *kebele* 40 had this facility. A small number (3.4%) of the household in the study area had no toilet facility.

Table 28: Latrine types in the study area

Type of latrine	The study area			Total	P- value
	Kebele 40	*Kebele* 41	*Kebele* 43		
Private	22(56.4)	6(15.4)	11(28.2)	39(11.1)	0.001
Communal	89(29.9)	107(35.7)	104(34.7)	300(85)	0.684
No latrine	6(50)	3(25)	3(25)	11(3.4)	0.340

Figures in parenthesis are percentages

Significant at P<0.01, Chi square test

4.7.3 Refuse disposal

Table 29 shows refuse disposal system in the study area. The main refuse disposal technique were composite pit and damping in the river. More than forty percent (42.9%), about a third (31.9%) and a quarter (25.2%) of the households in *kebele* 40, 41 and 43, respectively disposed their refuse in composite pits. About a half (53.2%) in *kebele* 43 and more than a third (36.7%) in *kebele* 41 disposed refuse in the river, while small number (10.1%) in *kebele* 40 disposed in the river. K*ebele* 40 had better refuse disposal facility. There was significant difference ($p<0.01$) in refuse disposal technique among the three *kebeles.*

Table 29: Method of waste disposal

Refuse disposal	The study area n=350			Total
	Kebele 40	*Kebele* 41	*Kebele* 43	
Composite pit	103(42.9)	76(31.9)	61(25.2)	240(68.6)
Damp in the river	12(10.1)	40(36.7)	58(53.2)	110(31.4)

Figures in parenthesis are percentages

P<0.01, Chi square test

4.8. Microbiological quality of the complementary diets

The microbiological quality of the complementary diets used in households was estimated by determination of bacterial load of 49 sub samples, sampled at random from 350 households. Table 30 summarises the mean counts of aerobic plate count and *Bacillus* species in different types of complementary foods. The mean aerobic plate count was high ($2x10^7$) in *faffa* followed by bread ($2.9x10^6$) and *atmit* ($2.5x10^6$).

Table 30: Aerobic plate count and Bacillus species in complementary diet

Microbial contaminant	Mean counts of organisms in the complementary foods						
	Faffa	*Cerifam*	*Injera*	*Atmit*	Bread	Potato	Cow milk
Aerobic plate count	$2x10^7$	$4x10^5$	$1.4x10^5$	$2.5x10^6$	$2.9x10^6$	$1.25x10^6$	$1.88x10^6$
Bacillus subtilis	$5.8x10^4$	$7.5x10^4$	$9.4x10^3$	$8.2x10^4$	$1x10^4$	$9.7x10^4$	$3.9x10^4$

Table 31 shows the distribution of Gram-negative organisms *Klebsiella* spp, *Enterobacter* spp, *Escherchia coli and* Enteropathogenic E.Coli in complementary foods.*Faffa,cerifam, atmit* and potato samples were notably contaminated with *klebssiella* spp. The mean count of K*lebseilla* in *cerifam* and *atmit* was highest ($3.5x10^4$ and $3.9x10^4$) compared to the other food samples. Cow milk and *cerifam* were highly contaminated ($1.88x10^6$, $1.5x10^6$) with E.coli and *Enterobacter* spp, respectively. The presence of Enteropathgenc E coli (EPEC) was noticed in five food samples.

The mean count of EPCE was highest ($2.7x10^4$) in potato food samples. Mold contamination was present only in the two samples namely, *Injera* and bread (Table 31). The number of mold count was higher ($1.3x10^5$) in bread than in *Injera* sample, which were $2.3x10^4$

Table 31: Gram negative organisms, EPEC and mold in complementary foods

Microbial Contaminants	Mean counts of bacteria in the complementary foods						
	Faffa	*Cerifam*	*Injera*	*Atmit*	Bread	Potato	Cow milk
Klebsiella Spp	$9.4x10^3$	$3.5x10^4$	ND	$3.9x10^4$	ND	$4.4x10^3$	ND
Enterobacter Spp	$4.5x10^4$	$1.5x10^6$	$2.7x10^4$	$2.2x10^3$	ND	$7.5x10^4$	ND
Eschercia coli	$1.2x10^6$	$2.5x10^5$	$1.3x10^5$	$2x10^3$	$2x10^5$	$4x10^5$	$1.8x10^6$
Entero-pathogenic *E.Coli*	$4.5x10^4$	$1.5x10^6$	ND	$2.2x10^3$	ND	$7.5x10^4$	ND
Mold count	ND	ND	$2.3x10^4$	ND	$1.3x10^5$	ND	ND

ND= not determined

CHAPTER FIVE: DISCUSSION

5.1 Demographic and socioeconomic characteristics of the study population

The dependent members of the households in the study area were 44.7% compared to 55.3% of economically productive, which characterises many communities in developing countries. The higher proportion (42.9%) of the young population in the study area is likely to cause constraints on nutrient adequacy, health and education of the households. The small number (1.8%) of people above 64 years indicates that there are few old people in the study area signifying the general low life expectancy among the study population.

The married mothers in the study population (64.2%) were comparable to the national marital status of 64.5% of married (CSA, 1994). The mean age for the mothers was 32 years. Stunting and wasting was reported among children of younger mothers than those of older mothers were (Efata, 2000). The average number of under-five children in the households was 1.3 and the average household size was 5.3, which was equivalent to Addis Ababa figure (CSA, 1994)..

The proportion of employment (10%) shows that there is a high rate of unemployment in the study area, which was however very low compared to Addis Ababa figure of 35%.

The proportion of maternal illiteracy in the study area was high (section 4.2.5) when compared to, Addis Ababa's 17% (CSA 1994). Educated mothers give their children complementary foods more frequently in more protected and cleaner condition.

Besides, these mothers have greater nutritional knowledge and better ability to make use of health care systems.

The mean monthly income for the households per month was 250 Birr (28.4dollars). This income falls in the poor category's that is income under 30 dollars per month (UNICEF, 1990). Under the circumstances there is limited purchasing power catering for food and others household necessities results in poor nutritional status of the children. Low household income directly affects the food intake frequency, childcare and health services for the poor. However, there was no relationship between household income and nutritional status of the household children and this could be due to the intervention programme previously carried out in the study area.

The households in the study area were very poor as indicated by the household assets (section 4.2.2). Poor housing conditions and assets are a manifestation of typical slum communities. Although the house roofs were mainly constructed of corrugated iron sheets, the house floors were mainly (86%) made of mud in *kebele* 43, while more than 40 % in *kebele* 40 and 41 had mud floors. The same finding was reported by Harpham et al., (1988).

5.2 Child feeding and adequacy of complementary foods

5.2.1 Child feeding

Breast-feeding was extended up to 24 months among children. A similar study in low-income urban households in Ethiopia was reported by Almedom, (1991). A study by Geneno et al, (1998) reported that the mean duration of breast-feeding was 21.7 months among the study children. Brown et al (1990) showed that infants and children who received about a half of their energy intake from breast milk detected no significant change in total energy intake during diarrhea and febrile illness. Breast-feeding reduces the risk of infection, maintains the energy intake during illness, and minimizes the common childhood infection.

Majority of the children started complementary feeding at the age of 4-6 months. This age was recommended by WHO (1995) as a transitional period to consume solid foods. About (11.4%) of the children started complementary feeding between 7-12 months where breast milk alone was insufficient to meet infant energy needs. Almedom, (1991) reported late introduction of complementary diets where the mean age of complementary diets introduction was 7.2 months in the slum area of Addis Ababa. In developing countries, poor mothers tend to breast feed longer than those who are wealthier. This can affect the nutritional status of the children by late introduction of complementary foods (WHO, 1998). *Cerifam* which is a commercial complementary food was used by a higher proportion (52.2%) of the children in *kebele* 40 may indicate better living conditions in the area. Majority of the children used spoon method of feeding which can minimize the chance of food contamination.

Although mothers are the main caregivers, responsibility of care giving was shared among other members of the household. In this study, it was observed that children were often left on their own or with older sibling who also require care. A high proportion (31%) of children in the study households were under the care of siblings during the absence of mothers. Women in the urban population had to take up full or part time jobs to support their family income. Under these conditions, the mothers have less time to look after their children, and leave them with other young children who are unable to prepare their diets properly (Harpham et al., 1988). Care given by any one except the mother in the first year of life can be associated with higher mortality and lower nutritional status of the child (WHO, 1998)

5.2.2 Food consumption and adequacy for complementary diets

The intake of protein rich foods (*faffa*, milk and meat), vegetables and fruits by the children in the study area was low. Frequency of feeding and consumption of meals has effect on daily energy intake of the children. The low frequency of meals per day among the children can be related to inadequate food supply and lack of money to buy food. Since all the population, depend on purchased food rather than producing it themselves was difficult to get enough food with the limited monthly income. The lower frequency of consumption of fruit, vegetables and meat by the children suggest that the children depend on diet that was lacking in some important vitamins and minerals.

The calorie intake (section 4.3.3.1) showed that within the age group 4-6 months, the proportion of females consuming foods with calories below RDA was higher than the male

but with the age group of 7-9 month, the reverse was true. High proportion (84%) for males and 80.8% for females were below RDA in the age group 13-24 months.

There was a trend for calorie intake decline as the age of the children increased. The calorie intake results showed that there was inadequacy in all age groups with high proportion in the age group 13-24 months. This low calorie intake can be attributed to several factors including, household size, and resource availability and nutrition education.

There was no significance difference ($p>0.05$) in calorie intake between male and female children but a significance difference ($p<0.01$) was seen within male and female children. In terms of calorie adequacy, the intake was inadequate for majority of the children in the age group of 13-24 months and in a small proportion in the rest of the age groups.

Although protein intake level was adequate among the study children, the protein source was mainly of plant origin where the biological value is low compared to animal protein. Only 1% and 29.3% of the children took meat and milk respectively on a daily basis, indicating a low frequency of animal protein consumption. Tessema and Hailu, (1997) also reported similar low intake of animal protein, where 27% of the children did not have any of the animals or vegetable sources of diet, respectively. This indicates low quality of the diets that predisposes the children to a number of micronutrient deficiencies.

Combination of foodstuffs in the right proportion can provide protein of similar nutritional value profile with those of animals' proteins. Therefore, the introduction of mixed cereals and legumes in appropriate ratios should be recommended.

5.2.3 The impact of dietary adequacy on the nutritional status of the children

The nutritional status of the children was affected by the calorie intake. Less than a half and about a third of the children who did not meet their RDA were stunted and underweight respectively. Only a tenth were wasted among those who did not meet RDA. This shows that the amount of energy intake was lower than RDA, which would put the children at risk of malnutrition. The proportions of children who are below their RDA for their calorie intake were 1.4 times at risk of stunting, and underweight. The low protein and energy intake could predispose the study children to protein energy malnutrition.

5.3 Hygiene and water quality

Water availability and hygiene are good socio-economic indicators .The information on sources of water supply in the study area showed that 99.4% of the households used piped water, which reflects the situation in Addis Ababa where an average of about 98% households had piped water. The average amount of water used by the households per day was 63 litres, about 13 litres per person compared to 20-30 litres, the minimum acceptable amount of water required per person per day (Efata, 2000).

Only 3.4% of the study population had no latrine, which is very low when compared with Addis Ababa figure (24.9%) .In 31.4% of the households, there was no access to refuse disposal facility. Similar finding was reported in slum areas of Nairobi, where 36% of slum population lack access to such facilities (GOK/UNICEF, 1992). Poor access to adequate means of excreta disposal and the presence of pit latrine in flooded area can cause high incidence of diarrhoea, which indicate high extent of complementary food contamination.

ck of safe drinking water and poor hygiene can contribute to incidences of disease and nutrition which are the principle immediate causes of maternal and child death

OK/UNICEF, 1992)

Child and maternal morbidity

.1 Child Morbidity

gh prevalence of morbidity was reported in the study household children suffering inly from diarrhea and coughing with prevalence of 28% and 26.7% respectively. A ilar study by Brown et al., (1994) showed that 27.8% and 15.5% for upper respiratory ection and diarrhea, respectively. In addition, previous report in the study area showed h rate of acute upper respiratory infection (Stukey, 1997).

ring diarrhea, there is an increased loss of water and electrolyte in the liquid stool. sides these, a decrease in food intake and nutrient absorption and increased nutrient uirement often combine to cause weight loss and growth failure (WHO, 2000). Thus, nutritional status of the child declines and the preexisting malnutrition is made worse higher prevalence of malnutrition could be associated with higher morbidity rate omkins and Waston, 1989). Most infection are associated with a reduced food intake, s of body nutrient through increased metabolism e.g. during fever reduced nutrients ake due to anorexia. However, in the present study there was no relationship between orbidity and nutritional status of the children, although high contamination level of mplementary with pathogenic *E.coli* and other coliforms were reported.

Contrary to this study, Abate (1998) reported a significant association of malnourished children with diarrhea in slum areas of Addis Ababa. In addition, WHO, (1997) reported association of nutritional status, child mortality and morbidity plus a general increase of the number of malnourished children. As indicated in the study results 84% of the children were fully immunized for their appropriate age. According to Viteri, (1987) immunization against disease of childhood is the appropriate protective mechanism in attaining better nutrition and health.

5.4.2 Maternal Morbidity

High prevalence of coughing and fever (56% and 14%), respectively among mothers in the study area is probably the result of poor hygiene, and low household income. A good mother health condition has its own effects on child development and growth (World Bank, 1996). Maternal morbidity has a negative effect on childcare and affects the nutritional status of the children .A sick mother may not able to prepare food for her child and would be unable to look after the child. A study in maternal morbidity based on developing countries reported that 29% of pregnant women in India had serious illnesses and 26% suffered from fever. The same study indicated that 11 and 8% of the women suffered from parasitic and respiratory infection respectively.

5.5 Nutritional status

5.5.1 Nutritional status of the study children

The overall nutritional status of children in the study population were 9.4%, 26.6% and 38.6% for wasting underweight and stunting, respectively. This result was less than that reported by Abate, (1998) for underweight and stunting.

This study reported higher cases of wasting than 8%, the average for Ethiopia. The high prevalence of wasting can be explained by the recent or short-term shortage of foods, which is a measure of acute malnutrition. The present figure of wasting of 9.4% is more than double the 3.4% from the study by Abate (1998) but; stunting and underweight level in the present study household children was smaller than the same study. The prevalence for stunting was high (38.6%) and the children in the age group 12-17 and 18-24 months had the highest prevalence. Stunting is a cumulative process of nutritional deficits and is usually associated with long-term poverty, and is common in the second year of life between 12-23 months (Efata, 2000). In Africa the prevalence of stunting was higher than underweight (WHO, 1997). Wasting in African countries was reported high in the eastern middle and western part and low in northern and southern area. Results from the present study showed that there was an increase in the level of malnutrition as the age of the children increased. Similar result were obtained by Kielmann et al., (1988) in Samburu district (Kenya) where stunting increased with age which can be to feeding children with poor complementary foods as they are weaned.

5.5.2 Nutritional status of the mother

About 18.4% of the mothers in the present study were reported be malnourished with a BMI of less than 18.5. This value indicates that the mothers are probably undernourished. Adequate diet for women has to be seen as a central issue and a major factor in relation to progress in the health and nutritional well being of the children (UNICEF, 1983).

5.6 Food microbiological analysis

Although food is an essential substance to life, it can also bee good vehicle for the transmission of causative agents of disease like bacteria virus and fungi. Spoilage microorganisms cause off-flavor, odor, color change and nutritive quality deterioration of the food they live on and make it unfit for human consumption (Geyid, 1987). The results from the present study show that the complementary foods both commercial and locally produced were contaminated with coliforms, *bacillus.*spp, mold and Entero pathogenic *E.Coli*. In the present study *Bacillus subtilis* was isolated from the examined food samples. *Bacillus subtilis* undergoes the type of spoilage known as ropiness in home made breads (Jay, 1986). The number of *Bacillus subtilis* was beyond the acceptable limit. The presence of enteric pathogens like *E.coli* has been associated with childhood diarrhea. Transmission of these organisms takes place by fecal-oral route, through contaminated food, water or by direct contact with carriers especially those involved in food handling or serving (Abbar and Kaddar, 1991).

A similar study by W.Tenssay and Mengistu, (1997) in Jimma Ethiopia reported that *Enterobacter* spp, *E.coli*, *klebsiella* spp and *citrobacter* spp were isolated from complementary foods. Fifty percent of the complementary foods harbored bacterial counts of over $2x10^6$/ ml. They also reported that the contamination of weaning foods was significantly associated with unsafe water supply, storage at ambient temperature for long time and the method of feeding.

Standard of personal hygiene and public sanitation are low in many countries. It has been shown that the indigenous weaning foods are significant sources of childhood diarrhea (Simango and Rukure, 1992).

The presence of E.coli bacteria in food product generally provides index of hygienic standard of the product and its keeping quality. In analyzed samples, mold growth was seen on *Injera* and bread samples, which was beyond the acceptable limit (Appendix 6). Certain strains of mold are known to produce mycotoxins in foods, which can inhibit the synthesis of protein in the body by interacting with ribonucleic acid (RNA). It can also be a cause of for hepatocellullar carcinoma (FAO, 1994). The isolated number of aerobic plate count and other organisms were above the maximum acceptable limit (Appendix 6,7). This shows the poor bacteriological quality of infant foods a significant causal factor in the etiology of complementary feeding diarrhea and the study can speculate on the effect of the repeated consumption of contaminated food in the study area.

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The finding of this study suggests that the three *kebeles* were different in socio economic and demographic indicators, child feeding (including nutritional status) and hygienic practices. Food intake was inadequate among the study children with high proportion in the age group 13-24 months. This inadequacy shows an impact on the nutritional status of the children.

The children consumed low diversified diet, which imply they may not have provided with the most important micronutrients. Although protein intake was met, the source was mainly of plant origin where biological value is lower than those of animal origin. Calcium intake of the children was low when compared to iron intake.

The intake of vegetable fruits and protein rich food was low. This could be attributed to low monthly income for the household's not able to purchase these food items. The nutrient intake of the children could be influenced by the household size. Larger household size results in less quantity of food per person. There was an effect of dietary intake on the nutritional status of the children.

Almost all food samples were contaminated by pathogenic and spoilage organisms. Even though there was no association in food spoilage and the nutritional status the presence of these organisms in foodstuff can cause diarrhea and disease.

6.2 Recommendations

Intervention programme should be planned to boost the nutrient intake of the children by supplying food items like vegetables, meat and milk, which are important source of vitamins and minerals. Also mixing of cereals with legume can balance the protein requirement.

For household with low monthly income and mothers without jobs, income-generating programs should be planned to improve their living status and keep up the nutritional status of their children.

Appropriate nutrition and health education to the mothers or caregivers should be offered on safe preparation and handling of complementary foods, feed their children, and how to avoid food born disease.

REFERENCES

Abate, G. (1998). Childcare practice in households with malnourished children and those with well nourished children in a slum area of Addis Ababa, Ethiopia. Pp 72

Abbar,F. and Kaddar,H.K.(1991).Bacteriological milk study on Iraq milk products. Journal of Appl. Bact. **71**: 497-500.

Almedom,A.M.(1991). Infant feeding in urban low- income households in Ethiopia. The waning process. Ecology of Food and Nutrition **25**: 97-109.

ACC/SCN, WHO (1997). Nutrition and Poverty. 24th. Symposium. No. 16 pp 26.

ACC/SCN, (2000). Nutrition throughout the life cycle. 4th. Report on the world situation. Pp 4-55 Geneva, Switzerland.

ACC/SCN, United Nations (1994). Update on Nutrition Situation. pp: 27-35, 62-80

Ahmed,N.U. (1994). Assessment of the impact of hygiene intervention on environmental sanitation, childhood diarrhoea, and the growth of children in rural Bangladesh. Food and Nutrition Bulletin. **15** (1): 40-52.

Barrell, R.A.E. and Rowlad, M.G.M. (1979). Infant's foods as a potential source of diarrhoeal illness in rural West Africa. Transaction of the Royal Society of Tropical Medicine and Hygiene .**73** (1): 85-90.

Brown, K.H. (1997). Complementary feeding in developing countries: Factors affecting energy intake. Proceeding of Nutrition Society. **56**: 139-148.

Brown,L.V., Zeitun, M.F.,Weed,L.H, Rogers, B.L.,Peterson,K.E. ,Huq, N. and Gershoff,S.N (1994). Evaluation of the impact of message to improve the diet of lactating rural Bangladesh women on their dietary practice and the growth of their breast-fed infants. Food and Nutrition Bulletin .**15**(4): 320-334.

Cameron, M. and Hofvander, Y. (1983). Manual on feeding infants and young children. pp: 19-23, Oxford University Press.

Claus,D and Berkeley, R.C.W.(1984). Bergeas Manual of Systematic Bacteriology Vo.2 Williams and Wilkins, London.

CSA (1995). The transitional government of Ethiopia .The 1994 population and housing census of Ethiopia results for Addis Ababa. Vol.1. Statistical Report of Addis Ababa, Ethiopia.

CSA (1992). The transitional government of Ethiopia. Report on the National Rural Nutrition Survey, Core Module. Statistical Bulletin. 113: pp 88-89.126-127, 167-168

Demisse, T., Hidar, J.Geberesilassie, H., Biratu, E. and Fuffa, H. (1998). Vitamin A status in three Woredas of Kambata, Alaba and Timbaro zone Southern People's Region Ethiopia. Ethiopian Journal of Health Development. **12** (3): 225-229.

Erku.W.A. and Ashenafi,M.(1998).Prevalence of food borne pathogens and growth potential of salmonella on weaning foods from Addis Ababa ,Ethiopia. East African Medical Journal. **75** (4): 215-218

Efata, M.C.(2000). The prevalence of malnutrition among children 6-59 months and some selected maternal associated factors in Busia sub-district in Toronto. District, Uganda. pp 95,107-114.

EHNRI and FAO (1998) Food composition table for use in Ethiopia Part 4. Pp 1-33 EHNRI, Addis Ababa.

FAO (1994). Grain storage techqniqeus. Evolution and trends in developing countries Procter,D.L.(ed) 1994. F.A.O. Agriculture Services Bulletin. Rome, Italy pp 1-35,135-145.

Fieldhouse, P. (1986). Food and Nutrition, Custom and Culture. Pp: 1-4, 109-111. Croom Helm Ltd.

Fisher,A.A. Laing, J.E. Stoeckel, J.E. and Townsend, J.W.,(1991). Handbook for family planning operations research design. 2nd ed. Pp 45.

Gebre, B., Ayle, F. & Shiferaw, M.(1999).Pattern and determinant of under five mortality in Jimma zone, South-West Ethiopia. Journal of Health Science. **9** (2) 101-108.

Genebo, T., Girma,W.Hidar,J. and Demissie,T.(1998). Ethiopian Journal of Health Development. **12** (2): 69-73.

Genebo, T.and Gelaw, M. (2000). Knowledge and attitude of the community towards rich sources of vitamin A and iron in relation to malnutrition. Ethiopian Journal of Health Development. **14** (1): pp 23-29.

Getaneh, T., Assefa, A., and Tadesse, Z. (1997). The knowledge and practice. Bulletin of Jimma Institute of Health Science. 7 (2): pp121-130.

Geyied, A. (1987). Short notes on the micro organisms involved in food microbiology. Pp 8-9 and 38-43 NRIH, Adiss Ababa.

Lee. R.O. and Nieman, D.C.(1996). Nutritional Assessment 2nd ed. pp 392-442 USA.

Gillespie, S.R. and Mason ,J.B. (1991). Nutrition-relevant actions. ACC. Sub Committee on Nutriton. pp: 93-100.

Harpham ,T.,Lusty,T., and Vaughan, P.(1988). In the shadow of the city. Community Health and the Urban Poor. Oxford University Press,Oxford .pp 24-31.

Horner, M.R., Stinton N.L& Pringle D.I. (1981). Malnutrition and associated factors in preschool Miskito Indians in Nicaragua. Ecology of Food and Nutrition. **10:** 213-220.

Jay.J.M. (1986). Modern Food Microbiology, 3rd.ed. **10**: 242-49 VNR, NewYork.

Jembere,T. (1985). A case study of health component in Kebele 41 "Keftegnaa"3. In the shadow of the city. Community Health and the Urban Poor. Pp 153-162, 24-38 Oxford University Press, Oxford.

Ketsela, T., Asfaw, M. and Kebede, D. (1990). Patterns of breast-feeding in western Ethiopia and their relationship to acute diarrhoea in infants. Journal of Tropical Paediatrics. **36**:180-183.

Kielmann,A.A. and Applied human Nutrition Unit (1988). Assessment of the Nutritional Impact of the Wamba Food Security Programme. Unit of Applied Nutrition Departmentt.of Food Technology and Nutrition. pp 31-36.

King, F.S. and Burgess, A. (1993). Nutrition for developing countries. 2nd. ed. **10** 91-96 ELBS/ Oxford University Press.

Madise, N.J. and Mpoma, M.(1997). Child malnutrition and feeding practice in Malawi. Food and Nutrition Bulletin. **18** (2): 190-201.

McLaren, D.S (1981). Nutrition and its disorders. 3rd. ed. pp: 229-242. Churchill Living Stone Medical Text.

Mekonnen, Y., Ayalew,T. and Dejene, A.(1995). Estimation of child mortality in Addis Ababa. Ethiopian Journal of Health Development. **9** (3): 141-145.

Motarjemi,Y. Kaferste, F.G and Queevedo, F. (1994). Complementary foods a hazard for the very young. International Journal of Health Development. **15** (1) WHO, Geneva.

Nancy E.R. (1997). Gender, Power and Population Cange. Population Bulletin. pp 4-6, 12-14.

OAU/UNICEF,(1992). African Children, African Future. Pp: 33-34. Senegal, November 25-27.

Piechulek, H. Aldana, M, and Hassan, N. (2000). Feeding practice and malnutrition in children in rural Bangladesh. Food and Nutrition Bulletin. **20** (4): 395-400.

Simango, C. and Rukure, G. (1992). Survival of enteric pathogens in traditional fermented foods. Journal of Applied Bacteriology. **73**:37-40.

Stuckey, J.(1997). Integrated Holistic Approach Urban Development Project. Nutrition Evaluation Programme pp 1-13.Addis Ababa.

Takyi, E.K(1999). Nutritional status, food consumption and nutrient intake of pre School children in Northern Ghana. Food and Nutrition Bulletin 20(4) UNU.

Tessema,A. and Hailu, A.(1997). Child feeding practice in northern Ethiopia. East African Medical Journal **74** (2) 92-95

Thomas, J.G. (1997). Population and Reproductive Health in Sub-Saharan Africa. Population Bulletin. pp 38.

Tomkins, A., Behrens, R. and Roy, S. (1993). Functional Significance of micronutrients Under nutrition. **52**: 131-142. Proceeding of the Nutrition, Dublin.

Tomkins, A and Waston, F.(1989). Malnutrition and Infection No.5 pp1-9 United Nations Geneva.

Tontisirin, K. and Yambourist (1995). Appropriate weaning practice and foods to prevent Protein energy malnutrition. Food and Nutrition Bulletin. **16**(1): 34-39.

UNDP,(1997) .Third report on the world nutrition situation. pp 7. Switzerland Geneva.

UNICEF, (1997). Malnutrition in South Asia. A Regional Profile United Nation Children fund.No.5 Pp1-4, ROSA.

UNICEF, (1998). The state of the world children. Pp 14-15 Oxford University Press

UNICEF, (1990). Challenges for children and women in the 1990's. pp 19-21.Eastern and Southern Africa Regional Office.

Viteri, F.(1987). Nutrition related health consequences of urbanization. Food and Nutrition Bulletin. **9**(4):33-49.

WHO, 1983 Measuring changes in nutritionaal status. Guidelines for assessing the nutritional impact of supplementary feeding programme for vulnerable groups Geneva.

W.Tensay, Z. and Mengistu, A. (1997). Indigenous weaning foods: Hygiene and diarrhoea disease in rural Ethiopia setting, Jimma Zone. Ethiopian Journal of Health Development.**11** (2): 149-156.

W.Tensay, Z. and Mengistu, A. (1997). Bacterial isolates from indigenous weaning foods in rural Ethiopia setting Jimma zone, Southwest Ethiopia. Ethiopian Medical Journal. **35**: 93-102.

W.Tensay, Z. and Tesfaye, H. (1992). Isolation of enteric pathogen and coliform bacteria from infant feeding bottle content in Addis Ababa, Ethiopia. Ethiopian Journal of Health Development. **6** (1): 1-4.

WHO, (1995). Nutrition. The world declaration and plan of action for nutrition **2**: Switzerland, Geneva.

WHO, (1997). Global database on child growth and malnutrition, Geneva.

WHO, (1998). Complementary feeding of young children in developing countries: A Review of Current Scientific knowledge. Pp 45-106, Geneva.

WHO, (1999). Complementary feeding of young children in Africa and Middle East. pp 59-95, 271.

WHO, (2000). Management of child with a serious infection or sever malnutrition. Geneva, Switzerland.

WHO, (2000). The International Journal of Public Health. **78**. (9): 1117-1126.

World Bank (1996). Improving Women's Health in India. pp, 45-59, 30-31

Yemer, G. (2000). Malnutrition among children in Southern Ethiopia. Level and risk factors. Ethiopian Journal of Health Development.**14** (3): 283-292

Yonas, T., Tezera F, Melake U., Jemal H., and Wondemu T., (1996). Vitamin A deficency : A serious threat in Dodota district in Central Ethiopia. East African Medical Journal. **73** (5): 303-307.

Yusuf, M.E (2000). Nutritional status of preschool children in North Ethiopia. East African Medical Journal. 77 (8) 425-427.

Zewdie W.G. (1993). Experience in solving approaches of the nutrition problem in Ethiopia. Executive food and nutrition programmes in East, Central and South Africa. Experience and practice proceeding of workshop held in Harare 22 August-September. Pp: 51-56

APPENDICES

Appendix 1:Questionnaire

Questionnaire number_____Date of interview_____

Name of interviewer_____

Zone_____Woreda_____ Kebele_____House No _____

Demographic and Socio Economic Information

1. Name of respondent_____
2. Name of House Hold Head_____
3. Indicate in the Table below the entire household residing the household.

S.no	Name	Age		Sex	Rel	R/s	Occ	Mar.sts.	Ethni.	Edu	Tot.inc of HH
		Y	M								

Y=Years, M=Months, Tot.inc= Total income of the Household

Sex
Male=1
Female=2

Relationship to HHH
Husband=1
Wife=2
Children of both=3
Son /daughter of Husband=4
Son or daughter of Spouse=5
Brother /sister=6
Other relatives=7
No family member=8

Education
Illiterate=1
Preschool=2
Primary=3
Secondary=4
College=5
Others=6

Religion
Orthodox=1
Muslim=2
Catholic=3
Protestant=
Others=5

Marital status
Single=1
Married=2
Divorced=3
Widowed=4
Separated=5
Not applicable=6

Occupation
Preschool children=1
Housewife=2
Herding=3
4 Food for work=4
Cash for work=5
Salary employed=6
Ex-solder=7
Gift=8

Ethnic group
Oromo=2
Tigre=3
Gurage=4
Dorzie=5
Wolaita=6
Kembata=7
Others(specify)=8

Occupation
Student=9
Causal laborers=10
Business men=11
Retailers=12
Dependent=13
Others (specify)=14

4. Do you own any of the following?

S.no	Items	Yes	No
1	Radio		
2	Television		
3	Refrigerator		
4	Dish rack		
5	Hang line		
6	Bathroom		
7	Refuse pit		
8	House rental or own		
9	Kitchen garden		
10	Car		
11	Electric clay stove		
12	Others (specify)		

5. Record the type of house roof.

1= grass thatched 2= reeds 3= corrugated iron sheet 4= others (specify)

6. Record the type of floor.

1= mud 2= wooden 3= cemented 4= others (specify)

7. Record the type of wall.

   1= mud 2= wood 3= bricks 4= clay 5= others (specify)

CHILD FEEDING

8. Name of the child_____

9. Date of birth_____

10. Age in months _____

11. Age recorded from

    1= growth monitoring card 2= mothers 3= clinical estimate 4= historical events

12. Sex_____ 1= male 2= female

13. For how long have you breast-fed? 1= 3 months 2= 6 months 3=9 months 4=12 months 5= 24 months 6= others (specify)----------

14. At what age did you start giving complementary diet to your child? _____Months.

15. What type of foods and drinks are introduced and what method of feeding have you used?

Type of dish	Name of ingredients	Method of feeding

Codes for method of feeding

1= spoon
2= bottle feeding
3= hand feeding
4= Cup

16. Does the mother have income generating activity?

1= yes 2= no

17. If yes what is the activity she is involve in?

1=hand crafts 2= domestic labor 3= retailing 4= food for work 5= others (specify)

MORBIDITY AND IMMUNISATION

18. Is the child fully immunised?

1=yes 2= No

19. During the last seven days did your child suffer from any disease?

1= yes 2= No

20. If yes what type of illness he/ she suffered from?

1= Diarrhoea 2= Fever 3= Running nose 4= Cough 5= Vomiting 6= Others (specify)____

21. How did you treat the illness?

1= Traditional 2= ORS 3= Hospital 4= others (specify) _____

22. During the last two weeks did the mother of this child suffer from any sickness?

1= yes 2= No

23. If yes from which illness she suffered

1= Fever 2= Diarrhoea 3= Cough 4= Vomiting 5= others (specify)_____

24. Who take cares of the child when the mother is away from home?

1= Father 2= Sibling 3= Maid 4= Grand mother 5= others (specify)_____

25. Who usually prepares the meal for the child?

1= Mother 2= Grand mother 3= Maid 4= Sibling 5= others (specify)_____

26. Who usually feeds the child?

1= Mother 2= Grand mother 3= Sibling 4= Maid 5= others (specify)_____

WATER, SANITATION AND HYGIENE

27. What type of latrine do you have?

1= Private 2= Communal 3= None

28. Is it in use and clean?

1= Yes 2= No

29. What is your source of water?

1= Tap water in the house 2= Communal tap 3= Tap but purchased from neighbours

4= others (specify)

30. Is it from protected source or unprotected source? _____

31. Do you treat the water before drinking?

1= yes 2= no

32. How much water do you fetch in the last 24 hrs? _____

33. Where do you store your drinking water?

1=Plastic 2= Clay pot 3= Metallic 4= others (specify)_____

34. Do you wash your hand before feeding the baby?

1=Yes 2= No

35. Where do you dispose your refuse?

1= Composite pit 2= Kitchen garden 3= Bury 4=others (specify)

36. Did you feed your child uncooked food?

1= yes 2= No

37. Did you give your child un boiled water?

1= yes 2= No

THE INDEX CHILD FOOD INTAKE: 24-HOUR RECALL

38. Let me know the foods consumed in the last 24 hours in these households, their amounts, ingredients and the amounts served to the child and the left over

Indicate name of the child_____ Serial number_____

Time	Dish	Name of ingredient	Amount of ingredient in the meal	Amount of food served to the child	Amount of food consumed by the child	Amount of food left over
Breakfast						
Snack						
Lunch						
Snack						
Dinner						

39. For each food item, indicate with a check mark the category that best describes Frequency with which you usually eat that particular food item.

Food frequency for the index child. Name of the child _____

S.No	Food item	More than once per day	Once per day	3-6 times per week	Once or twice per week	Once per month or less	Only during holiday	Never
1	Beef							
2	Milk							
3	Faffa							
4	Porridge/atmit							
5	Eggs							
6	Injera/Wat							
7	Potato							
8	Vegetables							
9	Banana							
10	Orange							
11	Bread							
12	Bulla							
Enter other foods not listed that are eaten regularly								

40. Anthropometry of all the index children aged 6-24 months in a household (confirm age from the card)

Household number_____ Date of weighing_____

Child no	Child's name	Sex	Date of birth	Age in months	Weight (0.1 kg)		Height (0.1cm)		MUAC (0.1mm)	

41. Anthropometry measurements for adults in the household

S.no	Parents	Check (x)	Height		Weight		MUAC	
	Mother		1st	2nd	1st	2nd	1st	2nd
	Father							
	Others(if parents are not in)							

Appendix 2: Dietary reference value of Energy for male and female and Protein

Age in months	Energy in K/Cal		Protein in grams
	Male (WHO, EAR)	Female (WHO, EAR)	
4-6	690	645	12.7
7-9	825	765	13.7
10-12	920	865	14.9
13-24	1230	1165	14.5

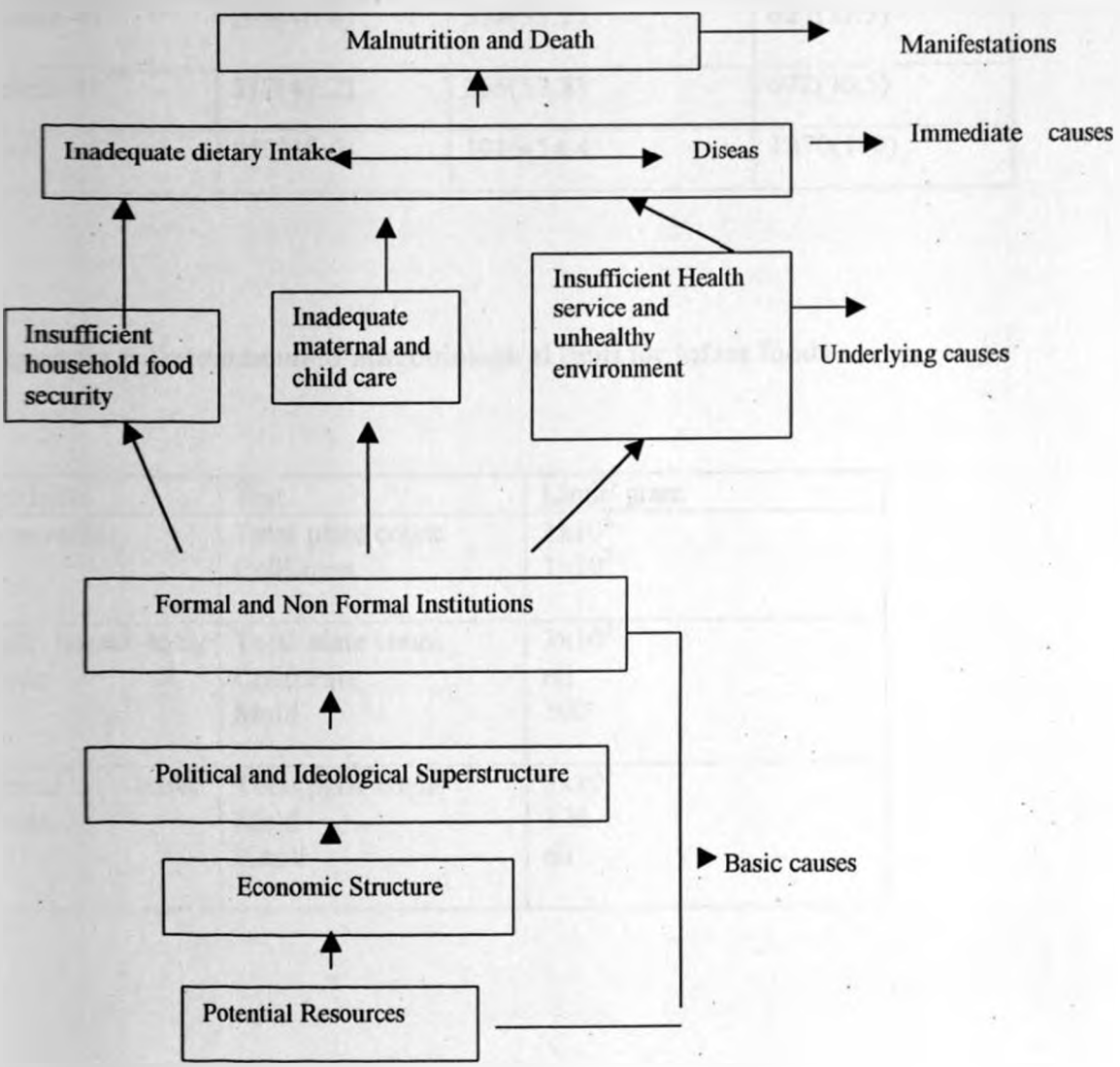
SOURCE: HUMAN NUTRITION DIETETICS, 1993.

Appendix: 3 Dietary reference value of iron and calcium

Age in months	Iron mg/day	Calcium mg/day
4-6	8.5	500
7-12	8.5	600
1-3 years	8.5	400

SOURCE: HUMAN NUTRITION DIETETICS 1993. 10th ed.

Appendix 4: Multiple causes of malnutrition



Appendix 5: Distribution of household population by sex in the study area

Study area	Sex		Total
	Male	Female	
Kebele 40	243(42.5)	328(57.5)	571(30.5)
Kebele 41	293(46.8)	334(53.2)	627(33.5)
Kebele 43	317(47.2)	355(52.8)	672(36.5)
Total	853(45.6)	1016(54.4)	1870(100)

Appendix 6 Recommended microbiological limit for infant foods

Products	Test	Limit/ gram
Cow milk	Total plate count Coliforms	$1x10^6$ $1x10^3$
Milk based baby foods	Total plate count Coliforms Mold	$3x10^3$ nil 300
Cereal based foods	Total plate count Mold E.coli	$3x10^3$ 300 nil

Appendix 7 Recommended microbiological limits for unprocessed child food

Product	Test	Limit	
		Minimum	Maximum
Dietetic foods	Total plate count	10^4	10^6
	Coliforms	10^4	10^6
	Enterobactereacea	10	10^3
Cereal based product	Spore former	10^2	10^4
	Molds	10^2	10^4

Source: ICMSF, 1974 Micro organisms in food University of Toronto

Appendix: 8 Protein intake, by the children in the study area

Age groups (in months)	RDA	Mean protein	Proportion of children met RDA
4-6	12.7	16.9±5.4	92.6
7-9	13.7	18.9±5.8	81.1
10-12	14.9	17.4±4.2	65.7
13-24	14.5	18.4±4.6	79.9

Appendix 9: Calcium and Iron intake of children in the study area

Age groups	Calcium intake			Iron intake		
	RDA	Mean intake	Proportion of children met RDA	RDA	Mean intake	Proportion Of Children met RDA
6	500	386.7	25.9	8.5	10.7±7.3	59.3
7-12	600	406	13.5	8.5	13±3.7	90.4
13-24	400	334	29.7	5	13.4±4.2	99.1

P=0.007 for calcium P=0.000 for Iron Chi square test

Appendix: 10 Malnutrition and infection cycle