Does Dietary Diversity Predict the Nutritional Status of Adolescent in Jimma Zone, South West Ethiopia?

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DOES DIETARY DIVERSITY PREDICT THE NUTRITIONAL STATUS OF ADOLESCENT IN JIMMA ZONE, SOUTH WEST ETHIOPIA?

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Acknowledgments:

LIST OF ABBREVATIONS.

AOR- Adjusted odd ratio.

OR- Odd ratio.

DDS - Dietary Diversity Score

FAO - Food and Agriculture Organization of the United Nations

FFQ - Food Frequency Questionnaire

FSNP - Food Security and Nutrition Policy

GoE - Government of Ethiopia

IDDS - Individual Dietary Diversity Score

JLFSY- Jimma Longitudinal Family Survey Youth.

IFPRI - International Food Policy Research Institute

EDHS - Ethiopia Demographic and Health Survey

MDG - Millennium Development Goals

MUAC - Mid Upper Arm Circumference

NCHS **-** National Centre for Health Statistics

SD - Standard Deviation

SUN-Scale up Nutrition.

UNICEF **-** United Nations International Children's Emergency Fund

VIF - variance inflation factor.

ABSTRACT

Back ground. Dietary diversity is an aspect of dietary quality that indicates general nutritional adequacy.Malnutrition in adolescence is a major public health problem in the world, especially in developing countries leading to low bone mass, disability and reduced ability to learn and work at maximum productivity. There is limited knowledge in the area of dietary diversity and factors affecting adolescents despite evidence showing that adolescent nutrition has important direct and/or indirect consequences. There is no study that documented the association between dietary diversity and nutritional status of adolescents in Ethiopia.

Objective: The study was aimed to assess the association between dietary diversity and nutritional status of adolescents.

Methods: Data for this study were obtained from the baseline of a five years longitudinal survey that conducted in Jimma Zone, Southwest Ethiopia generated by the baseline survey of Jimma Longitudinal Family survey of youth conducted from 2005-2006 after getting permission. Anthropometric and socio-demographic data were captured from 2084 adolescents representing 3700 randomly selected households. Dietary data were collected using food frequency questionnaire spanning a period of one month before the survey. Anthropometric measurements were used to measure mid upper arm circumference, weight and height of the study participants. Bivariate and multivariable logistic regression analyses were used to determine the association between dietary diversity and nutritional status after controlling for potential confounders.

Result: Data from a total of 2084 (1025 female and 1059 male adolescents) involved in the baseline survey were used for this analyses. The overall prevalence of stunting and thinness were 26.1% and 22.3%, respectively.Stunting was higher among female (23.8%) than male (21.9%). while thinness was higher among males (27.5%) than female (25.3%). On multivariable logistic regression model after adjusting for other variables, being from rural area (AOR=0.687, 95% CI=0.514, 0.919), male sex adolescent (AOR =1.981, 95% CI=1.602, 2.449), households food insecurity (AOR =0.774, 95% CI=0.624, 0.958) and dietary diversity (AOR =1.295, 95% CI=1.006, 1.668) were significantly associated with nutritional status of stunting. Whereas, place of residence (AOR=1.678, 95% CI= 1.265, 2.225), households food insecurity (AOR=0.790, 95% CI=0.635, 0.984), and high workloads (AOR=0.666, 95% CI=0.501, 0.884) of adolescents were significantly associated with thinness, respectively.

In conclusion thinness and stunting are prevalent nutritional problems among adolescents and dietary diversity is an independent predictor. The findings reflect socio-demographic and economic characteristics are associated with underweight and stunting.Therefore, programs to support adequate nutrition for adolescents should target improving their dietary diversity to reduce the prevalence of stunting and thinness, especially in the rural areas.

Key words: Nutritional Status, Adolescents, Body Mass Index, Associated Factors; Jimma, Ethiopia.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

1.1 Background

The term adolescents as defined by WHO as the group that includes the persons 10-19 years as well asit is a transition period between childhood and adulthood. It roughly make up of 1.2 billion (20%) adolescents of total population of the world.global adolescent population will increase from 1.2 billion to 1.3 billion from 2010 to 2030(1).

Adolescence is characterized by the growth spurt, a period in which growth is very fast. This period is the second most critical period of physical growth in the life cycle after the first year because it is a time of intense physical, psychosocial, and cognitive developmentand growth spurtthat occur throughout adolescence directly affect nutritional status and nutrient needs.This sudden growth spurt is associated with hormonal, cognitive, and emotional changes that make adolescence a more especially vulnerable period of life (1).While changes in one's lifestyle may affect eating habits and food choices; this is because adolescence is the only time following infancy when the rates of physical growth actually increase maximally.And also adolescent represent a window of opportunity to prepare nutritionally for a healthy adult life.

Increased nutritional needs to adolescents gain up to 50% of their adult weight, more than 20% of their adult height, and 50% of their adult skeletal mass and soft tissue, organs and even red blood cell mass increase in size. Due to it is a time when individuals grow faster than at any other time of life except for their first year, this condition needs energy requirement compared to any age group (~2,420 kcal/day), and protein and micronutrient demands on the body to enable this rate of growth. Hence, Nutrition during adolescence plays an important role in the individual's life (1,2).

Hence, adolescent nutrition is an important for supporting the physical growth of the body and for preventing future health problems as well as a time to prepare for the nutritional demands of pregnancy and lactation that girls may experience in later life (1,2).Adolescence is also challenging for nutrition, even if nutritional vulnerability may not be as great as in infancy and childhood.

Adolescents also exposed to malnutrition problem as well as nutritionally they are vulnerable group for a number of specific reasons, like their have ----eating patterns and lifestyles, risk-taking behaviors and susceptibility to environmental influences.

Africa adolescent population grow much more rapidly than Asia and Latin America (1,3,4)with largest increase occurring in sub-Saharan Africa. The vast majority of adolescents (90%) live in low- or middle-income countries. In some countries, as many as half of all adolescents are stunted and thinned(4)which means their physical and cognitive development has been restricted because of inadequate nutrition.

Adolescents in Ethiopia, also a period of transition for human growth, it is not given any attention during their growth and In Ethiopia, nutritional problems may represent a heavy health burden. Hence, nutrition is a main component of health and development for adolescents(1). This because human health is heavily dependent upon balanced diet which requires diversified diet of adequate quantity. That means lack of dietary diversity has been identified by other studies to be a particularly severe problem among poor populations especially in the developing world (4,32).

Adolescent nutrition is therefore important for supporting the physical growth of the body and for preventing future health problems. For that reason all parents should pay particular attention to the nutritional needs of their teenagers(1,3). This because of during this time, physical changes affect the body's nutritional needs, while changes in one's lifestyle may affect eating habits and food choices.

Therefore, the reason that, inclined to adolescence research is lack of data for policy discourse related to the nutritional problems of adolescents; little program experience; and the shortage of resources-contribute to a critical lost opportunity to strengthen the health, development, and economic progress of nations(4,6). This discussion paper intends to make evidence-based recommendations directed at the health sector to improve the support of health-care providers to nutritional health of adolescents, particularly in developing countries (1). Hence, this study aimed to determine nutritional status of adolescents, dietary diversity and assess the factors that influence the nutritional status of adolescent in Jimma Zone, south west, Ethiopia.

1.2. Statement of problem

Dietary diversity is defined as the consumption of an adequate variety of food group's Human health is heavily dependent upon intake of adequate quantity and quality of food(2,12).

Major reason for focusing on adolescents:

First reason, adolescence is commonly regarded as a relatively healthy period of the life cycle. Certainly, adolescents are perhaps less vulnerable to infection than they were at a younger age. This may contribute to their being somewhat neglected, but also it may mean that there is adolescence less interference with adequate physiological utilization of food nutrients(1,3,4).

Second reason, adolescents is period of a child's life is a unique opportunity to break a range of vicious cycles of structural problems that are passed from one generation to the next (7).As well as they have typically being considered as low risk of poor health and often receive few health care source and little attention from the community. preparing the adolescents for the demands of adolescent nutritional health life that increased enhancing their pre-pregnancy weight especial in girls and stores of nutrients in both girls and boys, thus contributing to improved future adolescents outcome, while preserving the adolescents nutritional status and well-being (7,10).

Vicious interactions between malnutrition, poor health, and impaired cognitive development set children on lower development paths and lead to irreversible changes, hence a non-diversified diet can have negative consequences on individuals' health, well-being and development mainly by reducing physical capacities and resistance to infection(11,12).

Under nutrition is a major public-health problem in the world especial in developing countries those who are in low and middle-income due to most people consumed non-diversified diet(13,14), hence Optimal nutrition during this period of life is therefore crucial(15,16). This because poor nutrition during adolescence will not only affect adult body size, resulting in shortness or thinness, but may also affect the nutritional status of any children born to mothers who were malnourished during adolescence (1). Below the prevalence of under nutrition in some countries are:

Especially Under-nutrition among adolescents is a serious public health problem internationally, particularly in developing countries(4).Global studies shown that, in India and Philippinesthe stunting was highly prevalent in adolescent boys and girls, ranging from 32% to 65%

respectively(17). In another study done in India Bangle rural were found to be 46.6% stunting and 42.4% thinness for and respectively (18).

Few studies in Africa have used the WHO recommended references to assess under nutrition among adolescents. Of those that have, the prevalence of under nutrition among adolescents is in the range of 4-30%, substantially lower than South Asia as well as stunting in 2010 was 38% and has not shown a substantial decreasing trend, this because of population increase(4).

In study conducted in Nigeria shown that, the prevalence of nutritional status of adolescent girls are 10% of rural and 5% of urban girls were stunted while 16% of rural versus s 8% of urban girls could be considered thinned(19). However, these studies did not involve both sex of adolescents which conducted for only girls, but this present study includes both sexes

Within Africa, higher prevalence of under nutrition among adolescents has been found in Ethiopia (27%)(13), Tanzania (21%)(15).Study in Kenyadetermined that 16.6% of their adolescent sample was undernourished. Ethiopia, as the developing country, nutritional problems is one of the major health problems for all stage of human life(21).

Due to food insecurity, the prevalence of being under nutrition among adolescents in Sub-Saharan Africa including Ethiopia is as high as 30% (6). In addition, these few studies suggest that there are more undernourished adolescents in Sub-Saharan Africa and a higher prevalence in rural than in urban areas (20).

Ethiopia is estimated that adolescents represent more than quarter (25.9%) of the total population (15). This significant number of adolescent worldwide and especially developing country where huge number of adolescent resides; deserve to reach and maintain the highest level of health. Ethiopia in sub sub-Saharan countries with the highest rates of malnutrition (2,21). Among population of 85 million 46% are under nourished. One of every four (26%) women of reproductive age suffer undernourishment – twice the Sub-Saharan average of 13.3 % (14).This because of the socio-economic conditions, which is based on small landholder agriculture related with food insecurity encompassing 85% living in rural areas (8,21). Concerning adolescent nutritional status some studies done before in different part of the country has been demonstrate to be high .For example study done on adolescent girl from rural communities in Tigray show highest underweight (27%) and Stunting (26.5%)respectively, helped to close the research gap

in the area, although it is still focused only on rural adolescent girls, on small geographic area and small population(13, 21).Another Study also shown that, childhood under nutrition continues to persist throughout adolescence but little attention has been given to under nutrition of adolescents perhaps for the belief that adolescents are low-risk groups. The available studies focused on factors affecting pregnancy outcomes rather than on problems associated with normal growth and development of adolescents (17,21).

Nutritional difficulties have increasing adverse consequences on adolescents due to malnutrition is the underlying cause of one third of the 7.6 million child deaths each year before their fifth birthday. In addition, chronic malnutrition causes devastating and irreversible damage like: impaired cognitive development and social capacities and also it, poorer educational achievement and human capital formationand also associated with poor developmental achievement in young children(13).

As a transitional period between childhood and adulthood, adolescence provides an opportunity to prepare for a healthy productive and reproductive life. (22). However, the timing and duration of this adolescents development is influenced by a number of factors, by causing different adverse effect in adolescent life including physical activity, diet, Environmental factors, body composition and genetic characteristics (23). Hence, childhood under nutrition continues to persist throughout adolescence but little attention has been given to nutrition of adolescents perhaps for the belief that adolescents are a low-risk group and they may resist the infection.

Even if the fifth Millennium Development Goal (MDG) is to improve maternal health and thus reduce maternal mortality by three-quarters (EMDG), and the fourth goal aims at reducing infant mortality by half by 2015, the latter goal may not be achieved considering that maternal nutritional status contributes a great deal to both. In addition, there is limited information with regard to dietary diversity and its association with adolescent nutritional status in south west Ethiopia which is prone to frequent droughts and thus is highly vulnerable to food insecurity this circumstance leads the adolescents to unexpected nutritional problem. Despite of above facts, there is little information about the nutritional status of adolescents in Ethiopia(23).

There is adequate evidence that little has been made in reducing child malnutrition over the past 17 years in Ethiopia calling for better adolescent nutrition top compensate for the poor growth

accrued since childhood. However, nutritional status of adolescents have not been studied in detail and there is still little information about the nutritional status of adolescents whether dietary diversity can make a difference a solution(22,24). The for adolescent nutrition has little information that can influence policy maker's interest related to the nutritional problems of adolescents although recently school based nutrition and health program has been considered in the revised national nutrition program of Ethiopia (4).Even though programmes to support adolescent nutrition are lagging behind the international call for focus on this area and the general increase in attention on nutrition nationally and internationally(7,8).

The SUN intervention program also in Africa including Ethiopia participated where plans were available, fewer than half. Only seven (Bangladesh, Benin, Ethiopia, Guatemala, Madagascar, Mozambiqueand Nepal) included support for adolescent nutrition,or improving adolescents' nutrition status as partof a strategic objective or result to achieve MDGs1 goal(4,23).

In Ethiopia there is no progress has been made in reducing children malnutrition over the past 17 years, this because of undernourishment of children has been well documented, but concerning the nutritional status of adolescents have not been studied in detail and there is still little information about the nutritional status of adolescents in Ethiopian despite of above facts(7,25).Evidence showed that the reason for suffering of adolescent nutrition is may be low policymaker interest in the nutritional problems of adolescents; little program experience (adolescents nutrition program not included in NNP for screening and interventional purpose) and the shortage of resources-contribute to a critical lost opportunity to strengthen the health, development, and economic progress of nations (6,9).

There could be several underlying and basic causes for the Nutritional Status problem; some of which could be due to One way to break integration cycle of nutrition problem by improve adolescents nutrition and others related factorsbut, if it is not broken will go on resulting in more and more severe consequences (4).

Evidence also shows that food insecurity is associated with poor development and morbidity in children and poor subsequent dietary habits in adolescents (22,26). Drought, civil war and political instability are also the major contributing factors (8,24). There could be several underlying and basic causes for the nutritional status problem; like low agricultural production,

low and inadequate food consumption, disease (lack of access to health services) and falling gross national product per capita. Drought, civil war and political instability are also the major contributing factors (20,27). Thus, this study aimed to determine nutritional status of adolescents and its association with dietary diversity in Jimma Zone, south west, Ethiopia.

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview

Globally, hunger and malnutrition are two of the most significant challenges(1).Malnutrition is a risk factor for illness and death withmillions of pregnant women and young children being affected due to infections, poor andinadequate diet; it increases the risk and worsens the severity of infections(27).Adolescents are most affected bymalnutrition as they have increased nutritional needs to support healthy growth(3,4).A few studies conducted in some countries to determine adolescent nutritional status and identified factors influencing nutritional status of adolescent. This literature review contains Determinants of dietary diversity to nutritional status of adolescent of the study participants that include socio-demographic and economic factors, Health status related factors, HH factors, dietary related factors.

2.2 Socio-demographic and economic related factors.

Socio-demographic and economic related factors are the most known determinants associated with the nutritional status of adolescent: age, sex, residence, education status, family income, adolescent workload …etc.

The study done in India Bangle showed that, the highest prevalence of stunting was observed among boys of 17 years (63.6%) and among girls of 15 years (70.0%) and thinness was found among boys (53.1%) than girls (32.0%)(18).A study done in Nepal showed that, allowing comparisons of boys and girls, there was twice as much under nutrition in boys as in girls (28).A study done in Bangladesh showed that, the lower educations of adolescent girls were more likely to be stunted than their counterpart youth(29). In this study the nutritional status of boys was not assessed. Across sectional studies conducted in Kenya showed that, more adolescent boys were stunted than adolescent girls(30).A study conducted in Burkina Faso showed that, stunting rate was higher in boys than girls (8.8% of girls and 9.4% of boys) respectively and in peri-urban than urban(31).A study conducted in Nigeria Abeokuta showed that, when the age increased adolescent boys were more stunted than girl (19).

Some studies done in five countries below showed that, the rural school children in low income countries (Ghana, Tanzania, Indonesia, Vietnam and India) found the overall prevalence of stunting to be high in all five countries, ranging from 48 to 56% (32). A study done in Debre

Markos Amhara Regional State, Ethiopia shown that, adolescents living in rural areas were had high rate of stunting(25). A cross-sectional study conducted on nutritional status of adolescent girls in Tigray, Northern Ethiopia show that, age was strong predictor of stunting and thinness (21). However, this study conducted the only nutritional status of adolescent girl as well as small portion of population; hence this present study may assess both sexes. A cross-sectional study conducted in Jimma Zone, South West Ethiopia showed that, most of the stunted adolescents were males (67%), reside in rural (43%) than urban(20). A study conducted in Jimma zone shown that, male adolescent were more likely (16%) have low stunted than females adolescent (12%) (20). Another cross-sectional study conducted in Bedelle, South West Ethiopia shown that, when increase in family size, decrease in nutritional status in adolescent girls(25).

2.3 Environmental and Health related factors

Health status related factors are the most known determinants associated with the nutritional status of adolescents. Cooking place, availability of toilet, drinking of water source are some of the factors that are possibly associated with nutritional status.

Study done in Bangladesh showed that, prevalence morbidity like: fever (17%) and diarrheal diseases (3%) among adolescent girls (33).A cross sectional study done in Bedelle south west of Ethiopia showed that, 20.4% of respondents experienced diarrheal disease in the last two months. However, this study also assessed only nutritional status of adolescent girls, and did not show the association between dietary diversity and nutritional status of adolescents (25).

2.4 Dietary related factors

Dietary related factors are the most known determinants associated with the nutritional status of adolescent.

A cross-sectional study conducted on adolescent in Tehran showed that, 50% of adolescents had Dietary Diversity scores ≥ 6 (34).A study done in Nepal children showed that, fed complementary food less than four times a day were 3.60 times more likely to be malnourished than their counter parts(28).A study conducted in Kenya on adolescent girl showed that, stunting was positively correlated with the socio economic status.However, that this paper not consider about boy nutritional status(30).

9

2.5 Households factors:

Household's factors are the most known determinants associated with the nutritional status of adolescent.Like: Household food insecurity,adolescent food insecurity and adolescent workload.

A cross sectional study conducted in Bangladesh shown that, household food insecurity was a significant determinant of adolescent under nutrition in the form of stunting, underweight and wasting (33).A cross sectional study done in sir Lankashown that, 43% of adolescents were thinness because of household food insecurity(14).A study done in sir Lanka shown that, 14% of adolescents were stunted because of household food insecurity(14).Another studies result from eight different countries of Asia and Africa shown that, household food insecurity was the significant determinants of adolescent nutritional status in the form of stunting and thinness (35).A study done in Mali showed an inverse relationship between measures of workloads and female adolescents' nutritional status(36).A study conducted in Kenya revealed, severe food insecurity to be strongly associated with stunting in adolescent(30).A cross sectional study done in Dollo Ado district, Somali region showed the level of children under nutrition in the country was 42.3% wasting, 34.4% stunting, and 47.7% underweight showed the level of children under nutrition in the country this due to household food insecurity(5).

1.3. Significance of the study

Malnutrition is widely spread problem affecting people who are found in all corners of the world, including both the developed and developing countries. But the problem is mostly prevalent in developing countries like Ethiopia, even though many governmental and nongovernmental organizations are striving to decrease the prevalence.Problem of malnutrition is currently existing problem. Prioritizing one extreme of malnutrition over the other is difficult on limited budget. But under nutrition continues to be the main focus of research health care spending.

For a number of years, the health of adolescents has not been a major concern and research has consequently been limited, as they are believed to be less susceptible to disease and suffer from fewer life-threatening conditions than children and elderly people. Adolescent nutrition receives very little attention and difficult to quantify accurately in this age group due to rapid change in

growth and development and lack of consensus over which definition to use. Problem of malnutrition needs collaborative effort planners, policy makers and the community at large(16).

Therefore findings of this study will contribute baseline data on the issue and will prompt support and promote cooperation among the different stakeholders towards the initiation of a sustainable nutrition and health promotion program for adolescents in this study area.

2.6. Conceptual framework

Many studies in different parts of the world reviewed that adolescent nutrition in general are affected by different factors. For this study according to the literature review the main factors are identified as socio-demographic & economic factors, household and health related factors, related factors, and dietary related factors. It helps to summarize the determinant factors and analyse the association between dependent and independent variables.

Figure 1:-Conceptual frame work of dietary diversity to Nutritional status synthesized by the author based on different literature review that concerned adolescent UNICEF (2008) and Black et al. (2013) (4.8).

CHAPTER THREE: OBJECTIVE OF THE STUDY

3.1. GeneralObjectives

- The general objective of this study was to assess nutritional status and its association with dietary diversity of adolescents in Jimma Zone South West, Ethiopia.

3.2.The specific objectives

- To determine the nutritional status of adolescents in Jimma Zone southwest Ethiopia
- To determine the association between dietary diversity and nutritional status of adolescents after controlling for confounders.

CHAPTER FOUR: METHODOLOGY

4.1 Study area and period: The study was conducted in Jimma zonewhich is one of the 18 zones found in oromiya region, having a total of 17 woredas and two town administrations.

The study was conducted in Dedo, Manna and Kersa Woredas of Jimma zone.Jimma zone representing the different agro ecological areas such as vegetable growing, coffee growing and cereal growing areas respectively.

4.2 Study Design.A community-based cross-sectional analysiswas conducted from September 2005 to March 2006 data set. The data set from September 2005 to March 2006 is the one of comprehensive longitudinal survey of adolescents conducted in Jimma zoneas part of demographic and Health Surveys project.

4.3Population

4.3.1 Source of population:

The source population was all adolescents in the specified age groups residing in the study Woredas during the data collection period.

4.3.2 Study population:

Adolescents in the specified age group randomly selected into the baseline survey.

4.4. Inclusion and exclusion criteria

4.4.1.Inclusion criteria:

Adolescents who have permanent residence (live for more than 6 months) in the study area having apparently healthy adolescent from 13-17 years old, with no disability were included in to the study at the time of survey.

4.4.2. Exclusion criteria:

As this report is based on secondary data analyses, adolescents in the sample with missing values and with incomplete data were excluded.

4.4.3. Sampling Procedure

Data for this study were obtained from a longitudinal survey of adolescents enrolled in the first round of the five year longitudinal study of adolescents conducted in Jimma zone, Southwest Ethiopia. A census was done to generate the list of all households which gave a sampling frame for random selection of 3,700 households from the total of 5,795 households in the list. A two-stage sampling plan was used to select the target sample of adolescents. Households were classified into urban (Jimma city), semi urban (Mana, Dedo, and Yebbu towns), and six rural communities in the vicinity of the small towns.

At the first stage, households were randomly sampled with the sample size in each kebele determined by the relative proportion of the study population in the kebele and the overall target sample size. In the second stage, one adolescent (a boy or a girl) was randomly selected from each household. Using this sampling strategy, a total of 1059 boys and 1025 girls were interviewed in round one. For this particular study all the 2084 adolescents in the first round of the five-year longitudinal Family survey of youth were included.

4.5 Study Variables and Measurements

4.5.1 Dependent variable

Adolescent Nutritional Status (Thinness and stunting).

4.5.2. Independent variables

- Age.
- Sex.
- Residence.
- Family size.
- House Hold income.
- Mother educational status.
- Father educational status.
- High workload of adolescent.
- Dietary diversity.
- General health.
- Drink source of water.

- Cooking of place.

- Availability of Toilet.

- House Hold food insecurity.

- Adolescent food insecurity.

- Highest grade completed by the adolescents

- Female household headed.

4.6. Data collection: Structured adolescent level questionnaires were used to collect data. The questionnaires were interviewer-administered and translated into Amharic and Oromifa languages and checked for consistency by another person who speaks both Oromifa and English. The questionnaire focused on issues related to adolescents' experiences of nutritional status, socio demography and economic, environmental related factorsand Food insecurity and anthropometric measurements of the adolescent. The interview was conducted in a private place by an interviewer of the same sex.Each data collector was interviewed to obtain information on demographic and socioeconomic characteristics of the adolescent's family.

4.7. Data quality control: The interviewers received one week of intensive training prior to the pretest and an additional week of training was given with the final version of the questionnaire before the start of the actual interviews. Supervisors checked the data collection process and filled questionnaires daily to ensure accuracy of the data.

Supervisors kept track of the field procedures and checked the completed questionnaires every day to ensure accuracy of the data collected and the research team supervised the data collection team every week.

Dietary diversity was assessed using a food frequency questionnaire containing food items that are commonly consumed in the study area. The list of food items was developed based on an extensive interview of the data collectors who are from the study area and who knew the culture and language and key informants in the study area on the types of foods commonly consumed. The food frequency questionnaire was pre-tested on 200 adolescents selected from a community in Jimma city (not included in the sample)and the food items commonly consumed in the area and the patterns over the week days observed during the pretest were used to refine the food frequency questionnaire.

Given the large variation of dietary habits in the local community over the days of the week, the consumption of each food item per day was not taken as a cut-off point to define consumers. Rather, adolescents were coded as a ''consumer'' of a food item if they had consumed the food item at least once per week (6,8).A Dietary Diversity Score (DDS) was constructed by counting the intake of the food groups over a period of one week based on the definition that it is the sum of food groups consumed over the reference period. For example, an adolescent who consumed one item from each of the food groups at least once during the week would have the maximum DDS. (6).The DDS was converted into tertiles and the highest tertile was used to define ''high'' dietary diversity score, while the two lower tertiles combined were labeled as ''low'' dietary diversity score.

4.7.1. Anthropometric measurements:

We measured height to the nearest 0.1 cm using a stadiometer (SECA, Hannover, Germany) and weight to the nearest 0.1 kg using digital scales (SECA).

The data were used to calculate: height-for-age, of respondents. The weight was measured using portable standing scale. It has ability to measure weight from 0 to 150 Kg. The weight was recorded to the nearest 0.1 kg. It was calibrated against known weight regularly. During the procedure the subjects have worn light clothes and bare foot. Height in cm was marked on a wall with a help of a measuring tape. All girls was measured against the wall without foot wear and with heels together and their heads positioned and eyes looking straight ahead (Frankfurt plane) so that the line of vision was perpendicular to the body and wood scale was brought down to the top most point on the head(1). The height was recorded to the nearest 0.1cm. The same measurer was employed for a given anthropometric measurement to avoid variability. The level of stunting (height for age *z*-scores), which is an indicator of chronic malnutrition, and thinness (BMI for age *z*-scores), which is another indicator of malnutrition, were calculated using WHO Athro-Plus software**(7).**Both HAZ and BAZ score of individuals or nutritional survey was calculated by using WHO AnthroPlus Software for assessing growth of the world's children and adolescents. Thus, those below -2 standard deviations of the NCHS median reference for height-for-age and weight-for-height were defined as stunting(5).

4.8. Data processing and Analysis.

Data were entered into Epi Info version 3.5.1 then exported to and analyzed by using SPSS for Windows software (version 16.0). Analyses of data were done using step wise bivariate for identify candidate variables and multivariate logistic regression to observe the effect of independent variables on the dependent variable by controlling confounders. Statistical significance was evaluated at 95% levels of significance or p-value <0.05 in logistic regression result was considered as associated factors for stunting and thinness.

Descriptive statistics is used to describe the finding after analyses by using figures, percentages, and frequency tables. For continuous variables normality was checked.

2.9. Ethical clearance

The study obtained ethical Clearance from the Ethical Review Board of Jimma University Ethiopia and Institutional Review Board (IRB) of Brown University USA.

4.10. Dissemination plan

Findings of the study will be submitted to Jimma University, College of public health and Medical science, Department of population and family health, it will be also presented to Jimma University. The report will be submitted for publication on a scientific Journal.

4.11. Strength of the study

The study large sample size representative sample as the sampling strategy was random.

4.12. Operational Definitions

Dietary diversity scores: in the study was created by summing up the number of food groups consumed over one month period before the survey. A Dietary Diversity Score (DDS) was constructed by counting the intake of the food groups over a period of one week based on the definition that it is the sum of food groups consumed over the reference period. For example, an adolescent who consumed one item from each of the food groups at least once during the week would have the maximum DDS. Adolescents were asked whether they had consumed a food item over the reference period of month. The responses were recorded as per day, per week and per month.Later on all the responses were changed into per week based on the definition that a

consumer is considered if he/she had consumed a particular food group over a period of one week.

Familysize: refers total number of people living in a house during the study period.

Income: It is periodical monthly earning from one's business, lands, work, investment etc.

Malnutrition: in the study is defined in this case as stunting (height for age Z-score< -2) and thinness (BMI for age Z-score <-2).

CHAPTER FIVE: RESULTS.

5.1. Socio-demographic characteristics of the study participants

All of 2084 participants interviewed in the study the study sample which constituted 1059 (50.8%) boys and 1025 (49.2%) girls with mean age of 14.78 years and a standard deviation of 1.34.Regarding place of residence, majority of the respondents 793 (38.1%) were living in rural area. concerning educational background of their parents father and mother, their educational status had no 603 (28.9 %) and 1179 (56.6 %) were mothers and fathers respectively. The mean (±SD) age of the adolescents, highest grade completed, household Income, and household size of the adolescents were 14.78 (±1.34), 5.16 (±2.66), 105.77 (±188.13), and 8.49 (±3.42) respectively for nutritional status of adolescents (Table1).

Table 1: Socio-demographic characteristics of study samples of adolescents in Jimma Zone south west, Ethiopia, October, 2015 (n=2084).

Variables	Category	Frequency (n=2084)	Percent %)
Residence	Urban	734	35.2
	Semi-urban	557	26.7
	Rural	793	38.1
Sex	Male	1059	50.8
	Female	1025	49.2
Mother's educational status	No education.	717	34.4
	Primary education.	918	44.1
	Secondary education.	317	15.2
	College and above	132	6.3
Father's educational status	No education.	603	28.9
	Primary education.	655	32.5
	Secondary education.	559	26.8
	College and above	267	12.8
Age in years mean (±SD)	14.78 (±1.34)		
Household income mean (±SD)	105.77 (±188.13)		
Household size mean (±SD)	8.49 (±3.42)		
Highest-grade completed mean (±SD)	5.16 (±2.66)		

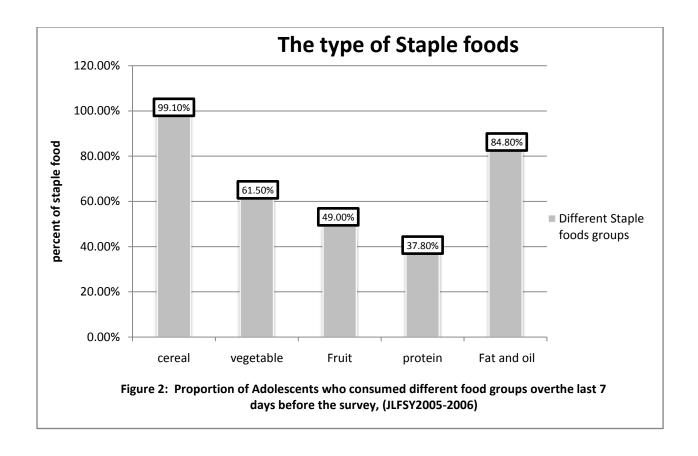**Householdsand Environmental and health related characteristics of respondents.**

From total study participants nearly half824(39.4%)ofhouseholds were food insecured. While 1260 (60.1%) of households were food secured. About 287(14.8%) of the respondents were using unprotected water. Concerning general health only 139 (6.7%) of the respondentshad poor to bad health status. Nearly half 881 (42.3%) of the adolescents were used open filled disposal system.Regardingavailable toilet use majority 1848 (88.7%) of the respondents had not have their own of toilet,only 236 (11.3 %) of respondents had their own available toilet. Concerning high work load of adolescents, majority 400 (80.8%) of respondents had high work load in their house, this condition may affect the feeding habit of adolescents because most of time they may skip their meal (Table2).

Table 2: Households status and Environmental health related characteristics of study samples of adolescents in Jimma Zone south west, Ethiopia, October, 2015 (n=2084).
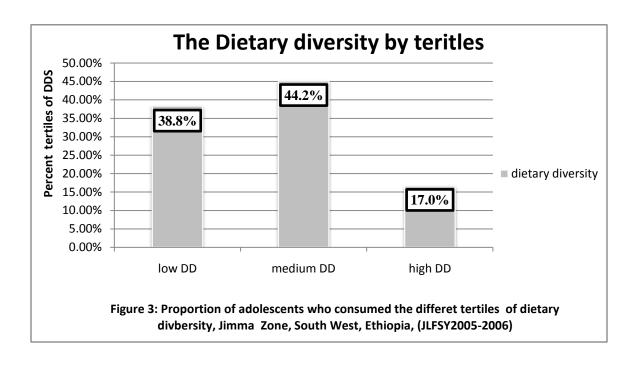
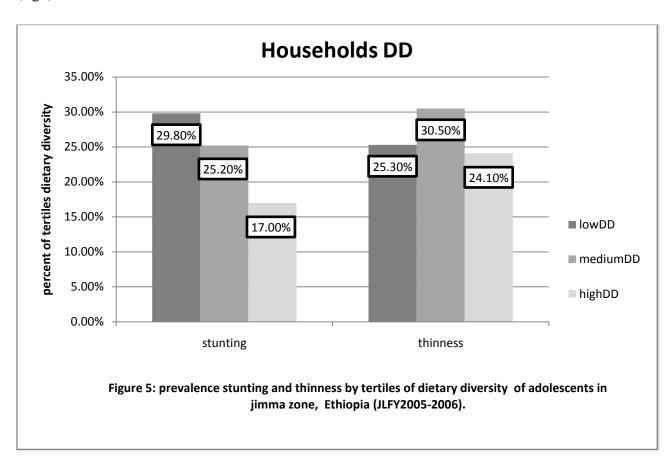| Variables	Category	Frequency (n=2084)	Percentage (%)
Adolescent food insecurity	Secure	1656	79.5
	insecure	428	20.5
House hold food security	Secure	1260	60.5
	Insecure	824	39.4
General health	Good to very good	1945	93.3
	Poor to bad	139	6.7
Garbage	proper	1203	57.7
	Open filled	881	42.3
Sources of water	Unprotected source	287	14.8
	Tap or protected spring	1797	85.2
Cooking place	With Sleeping room	305	14.6
	Kitchen connected to living room	386	18.5
	Separate place	1393	66.8
Available toilet	Yes	236	11.3
	No	1848	88.7
High work load of adolescent.	Yes	1684	80.8
	No	400	19.2
Female households headed	Yes	388	18.6
	No	1696	81.4

Dietary Diversity of the Adolescents.

In this study,majority 2065 (99.1 %) of the respondents reported that their staple food were preparing fromcerealsfood group like (teff, wheat, Barley and sorghum)which was predominant staple food group and consumed it as an integral part of the main meal, about 1767 (84.8%) of the respondents were consumed fats and oils which was second predominant staple food groups as next from cereal foods. Vegetablesalso another staple food groups, Over 1282 (61.5%) of the respondents were consumed vegetables and 1021(49.0%), 788 (37.8%) of

respondents were consumed fruit and protein respectively (fig2).

The type of Staple foods

Figure 2: Proportion of Adolescents who consumed different food groups overthe last 7 days before the survey, (JLFSY2005-2006)

Regarding the proportion of households dietary diversity, the study participants had large difference between low tertiles of dietary diversity and high tertiles of dietary diversity,in this study about 354 (17.0%) of respondents had high dietary diversity, while the remaining 808 (38.8%) of the respondents had low dietary diversity, this indicatethe majority study participants were found in low dietary diversitygroups, hencethey are more likely risked for nutritional problem as compared to counterpart. However, the medium (44.2%) DDs tertileshave high percent of respondents which includein low DD tertilesbecause DDs<6(Fig3).

Figure 3: Proportion of adolescents who consumed the differet tertiles of dietary divbersity, Jimma Zone, South West, Ethiopia, (JLFSY2005-2006)
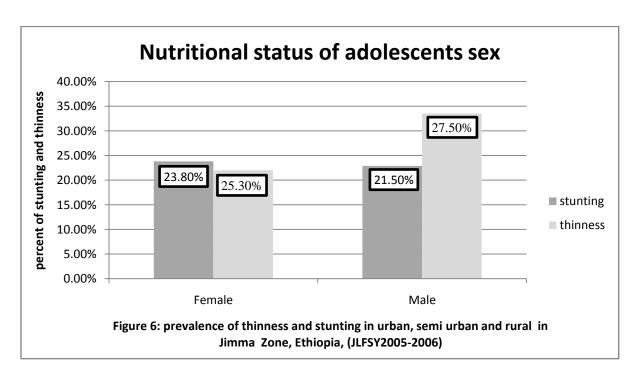
Regarding to their dietary diversity, from those who had high dietary diversity of adolescents 17.0% and 24.1% of respondents were nutritional stunted and thin respectively. Whilefrom those who had low dietary diversity of adolescents 29.8% and 25.3% of respondents were nutritional stunted and thin respectively. This indicates that, the nutritional problem both stunting and thinness are high in low dietary diversifiedadolescents.Therefore, low dietary diversity adolescentswere more likely exposed tounder nutritionthan high dietary diversity adolescents. (fig4).
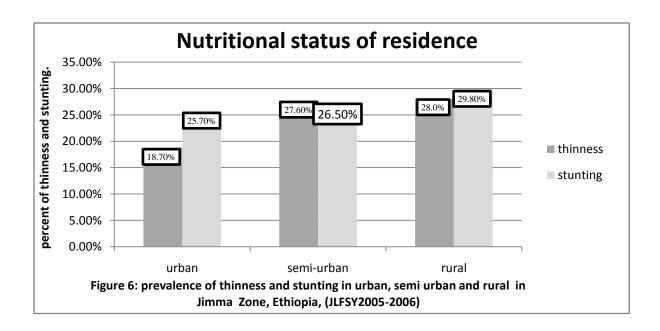

Figure 5: prevalence stunting and thinness by tertiles of dietary diversity of adolescents in jimma zone, Ethiopia (JLFY2005-2006).

Nutritional status of respondents.

The mean (±SD) of height, weight, stunting (HAZ) and thinness (BAZ) of the respondents were 132.41 cm (±56.48), 43.3 kg (±8.8), 23.2 cm (±1.9) and 19.8 kg/m2 (±2.0) respectively. This study was found that, the overall prevalence 575 (26.1%) of respondents were nutritional stunted and 525 (22.3%) of respondents were nutritional thin.This present finding showed that presence of high prevalence of adolescent under nutrition in the study communities and that also an alarm for intergenerational effect of malnutrition among adolescent.The Possible reason may be due to differences in socio-economic, cultural influence, educational, feeding habits, and environmental factors. From this present finding 27.5% males of adolescents and 25.3% female of adolescents were nutritional thin respectively, this finding indicates males of adolescents were more thinness than from those female adolescents.This could be attributed to socio cultural influence; at the early age parents give priority care for boys than girls. While about 23.8% of female and 21.5% of male adolescents were nutritional stunted respectively, this finding indicates female adolescents were more likely stunted as compared to male. This could be attributed the parents give priority care for boys than girls. However, when the child becomes older, girls were culturally involved in the cooking of family-food and they had access to food. So girls have better nutritional status as compared to boys (Fig6).

Figure 6: prevalence of thinness and stunting in urban, semi urban and rural in Jimma Zone, Ethiopia, (JLFSY2005-2006)

In figure below, about 28.0%of rural adolescents were nutritional thin; this indicates adolescents who live in rural area were more risk for thinness thanfrom the counter parts of residence adolescent's. While about 29.9% of rural adolescents were nutritional stunted, this indicates being the rural residence adolescents more exposed for nutritional stunting and thinness than urban residence adolescents(Fig6).

Nutritional status of residence

Figure 6: prevalence of thinness and stunting in urban, semi urban and rural in Jimma Zone, Ethiopia, (JLFSY2005-2006)

Factors Associated with nutritional status of respondents

In below table, family size, households food insecurity, dietary diversity (p<0.05) were associated factors for nutritional status of thinness. On average, 24% of the thin and stunted adolescents did not secure their food in households in the study area.While households food insecurity, dietary diversity and adolescent high work load (p<0.05) were significantly associated with stunting.

Stunting wassignificantly lower among males than female across all age groups (P/0.001) (P<0.001). However, thinness is greater in male than female in all age groups sex of adolescent P > 0.05), thisindicatethe risk of thinness was significantly higher for adolescent males than female.The possible reason may be this may be because of the fact that biological, behavioral, and sociocultural mechanisms have been proposed for the gender differences in morbidity and mortality (Table3).

Table3. Associated Factors with thinness and stunting among adolescents in Jimma zone south west, Ethiopia, (JLFSY2005-2006) (N=2084).

Variables	Category (n=2084)	Thinness (%) (BAZ<−2)	P-value	Stunting (%) (HAZ<−2)	P-value
Residence	Urban	18.7		25.7	
	Semi urban	27.6	P=0.001	26.5	P =0.001
	rural	29.9		29.9	
Sex of adolescent	Male	27.5	P=0.307	22.9	P =0.001
	Female	25.3		23.8	
Household food insecurity	Secure	28.1	P=0.05	24.7	P =0.044
	Insecure	24.3		29.5	
adolescent food insecurity	Secure	19.3	P=0.188	23.3	P =0.056
	insecure	23.8		20.5	
Dietary diversity	Low	26		30	
	Medium	71	P=0.243	70	P =0.029
	High	25.4		24	
High Work load of adolescents	No	24.4	P=0.821	26.1	P =0.05
	Yes.	29		34.8	
Age in years (±SD)	14.68 (±1.34)		P=0.001	14.68 (±1.34)	P=0.001
Household income (±SD)	105.77 (±188.13)		P=0.686	105.77 (±188.13)	P=0.539
Household size (±SD)	8.49 (±3.42)		P=0.021	8.49 (±3.42)	P=0.166
Highest grade completed (±SD)	5.3 (±2.66)		P< .001	5.16 (±2.66)	P 0.001

Food insecure adolescents were more likely to have low dietary diversity as compared to food secure adolescent(P=0.0001)this indicate that, food insecure adolescents are at high risk of multiple nutrient deficiencies due to lack of balanced diet as compared to food secured adolescents. Dietary diversity had statistical significant association with place of residence (p=0.0001), being urban adolescents having better dietary diversity than rural adolescents. There was a significant association between dietary diversity scores and level of education of their mothers (p<0.05), this indicating, the adolescents of educated mothers have better dietary diversity than those of non-educated mothers for their adolescents care provision. Adolescents with high work load had statistically significant association with dietary diversity (p<0.05), indicating that high work load of adolescents exposes them to low dietary diversity (Table).

Table 4: Associated factors of nutritional status with Dietary diversity among adolescents of Jimma zone, south west of Ethiopia, (JLFSY2005-2006) (N=2084).

Variables	category	Dietary diversity (DD)			X2	df	P-value
		Low (n=807)	Medium (n=925)	High (n=352)			
Age in years	12	1			15.95	10	0.101
	13	35.4	47.4	17.2			
	14	37.2	46.3	16.5			
	15	37.6	43.4	19			
	16	46.4	39.6	14			
	17	38.1	44.5	17.4			
Residence	Urban	16.9	16.1	67	4.53	4	0.0001
	Semi-urban	22.7	58.3	19			
	Rural	23.1	61.5	15.3			
Sex of adolescents	Male	38.4	41.9	19.7	0.234	2	0.889
	Female	39.2	43.9	16.9			
Educational status	No education	34.7	52.3	13	31.25	8	0.0001
	Primary education.	46.1	36.4	17.5			
	Secondereducation.	45.8	39.9	14.5			
	College and above	42.5	38.8	18.8			

Households	secure	39.8	46	14.2	16.4	2	0.0001
food insecurity	insecure	37.1	41.9	21			
Adolescents	Secure	39.1	43.8	17	2.44	2	0.295
food insecurity	insecure	34.9	49.1	15.9			

Results of Multivariate logistic regression on factors associated with stunting in adolescents of Jimma zone (JLFSY2005-2006) (N=2084).

Bivariate and multiple logistic regression analysis were applied to identify the risk of thinness. As showed on Table6 below, adjusting the confounder variables through multivariate logistic analysis.

After adjusted binary logistic regression analysis, place of residence (AOR =0.687, 95% CI=0.514, 0.919), sex of adolescents (AOR =1.981, 95% CI=1.602, 2.449), households' food insecurity (AOR =0.774, 95% CI=0.624, 0.958)and dietary diversity score (AOR =1.295, 95% CI=1.006, 1.668)were statistically significant withstunting. Being rural adolescents were0.687 times more likely to stunted as compared than those in urban adolescents (AOR =0.687, 95% CI=0.514, 0.919) at p value less than 0.05. Similarly, it has also statistically significance association at sex of adolescents in which female adolescents were nearly two times more likely to stunted as compared than from males adolescents (AOR =1.981, 95% CI=1.602, 2.449) at p value less than 0.05 (Table5).

Table 4: Bivariate and multivariate logistic regression table for stunting of Jimma zone south west, Ethiopia,

 (JLFSY2005-2006) (N=2084).

Variables	Nutritional status by stunting Status.							p-value
	Category	Stunted		OR	95% (CI)	AOR	95% (CI)	
		Yes	No					
Residence	Urban(ref)	147	408		1		1	
	Semi urban	203	529	0.939	(0.732, 1.204)[a]	0.93	(0.707, 1.223)	0.157
	rural	194	477	0.933	(0.840, 1.337)[b]	0.687	**(0.514, 0.919)***	**0.035**
Sex of adolescent	Male(ref)	214	759		1		1	
	Female	330	655	0.556	(0.546,0.786)[b]	1.981	**(1.602, 2.449)****	**0.0001**
Household food insecurity	Secure(ref)	198	560		1		1	
	Insecure	346	854	0.873	(0.711, 1.071)[a]	0.774	**(0.624, 0.958)***	**0.025**
adolescent food insecurity	Secure (ref)	45	160		1		1	
	insecure	499	1254	0.707	(0.500, 1.000)[a]	0.655	(0.457, 0.937)	0.055
Dietary diversity.	Low (ref)	203	578	1.267	1		**1**	
	medium	92	241	0.920	(0.918, 1.482)[a]	1.324	(.994, 1.765)	0.067
	High	249	595	0.912	(0.814, 1.451)[a]	1.295	**(1.006, 1.668)***	**0.008**
High work load of adolescents	No (ref)	116	315		1		1	
	Yes.	428	1099	0.946	(0.946, 1.203)[b]	1.316	(0.987, 1.754)	0.065

Note: *-significant results

1-reference category.

Statistical significant (*p≤0.05)

Highly significant (**p≤0.001) **p≤0.001, *p≤0.05[b], p≤0.25[a]

Results of multivariable logistic regression on factors associated with thinness in adolescents of Jimma zone (JLFSY2005-2006) (N=2084).

In adjusted binary logistic regression analysis, high workloads of adolescents, place of residence and household's food insecurity were statistically significant with nutritional status of thinness. High workloads of adolescents were 0.698 times more likely thin than from those not had high high workloads of adolescents in their house (AOR =0.698, 95% CI=0.635, 0.984) at p value less than 0.05. Similarly, residence of adolescents were statistically significance association withnutritional status of thinness, rural adolescents were nearly three time thin than urban adolescents(AOR =1.178, 95% CI=1.265, 2.225) at p value less than 0.05 (Table6).

Table 5: Bivariate and multivariate logistic regression table for thinness of Jimma zone south west, Ethiopia (JLFSY2005-2006) (N=2084).

Variables	Category	Thinness Yes	Thinness No	OR	95% (CI)	AOR	95% (CI)	p-value
Resident	Urban(ref)	122	610		1		1	
	Semi urban	174	494	0.568	(1.687, 2.870)[b]	1.664	(1.266, 2.189)	0.056
	rural	169	384	0.8003	(1.358, 2.284)[b]	1.678	**(1.265, 2.225)****	**0.0001**
Mother educational status	No education(ref)	21	111		1		1	
	Primary education	72	263	0.691	(0.909, .386)[a]	0.901	(0.667,1.218)	0.520
	Secondary education	74	254	0.931	(0.589,1.056)	0.936	(0.690,1.271)	0.607
	College and above	298	858	0.839	(0.348,0.919)	0.681	(0.413,1.123)	0.122
Household food insecurity	Secure(ref)	166	588		1		1	
	Insecure	299	900	0.85	(0.684, 1.055)[b]	0.79	**(0,635, 0.984)***	**0.015**
adolescent food insecurity	Secure (ref)	44	178		1		1	
	insecure	421	1310	0.769	(0.543, 1.089)[a]	0.651	(0.443, 0.957)	0.132
Dietary diversity score.	Low (ref)	165	614		1		1	
	Medium	77	256	0.893	(0.967, 1.690)[b]	1.23	(0.911, 1.649)	0.535
	High	223	618	0.620	(0.723, 1.522)	1.29	(1.004, 1.657)	0.265
High Work load of adolescents	No (ref)	87	344		1		1	
	Yes.	378	1144	0.765	(0.589, 0.995)[a]	0.666	**(0.501, 0.884)***	**0.006**
Cooking place	Sleeping room(ref)	301	1049		1		1	
	Kitchen connected to living room.	69	186	0.774	(0.704,1.456)	1.072	(0.736,1.561)	0.638
	Separate place	95	253	0.988	(0.570,1.049)[a]	0.788	(0.561,1.106)	0.226

Note: *-significant results

1-reference category.

Statistical significant (*p≤0.05)

Highly significant (**p≤0.001), *p≤0.05[b], p≤0.25[a]

CHAPTER SIX: DISCUSSION

It was found that the overall prevalence of stunting among adolescent in this study area was 26.1%, this finding is high as compared with studies was conducted in Pakistan 14% (18), Siri Lanka 19% (14) and in India 18.5 % (37), Nigeria 17.4% (19), in Kenya 16.64 % (30). The Possible reason may be due to differences in socio-economic, cultural, educational, feeding habits, and environmental factors. The other justification may result from the current concern of the Ethiopian policy towards nutrition not given attention for adolescent nutrition (27,25).

It was found that the overall prevalence of thinness among adolescents in this study area was 22.3%. This finding is a high as compare to the study conducted in Kenya 21.9 % (19)andin east central Uganda (38). However it is inconsistent with study done in rural community of Tigray region shown that, the prevalence of thinness was 26.5% (21), in Siri Lanka 43%, (14), India 53.0%, (15), Bangladesh 50.0%, (29), and Nepal 36.6% (28). This difference might be due to the difference in socio-demographic and economic characteristics in study areas.

After Adjusting simultaneously for other variables in a multivariable binary logistic regression modelplace of residence, female sex of adolescent, household's food insecurity and dietary diversity are significant predictors of stunting for adolescent in study area. Whilehigh work loads of adolescents, residence of adolescents and household's food insecurity were significant predictors of thinness in study area.

In this study, adolescent stunting was significantly associated with rural residence. Being rural adolescents were more likelystunted than those urban adolescents. which is similar to the report from India (37), in Burkina Faso (31), Nigeria (19), and Ethiopia, Debre Markos (25). The possible reason could be the fact that mothers in the urban setting have more access to nutrition related information that could be disseminated through different mass media and such information enables urban mothers to feed their child properly compared to their counterparts.

In this study, stunting of adolescents was significantly associated with female sex of adolescent. Female were nearly twice more likely stunted than their counterparts of adolescents. Similarly, other studies in India and UAE, under nutrition was significantly prevalent in girls than boys (37).The possible reason could be attributed to socio cultural influence; at the early age parents give priority care for boys than girls. In contrast, other studies in Kenya (30), Nigeria(19), and in

Bangladesh (33)explained that more boys were stunted than girls. This could be the preference towards daughters that occur as a result of low socio- and traditional beliefs around gender.

In this study, stunting was significantly associated with household food insecurity. Adolescents in food insecured households were more likely stunted than those from food secure households. Similarly, other studies in Bangladesh (39), Siri Lanka (14) and, in east-central Uganda(38)and in Jimma, Ethiopia (22) showed that household food insecurity was significant determinant of adolescent under nutrition in the form of stunting and thinness.Food insecure households are at risk of multiple nutrient deficiencies than from those food secured households (20,24) because they are not consuming a diversified diet due to so many factors final that lead to severe nutritional problem. The possible reason may be common practice in the study area to sell important cereals and legumes (peas, chickpeas and beans), including milk and milk products since they earn better income by selling these agricultural products rather than feeding these nutritious food items to their adolescents. Programs targeting improvement of household food security may play a major role in reduction of child malnutrition in these settings.

In this study, the adolescent stunting was significantly associated with dietary diversity of households. Adolescents with low dietary diversity were nearly twice stunted than from those with high dietary diversity households. This is similarity to the reports of other studies (7,12,34). The possible reason could be as a result of the difference in quality of care and feeding practices among big and small sized families.

In this study, thinness of adolescent was significantly associated with place of residence. Adolescents with rural residence were nearlytwice thin thanfrom those urban adolescents. This is similar with other reports from Jimma(20).The possible reason could be could be the fact that mothers in the urban setting have more access to nutrition related information that could be disseminated through different mass media and such information enables urban mothers to feed their child properly compared to their counterparts.In addition also this may be attributed due to differences in income, education and eating practice or low and inadequate food consumption and faulty interfamilial distribution of food because in rural community people were eating their meals two times per day in the morning and evening, so this could be seen as the main factor to be thin more in rural than urban.

Also the observed difference might be due to the setting difference, being urban and rural and majority of malnutrition is contributed by rural community.

In this study, thinness of adolescent was significantly associated with high work loads of adolescents. Adolescents with high workloads were more likely thin than from those had not high workloads. However, there are no available similar findings that support this finding. The possible reason may be socio-economic, cultural influence and family not gives attention for feeding the adolescents rather than order them for high workloads.

The findings also showed that, thinness of adolescents was significantly associated with household food insecurity. Significantly higher proportions of adolescents in food insecure households weremore likely thin than from those food secured households. Similarly, other studies in Bangladesh (29), Siri Lanka (14) and in eight different countries of Asia and Africa (35), in Kenya (30) and Jimma, Ethiopia (20)also showed that significant determinant of adolescents under nutrition in the form of stunting and thinness. This finding may leads programs formulated to improve household food security may play a major role in reduction of adolescent malnutrition in these settings.The possible reason may be common practice in the study area to sell important cereals and legumes (peas, chickpeas and beans), including milk and milk products since they earn better income by selling these agricultural products rather than feeding these nutritious food items to their children.

Thus, both stunting and thinness are the reflection of socioeconomic development demanding combination of different types of policies and programs towards the solution should be needed to reduce and prevent stunting and thinness problem, strategies need to be involved and more targeted interventions from community based, government and non-governmental wings through collaborated. This because adolescence occupies a crucial position in the life of human beings and characterized by rapid rate of growth or dynamic period of growth and undergo physical, mental, emotional and social changes during growth, besides the poor nutritional problem in adolescentsface adverse reproductive outcomes, retard growth, birth weight and others nutritional problem(22,27).For that reason promoting gender equality through effective behavior change communications needs to be considered(20,24). Further research will help to understand and identify the most effective strategies for reducing adolescent malnutrition in the study area

The findings implications on the health and wellbeing of adolescents in the study area. The high malnutrition rate of 26.1% the stunting and 22.3% the thinness among adolescents in Jimma zone is a concern as there are risks that are associated with under nutrition in adolescents. The adolescents and their households risk the consequences such as chronic illnesses in later years. The dietary diversity of the adolescents needs to be improved in order to ensure dietary quality and reduce consequences of malnutrition.

The low dietary intake by the adolescents implies that future generations are threatened given as a result of which the vicious cycle of malnutrition shall continue to exist in among the adolescents and the subsequent generations(27).The high proportion of adolescents with low dietary diversity indicates have a serious implication with regard to the micronutrient status of the adolescents and their subsequent growth and development.The low consumption of staple foods such as cereals, vegetable, fruit, fat and protein foods. Which also have could be a high proportion of the population that is at risk of chronic illnesses in later and for its consequences. The low nutritional status and dietary diversity incidences have a serious implication with regard to the micronutrient status of the adolescents in the Country level(27).

Conclusion:

In conclusion,the study revealed that under nutrition was a major prevalent problem 26.1%, 22.3% of adolescents were stunted and thin among these adolescents in study area respectively and dietary diversity is an independent predictor for outcome variable. The results imply that improving dietary diversity may contribute to the reduction of stunting among adolescents. Other interventions enhancing dietary diversity should be considered through nutrition behavior change communication together with adequate agricultural support.

Recommendation:
Recommendation for community:

- Whole community need to get awareness on nutrition of adolescent through health extension workers and others nutrition expertfor how enhancing them for both diversified local production and consumption of nutrient rich foods to prevent food insecurity and nutritional consequences through break the intergenerational cycle of malnutrition.

- Adolescent malnutrition intervention strategies should be focused not only on food security programs but also on diversity of agricultural products that are basic elements of food diversity and food items to provide the adolescent with balanced and nutritious food.
- Whole community (Families) should be support the adolescent with feeding local appropriate food production by reducing high workload of adolescents in their households through following nutrition guideline properly.

Recommendation for health facility and other collaborate bodies

- Adolescents need to learn about nutrition demand change during their adolescence period, on importance of balanced and adequate diet in both urban and rural area through nutrition guideline.
- Whole community need to get awareness on nutrition of adolescent and for high workload of adolescents that leads to adolescents in to nutritional problem through health extension worker and including in routine facilities service to implement nutrition guideline properly.
- There is a need to create awareness in the community to reduce high prevalence of malnutrition by diversification of diets through diet modifications and use of locally available foods; this can be done through promotion of community nutrition education and awareness programmes.

Recommendations at program planners.

- Promotion of dietary diversity and modification of diets through practical demonstrations in the community by community health workers and in all health facilities with an aim to improve the dietary diversity and thus the dietary quality of the adolescents.
- A multi-sectorial approach in policy and practice an aim to improve the dietary diversity and thus the dietary quality of the adolescents.

Recommendation for Researcher.

- Further longitudinal intervention study need to look at various modalities of enhancing access to diversified diet on the nutritional status of adolescents.

Reference

1.   World Health Organization (WHO). Standard for Adolescent Nutritional Status, Geneva, 2006.

2.   Black, RE, Victora, CG, Walker, SP, Bhutta, ZA, Christian, P, de Onis, M, Ezzati, M, Grantham-McGregor, S, Katz, J, Martorell, R, Uauy, R, and Maternal and Child Nutrition Study Group (2013) 'Maternal and child under nutrition and overweight in low-income and Middle-income countries', *The Lancet* 382, 9890, pp 427–51. doi: 10.1016/S0140-6736(13)60937-X.

3.   Guiseppina D. Nutrit789ion in Adolescent. Pediatrics in Review, 2000; 21(1):32-33.

4.   Kleigman B. Jenson, Staton. , Nelson Text Book of Pediatrics. 16th edition, 2004: Pp (49).

5.   International CSAEaI. Ethiopia Demographic and Health Survey 2011. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ICF International. 2012.

6.   FAO (2010) the State of Food Insecurity in the World 2010. Addressing food insecurity in protracted crises. Roma: FAO.

7.   Belachew T, Hadley C, Lindstrom D, Gebremariam A, Lachat C, et al. (2011) Food insecurity, school absenteeism and educational attainment: a longitudinal study. Nutrition J; 10:29.

8.   WFP & UNICEF (2009) Summary of food security and vulnerability in selected urban centers of Ethiopia, August 2009. Available: http:// home.wfp.org/ stellent/groups/public/ documents/ena/ wfp221386.pdf. Accessed 2011 Mar 16.

9.   Hadley C, Belachew T, Lindstrom D, Tessema F (2009) the forgotten population? Youth, Food insecurity, and rising prices: implications for the global food crisis. NAPA Bull; 32:77–91.

10.   G. Woldemariam and T. Genebo, *Determinants of Nutritional Status of Women and Children in Ethiopia*, Ethiopia Health and Nutrition Research Institute, Addis Ababa, Ethiopia; ORC Macro, Calverton, Md, USA, 2002.

11.   FAO, IFAD, WFP. The State of Food Insecurity in the World 2013. The Multiple Dimensions of Food Security. Rome, FAO. 2013.

12.   Mirmiran, P., Azadbakht, L., Esmaillzadeh, A. & Azizi, F. 2004. Dietary diversity score in adolescents- a good indicator of the nutritional adequacy of diets: Tehran lipid and glucose study. *Asia Pacific Journal of Clinical Nutrition* 13(1): 56-60.

13. Mulugeta A., et al., (2009). Nutritional Status of Adolescent Girls from Rural Communities of Tigray, Northern Ethiopia .Ethiopian Journal of health developmemt. 23(1), 5-11.

14. R.L.D.K, K.D.R.R…et al. High prevalence of malnutrition and Household food insecurity in rural subsistence paddy farming sector in Sri Lanka. Tropical agriculture research: vol: 19; 136-149(2007).

15. Ecker, O. & Kennedy, A., 2011. Making Agriculture Pro-Nutrition Opportunities in Tanzania. , (September).

16. Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A, Daniels, C. M., Deitchler, M... Torheim, L. E. (2010) Simple food group diversity indicators predict micronutrient adequacy of women's diets in 5 diverse, resource-poor settings. *Journal of Nutrition, 140*(11), 2059S-2069S. http://dx.doi.org/10.3945/jn.110.123414

17. Senauer B, Garcia M, Jacinto E: Determinants of the intra-household allocation of food in the rural Philippines. Am J Agric Econ 1988, 70 (1):170–180

18. Bose K, Bisai S. Prevalence of under nutrition among adolescents of West Bengal, India. J trop Pediatr 2008; 54(6):422-423.

19. Brabin L, Ikimalo J, Dollimore N, Kemp J, Ikokwu-Wonodi C, Babatunde S, Obunge O, Briggs N. 1997. How do they grow? A study of south-eastern Nigerian adolescent girls. Acta Paediatr 86:1114–1120.

20. Craig Hadley…et al **.**The Shape of Things to Come? Household Dependency Ratio and Adolescent Nutritional Status in Rural and Urban Ethiopia. DOI 10.1002/ajpa.21463 Published online in Wiley Online Library (wileyonlinelibrary.com)

21. Afework Mulugeta, Fitsum Hagos, Barbara Stoecker, Gideon Kruseman, Vincent Linderhof, Zenebe Abraha, Mekonen Yohannes and Girmay G. Samue. Nutritional Status of Adolescent Girls from Rural Communities of Tigray, Northern Ethiopia**.** Ethiop.J.Health Dev., 2009; 23 (1): 5- 11.

22. Huruy Assefa…et al.Socioeconomic Factors Associated with Underweight and Stunting among Adolescents of Jimma Zone, South West Ethiopia: A Cross-Sectional Study. Volume 2013, Article ID 238546, 7 pages

23. United Nation Population Fund. The Promise of Equality Gender .Equity, Reproductive Health and the Millennium Development Goals. State of world population 2005, UNFPA, 220 East 42nd Street, 23rd Fl. New York, NY 10017 U.S.A. 2.

24.   Belachew et al.: Food insecurity and linear growth of adolescents in Jimma Zone, Southwest Ethiopia. Nutrition Journal 2013 12:55.

25.   Zelellw DA, Gebreigziabher BG, Alene KA, Negatie BA, Kasahune TA (2014) Prevalence and Associated Factors of Stunting Among Schoolchildren, in Debre Markos Town and Gozamen Woreda, East Gojjam Zone, Amhara Regional State, Ethiopia, 2013. J Nutr Food Sci S8: 007. doi:10.4172/2155-9600.S8-007

26.   Ruel, M. T. (2003). Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. *International Food Policy Research Institute (IFPRI), 24*(2), 231-232 (a).

27   Beka T, Wambui K-M, Zewditu G, Girum T. Magnitude and Determinants of Stunting in Children Under-five Years of Age in Food Surplus Region of Ethiopia: The Case of West Gojam Zone. Ethiop J Health Dev. 2009; 23(2):98–106.

28   Paudel R, Pradhan B, Wagle R, Pahari D, Onta S. Risk Factors for Stunting Among Children: A Community Based Case Control Study in Nepal. Kathmandu Univ Med J 2012; 39(3):18–24.

29.   Choudhury KK, Hanifi MA, Rasheed S, Bhuya A (2000) Gender inequality and severe malnutrition among children in a remote rural area of Bangladesh. J Health Popul Nutr18: 123-

30.   Susan K, Guy P, Bart vdB. Household Food Insecurity Access: A Predictor of Overweight and Underweight among Kenyan Women. Agriculture & Food Security 2014; 3(2):1–8. doi: 10.1186/2048-7010-3- 2

31   Daboné C, Delisle HF, Receveur O (2011) Poor nutritional status of schoolchildren in urban and peri-urban areas of Ouagadougou (Burkina Faso) Nutr J 10: 34.

32.   [No authors listed] (1998) the anthropometric status of school children in five countries in the Partnership for Child Development. Proc Nutr Soc 57: 149-158.

33.   Ahmed F, Zareen M, Khan MR, Banu CP, Haq MN, Jackson AA. Dietary patterns, nutrient intake and growth of adolescent school girls in urban Bangladesh. Pub Health Nutr 1998; 1:83-92.

34.   Mishra G, Ball K, Arbuckle J, Crawford D. Adolescents in two district north and south of Tehran, MSPH in Nutrition Thesis, Faculty of Health, Tehran University of Medical Sciences, 1374. [in Persian]

35.   Stephanie P, Zulfiqar AB, Tahmeed A, Shamsir A, Pascal B, Munirul I, et al. Household food access and child malnutrition: results from the eight-country MAL-ED study. Population Health Metrics. 2012; 10(24).

36.   Pawloski LR. Growth and Development of adolescent girls from the Segou region of Mali (West Africa). Am J Phys Anthropol 2002; 117:364-372.

37. Haboubi G, Shaikh R (2009) "A comparison of the nutritional status of adolescents from selected schools of South India and UAE: a cross-sectional study". Indian J Community Med 34: 108-111.

38. Francis Lwanga...et al.Food Security and Nutritional Status of Children Residing in Sugarcane Growing Communities of East-Central Uganda: A Cross-sectional Study Journal of Food Security, 2015, Vol. 3, No. 2, 34-39.

39. Kuntal KS, Edward AF, Dewan SA, Shams EA, Lars AP, Kathleen MR. Household Food Security is Associated with Growth of Infants and Young Children in Rural Bangladesh. Public Health Nutrition: 12 (9), 1556–1562 2009; 12(9):1556–62. doi: 10.1017/S1368980009004765 PMID: 19232147

40. Fall., C…et al (2009). Maternal nutrition: Effects on health in the next generation. *Indian Journal of Medical Research,* 130, 593-599.

41. Mekonnen H, Tadesse T, Kisi T (2013) Malnutrition and its Correlates among Rural Primary School Children of Fogera District, NorthwestEthiopia. J Nutr Disorders Ther S12: 002. doi:10.4172/2161-0509.S12-002