ADDIS ABABA UNIVERSITY

SCHOOL OF PUBLIC HEALTH

Assessment of Sensitivity and Specificity of Mid-upper arm circumference (MUAC) in detecting under-nutrition of adult people with HIV that have ART follow up in selected Health facilities of Addis Ababa.

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ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
ART	Anti Retroviral Therapy
BMI	Body Mass Index
CDC	Centers for disease control & prevention
CED	Chronic Energy Deficiency
CI	Confidence Interval
CM	Centi Meter
DHS	Demographic and Health Survey
HIV	Human Immune Deficiency Virus
KG	Kilogram
MPH	Masters in Public Health
MUAC	Mid- Upper Arm Circumference
NCHS	National Centre for Health Statistics
NI	Nutritional Indices
OR	Odds Ratio
PI	Principal Investigator
PWH	Patient with Human immune Deficiency Virus
SPH	School of Public Health
SPSS	Statistical Package Software for Social Science
UNICEF	United Nations International Children's Emergency Fund
W/H	Weight-for-Height
WHO	World Health Organization

A B S T R A C T

Introduction: Mid-upper arm circumference (MUAC) is anthropometric measure used to evaluate adult nutritional status that has been found to be particularly effective in determining malnutrition among adults in developing countries.

Objective: To assess the sensitivity (SN) and specificity (SP) of mid-upper arm circumference (MUAC) in detecting under nutrition of adult people with HIV who have a follow up at ART clinic.

Methods: A cross-sectional study was conducted among adults with HIV, who have follow-up in three selected Governmental Hospitals of Addis Ababa city administration. Using multi stage sampling technique, a total of 594 samples were selected. MUAC, Height and weight were measured for each participant. The BMI was calculated as Wt/Ht^2. The internationally accepted cut-off points of BMI and MUAC were utilized to determine nutritional status. Receivers operating characteristic curve analyses were undertaken to discover the most suitable values of MUAC for both Men and Women.

Results: The prevalence of CED based on BMI (BMI <18.5) was 39.4% and 24.3% for male and female respectively, while based on MUAC (≤ 230 mm& ≤ 220mm) were 48.4% and 35.7% for male and female respectively. The sensitivity and specificity of MUAC for Female with optimal criteria of ≤224mm were 92.7% and 87.2%, whereas for Males MUAC with optimal criteria of ≤234mm were 94.9% and 68.5% respectively. The area under curve (AUC) was 0.93 (p<0.001). A MUAC value of ≤239mm was identified as the best cut off-points to identify CED (BMI <18.5) with SN and SP of 96.43% and 72.62%, respectively. The PPV was 56.6% (CI 89.9-99.3) with the highest NPV 98.2% (CI 66.8-77.9), thus having the highest Youden Index of 0.21.

A MUAC value of ≤242mm was identified as the best cut off to identify CED (BMI <18.5) with SN and SP of 96.91% and 58.39%, respectively. The PPV was 46.3 %(CI 91.2-99.4) with the highest NPV 98.1% (CI 50.0-66.4), thus having the highest Youden Index of 0.32.

Conclusion: a MUAC value of close to 242 mm (male) and 239mm (female) seemed to be appropriate as a simple and efficient cut-off point for the determination of under nutrition in adult PLWHIV.

Key words: Sensitivity, specificity, BMI, chronic energy deficiency, mid-upper arm circumference, nutritional status, ROC curve.

1. INTRODUCTION

1.1 BACKGROUND

Anthropometric measurements are well established and widely used as indicators of health and nutritional status in both children and adults(1).The assessment of nutritional status by anthropometry may seem to be a simple matter, in which the main constraints are practical, such as the availability of equipment and personnel(2). In clinical practice the classical use of anthropometry and other methods, such as biochemical and immunological tests, are being increasingly used (3).

Despite some limitations, in anthropometry, it still remains the most practical tool for the assessment of nutritional status among members of the community in developing countries. Body mass index (BMI) is widely accepted as one of the best indicators of nutritional status in adults(4) , and Mid-upper arm circumference (MUAC) is another anthropometric measure used to evaluate adult nutritional status that has been found to be particularly effective in determining malnutrition among adults in developing countries(5).

MUAC has been used for many years as an alternative index of nutritional status in situations, such as famines or refugee crises, where the collection of height and weight measurements is difficult (6, 7). It has been used as an additional screening tool in non emergency situations because of its power to predict under nutrition and mortality (8, 9). It is relatively easy to measure and a good predictor of immediate risk of death(10).

Screening test identifies individual at risk on the bases of an indicator and specific cut-off point, because of the sensitivity of test changes with the cut-off point, sensitivity alone cannot be used in comparing indicators. A good indicator is one that can best reflect the issue of concern or which predict a particular outcome(1).

This study attempted to assess the sensitivity and specificity of MUAC in correctly identifying the patient qualifying for supplementary feeding and examine whether or not BMI can be substituted by MUAC in assessing the nutritional status of people with HIV.

1.2 Statement of the Problem

For the Assessment of nutritional status in HIV-positive adults and adolescents, the National Guidelines for HIV/AIDS and Nutrition in Ethiopia recommend to take Weight, Height and MUAC (pregnant and postpartum women and/or adults who cannot stand straight) in every contact(11) which seems to increase the waiting time and inconvenience. Therefore, to implement supplementary feeding in settings where resources and trained health professionals are scarce, simple diagnostic tools are needed.

MUAC is such a tool which is useful in assessing nutritional status, that doesn't require extensive training, supervision, or fancy materials. MUAC is relatively easy to use and simple to understand for both community health workers and children's caretakers. Errors of measurement associated with MUAC are no more frequent than with either weight or height. Studies have shown that even for minimally trained health workers, intra- and inter-observer reliability of MUAC measurements are at least as good as other anthropometric indices(12, 13). In addition to reliability and simplicity, MUAC has demonstrated superior sensitivity to risk of death (14, 15), and can offer considerable cost advantages; MUAC tapes are less expensive than height boards.

BMI is another tool which is appropriate for population studies when it can be measured accurately in research conditions. The use of BMI in clinical practice may mask important weight changes and result in a failure to alert healthcare staff to a nutritional problem(16).

Screening and calculating BMI in an acute setting does not always have a positive effect on mortality and morbidity, and monitoring of weight changes in the community would highlight problems in a more timely manner(17). Mid-upper arm circumference is measurement which is a reliable and a feasible method of assessment of nutritional status of adults that can be used for screening. An important advantage of using MUAC compared with BMI is that it can be easily obtained in older persons using a simple measuring tape.

The complexity of calculations for health workers without mathematical backgrounds or access to calculation software is an issue. Other than these charts and tables may not be accessible to those working in traditional health/nutrition services which are often poorly equipped(18).

Being the simplest measure, MUAC has been suggested as a substitute for BMI when the rapid screening of an adult population is required as a prelude to targeting the provision of assistance to those who are undernourished(5)

1.3 Significance of the Study

Anthropometry is a useful tool, for nutritional assessment and monitoring of growth. In resource limited settings, assessment of all individual with the help of simple, easy and accurate method is needed. Hence, it would be of a great importance to identify universal screening strategies based on a simple, cheap and effective method which will be performed at day to day-care centers(19) which can avoid inclusion or exclusion errors and further depletes the existing scarce resource.

MUAC measurement is easier to perform on severely malnourished adults than BMI assessment(21) but no studies have identified the use of MUAC for patient with PLHIV. It is a potentially useful indicator requiring only a cheap, widely available and durable measuring tape that requires no calibration, and having the advantage that it can be measured in patients who have difficulty in standing. Therefore; identification of simple practical ways to assess nutritional status and related outcomes in patients with HIV/AIDS before and during treatment with particular reference to resource-limited settings is mandatory to provide appropriate interventions(20).

The prevalence of malnutrition is very high among PLWHA on ART in different Settings and remains to be the key challenge of ART programs in many countries of the World. In Ethiopia, although not well documented, some pocket studies conducted in different health institutions depict that the prevalence of malnutrition is high among PLWHA on ART. Various predictors of malnutrition were studied but the use of MUAC as alternative means of diagnosis has not been addressed well. Scientific evidence is needed to choose the best and easy means of diagnosis which further contribute for the pave in household food and nutrition security and adherence to ART and other treatment outcomes. The study on the

sensitivity and specificity of MUAC can serve as a significant contribution to answer this question.

Further, understanding of different diagnostic modalities of malnutrition have a crucial role in making decision to help those in need of supplementary food in a population where poverty and food insecurity are cross cutting problems could help to rethink on our ART program and mobilize resources to integrate programs like supplementary feeding in HIV/AIDS prevention and control effort.

The study can also help to support the consistency of research findings on malnutrition among PLHIV on ART evidenced locally in other areas and elsewhere in the world. Additional significance which can be gained by conducting this study is knowledge of sensitivity and specificity of MUAC in PLHIV on ART which enable to lay the base for other similar studies that may be conducted in the future.

2. LITERATURE REVIEW

Nutritional Assessment

Nutritional assessment was originally described as a set of medical tasks to determine the nutritional status of a person(22). Nutritional status refers to the condition of health of a population that is influenced by the intake and utilization of nutrients(23), and is assessed by direct and indirect methods. The direct methods are usually taken at the individual level, whereas indirect methods use population indices. Anthropometry, biochemical, clinical and dietary evaluation are direct methods. Indirect methods include vital health statistics, like morbidity and mortality, and economic variables like household income. Nutritional anthropometry can be defined as measurements of the physical dimensions and gross composition of the human body as a means of assessing nutritional status.

An ideal index of nutritional status for any age should be correlated with body fat and protein stores, healthy and functional outcome and must be simple to obtain and interpret in the field. It must also be accurate (close to the true value), valid (represent what it is thought to represent) and precise (repeatable). In addition to these requirements, as adult height is largely determined by an individual's genotype and childhood nutritional experience(24) , it follows that if an index is to reflect current nutritional status in adults it must be independent of height. Accurate assessment of nutritional status is important to plan and evaluate nutrition and health interventions. Anthropometry is the most useful tool for assessing the nutritional status of children and adult. In developing countries growth deficits are caused by two preventable factors, inadequate food and infections(25).

Anthropometric measurements, indices and indicators

Anthropometric measurements and indices describe body size, shape, and composition. Changes in body dimensions reflect the overall health and welfare of individuals and populations. Anthropometry is used to assess and predict performance, health and survival of individuals and reflect the economic and social well being of populations. It is a widely used, inexpensive and non-invasive measure of the general nutritional status of an individual or a population group. Recent studies have demonstrated the applications of

anthropometry to include the prediction of who will benefit from interventions, identifying social and economic inequity and evaluating responses to interventions.

It is a portable, inexpensive, noninvasive method and universally applicable(26) and involves the external measurement of morphological traits of human beings(27). It reflects both health and nutritional status of individuals and populations, such that they can be selected for intervention programs as well as for monitoring of health and nutrition(26).

Although anthropometry has been accepted as a method for defining the nutritional status of a population, the standard against which the nutritional status of a population can be compared to has been controversial. The National Centre for Health Statistics (NCHS) data has been used widely(28) but currently, the WHO multi-centre Growth Reference is recommended, to present nutritional indices in the form of Z scores, percentiles, or percentage of median.

Nutritional Indices

Anthropometric indices are combinations of measurements which are essential for the interpretation of measurements: it is evident that a value for body weight alone has no meaning unless it is related to an individual's age or height. Thus, for example, measurements of weight and height may be combined to produce the body mass index (weight/height^2) a ponderal index (weight/height^3), or weight may be related to height through the use of reference data. The anthropometric indices can be expressed in terms of Z-scores, percentiles, or percent of median, which can then be used for comparison purpose. Z-scores reflect the reference distribution and are comparable across ages and across indicators(29),(30).

There are many anthropometric indices for the assessment of nutritional status: Mid-upper arm circumference (MUAC), height-for-age (H/A), weight-for-height (W/H), weight-for-age (W/A), and body mass index of Quetlet. But the most common indices used to assess adult nutritional status are weight-for-height and MUAC.

Cut-off points

Universal cut-off points are often recommended, but are appropriate only if resources are adequate to handle all individuals selected for intervention because no adverse effect and side-effects for such a case, it is important that a high proportion of those who receive the intervention will not benefit from it. The cut-off point should be set at 100% sensitive, so that all those at risk who can benefit from the intervention are treated. Cut-offs are commonly set on the basis of experience in affluent population which shows that the proportion of individuals identified by a screen who can benefit is sufficient to warrant further diagnosis.

BMI cut-off points for screening adult admissions to feeding centers, extrapolated directly from CED, may be inappropriate. The cut-off point of 16 kg/ m^2, that indicates severe chronic under nutrition does not necessarily reflect the degree of acute under nutrition that requires specialized treatment(31, 32)

The following cuts-off points were used to identify CED, according to internationally accepted BMI guidelines: CED: BMI <18.5 and non-CED BMI ≥18.5. Subjects were also designated undernourished (UN), if they had a MUAC <220 mm and <230 mm for female and male respectively(1). The classification of categories of chronic under nutrition with BMI (kg/ m2) is as follow: Normal >=18.5, Grade I 17.0-18.4, Grade II 16.0-16.9, Grade III <=15.9(33) . World Health Organization classifies normal weight as a BMI of 18.5–24.9 kg/m^2, overweight as 25–29.9 kg/m^2 and obesity as +30 kg/m^2(17).

Nutritional Indicators

The term indicator relates to the use or application of indices. The indicator is often constructed from indices; thus the proportion of individuals below a certain level of weight-for –age is widely used as an indicator of the community status.

The anthropometric indices discussed here all related to body size and composition. Sometimes this is the only type of relationship that can be inferred; indices should then be referred to as body size or body composition indicators, rather than as nutrition or health indicators. A valid nutritional indicator owes a substantial proportion of its variability to differences in nutrition. For any given indicator, however, this proportion may vary across

or within populations. For instance, body mass index (BMI), the ratio of weight to the square of height, is a good indicator of variability in energy reserves in individuals with a secondary lifestyle, but not in athletes. Choice and condition of indicators should ultimately depend on the decision that will be made on the basis of the information they yield.

Sensitivity and specificity of indicator

Each of the indicators mentioned above has advantages and disadvantages. With regards to sensitivity and specificity, each indicator differs from the other. While some have a high sensitivity, others have a high specificity and vice versa. An ideal anthropometric indicator should have a high sensitivity to detect malnutrition accurately and also have a good specificity(34).

Screening tools should be set at 100% sensitivity to ensure that all those at risk who would benefit from nutritional support are treated(35). The sensitivity and specificity of MUAC in detecting obesity with stature showed that 79.4% and 77.6% respectively. Indicating best association between sensitivity and specificity(19).

Body mass index

Weight for height indices have long been used to assess the body composition of adults. Body composition is directly affected by nutritional risks. Different formulation of the height for weight index have been considered, the objective being to find an index that is highly correlated with height and uncorrelated with height ,i.e. inter individual variation should be due to difference in body weight as proxy for body energy stores and muscle mass and not in variations in height. The index of weight (kg) divided by height (cm) (body mass index has consistently been found to meet this criterion in different population groups. Other formulation have tended to be either correlated with height (weight /height) or to have relatively lower correlation with body weight and a negative, albeit low, correlation with height (e.g. weight/height^3 or its inverse).

The BMI is an indicator of body composition. It has been shown to be related to body fat mass and to fat free mass, the two main component of the body in addition to bone and water. Inter and international variations in BMI are then due to difference or changes in

the body fat mass and fat free mass. It has therefore been argued that a low BMI value represents a state of chronic energy deficiency (CED). BMI has also consistently been shown to be much less related to fat proportion, thus making it a valid indicator for both women and men. (Women normally have a large fat proportion than men).

Questions have arisen about the interpretation of BMI values in different populations. The relationship between BMI values and body energy stores appears to vary among different population groups in developing countries. Thus, a comparison across population may be somewhat compromised bur it can reasonably be argued that, in all population, low BMI values indicate both reduced fat and fat–free mass. It has been found that a reduction in the later mainly occurs at the expense of muscle. This, in turn, indicates that CED is likely to impair physical performance. At the upper end of the BMI distribution, the relation with body fat mass is consistently found to be strong, making the BMI a valid indicator for comparing the risk of various degree of obesity a cross population groups. BMI includes measures of stature and weight that are recorded accurately in kilograms and meters. BMI is calculated easily with a calculator or from one of many Web sites that perform this task using either English or metric measurement values.

Theoretical problems with BMI

Body shape - Many factors other than nutritional status determine BMI. Most important of these is body shape, in particular the ratio of leg-length to trunk-length, sometimes called the sitting-height to standing height ratio (SH/S) or Cormic index. This index varies both between populations and within populations. A great deal of research has focused on use of BMI for the assessment of chronic under nutrition in stable populations. This role is primarily that of prevalence estimation, providing information useful in planning at a population level. This is a different role to that of screening individuals who may be suffering from acute under nutrition in order to regulate admissions to feeding centers.

Mid-upper arm circumference (MUAC)

MUAC is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow (olecranon process and the acromium). It is good at predicting mortality and in some studies, MUAC alone(36-38) or MUAC for age predicted death in children better than any other anthropometric indicator, but not studied

in adult. This advantage of MUAC was greatest when the period of follow-up was short(39).The MUAC measurement requires little equipment and is easy to perform even on the most debilitated individuals. Although it is important to give workers training in how to take the measurement in order to reduce inter- and intra- observer error, the technique can be readily taught to minimally trained health workers(40). It is thus potentially suited to screening admissions to feeding centers during emergencies.

Measurements of adult MUAC have long been known to reflect changes in adult body weight(41), and the major determinants of MUAC, arm muscle and sub-cutaneous fat, are both important determinants of survival in starvation (42-44). As MUAC is less affected than BMI by the localized accumulation of excess fluid (pedal oedema, periorbital oedema, ascites) common in famine, it is likely to prove to be a more sensitive index of tissue atrophy than low body weight. It is also relatively independent of height (45).

The use of MUAC has not been evaluated as a prognostic indicator. However, estimates of arm muscle area (AMA) or corrected arm muscle area (CAMA), corrected for humerus cross-sectional area, have been incorporated into diagnostic schemes for adult under nutrition in hospitals(46) and used as prognostic indicators in the elderly and in cancer patients (47-48). However, it is unlikely that CAMA or AMA will be of use in emergency assessments as both require accurate measures of skin-fold thickness that would be hard to obtain given the rush and pressure of an emergency operation (33).

Advantage and challenges of MUAC and BMI

Some studies show MUAC is an appropriate method for the assessment of acute adult under nutrition. The method is useful for both screening acute adult under nutrition and for estimating prevalence of under nutrition at a population level(50). The recent recognition of the problem of adult malnutrition requires methods for specifying the severity of under nutrition. The measurement of mid upper arm circumference (MUAC) can now be used as a screening method for underweight(51).

Although advanced and sophisticated methods of measuring body composition are available and useful for research purposes, simple anthropometric measurements of height, weight, body mass index, MUAC and skin fold thicknesses at four sites (triceps,

biceps and sub-scapular and supra iliac sites) are generally useful for monitoring adiposity during pregnancy and lactation(52).

MUAC measurement was easier to perform on severely malnourished adults than BMI assessment. For MUAC, the patient could be standing, sitting, or, in extreme cases, lying. For BMI, patients are required to stand. Measuring BMI requires a height board, weighing scales, and mathematical calculations; to measure MUAC, only a tape measure is required(21).

An extensive study using data from 8 countries (Mali, India, Senegal, Zimbabwe, Somalia, Ethiopia, Papua New Guinea and China) suggested that MUAC could be used for the simple screening of nutritional status. Being the simplest measure, MUAC has been suggested as a substitute for BMI when the rapid screening of an adult population is required as a prelude to targeting the provision of assistance to those who are undernourished(50).

Since BMI may not always be a feasible measure in older persons(35) especially in a home situation, MUAC is proposed as an alternative anthropometric measure(53). This was supported by a recent study in community-dwelling older persons that showed that a low MUAC was more strongly associated with mortality than a low BMI. Therefore, MUAC was selected as a potential item instead of BMI(54).

Study done in India showed that the prevalence of CED based on BMI less than 18.5 was 55.3%, and the prevalence of CED based on MUAC less than 22.0 cm was 51.2%. Both of these prevalence rates are classified in the very high prevalence category (40%) and indicate a critical situation according to World Health Organization recommendations. Mean BMI increased significantly with higher quartile of MUAC. There was a significant positive association between MUAC and BMI, regression analysis demonstrated that MUAC had a significant positive impact on BMI; the percentage of the variation in BMI explained by MUAC was 52%. Logistic regression analysis demonstrated that overall, 82.11% of cases of CED were correctly classified by using MUAC. The use of MUAC correctly diagnosed 82.35% of cases of CED and 81.82% of women with normal nutritional status(16). But there is no research done in Ethiopia concerning the sensitivity and specificity of MUAC in adult population.

3. OBJECTIVE

3.1 General Objectives:

Assess the sensitivity and specificity of mid-upper arm circumference (MUAC) in detecting under nutrition of adult people with HIV who have a follow up at ART clinic using BMI as gold standard.

3.2 Specific Objectives:-

- To assess the nutritional status of adults with HIV using MUAC.
- To assess the nutritional status of adults with HIV using Ht and Wt (BMI).
- To examine the sensitivity and specificity of MUAC in identifying the undernourished patient qualifying to supplementary feeding.
- To recommend a feasible and appropriate Anthropometric measurement that best suit for screening.

4. METHODOLOGY

4.1. Study Design:

Institution based cross-sectional quantitative study design.

4.2. Study Area

This study was conducted in three governmental Hospitals found in Addis Ababa city Administration, which is the capital and largest city of Ethiopia as well as the country's commercial, manufacturing, and cultural center. Its projected population of 2013 is estimated to be 3,038,096 million that resides in 10 sub-cities and 116 woreda. In the city there were 36 private and 6 governmental hospitals, 52 health centers (of which 45 are public and 7 are NGO health centres), 136 health stations, 700 private clinics. Numbers of health facilities providing ART services were 66 in number and patients currently on ART were 54,667. The number of ART clients registered in each selected hospital namely Tikur Anbesa specialized (1,302), Saint Paul, Zewditu Memorial (1,018), Yekatit 12 (3,065), Gandi Mimorial(987) and Ras Desta Damtew Mimorial hospital(1,011).

4.3. Source Population

All adult people with HIV residing in Addis Ababa city Administration.

4.4. Study Population

All adult people with HIV in Addis Ababa city Administration, who have medical follow-up at the health institution (ART clinic).

Inclusion Criteria

Adult (15-49) who have regular follow up in the ART clinic not seriously ill / not currently hospitalized in the last one month.

Exclusion Criteria

Pregnant woman, Adult age above 49 years and who were seriously ill physically deformed and did not consent.

4.4. Sample Size

The required sample size of the study population was determined using single population proportion formula. Since the proportion of wasting by MUAC is not known 50% was taken to obtain sufficiently large sample size, five percent was added to the sample size for non response rate. Because of two staged cluster sampling technique was used, the initial sample size, was multiplied by 1.5 for design effect.

$$n = \frac{(z\ /2)^2\ p(1-p)}{(d)2}$$

Where: P- prevalence of wasting by MUAC (50%)

d =the margin of error between the sample and the population.

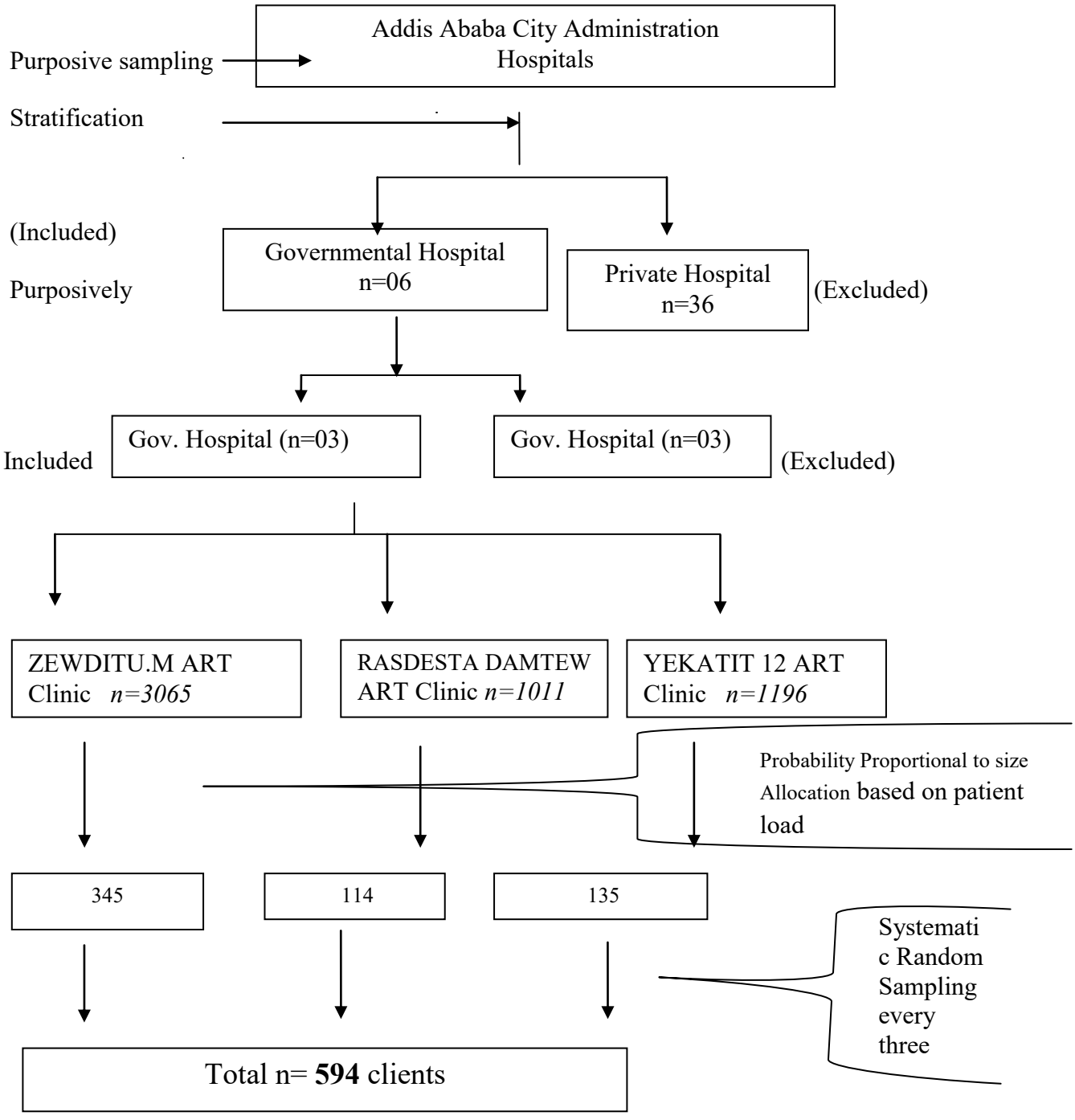
Z /2=Value of the standard normal distribution curve corresponding to level of significance alpha 0.05 = 1.96

Considering design effect of (1.5) and adjusted with the non response rate of 5% the final sample size calculated was 594.

4.5 Sampling Procedure:

A Multi stage sampling procedure was employed. The available Hospitals in the city ware stratified by ownership as Governmental (06) and private hospitals (n=36). In this study the private hospitals ware not considered because of less client flow. Among governmental hospitals, three hospitals with large client flow were included purposively. The rest three hospitals with less client flow and inconvenient was not included. Using probability proportional to sample size (PPS) the required sample size was allocated for selected Hospitals, after the required sample size is allocated to each hospital, eligible participants were selected using systematic random sampling (every third subject) until the required sample size was obtained(Fig-1).

Figure:-1 Schematic presentation of sampling procedure.



4.6 Data Collection

A pretested structured interview questionnaire that composed of socioeconomic, demographic, environmental, nutritional, diet related and anthropometry was used to collect quantitative data. Six data collectors and two supervisors including the principal investigator were involved in the data collection. Data collectors were recruited from Hospitals and Health centers located near the study area. The data collectors were nurses who had experience in data collection while supervisors were health professionals working in the hospital trained on malnutrition.

Both the interviewers and supervisors were trained for three days on the objective and methodology of the study, data collection and interviewing approach, how to take anthropometric measurements, data recording and ethics during field work.

The Data were collected at the same time in all Hospitals by separate data collectors. Anthropometric measurements were taken twice, and an average of the two readings was calculated. Body weight was measured using a digital scale and recorded to the nearest 100 g. Subjects were asked to remove footwear, heavy clothes and heavy items from their pockets. Participants' stature was assessed using a long standing height measurement to the nearest 0.1 cm. To aid straightening the spine, the reading was taken while the subject was inhaling deeply and the reading was taken to the nearest 0.1 cm. Arm span was measured while the subject was standing erect and looking straight ahead, with the back against the wall to provide support. The arms were outstretched at right angles to the body with palms facing forwards.

4.7 Data Quality Management

Questionnaire prepared in English was translated into Amharic language for field work and back to English for checking language consistency.

The interviewers and supervisors were trained about data collection, interviewing and measurement techniques for three days. Pre-test was done before the actual data collection work to see for the accuracy of responses and to estimate time needed and the questionnaire was adjusted accordingly. A digital Weighing scale was used to reduce

frequent calibration. On daily basis collected information was reviewed and possible errors were returned to the data collectors for correction.

4.8 Data Analysis Procedure

After the data collection was completed; first the data were checked for completeness and consistency, and then categorized, coded and entered using EPI-info Version 7.Then, the clean data exported to SPSS program for analysis; descriptive summary using frequencies, proportions, graphs and cross tabs was used to present study results. P-value less than 0.05 was considered as statistically significant. Logistic regression analysis was done; sensitivity and specificity was calculated using ROC (receiver operating curve) analysis of the software Medcalc version12.1.

BMI interpretation:- The World Health Organization(1998) defines underweight as BMI<18.5; normal weight as 18.5≥BMI<25; overweight as 25≥BMI<30; and obesity as BMI≥30(17).

MUAC interpretation:- MUAC was dichotomized into <220 mm for female and <230 mm for male based on the UN classification (for both men and women separately)(53).

4.9 Ethical Considerations

Ethical approval for the research was obtained from Addis Ababa University, College of Health Sciences, School of Public Health Research Ethics Review Committee. It was dual reviewed by Addis Ababa Health bureau research ethics committee. The local authorities were informed about the study objectives through a letter written from Addis Ababa Health Bureau to the city administration and health facilities to enhance cooperation.

Verbal consent was obtained from each selected participant to confirm willingness. Honest explanation of the study purpose, description of the benefits and an offer to answer all inquiries made to the respondents. Also affirmation was made that they are free to withdraw or discontinue participation without any form of prejudice. Privacy and confidentiality of collected information was ensured throughout the process; measures were taken to ensure respect, dignity and freedom of each individual participating in the study. During training of the interviewers, emphasis was given to the importance of obtaining informed consent (orally) and the avoidance of any kind of coercion. All information gained during the study was kept strictly confidential.

Sick and severely malnourished adult was linked to the nutrition center of the health facility (food by prescription) to obtain treatment and nutritional advice. The instruments and procedures was not causing any harm to the study subjects, the community, the data collectors and supervisors, involved in the study.

4.10 Operational Definitions

Under nutrition: - Which referees to reduced overall food intake in relation to the recommended daily dietary nutrition requirements.

Sensitivity: - Sensitivity is the number of people correctly identified by an indicator as being undernourished divided by the total number of undernourished people measured by MUAC. A sensitive indicator will identify a large proportion of the undernourished people measured.

Specificity: Specificity is the number of people correctly identified by an indicator as non-undernourished divided by the total number of non-undernourished people measured by MUAC. A specific indicator will correctly identify a large proportion of the non-undernourished people measured.

Protected water source: - are water from protected spring and private well.

Unprotected water source: - are water source from River, Pond and unprotected spring.

Hospital with low client flow: Are those hospitals that have clients less than 1,000clients in their outpatient department.

Youden index J (Youden, 1950) is defined as: J= max (sensitivity c +specificity c -1)

Where c ranges over all possible criterions

4.11 Dissemination of Results

The result of this study will be submitted to the School of Public Health, Addis Ababa Health Bureau and Woreda Health Office. The findings of this study will be presented in the annual scientific conference of Ethiopian Public Health Association, national and Regional conferences and publication will be considered.

5. RESULTS

5.1 Socio-demographic characteristics of study participants

A total of 594 adults with HIV aged 15-49 years were enrolled in the study out of which 593 consented to participate making the respondent rate at 99.8%. 46(41.5%) were male on ART for at least three months prior to the survey. The mean age of study participant was 34 years with 187(31.6%) of them belonging to the age group 33-37 years. The average family size was 3 persons per household with large proportion of households 532(89.7%) had no under five children while 50(8.4%) of the households had only one under five child and the maximum number of under five children in the households was three.

Among 593 study participants interviewed 231 (38.89%) were married, while 195 (32.8%) of the households were single. Almost half of the study participants belonged to Amhara Ethnic group and Orthodox Christian, 304(51.4%) and 112(18.9%) respectively. Assessment of educational status of the study participants showed that 233(39.3%) of them attended Grade 7-12 while 206(34.5%) were grade completed.

Assessment of the average monthly income that the households in which the study participants are living showed that 247(41.7%) of the study participant had monthly income of below 500 birr per month with the median income of 650 birr. About 207(34.9%) of the study participants are Private worker (self employed) while 139(23.4%) were Governmental employed (Table 1).

Table 1: Socio-demographic Characteristics of the study participants

Variable	N= 593	(%)
Sex		
Male	246	41.5
Female	347	58.5
Age(years)		
<= 20	16	2.7
21 – 26	53	8.9
27 – 32	136	22.9
33 – 37	187	31.6
38 – 43	118	19.9
44+	83	14
Marital status		
Single	195	32.8
Married	231	39
Divorced	78	13.2
Widowed	89	15
Religion		
Orthodox	304	51.3
Protestant	112	18.9
Muslim	82	13.8
Catholic	64	10.8
Educational status		
Illiterate	35	5.9
Grade 1-6 completed	119	20
Grade 7-12 completed	233	39.4
More than 12 grade	206	34.7
Occupation		
NGO employed	62	10.5
Government employed	139	23.4
Student	30	5.1
Housewife	81	13.7
Private employee	207	34.8
Merchant	62	10.5
Daily laborer	12	2
Monthly HH Income		
<= 500	247	41.7
501 – 1,000	157	26.5
1,001+	189	31.8
Total	**593**	**100**

5.2 Environmental Health and Related condition

As shown in the table two, majority of the study participants 574(96.8%) had water supply from protected source and 19(3.2%) had from unprotected source of which 314(53%) did not use any water treatment practice at household level. Majority of the study participants 559(94%) had latrine of them 251(42.3%) had shared VIP latrine while 143(24.1%) had shared latrine /wooden slap (Table 2).

Table 2: Environmental Health Related condition of the study participants in selected health facilities of Addis Ababa, May 2013.

Variable	N=593	(%)
Water supply		
Unprotected water source	19	3.2
Protected water source	574	96.8
Water treatment practice		
Yes	279	47
No	314	53
Presence of Latrine		
Yes	559	94.3
No	34	5.7
Types of Latrine		
Private pit / wooden slab	39	6.6
Private slab / cement slab	124	20.9
Shared latrine/wooden slab	143	24.1
Shared VIP latrine	251	42.3
Other	36	6.1
Total	**593**	**100**

5.3 Eating Habit and Dietary information

The study also sought to asses eating habit and dietary information of PLWHA and it was found that over half 351(59.2%) of the study participants were eating three meals per day, 162(27.3%) were eating greater than three meals per day, 47(7.9%) were eating two meals a day, whereas the remaining 26(4.4%) were eating less than one meal a day. The study revealed that majority 539(90.9%) of the respondents were eating breakfast daily, 35(5.9%) were eating breakfast sometimes, whereas 19(3.2%) had never eaten breakfast, 543(91.6%) of the respondent were eating lunch daily, 43(7.3%) were eating lunch sometimes, whereas 7(1.2%) had never eaten lunch. About 142(23.9%) of the respondent were eating snack daily, 299(50.4%) were eating snack sometimes, whereas 152(25.6%) had never eaten snack; 540(91.1%) of the respondent were eating dinner daily, 45(7.6%) were eating dinner sometimes, whereas 8(1.3%) had never eaten dinner. About 386(65.1%) of the respondent were eating fast foods daily, 190(32%) were eating fast foods sometimes, whereas 17(2.9%) were never eat fast foods in preceding 24 hours of the survey (Table 3).

Table 3: Eating habit and dietary information of the study participants in selected health facilities of Addis Ababa, May 2013.

Variable	*N=593*	%
Frequency of eating meal per day		
Less than one meal a day	26	4.4
One meal a day	7	1.2
Two meal a day	47	7.9
Three meal a day	351	59.2
Greater than three meal	162	27.3
Breakfast		
Daily	539	90.9
Sometimes	35	5.9
Never	19	3.2
Lunch		
Daily	543	91.6
Sometimes	43	7.3
Never	7	1.2
Snack		
Daily	142	23.9
Sometimes	299	50.4
Never	152	25.6
Dinner		
Daily	540	91.1
Sometimes	45	7.6
Never	8	1.3
Total	**593**	**100**

From the study, it was also observed that 334 (56.3%) of the study participants spent their time in sleeping six to nine hours a day, 154(26%) spent less than six hours a day whereas 105(17.7%) spent in sleeping greater than nine hours a day. Majority of the respondents 463(78.1%) were walking as means of travel for day to day activates, 103(17.4%) used driven car as means of travel and 27(4.6%) used cycle as means of travel for day to day activities (Table 4).

Table 4:- Sleeping pattern and walking style of the study participants in selected health facilities of Addis Ababa, May2013.

Variable	***N=593***	**%**
Time spent in sleeping		
Less than six hours a day	154	26.0
Six to nine hours a day	334	56.3
Greater than nine hours a day	105	17.7
Way of travel for day to day activates		
Walking	463	78.0
Cycle	27	4.6
Car	103	17.4
Total	**593**	**100**

5.4 Clinical condition and duration of ART

Assessment of clinical condition of the study participants indicated that majority of respondents 555(93.6%) were currently taking ART medication, of them 214(36.1%) were taking ART treatment for two to three years, 211(35.6%) took for more than five years, whereas 100(16.9%) took for less than one year. Majority of respondents 549(92.6%) know their current CD4 count, only 60(10.1%) of the study participants were admitted and 347 (58.5%) had weight gain in the last three months after ART. The average weight gain and loss were 4.0 kg and 5.8 kg respectively (Table 5)

Table 5: Clinical condition, Weight gain and loss after ART medication of study participants in selected health facilities of Addis Ababa, May 2013.

Variable	N=593	%
Currently taking ART		
Yes	555	93.6
No	38	6.4
Duration on ART Treatment		
Less than One year	100	16.9
Two to three years	214	36.1
Greater than five years	211	35.6
Not known	37	6.2
Admission in the Hospital in the last three month		
Yes	60	10.1
No	533	89.9
Weight gain within the last three month after ART medication		
Yes	347	58.5
No	246	41.5
Weigh Loss within the last three month after ART medication		
Yes	246	41.5
No	347	58.5
Weight gain in kg		
<= 5	222	37.4
5 - 10.99	72	12.1
11+	53	8.9
Weight loss in kg		
<= 5	190	32
6 - 9.99	51	8.8
10+	5	0.8
Total	**593**	**100**

5.5 Anthropometric data

The assessment of anthropometric measurement indicates that the mean and standard deviation of MUAC were 161.7± (8) mm. The mean weight, height, and BMI, 56.2 ± (9.3) kg, and 242± (31.5) mm, 21.5±3.4 kg/m^2 respectively (Table 6).

Table 6: Anthropometric result of the study respondents in selected health facilities of Addis Ababa, May 2013.

Variable	Mean	Std. Deviation	Minimum	Maximum
BMI(kg/m^2)	21.5	3.4	16.0	32.0
Height(cm)	161.7	8.1	130.0	182.0
MUAC(mm)	242.0	33.5	150.0	350.0
Weight(kg)	56.2	9.3	31.0	94.0

5.6 Nutritional findings based on MUAC and BMI

From the study we observed that 127 (48.4%) male respondents' were under nourished based on MUAC (<230cm), whereas 80 (32.5%) based on BMI (BMI ≤18.5 kg/m^2). About 223(64.3%) of female respondents' were undernourished (MUAC<220cm) based on MUAC, whereas 101 (29.1%) of female respondents are undernourished base on BMI (BMI ≤18.5 kg/m^2) (Table 7). Males are more obese than female in this study about 20 (8.1%) were as 16(4.6%) for female (Table7)

Table 7: Nutritional status based on of MUAC and BMI by sex of the study participants in selected health facilities of Addis Ababa, May 2013.

Variable	Nutritional status	N=593	%
MUAC			
Male	Normal (>231mm)	**119**	**51.6**
	Undernourished (<230mm)	127	48.4
	Total	246	100
Female	Normal (>221mm)	223	64.3
	Undernourished (<220mm)	124	35.7
	Total	347	100
BMI			
Male	CED (≤18.5kg/m^2)	80	32.5
	Normal(18.5 -24.9 kg/m^2)	92	37.4
	Overweight(25.0 -29.9kg/m^2)	54	22
	Obese(≥30.0kg/m^2)	20	8.1
	Total	246	100
Female	CED (≤18.5kg/m^2)	101	29.1
	Normal(18.5 -24.9 kg/m^2)	137	39.5
	Overweight(25.0 -29.9kg/m^2)	93	26.8
	Obese(≥30.0kg/m^2)	16	4.6
	Total	347	100

5.7 Sensitivity and specificity of MUAC and BMI

Receiver operating characteristic curve analysis of sensitivity and specificity of MUAC using the cutoff point of 240 and 220 for male and female is computed respectively using Medcalc version 12 Software. Subjects were aged between the age 18 and 49 years with a mean (SD) age of 34± (7.2) years. Subjects' nutritional status (NS) based on BMI and MUAC is provided (Table 7). The prevalence of CED for male and female (BMI <18.5) was 32.5%, 29.1%, and (MUAC <230 mm&, 220mm), 48.4%, 35.7% in male and female respectively. The sensitivity and specificity of MUAC for Female with optimal criteria of ≤220 were 91.09% and 86.99%, respectively whereas for Males MUAC with optimal criteria of ≤230 were 95% and 74% respectively.

Table 8: Cross tabulation of Nutritional classification of the study respondents in selected health facilities of Addis Ababa, May 2013

	Nutritional classification	**CED BMI (≤18.5kg/m2)**	**Well nourished BMI (>18.5kg/m2)**	**Total**
Female MUAC <220mm	CED	92	32	124
	Well nourished	9	214	223
	Total	124	223	347
Male MUAC <230mm	CED	76	43	119
	Well nourished	4	123	127
	Total	80	166	246

Receiver operating characteristic curve analysis of sensitivity and specificity of MUAC for Female with optimal criteria of ≤226mm were 94.86% and 85.9% respectively whereas for Males MUAC with optimal criteria of ≤234 were 94.8% and 68.5% respectively.

Figure 2: Receiver operating characteristic curve of MUAC of ***Female*** *respondents in selected health facilities of Addis Ababa, May 2013.*

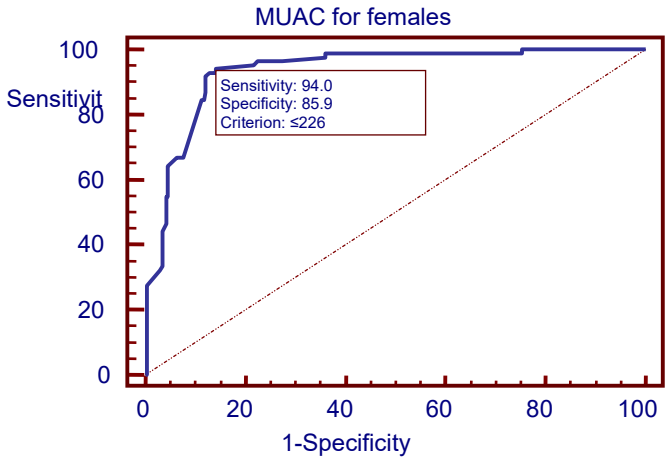


Table 9: Results of receiver operating characteristic curve analyses of ***mid-upper arm circumference*** *with* ***sensitivity and specificity*** *of* ***female*** *respondents in selected health facilities of Addis Ababa, May 2013.*

Criterion	Sensitivity	95% CI	Specificity	95% CI	PPV	NPV	YI
≤226mm	**94.05**	**86.7 - 98.0**	**85.93**	**81.1 - 89.9**	**71.2**	**97.5**	**0.135**
≤230mm	95.24	88.3 - 98.7	78.33	72.9 - 83.2	61.9	97.8	0.184
≤231mm	96.43	89.9 - 99.3	77.57	72.0 - 82.5	61.4	98.3	0.183
≤239mm	96.43	89.9 - 99.3	72.62	66.8 - 77.9	56.6	98.2	0.219
≤240mm	97.62	91.7 - 99.7	63.88	57.8 - 69.7	50	98.6	0.277
≤240.5mm	98.81	93.5 - 100.0	63.88	57.8 - 69.7	50.3	99.3	0.27

The results of ROC curve analyses for Female MUAC are presented (Table 9), with the sensitivity (SN), specificity (SP), positive predictive value (PPV) and negative predictive value (NPV) for each MUAC value to identify CED.

*Table10: Estimated **specificity** at fixed **sensitivity** of **Female** respondents in selected health facilities of Addis Ababa, May 2013.*

Estimated specificity at fixed sensitivity			
Sensitivity	**Specificity**	**95% CI[a]**	**Criterion**
80	89.56	85.42 to 93.46	≤221.7467
90	87.83	81.90 to 92.02	≤223.43
95	79.85	58.92 to 89.35	≤229.2
97.5	**64.75**	**18.77 to 82.56**	**≤239.9**
Estimated sensitivity at fixed specificity			
Specificity	**Sensitivity**	**95% CI[a]**	**Criterion**
80	94.98	88.78 to 98.79	≤229.12
90	77.92	61.77 to 95.34	≤221.63
95	64.83	36.60 to 78.47	≤219.23
97.5	31.17	18.93 to 55.94	≤209.7964

*Figure 3: Receiver operating characteristic curve analysis of MUAC of M**ale** respondents in selected health facilities of Addis Ababa, May 2013.*

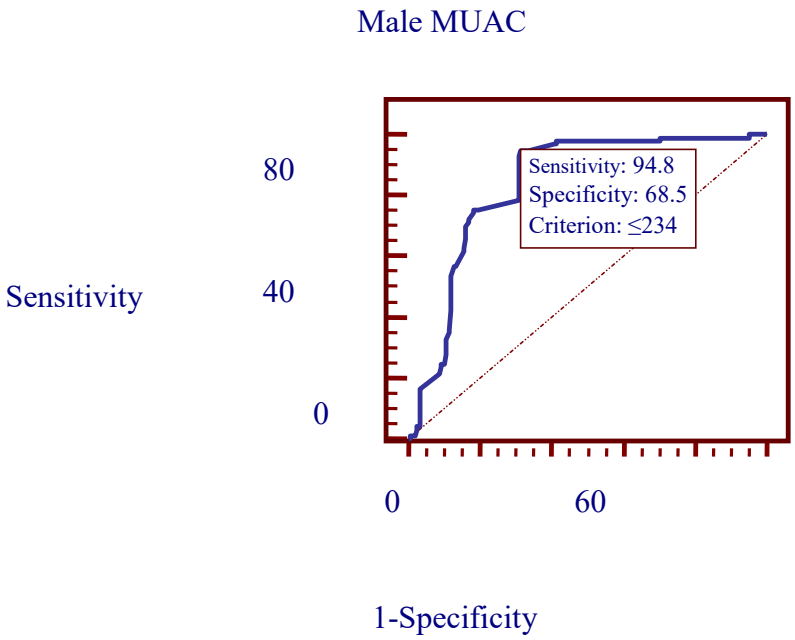


*Table 11: Results of receiver operating characteristic curve analyses of **mid-upper arm circumference** with **sensitivity and specificity** of Male respondents in selected health facilities of Addis Ababa, May 2013.*

Criterion	Sensitivity	95% CI	Specificity	95% CI	PPV	NPV	YI
≤234mm	**94.85**	**88.4 - 98.3**	**68.46**	**60.3 - 75.8**	**52.7**	**97.3**	**0.258**
≤239mm	94.85	88.4 - 98.3	66.44	58.3 - 74.0	51.1	97.2	0.273
≤240mm	96.91	91.2 - 99.4	59.06	50.7 - 67.0	46.7	98.1	0.316
≤242mm	96.91	91.2 - 99.4	58.39	50.0 - 66.4	46.3	98.1	0.32
≤244mm	97.94	92.7 - 99.7	58.39	50.0 - 66.4	46.5	98.7	0.315

The results of ROC curve analyses of Male MUAC are presented (Table 11), with the sensitivity (SN), specificity (SP), positive predictive value (PPV) and negative predictive value (NPV) for each MUAC value to identify CED.

Table 12: Estimated specificity at fixed sensitivity of Male respondents in selected health facilities of Addis Ababa, May 2013.

Estimated specificity at fixed sensitivity			
Sensitivity	**Specificity**	**95% CI[a]**	**Criterion**
80	69.13	59.65 to 79.87	≤230.32
90	69.13	61.07 to 76.36	≤232.55
95	65.89	27.52 to 75.17	≤239.075
97.5	58.39	4.70 to 73.15	≤243.15
Estimated sensitivity at fixed specificity			
Specificity	**Sensitivity**	**95% CI[a]**	**Criterion**
80	75.4	60.63 to 85.57	≤228.0941
90	24.74	13.22 to 60.82	≤212.45
95	18.07	1.78 to 28.04	≤209.3062
97.5	2.53	0.00 to 22.99	≤187.525

Logistic regression analysis demonstrated that MUAC had a significant positive impact on BMI; the percentage of the variation in BMI explained by MUAC was 71%. 9. Regression analysis demonstrated that overall, 82.11% of cases of CED were correctly classified by using MUAC. The use of MUAC for female correctly diagnosed 74.2% of cases of CED and 96% with normal nutritional status and the use of MUAC for male correctly diagnosed 96.9% of cases of CED and 63.9% with normal nutritional status. Similar study done on MUAC correctly diagnosed 82.35% of cases of CED and 81.82% of women with normal nutritional status.

6. DISCUSSION

The present study found that thirty five percent of women based on MUAC (≤220mm) and twenty-nine percent based on BMI (less than 18.5 kg/m^2) were Undernourished whereas forty-eight percent of men based on MUAC (≤230mm) and thirty–two percent based on BMI were undernourished. Since the study aimed at detecting the sensitivity and specificity of MUAC in detecting under nutrition of PLWH. The determination of an adult population's Nutritional Status is recognized as of prime importance when assessing for population health and wellbeing. There are different modalities for this, BMI is most often used and MUAC is also recognized as a useful and simpler tool for screening adult individuals for poor nutritional status(57) and has been shown to accurately reflect adult nutritional status as defined by BMI(58).

The prevalence of CED (BMI ≤18.5) was 32.5% and 29.1% for male and female, were as the prevalence of under nutrition based on (MUAC ≤230 mm&, ≤220mm) were 48.4% and 35.7% in male and female respectively. The sensitivity and specificity of MUAC for Female and Male with optimal criteria of ≤220mm and ≤230mm were 91.9% and 95% respectively whereas for Males MUAC with optimal criteria of ≤234mm were 94.8% and 68.4% respectively. The sensitivity and specificity of MUAC for Female and male with optimal criteria of ≤224mm were 92.8% and 87.0%, respectively whereas for Males MUAC with optimal criteria of ≤234mm were 94.8% and 68.4% respectively.

There was a significant positive association between MUAC and BMI, regression analysis demonstrated that MUAC had a significant positive relation with BMI; the percentage of the variation in BMI explained by MUAC was 71%. The binary Logistic regression analysis demonstrated that overall, 82.2% of cases of CED were correctly classified by using MUAC. The use of MUAC for female correctly diagnosed 74.2% of cases of CED and 96% with normal nutritional status and the use of MUAC for male correctly diagnosed 96.9% of cases of CED and 63.9% with normal nutritional status this finding is similar with other studies done on MUAC which correctly diagnosed 82.4% of cases of CED and 81.82% of women with normal nutritional status.

The present study demonstrated a significant positive correlation between MUAC and BMI(r=.71, p<0.01). MUAC value of 239 mm was found to be most appropriate in identification of female subjects with CED, and a value of 242 mm was most useful in identifying men with CED. Both of these values are higher than the internationally recommended men's MUAC cut-off value of 230 mm and females 220mm.

It is also recognized as an effective means of screening for poor NS in adults(59-57). However, the recommended MUAC cut-off value of 230 mm to define in men(5) may not be the most appropriate for all ethnic groups. A study from Nigeria(60) reported that a MUAC cut-off point of 230 mm was optimal for the north of the country, while a 240 mm Cut-off point was more appropriate for the south. Thus, there is a need to establish ethno-specific MUAC cut-off points. Similarly, a cut-off point of 240 mm was reported to be suitable in a recent study from the south of India(61); however, a recent study(62) of non-tribal adult slum dwellers of Bengalee ethnicity in West Bengal, India, reported a MUAC value of 240 mm to be the most appropriate cut-off point for identifying CED (BMI<18.5). A possible reason for cut-off points being higher than that suggested by James et al(5) is that persons of South Asian origin (eg the Oraon) have higher levels of regional adiposity (irrespective of BMI) compared with other ethnic groups(63)-(64).

Under nutrition is more prevalent in males than females this might be due to the peripheral adiposity of females, Individuals with a MUAC less than 240 mm were approximately twice as likely to report recent illness compared with those with a MUAC equal to or above 240 mm(62). Again in this study, MUAC close to 240 mm was appropriately sensitive to reported illness. However, this study combined with the similar findings discussed, suggests an urgent need to revisit BMI and MUAC cut-off values as the measures of CED and under-nutrition.

The area under curve (AUC) was 0.93 (p<0.001) (Table 9). A MUAC value of ≤ 239mm for female was identified as the best cut off to identify CED (BMI <18.5kg/m^2) with SN and SP of 96.43% and 72.62%, respectively. The PPV was 56.6(CI 89.9-99.3) with the highest NPV 98.2 (CI 66.8-77.9), thus having the highest YI of 0.21.

Another result of ROC curve analyses for Male MUAC are presented, with the sensitivity (SN), specificity (SP), positive predictive value (PPV) and negative predictive value (NPV) for each MUAC value to identify CED. The area under the curve (AUC) was 0.83 (p<0.0001) (Table 11). A MUAC value of <= 242mm for males was identified as the best cut off to identify CED (BMI <18.5) with SN and SP of 96.91% and 58.39%, respectively. The PPV was 46.3(CI 91.2-99.4) with the highest NPV 98.1 (CI 50.0-66.4), thus having the highest Youden Index of 0.32.

The mean BMI in this study for age group15-49 is 21.85 kg/m2 and 21.02 kg/m2 for women and men respectively. Forty-two percent of women have a normal BMI (between 18.5 and 24.9 kg/m2), while 29 percent of women are thin or undernourished (BMI less than 18.5 kg/m2) and 7 percent are overweight or obese (BMI 25 kg/m2 or above) this finding is supported by other studies except undernourished27% (49). Thirty –two percent of men have normal BMI (between 18.5 and 24.9 kg/m2), while 39.4 percent of men are thin or undernourished (BMI less than 18.5 kg/m2) and 4.5 percent are overweight or obese (BMI 25 kg/m2 or above).

7. STRENGTHS AND LIMITATIONS OF THE STUDY

7.1 Strengths of the study

It is the first in its type and can be used as a base line for further researches in the area. The study used Probability sampling method so that it is possible to generalize for the whole population.

Data was collected from different hospitals to catch heterogynous group and having sufficient sample size.

This study was done in the absence of similar study done before.

7.2 Limitation of the study

One obvious limitation of this study was that the data came from one geographical location Addis Ababa. Therefore, using the standard cut-off point for this specific population might be not feasible and for wider use, further validation studies are needed with larger sample sizes Anthropometric error might occur. In addition, similar studies are needed with female and male participants to confirm the recommended cut-off points of MUAC of 220 mm and 240mm in determine a more appropriate and efficient cut-off point. The study doesn't consider the ethnic difference of respondents.

8. CONCLUSIONS

Use of MUAC with higher cut-off will increase identification of those at risk of dying in low income setting. MUAC cut-off points used in this study for CED in male and female were 220 mm and 230 mm, respectively. Nevertheless, because CED and illness are associated phenomena, it is proposed that a MUAC of close to 242 cm & 239cm for male and female respectively should be used as an efficient cut-off point when screening for clinical undernourishment among the adult PLWHIV. The sensitivity and specificity of MUAC using cut-off point 230 &220 mm for male and female are having less sensitive and specific which indicates that the cut of point we used are accurate for both sexes. MUAC measurement is suggested to be more suitable in limited-resource situations during a short-term population screening. It is also proposed that further work be undertaken among different location to test conventional cut offs and sensitivity and specificity for MUAC and establish appropriate and specific alternatives. The MUAC is a much simpler measure compared with BMI, requiring no calculations by busy healthcare workers such as nurses, therefore reducing the chances of error.

The drawback of using the standard MUAC cut off point for this specific population group might increase the exclusion error. In this way, use of the proposed revised cut-off point is likely to have large public health implications, especially with respect to primary healthcare related to CED and morbidity.

9. RECOMMENDATIONS

- Revising the cut off pointes of both BMI and MUAC to identify CED is necessary to improve the quality of care for the PLWHIV to determine for the need of supplementation food.
- MUAC is best predictor of CED than BMI so using MUAC as both admission and discharging criteria.
- It is recommended that MUAC cut-off points should be ≤242mm for male and ≤ 239mm for female as best cutoff pointes to identify CED.
- Further nationwide study is recommended.
- MUAC is a feasible and appropriate anthropometric measurement that best suit for screening.

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ANNEX I: -

INFORMATION SHEET- ENGLISH VERSION

PART I: INFORMATION SHEET

Introduction

I am data collector -----, working for Mr. Tesfaye Abrhame from Addis Ababa University School of Public Health for the partial fulfillment of Masters in public Health. We are doing research on HIV/AIDS and NUTRITION which is very common problem in this country. I am going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research. There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask me.

Purpose of the research

Ethiopia has one of the world's highest Numbers of under nutrition. Malnutrition and HIV/AIDS exacerbate one another. PLHIV are more likely to become malnourished because of many reasons. Malnutrition contributes to immune system impairment, making the body vulnerable to frequent illness and increasing its energy and nutrient demand so in order to plan and implement different intervention strategy the nutritional status of this specific population group is mandatory. The reason of this study is to find out the most simple and easy way of assessing the nutritional status.

Type of Research Intervention

This research will involve take some measurements including mid-upper arm circumference, weight and height from you and we would like to ask you few questions about your feeding practice, eating and health habits and antiretroviral treatment.

Participant selection: We are inviting all adults with HIV/AIDS and have follow up in this hospital.

Voluntary Participation

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. Whether you choose to participate or not, all the services you receive at this clinic will

continue and nothing will change. If you choose not to participate in this research project, you will get the treatment that is routinely offered in this clinic/hospital, and we will tell you more about it later. You may change your mind later and stop participating even if you agreed earlier.

Benefits

There may not be any benefit for you but your participation is likely to help us find the answer to the research question. There may not be any benefit to the society at this stage of the research, but future generations are likely to benefit.

Incentives: There is no incentive provided to you as being participated in the research.

Confidentiality

The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no-one but the researchers will be able to see it. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key.

Sharing the Results

The knowledge that we get from doing this research will be shared with you through community meetings before it is made widely available to the public. Confidential information will not be shared. There will be small meetings in the community and these will be announced. After these meetings, we will publish the results in order that other interested people may learn from our research.

Right to Refuse or Withdraw

You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice and all of your rights will still be respected.

Who to Contact: If you have any questions you may ask them now or later, even after the study has started. If you wish to ask questions later, you may contact any of the following:

Principal investigator: - Tesfaye Abrhame

Tel: 0911711038, P.Box: 10410

Email: tesfakal.2009@gmail.com

PART II: Certificate of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Print Name of Participant_____

Signature of Participant _____

Date _____

Day/month/year

If illiterate

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness_____ **AND** **Thumb print of participant**

Signature of witness _____

Date _____

Day/month/year

Print Name of Researcher/person taking the consent_____

Signature of Researcher /person taking the consent_____

Date _____

Day/month/year

ANNEX II:

ENGLISH VERSION QUESTIONNAIRES

ADDIS ABABA UNIVERSITY SCHOOL OF PUBLIC HEALTH

Survey Questioners to Assess Nutritional Status of People with HIV in Addis Ababa

PART ONE: SOCIO-DEMOGRAPHIC AND ECONOMIC RELATED QUESTIONNAIRE
ID. No_____

NO	QUESTION	RESPONSE	REMARK
101	Age	_____	
102	Sex of the Respondent	1. Male 2. Female	
103	Educational status?	1. Illiterate and never Write and Read 2. Attended formal Education possible to read and write 3. 1-6 Grade completed 4. 7-12Grade completed 5. Higher Grade completed	
104	Occupation of Respondent (More than one answer is possible)	1. No occupation 2. Governmental/private employee 3. Student 4. Housewife only 5. Private worker 6. pensioner 7. Other (specify)_____	
105	Average monthly income of the House Hold	_____ Birr	
106	Marital status	1. Single 2. Married 3. Divorced 4. Widowed	

		5. Not interested to Explain	
107	What is your religion	1. Orthodox 2. Muslim 3. Protestant 4. Catholic 5. Others(specify_____	
108	Ethnicity	1. Amhara 2. Gurage 3. Oromo 4. Tigre 5. Others (specify)_____	
109	Total family size (How many person live in the HH?)	In number_____	
110	How many Under five children are Living in the house?	In number_____	
PART TWO: ENVIRONMENTAL CONDITION RELATED QUESTIONNAIRE			
201	What is your main source of drinking water?	1. River 2. Pond 3. Un protected spring 4. Protected spring 5. Private well 6. Public tap 7. Other (specify)_____	
202	Do you treat water in any way to make it safer?	1. Yes 2. No	
203	Do you have latrine?	1. Yes 2. No	If No go to Q 205
204	Type of latrine you use?	1. Private pit / wooden slab	

		2. Private slab / cement slab 3. Shared latrine/wooden slab 4. Shared VIP latrine 5. Other (Specify)_____	
205	How do you dispose garbage?	1. Open field disposal 2. In a pit 3. Common pit 4. Composting 5. Burning 6. Other (specify)_____	
PART THREE: EATING HABIT & DITERY INFORMATION RELATED QUESTIONNAIRE			
301	How many times you normally eat per day?	1. Less than one meal a day 2. One meal a day 3. Two meal a day 4. Three meal a day 5. Greater than three meal	
302	How often do you eat Breakfast?	1. Daily 2. Sometimes 3. Never	
303	How often do you eat Lunch?	1. Daily 2. Sometimes 3. Never	
304	How often do you eat Snack?	1. Daily 2. Sometimes 3. Never	
305	How often do you eat Dinner?	1. Daily 2. Sometimes 3. Never	
306	How often do you eat Fast	1. Daily	

	foods?	2. Sometimes 3. Never	
307	Hours spent with sleeping?	1. Less than six hours a day 2. Six to nine hours a day 3. Greater than nine hours a day	
308	What means do you use to go from home to school?	1. Walking 2. Cycle 3. Driven	
PART FOUR: CLINICAL CONDITION AND ART RELATED QUESTIONNAIRE			
401	Are you currently taking ART?	1. Yes 2. No 3. Don't know /not sure/	If no go to Q403
402	How Long Have you been on ART?	1. Less than one years 2. 2-5 years 3. Greater than 5 years 4. Not known	
403	Do you know your current CD4 count ?	1. Yes 2. No 3. Do not know/not sure/	If no go to Q405
404	If yes, how many?	_____ in kg.	
405	Have you been admitted in the past three month?	1. Yes 2. No 3. Do not know/not sure/	
406	Is there any Weight gain After HART?	1. Yes 2. No 3. Not known	If no go to Q408
407	If yes, can you estimate the weight gain?	_____ in kg.	

408	Is there any Weight Loss After HAART ?	1. Yes 2. No 3. Not known	If no go to Q501
409	If yes, can you estimate the weight loss?	_____ in kg.	
PART FIVE: ANTROPOMETRIC MESURMENT			
501	Height(cm)	Reading 1___ Reading2__ Average___	
502	Weight(cm)	Reading 1___ Reading2__ Average___	
503	MUAC (cm)	Reading 1___ Reading2__ Average___	
504	Which Anthropometric measurement is Convenient to screening?	1.MUAC 2.Wt 3.Ht	
505	Which Anthropometric measurement would you recommend and why?	1.MUAC 2.Wt 3.Ht	