Alice Gibron Temu

Needs and Possibilities for Improving Maternal Nutrition in Rural Tanzania

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Needs and Possibilities for Improving Maternal Nutrition in Rural Tanzania

A dissertation submitted to the faculty of Agricultural, Nutritional, and Environmental Science (FB 09) in partial fulfillment for the requirements of the Doctor of Home Economics and Nutritional Science of University of Giessen, Germany

by:

Alice Gibron Temu
from Dar es Salaam, Tanzania

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Examination Committee

Head of the Committee	Prof. Dr. Annette Otte
Supervisor	Prof. Dr. med. Michael Krawinkel
Co-supervisor	Prof. Dr. Ingrid Hoffmann
Additional Examiner	Prof. Dr. Claus Leitzmann
Additional Examiner	Prof. Dr. Siegfried Bauer

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Abbreviations

MDGs	Millennium Development Goals
LDC	Least Development Country
GNI	Gross National Income
GDP	Gross Domestic Product
HBS	House Budget Survey
NBS	National Bureau of Statistics
DHS	Demographic Household Survey
TFNC	Tanzania Food and Nutrition Centre
WHO	World Health Organization
UNICEF	United Nations International Children's Emergency Fund
JNSP	Joint Nutrition Support Program
FAO	Food and Agriculture Organization
m	Meter
mm	Millimeter
MUAC	Mid-Upper Arm Circumference
Hb	Hemoglobin
sTfR	Soluble Transferrin Receptor
RBP	Retinol Binding Protein
CRP	C-Reactive Protein
AGP	Acid Glycoprotein
g/L	Gram per Liter
mg/L	Milligram per Liter
µmol/L	Micromole per Liter
g/dl	Gram per Deciliter
kg/m^2	Kilogram per Square Meter
BMI	Body Mass Index
VAD	Vitamin A Deficiency

1. Introduction

Maternal mortality remains high, particularly in developing countries where 99% of the deaths occur. Each year more than half a million women die from treatable or preventable complications during childbirth. Little progress has been made in saving women's lives between 1990 and 2005. Globally maternal mortality has decreased by less than 1 percent per year during this period. Although other regions such as Northern Africa, Latin America, and the Caribbean as well as South-East Asia managed to reduce their maternal mortality ratio by one third, in Sub-Saharan Africa, the region with the highest level of maternal mortality, progress made was negligible. The fact that maternal deaths are due to multiple causes– hemorrhages, hypertensive disorders, infections, obstructed labor, anemia, abortions, and other causes– no single intervention can address maternal problems unless well planned surveys come up with location-specific findings. Although reproductive health care services– prenatal, antennal, and postnatal health care services as well as attendance at delivery by health personnel- could indeed prevent most of these deaths, other causes, which constitute 25% of the causes of maternal deaths, should be given attention.

Improving women's nutritional status, especially during their childbearing years, is an important element of reproductive health (UN, 2007; UN 2008; Mackay, 2000). Among others, efforts to improve maternal health and nutrition should include the prevention and treatment of parasitic infections, in addition to the improvement of dietary intake throughout the life cycle and the elimination of micronutrient deficiencies. Micronutrient deficiencies, especially of iron, vitamin A, and iodine, are the most common forms of malnutrition problems worldwide caused by insufficient dietary intake. Globally, more than two billion people are suffering from micronutrient malnutrition, whereby women and children are at a high risk (WHO/UNICEF, 1995; WHO/UNICEF/ICCDD, 1994; WHO, 1992).

Inadequate maternal nutrition contributes to low pregnancy weight gain, low fetal growth, and an increased risk for low birth weight (Rush, 1988; Rush, 1980). About 16% of all live births worldwide have low birth weight; more than 90% of these are in low

income countries, particularly, in Asia and Sub-Saharan countries (Pojda, 2000). More than two-third of births in many parts of these countries are not reported, because many of the deliveries occur in homes or small health clinics. Thus, data for the examination of low birth weight trends in these countries are limited and of questionable quality when available. This may be caused by faulty or unadjusted scales as well as others coming for measurement several days after the delivery. This may therefore result in an underestimation of the actual prevalence of low birth weight, since people with lower income, who are at higher risk, may less likely be included in a hospital or urban-based data set (Ramakrishnan, 2004).

Although since the late 1980s maternal health and reduction of maternal mortality has been one of the key issues discussed in several international conferences, including the United Nations Millennium Summit involving about 200 United Nations members and more than 20 international organizations held in 2000, it has remained high, especially in Sub-Saharan and Southern Asian countries, where most deaths occur. Maternal malnutrition continues to be a major contributor to adverse reproductive outcomes. Poor nutrition is known to be one of the major causes of low birth weight, especially in developing countries. The ratio of a woman's risk of dying from treatable or preventable complications during pregnancy and childbirth over the course of her lifetime in Africa is 332 times higher compared to developed regions; 1 in 22 and 1 in 7,300, respectively (UN, 2006; UN 2008). Maternal nutrition factors both before and during pregnancy account for more than 50% of the causes of low birth weight in developing countries (Kramer, 1987). Many other non-nutritional factors such as infections and poor housing quality are also known to account for low birth weight. Nevertheless, at the moment little is known about the interaction of these factors with nutrition during pregnancy, despite the awareness of the role of the interaction between nutrition and infection in human health (Ramakrishnan 2001).

Tanzania has set and applied different policies in trying to reduce maternal and child mortality. The Tanzanian health and nutrition policy aims to improve the health and well-being of all people in need with emphasis on the most vulnerable groups – women and children – by providing adequate maternal and child health services, promoting

adequate nutrition, and controlling communicable diseases in urban as well as rural areas (Tanzania national Website, 2009). Nutrition policy seeks to enable all people not only to produce but also to consume foods that adequately meet their nutritional needs by strengthening the supply of foods from the market to the household level and hence improving the nutritional status of the whole country, especially of women and children. The policy also includes the formulation and development of research which facilitates solving these kinds of problems (Arvidson, 2006; Ministry of Health Tanzania, 2003).

Despite the policy set and efforts made to achieve high rates of coverage in antenatal care (78%), 1-year-old children immunization (90%), and full coverage of free vitamin A supplements for under-five children (95%), the general health and nutritional status of the population of Tanzania remains poor. Maternal and child malnutrition has been unacceptably high for more than two decades. The percentage of women delivering under assistance of skilled health workers has been low and stagnated at 43% since 1990. Maternal mortality and low birth weight have not significantly improved, remaining high at 580/10,000 live births and 10% respectively, also since 1999. Though infant and under-five mortality rates have shown a decreasing trend from 102 to 74 and 161 to 118 between 1990 and 2006 respectively, Tanzania is not on track to meet the Millennium Development Goals (MDGs) of reducing infant and under-five mortality rate by two-thirds by the year 2015 (UN 2008; UNICEF 2009).

Unless adequate, urgent, multi-sectored actions take place to address and improve all components of the causes of maternal malnutrition, good maternal nutrition will remain a challenge, especially in the rural areas of Tanzania where the number of people using improved drinking water sources, using adequate sanitation facilities, receiving adequate antenatal and postnatal health care services, receiving full coverage of immunization and supplementation, and where deliveries attended by skilled health workers are still low compared to their urban counterparts (UN 2008; UNICEF 2009).

This study investigates problems facing women of childbearing age in rural areas of Tanzania, and thence outlines special needs for possible interventions that are feasible, sustainable, and implementable to improve maternal health and nutrition.

Justification and objective of the study

The current understandings and experiences with the strategies of reducing maternal malnutrition have shown that no single approach can be effective in all settings. Since malnutrition is due to multiple causes, an appropriate solution to this problem requires multi-disciplinary actions involving various sectors. Therefore assessment of the characteristics of the women of reproductive age in rural areas – demographic and socioeconomic structure, nutritional deficiencies, and health needs – is crucial for understanding the special needs and possible interventions that could be implemented for women of childbearing age in rural areas of Tanzania. Thus this study was conducted to map the current health and nutritional status of the women of reproductive age in the Iringa Rural district, Tanzania in order to develop feasible and sustainable strategies for maternal nutrition interventions suitable for rural populations in Tanzania.

Overall Objective

The overall objective of this study was to explore needs and possibilities for improving maternal nutrition of populations in rural areas of Tanzania.

Specific Objectives

Specific objectives of this study focused on the determinants of nutritional status among women of reproductive age (women aged between 15 and 44 years) in Iringa Rural district, Tanzania:

1. To assess food availability, food consumption and nutrient intake of the women

2. To study the women's knowledge, awareness and perception towards the importance of micronutrients for pregnant women and birth outcomes.

3. To assess availability, accessibility and utilization of health care services among women in the study area.

Background of the study area

Economy

Tanzania is one of the Least Developed Countries (LDC) with a per capita gross national income (GNI) of $ 340, and a 5.9% average annual inflation rate. The population of people living below $ 1 a day in Tanzania is estimated at 58% (Tanzania national Website, 2009; Tanzania National Website, 2007). Agricultural activities have been the major source of the country's economy, accounting for about 50% of the nation's income, and providing up to 80% of the country's employment. The country's annual gross domestic product (GDP) per capita and real GDP growth rate is estimated at 6.8% (DFAT, 2007). However with the average annual population growth rate of more than 2%, the annual per capita growth rate may adjust to a lower value (Tanzania National Website, 2007a).

Geography

Tanzania is located between 29°50´ and 45°40´ longitudes east and between 1°00´ and 11°50´ latitudes south. The country borders Kenya, and Uganda to the north; Zambia, Malawi, and Mozambique to the south; Rwanda, Burundi, and the Democratic Republic of Congo to the west; and the Indian Ocean to the east (National Bureau of Statistics, 2005). The country's surface area is about 944,800 km² (94.5 million ha), where 99.7% of the area is the mainland, and the remaining 0.3% is the island of Zanzibar. About 40 million ha is rain-fed, arable land of which only 6.2 million ha is actually cultivated, with an increase of about 5% per year. Of the cultivated land, more than 80% is still cultivated by hand hoes.

Population

The population was estimated at 31.2 million in 1998 with an annual growth rate of 2.8 percent (Tanzania National Website, 2007). The population distribution by age and sex indicated by the National Bureau of Statistics in 2005 showed that 47% of the population is below the age of 15. This is said to be due to the high level of fertility in the past, which in turn puts a substantial burden on people between ages 15 and 64 (the economically productive age) to support the younger and older; 47% and 4%,

respectively (Tanzania National Website, 2009). Up until 2005 the population had increased to 37.5 million, with a crude birth rate of 37, a crude death rate of 17, and a life expectancy of 46 years, and reached the current population of 39.3 million, with a 2.1% population growth rate, a birth rate of 36, and a death rate of 13.4 (DFAT, 2007; Tanzania National Website, 2009; CIA, 2007).

Education

Education is one of the key factors affecting lifestyle, health, and nutrition status. Previous studies have shown that among other factors, the level of education has a strong effect on reproductive behavior, attitude, and practice towards family health and hygiene, mortality, and morbidity of infants and children.

The formal education system in Tanzania consists of three levels; basic, secondary, and tertiary. The basic level includes seven years of primary school education. The secondary level covers four years of secondary school education; ordinary level, and two years of advanced level of secondary school. And the tertiary level includes up to three years or more of college or university education.

According to the Tanzanian Demographic and Health Survey 2004/05 (2005), in Tanzania still there is a gap in level of education between males and females. One forth of males in Tanzania never attends school compared to one third of females. Furthermore, people living in urban centers are more likely to attend school and less likely to drop out compared to people living in the rural areas. The median number of years of schooling among both males and females living in urban centers is estimated at 6.1 years, compared to 2.5 and 1.5 years of schooling for males and females, respectively living in the rural (National Bureau of Statistics, 2005).

Health

According to the 2002/03 report of the ministry of health of the republic of Tanzania, health facilities in Tanzania are divided into seven levels (Tanzania National Website, 2008):

1. Village health services: The lowest levels of health care services; provide preventive services that can be offered in homes.

2. Dispensary services (2,450): Each can provide health care services to 6,000-10,000 people and supervise all village health workers.

3. Health center services (409): Each is expected to provide health care services to 50,000 people (about a population of one administrative division).

4. District hospitals (55): Should be in every district; however this is not the case.

5. Regional hospitals (17): Each provides similar health care services to those at district hospitals, except regional hospitals have specialists in various fields and therefore have the ability to provide additional health care services which are not provided at district hospitals.

6. Referral/consultant hospitals (4): The highest level of health care services in the country. Among other services, they provide major treatments such as operations.

7. Treatment abroad: In the case of some diseases that require special treatments whose facilities and equipments are not available in the country, some patients are sent abroad for treatment.

Among others, the problem of accessing health facilities affects mostly rural women, women with large families, and women who do not work for cash. The percentage of women in rural Tanzania who deliver their babies at home is higher (63%) compared to those in the urban areas; 19% (National Bureau of Statistics, 2005). The total percentage of the country's population using improved drinking water sources estimated in 2005 was 62%, where 85% was in the urban areas and 49% was in the rural areas (Tanzania National Website, 2008). The percentage of the country's population using adequate sanitation facilities was estimated at 47% in total, of which 53% was in the urban areas and 43% was in the rural areas (Tanzania National Website, 2007).

Nutrition

Since the 1980s the topic of nutrition started getting attention in Tanzania. This was the period when most of the nutrition data (countrywide) were collected. Information about maternal mortality, low birth weight, infant and child mortality and morbidity, underweight, wasting, and stunting were collected and made available by the National Bureau of Statistics (NBS), Household Budget Survey (HBS), Demographics Health Survey (DHS), and other organizations such as the Tanzanian Food and Nutrition Center (TFNC). In addition, during the '80s major externally funded data collection and interventions to decrease infant and child mortality, improving child growth and development as well as improving maternal health and nutrition – Joint WHO/UNICEF Nutrition Support Program (JNSP), Iringa Region, Tanzania – were conducted (Joint WHO/UNICEF, 2009). Furthermore, in the '80s some nutrition-related policies and programs were made. Among other things, nutrition policies aimed to improve the nutritional situation of the Tanzanian community, especially of women and children. It also aimed to enable Tanzanians to produce and consume foods which can adequately meet their nutritional needs and to establish a viable research program to facilitate the improvement of food and nutrition in the country (WHO/UNICEF, 1995).

Study Model

Definition of the Model

To assess the nutritional and health status of the women of reproductive age in rural Tanzania and their relation to dietary patterns and infections, a case study model was used. A case study is one of several methods used in conducting research in social or socio-science related subjects. It usually emphasizes on an intensive understanding of a complex situation involving limited number of events or conditions and their relationships, and it can strengthen what is already known from previous studies (Soy, 1997). The purpose of a case study is to analyze a real life situation and identify major problems that exist in order to suggest solutions to these problems. There are two types of case studies, the analytical and the problem-oriented approach. The analytical approach examines a situation in order to understand what has happened and why it happened the way it did. This method does not necessarily identify problems or suggest

solutions to the problems. The problem-oriented method on the other hand identifies major problems which exist in a situation or community and provides recommendations for appropriate strategies based on the findings towards solutions to the problems observed (Monash University, 2009).

Selection of the Model

The problem-oriented type of a case study was chosen in this study based on its purpose of analyzing the real nutrition and health situation of the women of reproductive age in the Iringa Rural District and its goal of developing suitable guidelines to improve the health and livelihood of women in rural areas of Tanzania.

Application of the Model

Use of the case study method began in the early 20th century. Its application in social and socio-science related fields was further developed in the '60s. The case study method has been criticized by many researchers. Some argue that, since case studies normally involved a small number of cases, they cannot provide enough evidence to establish reliability or generality in the findings. On the other hand, some feel that an intense exposure in studying the case may introduce a bias to the findings. Others assume that the case study method is beneficial as a mere exploratory tool. In spite of all these critics, many researchers have continued using the case study method with success in planning, designing, and implementing suitable strategies in solving problems (Young, 2005; Temu, 2008; Leshabari, 2008; Von Both, 2008).

Based on the problem-oriented approach, a causal model of the nutritional situation was developed in order to simplify the assessment and understanding of the real situation in the study area. Following the WHO Guideline to Nutritional Assessments, this model was used to elaborate causal factors – certain variables which are assumed to directly or indirectly influence the nutritional status of the women in the study area and to develop a multi-disciplinary solution approach which highlights solutions to the problems. As illustrated in the hypothetical causal model in Figure 1, each factor can

directly influence the nutritional status or act as a link in the hierarchical causal chain leading to the nutritional situation observed (Beghin, 1988).

According to the WHO Guideline to Nutritional Assessments, there are two ways to build a causal model; a top-down and a bottom-up. A top-down way begins with the basic causes of malnutrition progressing downwards towards the final outcomes, seen as a result of converging influences. On the other hand a bottom-up way begins with the final outcome, breaking down toward the factors assumed to play a causal role in the situation (Beghin, 1988). The current study adopted the bottom-up way of building a causal model and the FAO Family Nutrition Guide to develop the hypothetical causal model that was used to assess the factors associated with the maternal malnutrition in the study area as indicated in Figure 1.1 (Burgess, 2004).

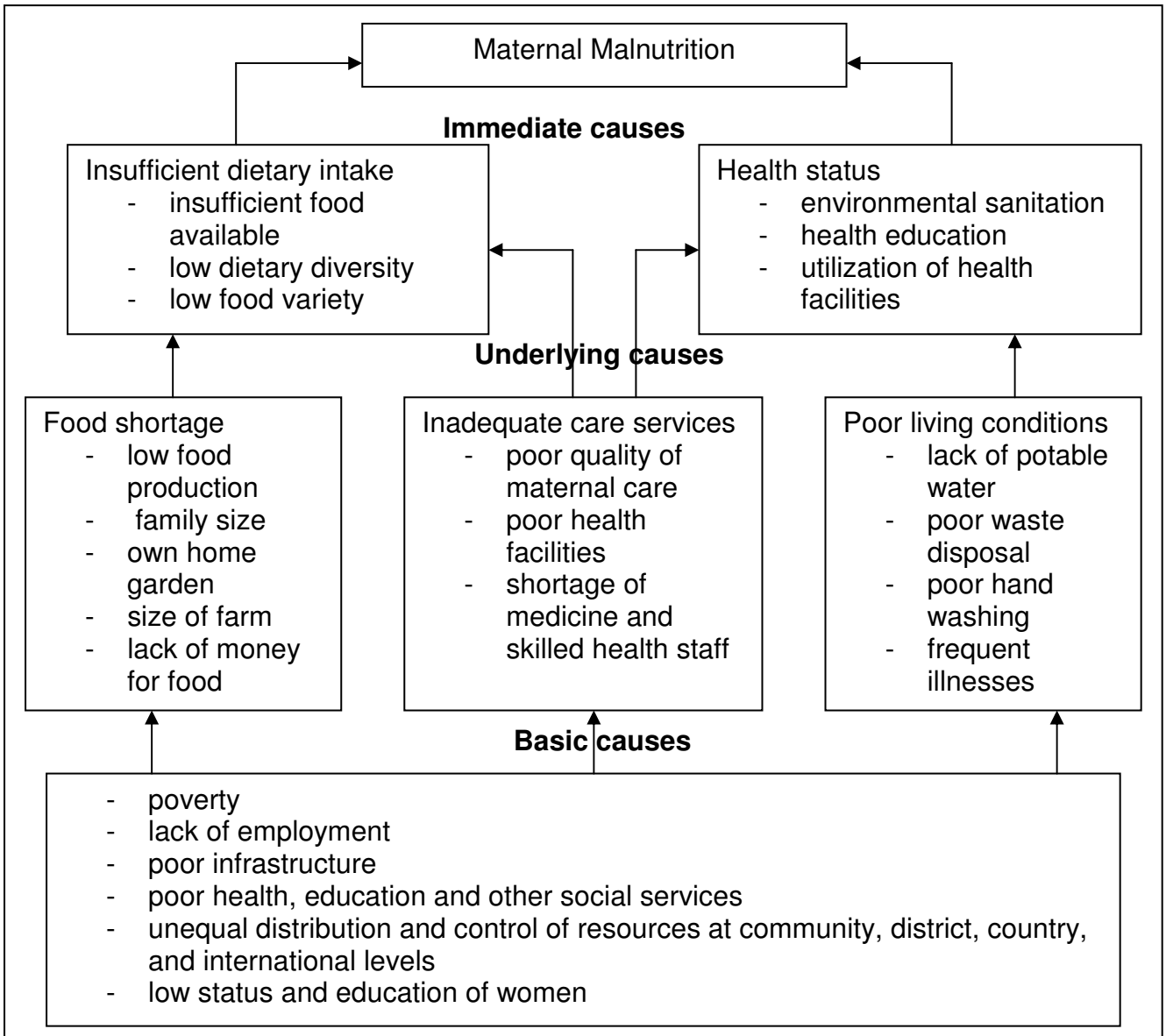

Figure 1.1: Hypothetical Causal Model Analysis
Source: Modified after Burgess, 2004.

2. Methods and Materials

2.1 Study area and the subjects

The study was conducted between February and April 2008 in the Iringa Rural District, Tanzania. Iringa is one of the 26 regions in Tanzania and one of the three located in the southern highlands zone of the country. It is situated between longitude 35 west and 36 east and latitude 7 north and 8 south of the Equator. Iringa has a total area of 5.7 million hectors of which 4.2 million hectors (~74%) are cultivatable. The region is divided into seven districts; Kilolo, Iringa Rural, Iringa Urban, Mufindi, Njombe, Makete, and Ludewa (Appendix 1). The total population of Iringa Rural District is estimated at 245,623, with about 50% female, among which 20% are women of child bearing age (women aged between 15 and 44 years) (Tanzania National Website, 2007). The climate of Iringa varies from cool tropical to semi-arid tropical.

The temperature ranges from a minimum of 12°C in June, July, and August to 27°C in October and November, with an annual average minimum and maximum of 16°C and 24°C, respectively. The highest altitude zone (1,500–2,700 m at sea level) receives over 1,500 mm of rainfall *per annum*, whereas the lowest altitude zone;(900–1,200 m at sea level), which includes the drier areas, receives an average rainfall of 500 to 600 mm *per annum* (Weatheronline, 2009).

With regard to its climate, the Iringa Region is characterized by intense agricultural activities. Nevertheless, the majority of its farmers are involved in a small scale hand hoe rain-dependent farming system. This system basically focuses on subsistence economy. Farmers produce crops to merely meet their food and other basic domestic needs. Iringa mainly grows corn, Irish potatoes, sweet potatoes, paddy, wheat, and beans as staple foods, vegetables, and fruits. Most of the villagers in Iringa also keep domestic animals such as chickens, ducks, goats, sheep, cows, and pigs. High food shortage months include January through March, whereas the adequate food period includes July through September.

The Iringa Rural District was chosen because it is one among the areas in the Southern Highlands with high rate of food insecurity, micronutrient deficiencies, low birth weight,

as well as high incidences of malaria and other parasitic infections (Kinabo, 2004; Tanzania national Website, 2005; WHO/UNICEF, 1995).

2.2 Study design

The study was a cross sectional community baseline survey. Data were collected in one continuous phase between February and April 2008. Information about the study areas and geographical differences were sought before sampling. During this process, the population size for each consenting hamlet and its geographical characteristics was studied in order to provide the necessary judgement required for the formation of a heterogeneous group. Therefore appropriate selection and randomization of the hamlets and a stratified random sampling of an equal proportional number of women of reproductive age in each hamlet was attained.

Both quantitative and qualitative research methods were applied in data collection (McKeganey NP and Bloor MJ, 1981; Kok G et al. 2004). Qualitative data collected include questionnaire interviews including a food frequency questionnaire and a twenty-four hour dietary recall, key informative group discussions, participatory observation, Bitot's spots, and goiter examinations. The quantitative data collected include height, weight, mid upper arm circumference (MUAC), plasma levels for hemoglobin concentration (Hb), soluble transferrin receptor (sTfR), retinol-binding protein (RBP), C-reactive protein (CRP), and acid glycoprotein (AGP).

Sampling and sample size

Sampling included women aged between 15 and 44 years living in all nine hamlets in the village of Malinzanga, Iringa Rural district, Iringa, Tanzania.

Stratification and simple random sampling methods were used in calculating the sample size. The sample size was calculated based on the prevalence of anemia among women of child bearing age, 59%, in Tanzania with a significance level of 5% and a confidence power of 95% (Massawe, 2002).

Sachs's formula was applied in calculating the minimum sample size:

$[n = z^2 \times p\ (1\text{-}p)/\ (a)^2]$

n = minimum number of a sample size

z = given constant (1.96)

p = prevalence (60%)

a = uncertainty (5%)

$n = [1.96^2 \times 0.6\ (1 - 0.6) / (0.05)^2]$

n = [3.8416 x 0.6 (0.4) / (0.0025)]

n = 2.2305 x 160

n = 354

To accommodate partial responses, an additional 10% of the minimum sample size was added. 354 + (10/100 x 354) = 389 Hence a total of 389 women were included in this study.

In doing so, a hamlet population size was divided by the total village population size and multiplied by 100 in order to obtain a percentage population for a hamlet. In order to obtain the number of women to be included in the sample size, the percentages obtained from each hamlet were multiplied by the calculated sample size. Therefore, regardless of a hamlet's population size, an equal proportion of women from each hamlet was randomly selected (Table 2.1).

(Population of a hamlet) / (total population of the village) x 100 = percentage of women aged 15 to 44 from a hamlet included in the sample size.

➔ 158 / 5,123 x 100 = 3.08%

(Percentage of a hamlet population) / (calculated sample size) = (number of women aged 15 to 44 included in the sample size).

➔ 3.08 / 100 x 389 = 11.98 ~ 12.

Therefore 12 women aged between 15 and 44 years were selected from Malinzanga hamlet.

Table 2.1: Stratification of the sample size

Hamlets	Total Population	Percentage of total population	Number of women in the study
Malinzanga	158	3%	12
Mlowa	250	5%	20
Ndorobo 'A'	751	15%	58
Mtakuja	867	17%	66
Majengo 'A'	826	16%	62
Majengo 'B'	724	14%	54
Ikononngo	198	4%	16
Ndorobo 'B'	620	12%	47
Matalawe	729	14%	54
Total	**5,123**	**100%**	**389**

Training on survey instruments

Six enumerators were trained on the use and application of the survey instruments. Selection of the enumerators was based on having a basic knowledge of community nutrition and good communication skills in Swahili and vernacular. During this process enumerators were thoroughly trained on the questionnaire in the sense that each question was discussed together to ensure uniformity in understanding. The training on the use and application of the survey instruments took one day (March 5th, 2008) followed by two days (March 6th – 7th, 2008) for pre-testing the materials. The training was necessary and very useful in order to have a common understanding so as to obtain the information required for the research (Picture 2.1).

Picture 2.1: Training of enumerators

Pre-testing

The materials for data collection were translated into Swahili from English prior to the data collection. Pre-testing of the questionnaire and other survey instruments for measuring weight, height, MUAC, and hemoglobin concentration was performed two days prior the actual data collection.

Ten women were invited and asked for their verbal consent to participate in the pre-testing of the research materials. During this process, women were interviewed, enumerators measured weight, height, and mid upper arm circumference. Blood samples from the women were also taken from finger pricks for hemoglobin concentration. The remaining blood drops were smeared onto dry filter paper for further analysis of the plasma soluble transferrin receptor, retinol-binding proteins, C-reactive protein, and acid glycoprotein which was later performed in Germany.

2.3 Quantitative data collection

Interviews

Interviews were conducted individually at each participant's homestead. As calculated and planned, enumerators went to every third household in the selected study area to interview a woman. Before a woman was interviewed, she was asked for her verbal consent to participate in the interview and the measurements to be taken. The enumerators used a structured questionnaire with a list of closed questions, whereby a woman had to choose one of the already provided alternative optional answers to answer the respective questions; yes/no questions; multiple choice; as well as limited fill–in-the-blank questions (Picture 2.2).

The structured interview questionnaire was used to obtain information on household and socio-economics, livestock keeping and agricultural activities, food patterns and regimes, nutrition education, supplementation, availability and use of health care services, pregnancy and caring during pregnancy, common illnesses, HIV/AIDS, water, sanitation, and lifestyle. For instance, the respondents were asked whether they produce any crop or keep any domestic animals. The respondents were also asked whether they had had malaria, fever, cough or diarrhea in the previous three months (Appendix 2). A total number of 389 women who verbally availed themselves to participate in the study were interviewed.

Anthropometric indicators:

Weight

After a total of 50 women were interviewed, a measurement session was scheduled. Seca 862 calibrated digital personal scales (Seca GmbH & Co. KG, Hamburg, Germany) were used to weigh the respondents. In every weighing session, the scales were calibrated before weighing the respondents began. To be weighed, the respondents had to stand upright on a digital personal scale with no excess clothes. The scale had a capacity of measuring up to 200 kg. The weight was recorded to the nearest 100 g.

Picture 2.2: Interviewing a woman

Height

The height of the respondents was measured using a Person-Check person-measuring height instrument (Kawe Kirschner & Wilhelm). Respondents had to stand upright on the floor board of the Person-Check person-measuring height instrument with the back and shoulders touching the vertical backboard and the feet-ankles touching the base of the vertical backboard. The scale had the capacity to measure up to 2 m, and the height was recorded to the nearest 0.1 cm. The height and weight values were used to calculate the body mass index. This calculation was computed by dividing weight in kilograms by height in meters squared. Based on the WHO BMI classification (Table 2.2), women were classified as underweight if they had a BMI of less than 18.50 kg/m², normal weight if they had BMI between 18.50 and 24.99 kg/m², overweight if they had a BMI between 25.00 kg/m² and 29.99 kg/m², and obese if they had BMI 30.00 kg/m² or above (WHO, 2009).

Table 2.2: Classification of underweight, overweight and obesity according to WHO BMI cutoff points

BMI Classification	BMI (kg/m²) cut-off points
Underweight	**< 18.50**
Severe thinness	< 16.00
Moderate thinness	16.00 - 16.99
Mild thinness	17.00 - 18.49
Normal range	**18.50 - 24.99**
Overweight	**≥ 25.00**
Pre-obese	25.00 - 29.99
Obese	**≥ 30.00**
Obese class I	30.00 - 34-99
Obese class II	35.00 - 39.99
Obese class III	≥ 40.00

Source: WHO, 1995; WHO, 2000; and WHO 2004, WHO, 2009.

Mid-upper arm circumference (MUAC)

MUAC of the respondents was measured using a measuring tape. Respondents had to stand upright on a leveled surface and make a 90 degree angle with the left hand. The length of the upper arm (from the shoulder bone to the elbow) was first measured, and the mid-point was marked. Then the respondents had to put the arm straight down. Using the marked mid-point as a starting point the circumference of the upper arm was measured and recorded to the nearest 0.1 cm. Based on the UNSCN and UNICEF recommended cut-off points, undernourished pregnant and non-pregnant women were categorized as indicated in Table 2.3.

Table 2.3: Classification of adult severe, moderate and mild undernutrition based on WHO MUAC cutoff points

MUAC Classification	MUAC (cm) Non pregnant cutoffs	MUAC (cm) Pregnant cutoffs
Mild undernutrition	< 22.00	< 22.00
Severe undernutrition	<16.00	<20.70
Moderate undernutrition	<18.50	<23.00

Source: James, 1994; UNSCN, 2009; UNICEF, 2004.

Clinical Tests and Biochemical Measurements:

Tests for goiters and Bitot's spots

Signs of goiters and Bitot's spots, as well as the measurement of hemoglobin concentration were done by nurses. The women had to sit on a chair for the examination. As illustrated in Picture 2.3 top left, a nurse palpated a woman's neck to identify nodes or enlargements as an indicator for a goiter. Bitot's spots were spotted with an examination of the eyes wide open, and impaired dark adaptation by asking whether a respondent had difficulty seeing during the night. For any suspicions of Bitot's spots, a picture of the eye(s) was/were taken (Picture 2.3 top right).

Measurements of hemoglobin concentration

Hemoglobin concentration was measured by using a HemoCue Hb 201^+ Analyzer as shown in Picture 2.3 bottom left. The measurement was determined by capillary blood, which was obtained by pricking the third finger using disposable sterile lancets which allowed a relatively painless puncture. Following the HemoCue Hb 201^+ Analyzer Operation Manual the device was calibrated and set to the measuring position (Hemocue Website, 2009). The tip of the sterile microcuvette was used to suck the blood from a finger prick by capillarity to fill the small circular space. The filled microcuvette was placed in the cuvette holder in the HemoCue Hb 201^+ Analyzer in order to obtain a hemoglobin value which appeared on the display. The hemoglobin concentration was recorded to the nearest 0.01 g/dl. In every measurement session, the HemoCue Hb 201^+ Analyzer was cleaned with HemoCue cleaner to remove any blood that might have remained in the cuvette holder. To determine the prevalence of anemia, the Center for Disease Control (CDC) criteria for anemia in child bearing-aged women was used. Anemia was defined in four categories; no anemia (normal hemoglobin), mild anemia, moderate anemia, and severe anemia based on hemoglobin concentration and pregnancy status as shown in Table 2.4 (CDC, 1989).

Table 2.4: Classification for mild, moderate, and severe anemia according to WHO hemoglobin concentration cutoff points

Classification	Non-pregnant women	Pregnant women
Normal hemoglobin	≥12 g/dl	≥11 g/dl
Mild anemia	10.0 - 11.9 g/dl	10.0 – 10.9 g/dl
Moderate anemia	7.0 – 9.9 g/dl	7.0 – 9.9 g/dl
Severe anemia	<7.0 g/dl	<7.0 g/dl

Source: CDC, 1989.

Measurements of retinol binding protein, C-reactive protein, and acid glycoprotein

The capillary blood drops on the fingertips were smeared onto two circles on a dry filter paper (Whatman 903 Specimen Collection Paper, Schleicher & Schuell) as shown in Picture 2.3 bottom right. The filter papers were allowed to dry for 2 to 3 days, then sealed in zipped plastic bags with desiccant to remove moisture and stored under cold conditions until transported to Germany, where further analysis of soluble transferrin receptor, retinol-binding protein, C-reactive protein, and acid glycoprotein measurements were performed. The analysis of all four parameters was performed simultaneously by using Inexpensive, Sensitive, and Simple Sandwich Enzyme-Linked Immunosorbent Assay Technique (ELISA technique) as elaborated in detail in Erhardt, 2004. A cut-off point of 8 mg/L was used for sTfR, and women with plasma TfR greater than 8 mg/L were classified as iron deficient. CRP (g/L) and AGP (g/L) were analyzed and cutoff points of 5 g/L and 1 g/L were used respectively. Women were classified as having an acute infection if they had a plasma CRP greater than 5 g/L, and having chronic infection if they had plasma AGP greater than 1 g/L.

Table 2.5: Criteria for vitamin A deficiencies in adults based on WHO RBP cutoff points

Classification	RBP (µmol/L) cut-off points
Vitamin A deficiency	≤ 1.05 µmol/L
Moderate vitamin A deficiency	0.7 – 1.05 µmol/L
Severe vitamin A deficiency	< 0.7 µmol/L
Normal range	> 1.05 µmol/L

Source: WHO, 1994.

WHO references were used to classify the vitamin A status based on RBP plasma level (Table 2.5). Women were classified as having severe vitamin A deficiency if they had plasma RBP of less than 0.7 µmol/L, moderate vitamin A deficiency if they had plasma RBP between 0.7 and 1.05 µmol/L, and no vitamin A deficiency if they had plasma RBP greater than 1.05 µmol/L (WHO, 1994).

Picture 2.3: The nurse is palpating a woman's neck (top left), observing eyes (top right), withdrawing blood for hemoglobin concentration (bottom left), smearing blood on dry filter paper (bottom right).

2.4 Qualitative data collection

Assessment of dietary intake:

A twenty-four hour dietary recall

A twenty-four hour dietary recall was conducted on all 389 women in the sample group. Similarly to the questionnaire interview, the twenty-four hour dietary recall interviews were conducted at the respondents' homesteads by community nutrition workers. The

respondents were asked to describe the type and amount of food which they had consumed in the previous 24 hours (Appendix 2). Measurements of the actual amount of food consumed by the women were limited due to a lack of portable measuring instruments at the respondents' homesteads. Nevertheless, the respondents were requested to approximate the amount in terms of number of spoons, cups, pieces, grams, plates, bowls or glasses consumed in the previous 24 hours. The methods of preparation; i.e. boiling, frying, steaming, baking; were also ascertained from the respondents in order to calculate nutrient values consumed by the women.

The responses to these questions were entered and analyzed in SPSS based on the FAO/WHO Guidelines for Dietary Diversity Questionnaire (Table 2.5). The dietary recall data were used to calculate food variety scores and dietary diversity scores which were computed by adding up the number of consumed individual food items and food groups, respectively.

Food Frequency Questionnaire

In the food frequency questionnaire the respondents were asked to provide information on the frequency of consumption of food per day, per week, or per month for each food item following the list of items commonly consumed in the study area (Appendix 2). For statistical and validation purposes, the food items were classified into 12 food groups based on the adapted FAO and FANTA Guidelines for Measuring Household and Individual Dietary Diversity (FAO/FANTA, 2007) (Table 2.6). The frequency of consumption for each food item was categorized into three groups; i) ≥ 1 per day, ii) ≥ 1 per week, iii) ≤ 3 per month. Group i) represented high consumption (daily), group ii) medium consumption (weekly), and group iii) represented low consumption values (monthly or less, or never). The food frequency data were entered and computed in SPSS 17.0.

Focus group discussions

In the focus group discussions, selected respondents were requested to respond to a series of open-ended questions from general to specific issues. The main researcher tailored a set of questions to five different groups of key informative persons;

community nutrition workers, village leaders, health workers, traditional birth attendants and a group of women. Between 2 and 6 respondents were randomly selected to respond to the selected specific issues (Appendix 3). A group of six community nutrition workers, four village leaders, three health personnel, two traditional birth attendants and six women were separately interviewed.

Table 2.6 Dietary Diversity Questionnaire

No.	Food group	Food items	Yes=1 No=0
1	Vitamin A rich fruits, vegetables, and tubers	Pumpkins, carrots, sweet potatoes that are orange inside, sweet peppers, ripe mangoes, papayas, wild vitamin A-rich fruits	
2	Dark green leafy vegetables	Pumpkin leaves, cowpea leaves, amaranth leaves, sweet potato leaves, cassava leaves, wild vitamin A-rich leaves	
3	Cereals	Rice, bread, spaghetti, biscuits, cookies, sambusa, *maandazi, vitumbua, chapati, karimati, ugali* (porridge or pastes from millet, sorghum, corn, wheat, and other locally available grains)	
4	White tubers and roots	White potatoes, white coco-yams, cassava, or foods made from root crops	
5	Meat	Beef, pork, lamb, goat, rabbit, wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats	
6	Other fruits	Other fruits including wild fruits	
7	Legume nuts and seeds	Beans, peas, cowpeas, lentils, groundnuts and other legume crops	
8	Eggs	Eggs	
9	Fish	Fresh or dried fish or shellfish	
10	Other vegetables	Tomatoes, onions, eggplants, okra, including wild vegetables	
11	Milk and milk products	milk, yogurt, or other milk products	
12	Oils and fats	oils, fats or butter, margarine added to food or used for cooking	

Source: Modified after FAO/FANTA (2007).

Each group had a set of open-ended questions to respond to in a discussion setting. The discussions were held in the village offices or at the dispensary (Picture 2.4). In addition to notes taken, the discussions were recorded into a digital voice recorder. For each group, a maximum length of time of 5 minutes was taken to discuss one question and 45 minutes to complete the whole discussion.

Focus group discussions were prepared to probe the groups in order to provide more detailed information concerning specific issues regarding their expertise. Similarly to the questionnaire interview, respondents in each group were asked for their verbal consent to participate in the focus group discussion as well as to be recorded.

Picture 2.4: Village leaders (top left), health workers (top right), traditional birth attendants (bottom left), a mix of a group of women (bottom right)

Knowledge of micronutrients among women

The knowledge of micronutrients among the women of child bearing age in the study area was assessed by the questionnaire interview and determined by the sum of the points scored by the respondents providing information on their knowledge of iron, folic acid, vitamin A, and iodine. In addition, information regarding foods with a high content of these micronutrients was gathered from the respondents who reported having knowledge of any of these micronutrients. Furthermore, the importance of these micronutrients to maternal health was also inquired from all of the respondents who reported having knowledge of any of these micronutrients. Based on these questions, knowledge of micronutrients was determined by scaling the points scored as low, medium, and high. The first question about whether the respondents had any knowledge concerning iron, folic acid, iodine, and vitamin A had 1 point for yes and 0 points for no. Respondents were categorized into four groups: no knowledge, low knowledge, medium knowledge, and high knowledge for both the second and the third question. Respondents were labeled as having no knowledge of foods rich in a particular nutrient or no knowledge of the importance of the nutrient to maternal health if they could not identify even one type of food with a high content of that nutrient or could not name one important aspect of the nutrient to maternal health. Respondents who could identify only one type and could name only one important aspect were classified as having low knowledge. And the respondents who could identify two or more types and could also name two or more important aspects were classified as having medium or high knowledge, respectively. Total knowledge of the nutrients was computed by adding up the points scored from the three questions for each nutrient. Respondents who scored no points were classified as having absolutely no knowledge of the respective nutrient, between 1 and 4 points were classified as having low knowledge, between 5 and 9 points were classified as having medium knowledge, and those scored 10 points or above were classified as having high knowledge. Therefore, the total knowledge of micronutrients in this study was summarized by adding the total knowledge of three nutrients; iron, iodine and vitamin A. Knowledge of folic acid was excluded from the analysis because none of the respondents had any knowledge of it. Respondents who scored no points were then classified as having absolutely no

knowledge of micronutrients, between 1 and 12 points were classified as having low knowledge, between 13 and 27 points were classified as having medium knowledge, and those who scored 28 points or above were classified as having high knowledge of micronutrients.

Observation

A cross-walk observation around the study area to observe and document all real life aspects such as housing, agricultural activities, livestock keeping, home gardening, infrastructure, health facilities, water, and waste disposal was also conducted by the main researcher accompanied by a community nutrition worker. The documentation took place to countercheck the responses provided by the respondents in the questionnaire interview and in the focus group discussions.

2.5 Statistical analysis

Data were entered and analyzed using Microsoft Excel (MS Office 2007) and Statistical Package for the Social Sciences (SPSS version 17.0) and Analysis of Moment Structures (Amos 16.0). The data were analyzed based on the effects of all components assumed to contribute to maternal malnutrition as indicated in the hypothetical causal model above. Data analysis included descriptive statistics, correlation and regression analysis as well as structural equation modeling analysis.

Descriptive statistics

Descriptive statistics were generated for all continuous variables to screen the data, identify the outliers, search for normal distribution patterns, and organize the data into manageable units. The descriptive statistics were also generated to help determine whether the statistical techniques considered for the data analysis were appropriate.

In the presence of outliers; values more extreme than a 3-interquatile range of the box plot, new variables were created excluding these values. However, all tests were done first with the original variable, and then redone with the new variable to assess influence of such outliers. A normal distribution of the continuous variables was confirmed by Normal Q-Q Plot and the Kolmogorov Smirnoff test.

The strategy of data analysis was set in 3 steps; descriptive, correlation or regressions, and structural equation modeling analysis. In descriptive analysis, the differences between the international standards (cutoff pints) and the data observed in the current study were assessed for each primary outcome of the continuous variables; body mass index, mid-upper arm circumference, hemoglobin concentration, soluble transferrin receptor, retinol binding receptor, C-reactive protein, and acid glycoprotein. The primary outcomes were the means and medians of body mass index, mid-upper arm circumference, hemoglobin concentration, soluble transferrin receptor, retinol binding receptor, C-reactive protein and acid glycoprotein. Based on the international standards, frequencies, and percentages with respect to the primary outcomes; prevalence of underweight, overweight, and obese; prevalence of severe, moderate, and mild anemia; prevalence of iron deficiency; prevalence of severe and moderate vitamin A deficiency; and prevalence of acute and severe infections were generated and computed among the women in the study group.

In testing a simple association between variables, for instance co-existence of anemia and iron deficiency among the women in the sample group, crosstabs for two-way tables to calculate Pearson's chi-square test and the exact significance of the Fisher's exact test were applied. For a complex relationship between variables (more than two), anemia, iron deficiency, and vitamin A deficiency, regressions were applied.

Regression statistical analysis

Logistic regressions were applied for dichotomous-binary dependent variables. International references were used in transforming the dependent continuous variables into categorical ones as shown below.

(i) Anemia in non-pregnant women: pregnant women (Hb < 12g/dl: Hb < 11g/dl, coded 1 = yes, 0 = no).
(ii) Vitamin A deficiency (RBP < 1.05µmol/L, coded 1 = yes, 0 = no).
(iii) Iron deficiency (sTfR > 8mg/L, coded 1 = yes, 0 = no).
(iv) Acute infection (CRP > 5g/L, coded 1 = yes, 0 = no).

(v) Chronic infection (AGP > 1g/L, coded 1 = yes, 0 = no).

To determine the influence of various variables on the predictor variables of nutritional status, a binary logistic regression was applied. The binary logistic regression was adopted due to its qualitative nature of the binary predictor variable of 1 for presence and 0 for absence of a characteristic or outcome.

An example of binary logistic regression performed in this study was to determine whether pregnancy was a factor affecting the health and nutritional status of the women by comparing continuous independent variables of MUAC, hemoglobin concentration, sTfR, RBP, CRP, and AGP with the dependent variable of pregnant women and non pregnant women, coded 1 = pregnant or 0 = not pregnant. Depending on the nature of the data, different methods such as enter or forward: conditional, were inserted into the binary logistic regression model to estimate the effect.

For analysis of polynomial variables, variables with more than two categories, with or without class of orders, ordinal or multinomial regression models were applied, respectively. In the case of variables with a class of orders, the original continuous variables in the rosters were transformed into ordinal variables. For instance, dietary diversity scores were categorized into three class orders, low, medium, and high dietary diversity scores, whereby 1 = low (scored between 1 and 4), 2 = medium (scored between 5 and 9), and 3 = high (scored 10 and above). Meaningful exposure variables such as food availability (coded 1 = food secure, 0 = food insecure), predictor such as food variety scores coded 1 = low (scored between 1 and 4), 2 = medium (scored between 5 and 9), and 3 = high (scored 10 and above), and potential confounders such as pregnancy status (coded 1 = pregnant, 0 = not pregnant) were inserted into the model to test their influence in food consumption, nutrient intake and nutritional status, respectively.

Multinomial logistic regressions were applied when it was necessary to classify the respondents based on the set of cutoff points of the predictor variables with more than two categories however with no order of classes. For instance, body mass index was

categorized into three categories, underweight, overweight, and obese, whereby 1 = underweight (coded BMI < 18.50 kg/m²), 2 = overweight (coded BMI = 18.50 – 24.99 kg/m²), and 3 = obese (coded BMI ≥ 25.00 kg/m²) and inserted into a multinomial logistic regression model as a dependent variable with independent continuous variables, RBP, sTfR, and hemoglobin, to test their effect on the three categories of BMI in the model.

Structural equation modeling

Structural equation modeling (SEM), also known as analysis of causal modeling was applied in the analysis of the general linear model and factor analysis of the causes of maternal malnutrition.

A fit of structural equation models of different causes of maternal malnutrition, such as inadequate dietary intake, health status, food availability, frequent illnesses, and nutritional status were specified, modified, and by using simple drawing tools as suggested by Arbuckle in the Amos 16.0 User's Guide (King, 2000), step by step fit models were developed. Starting with direct immediate causes of malnutrition (dietary intake and health status), extending to indirect intermediate causes of malnutrition (food and heath security), to further basic causes of malnutrition (knowledge, income, and living conditions) as indicated in the study's hypothetical causal model, a series of structural equation models was developed. These models are used for the interpretation of the study's findings in the discussion.

2.6 Ethical consideration

The survey was reviewed and approved by the ethics committee of the University of Giessen, Germany and the Sokoine University of Agriculture, Morogoro, Tanzania. After gathering information, verbal consent to participate in the survey was sought from the women. Data entry and analysis were kept anonymous until the end of the study. Findings and publications of the study reveal no personal data of the respondents.

3. Results

3.1 Compliance

For compliance purposes, interviews were conducted in the respondents' homesteads. However, there were some dropouts because measurements were conducted at either dispensary or village offices. Two of the 389 women interviewed never came for the measurements. These women had a common reason, travelling to other parts of the country. Therefore, they were excluded from the analysis. In addition, 3 other women were excluded from the analysis because of their age being above the age range (between 15 and 44 year). Hence, a total of 384 women were included in the analysis. There was no need to interview more women because this number was within the computed value for statistical representative.

3.2 Demographic and Socioeconomic Characteristics

Age

The age of the respondents ranged between 15 and 44 years and had a mean of 27.7 ± 7.0. Age was categorized into three age groups; 15 to 22, 23 to 30, and 31 to 44 years old. A majority of the women aged between 23 and 30 years (40.6%) followed by those aged between 31 and 44 years (31.0%), and the smallest population age group was the young age, 15 to 22 years (28.4%).

Tribal Culture and Religion

The sampled population was dominated by two tribes; *Bena* and *Hehe*. The two tribes contributed over 90% of the total sample group. *Bena* was leading with 47.4% followed by *Hehe* with 43.2%. The remaining 9.4% included all other minority tribes living in Malinzanga village, namely, *Maasai, Mangati, Gogo* and *Nyakyusa*.

Hehe and *Bena* are some of the 120 ethnic groups in Tanzania, based in Iringa. In addition to *Swahili*, the *Hehe* and *Bena* people speak *Kihehe* (*Ki* stands for language) and *Kibena,* respectively, and are called *Wahehe* and *Wabena,* respectively. Wahehe

and Wabena are groups of people speaking the *Hehe* and *Bena* languages, respectively. Nevertheless, the two languages; *Kihehe* and *Kibena* are linguistically similar in the sense that both groups can understand each other in their own languages and live in peace in one place. The fact that the people mostly emerged from the same region and have the same ancestors means that they are also similar in social organization and culture. The *Wabena* and the *Wahehe* are primarily an agricultural people with the exception of some pastoral activities such as keeping a limited number of cattle and goats. They mainly produce maize, sweet potatoes, cassava, millet, sorghum, rice, groundnuts, beans, and sunflower for domestic consumption and commercial purposes. In addition, they produce pumpkin leaves, cowpea leaves, sweet potato leaves, and amaranth leaves for relish with the main staples.

Maasai and *Mangati* are the two major minority groups living in Malinzanga village. Both groups are pastoralist. Because they keep a large number of cattle, they sometimes are forced to compete for grazing land. Often this causes them to live in the forest and move to other areas where grazing is possible. As with the *Hehe* and *Bena*, in addition to *Swahili*, *Maasai* and *Mangati* speak *Kimaasai* and *Kimangati,* respectively. Although much is known about the *Maasai* people[1], little is known about the *Mangati*. It is believed that, between 1000 and 1800 AD the *Mangati* dominated northern Tanzania and southern Kenya. As it happened to the *Bena* who were forced by the *Hehe* to move out of the highland into the valleys during 19th Century, the *Mangati* were also displaced by the *Maasai* to move out of the area (UNSCN, 2009; Spear, 1993). Lately due to different circumstances such as drought and economic reasons, there has been a shift from a pastoral to an agro-pastoral lifestyle. The agriculturalists have started keeping livestock; likewise the pastoralists have started growing crops. Nevertheless, modes of agricultural production and keeping livestock remain different, based on the culture and tradition of growing crops and keeping animals. This also includes dietary patterns and food preparation. Pastoralists still prefer consuming fresh and fermented milk, blood, and raw meat, while agriculturists prefer consuming *ugali* with a side dish of green leafy vegetables, beans, or cooked meat.

[1] Based on clothing, jewelry, shelter, dance, and diet, and that the Maasai are one of the latest ethnic groups to arrive in East-Africa.

Ugali is made out of maize flour, sometimes, sorghum, millet, or cassava flour and hot water. It is basically a thick porridge that has a thicker consistence than mashed potatoes, and is cooked longer and turned frequently compared to mashed potatoes. In cooking *ugali*, water is first heated to a boiling point. While boiling, flour is added while turning until the preferred consistence is reached. Side dishes with *ugali* are prepared differently depending on available ingredients and food culture. For instance, vegetables, meat, or beans are first boiled to cook, then a stew is made by often frying onions and tomatoes, then vegetables, meat or beans and water are added. Milk is fermented for two to three days and consumed with ugali. Meat, mainly organs such as liver is also consumed raw with *ugali* (Ohna, 2007).

Most of the respondents in the study sample were Christians (93.2%). Only 5.5% reported being Muslim, and 1.3% was non-religious. The distribution of Christians, Muslims, or non-religious believers was similar in all ethnic groups. A majority of members of each ethnic group were Christians while the fewest were non-religious believers.

Marital status, household leadership and population distribution

Of all women interviewed, 74.0% were married, 19.5% were single, 6.5% were widowed, divorced, or lived with a man without a formal marriage. Among the women, only 6.2% were heads of the household.

The household size ranged between 1 and 18 with a median of 4. Sixteen percent of the households interviewed had more than 6 people and 10% had no more than 2 persons. More than 75% of the households had between 3 and 6 people.

Less than 10% of the women were pregnant during the survey. No pregnancy test was performed; women were simply asked whether they were pregnant at the time of the survey. Of the 33 women who reported being pregnant, additional information on how far they were (months) and whether they were tested at the dispensary was inquired. Thirty-two women were able to report the length of their pregnancy, and 1 was missing. Among the 32, 6 were in their first trimester (between 1 and 3 months), 10 in their

second trimester (between 4 and 6 months) and 16 in their third trimester (between 7 and 9 months). Only 28 women were tested at the dispensary. Among them, further information about how soon the pregnancy was diagnosed after becoming suspicious was also gathered. Of the 28, 8 tested after one month, 12 within 3 months and 8 after more than 3 months.

Education

The education level of the women in the study area was very low. Of the 384 women interviewed, less than 3.0% completed secondary school or obtained college or university education[2]. About 2.0% had partial secondary education[3]. Approximately 80.0% completed primary school education but did not continue with higher education. About 4% had partial primary education and 11.7% had no formal education, i.e. never attended formal school at all (Table 3.1).

The major reason reported by most of the women for not continuing with higher education was not passing the Standard Seven National Examination. Of the 308 women who completed primary school education, 81.2% did not pass the examination. Among these, 11% reported failing to pay school fees in private secondary school was a major reason for them not to continue with higher education.

Main occupation and source of income

Most of the villagers in the study area were mainly involved in farming activities. Of the 384 women interviewed, more than 75% reported farming being their main occupation. Approximately 15% kept livestock, and less than 10% were occupied by either self employment such as weaving baskets, tailoring, and convenience shops, or employment working as nurses and primary school teachers. The main source of income for most of the villagers in the study area was farming. About 90% of the women interviewed depended on farming for their livelihood. Less than 1% depended on livestock keeping, and 9.4% on self employment or formal employment (Table 3.1).

[2] completed more than 11 years of education
[3] completed primary school education and continued with secondary education but did not complete; completed less than 11 years of education

Lifestyle

Consumption of alcohol, cigarettes and other kinds of drugs in the study area was low. Out of 384 women interviewed, 13% and 16% consumed alcohol regularly and occasionally, respectively.

Table 3.1: Socio-economic characteristics among the women in the study sample, n=384

Socio demographic characteristics	Number	(%)
Age		
15 – 22 years	109	28.4%
23 – 30 years	156	40.6%
31 – 44 years	119	31.0%
Ethnic group/Tribe		
Bena	182	47.4%
Hehe	166	43.2%
Other	36	9.4%
Religion/Belief		
Christian	358	93.2%
Muslim	21	5.5%
Other	5	1.3%
Marital status		
Single	75	19.5%
Married	284	74.0%
Widowed	12	3.1%
Divorced	12	3.1%
Living with a partner	1	0.3%
Head of the household		
Head	24	6.2%
Wife	288	75.0%
Daughter	61	16.0%
Other	11	2.8%
Number of people in household		
1 - 2	27	7.0%
3 - 6	295	76.8%
7 - 18	62	16.1%
Pregnancy status		
Non pregnant	351	91.4%
Pregnant	33	8.6%
Education		
Never attended school	45	11.7%
Some Primary education	15	3.9%
Completed primary education	308	80.2%
Some secondary education	6	1.6%
Completed secondary education	7	1.8%
College/university education	3	0.8%
Main occupation		
Farming	293	76.3%
Livestock	58	15.1%
Other	33	8.6%
Main source of income		
Farming	345	89.8%
Livestock	3	0.8%
Other	36	9.4%
Alcohol consumption		
Regularly	50	13.0%
Occasionally	62	16.1%
Never	272	70.8%

The most commonly consumed alcohol was the traditional beer made out of germinated corn flour and fermented finger millet flour.

About 1% of the women smoked cigarettes regularly and 0.3% occasionally. The number of women who smoked cigars or other forms of unfiltered tobacco was less than 1% (Table 3.1).

3.3 Food production and livestock keeping

Of the 384 women in the sample group 372 (96.9%) had farms. Among these, 80% (296 out of 372) had a 3 hector farm or less, and only 20% (76 out of 372) had a farm larger than 3 hectors. The smallest farm owned was one fourth of a hector and the largest was 35 hectors with a median (inter-quartile) of 2 hectors (95% CI:1 to 3).

The highly produced staple foods in the study area were corn and paddy whereas the least produced staple foods were sorghum, millet, and cassava (Figure 3.1). Almost all the women interviewed produced corn (95%), and 55% produced paddy.

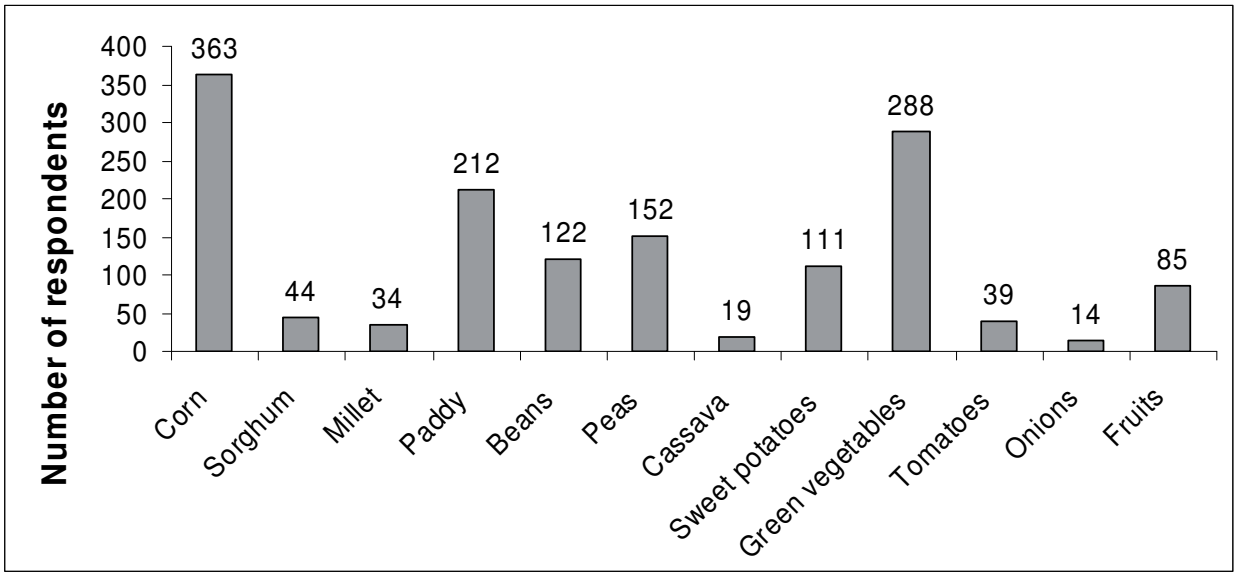

Figure 3.1: Crops produced in Malinzanga village, n = 384; multiple responses possible

A majority of the farmers in the community practiced the inter-cropping system by cultivating two or more different types of crops in one farm at one time, i.e. corn, groundnuts and sunflower or corn, finger millet and cowpeas. More than one third of the

villagers in the study area had no home garden for vegetable production. Among the 384 women interviewed 59% had a home garden for vegetable production. Nevertheless, as shown in Figure 3.1, about 75% of the women produced green leafy vegetables. The additional vegetable production of about 15% was due to the inter-cropping system which included vegetables. The most produced vegetables in the study area were pumpkin and sweet potato leaves. Of the 59% women who had home gardens for vegetable production 99% produced pumpkin leaves and 54% sweet potato leaves (Figure 3.2). Most of these women produced multiple types of vegetables.

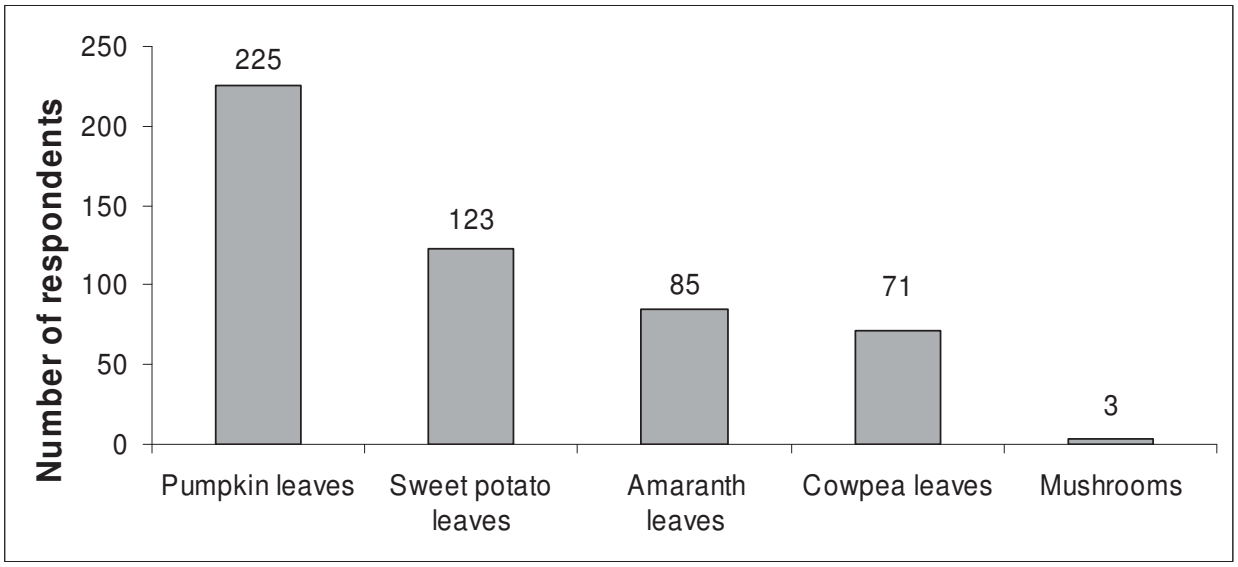

Figure 3.2: Vegetables produced in Malinzanga village, n = 228; multiple responses possible

Although the large proportion of the women in the study area were mainly farming, most of these women, 72% also kept at least one type of domestic animal. The most common domestic animals kept were chickens (Figure 3.3).

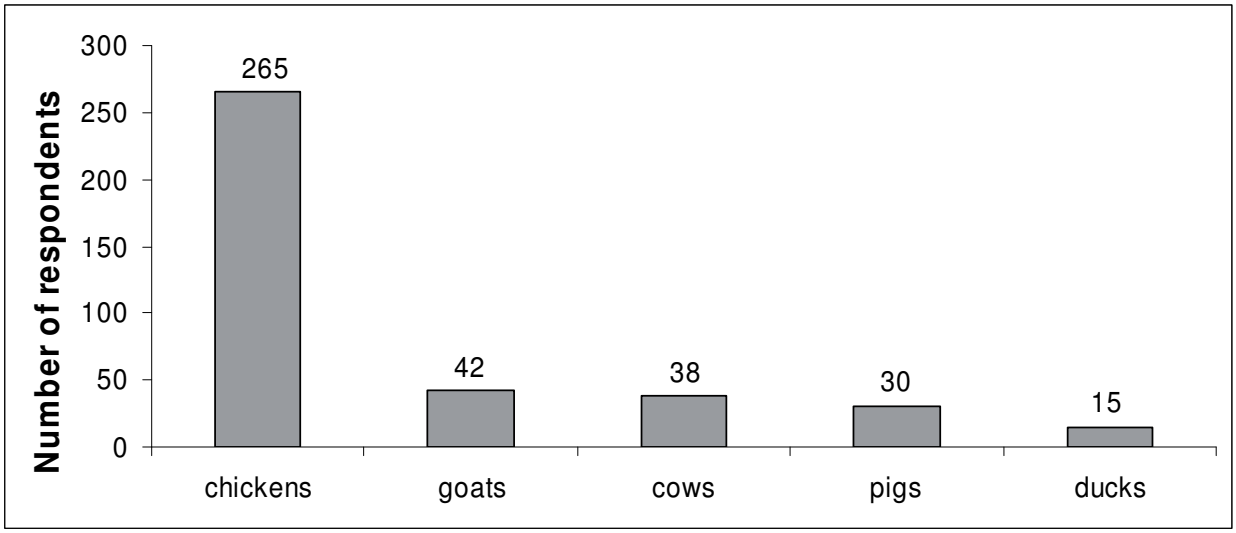

Figure 3.3: Domestic animals kept in Malinzanga village, n = 277; multiple responses possible

About 96% (265 of 277) of the women kept chickens ranging from 1 to 40 with median (inter-quartile) of 8 (95% CI: 4 to 12). Other domestic animals kept were goats, cows, pigs and ducks. Of the 277 women, about 15% kept goats, 14% cows, 11% pigs and 5% ducks. Not only was the number of women who kept cows, goats, pigs, and ducks small but also the number of animals kept was small. Although a few women kept up to 55 goats, 65 cows, 4 pigs and 15 ducks, as shown in figure 3.4, a majority of the women kept none or small numbers of cows, goats, pigs, and ducks.

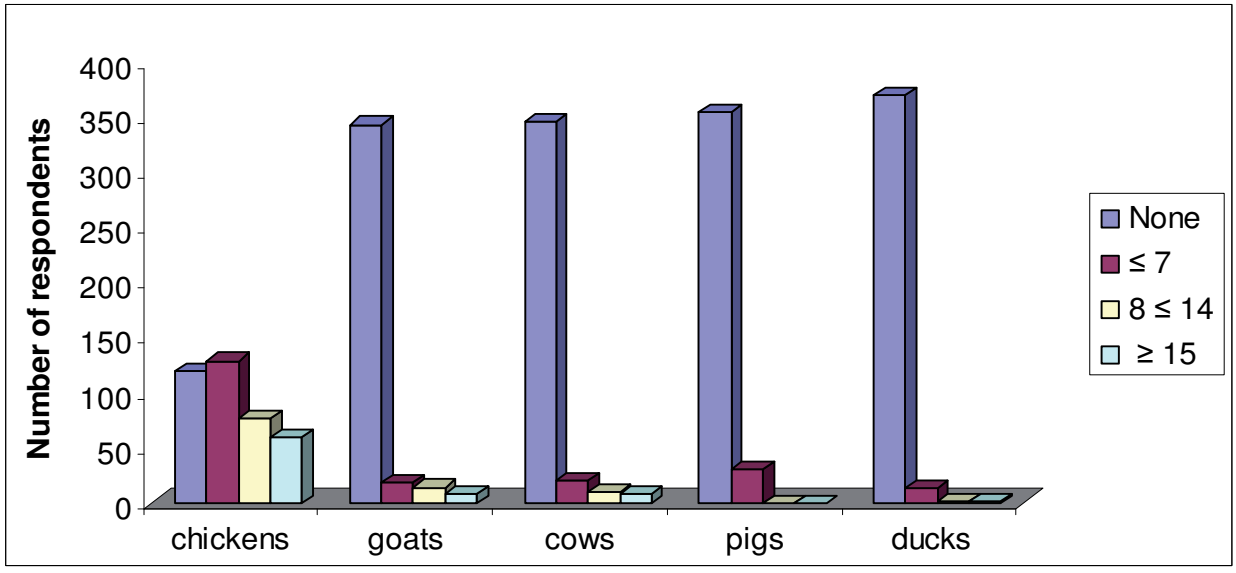

Figure 3.4: Numbers of domestic animals kept by the villagers in Malinzanga, n = 384; multiple responses possible

3.4 Food security

According to FAO (2000), food security is defined as a physical, social and economic access of all people at all times to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2000). Secured access to sufficient food at all times to all people in Malinzanga village was not the case. About 55% of the women interviewed reported having insufficient food at one point during the year. The length of the food shortage experienced ranged between two and seven months. A majority (96%) of these women usually experience a food shortage in February. Nevertheless, almost all of them are food secured in August and September (Figure 3.5).

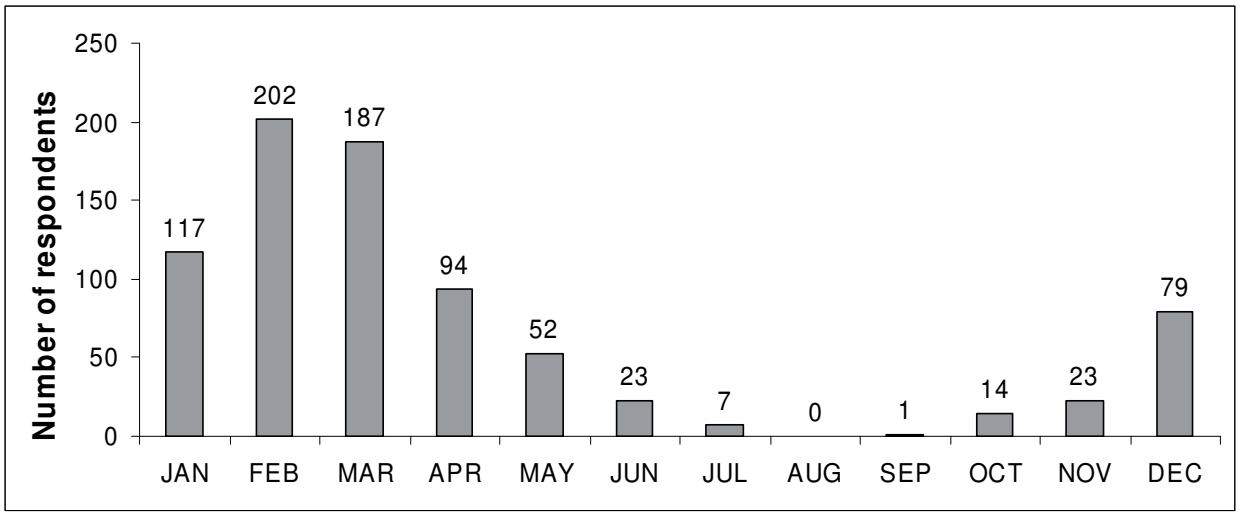

Figure 3.5: Months of the year women in Malinzanga village experienced food shortage, n = 211; multiple responses possible

3.5 Food variety scores and dietary diversity scores

Food diversification in Malinzanga village was low. The 24-hour dietary recall collected showed that consumption of food among the women of child bearing-age in the study area ranged between 3 and 14 different types of food items with a median (inter-quartile) of 7.0 (95% CI: 5 to 8). The largest proportion (18.5%) consumed 5 and the smallest (0.5%) consumed 14 different types of food items per day (Figure 3.6).

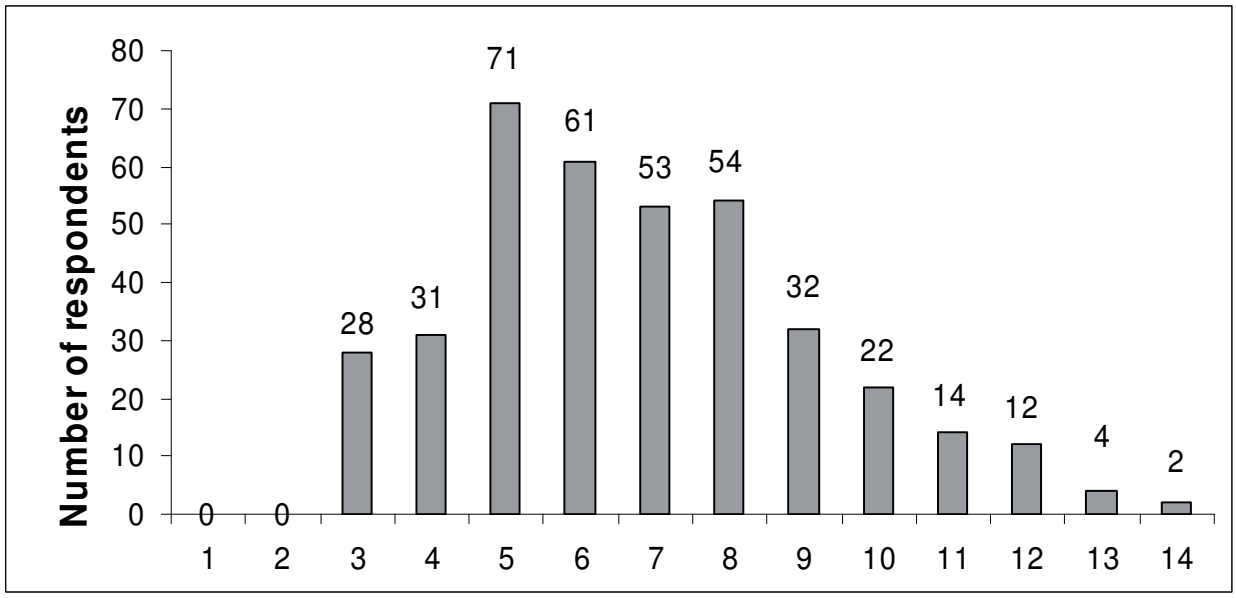

Figure 3.6: Food Variety Scores, n = 384

Consumption of different types of food groups in the study area was also low. Although consumption of different types of food groups among the women ranged between 3 and 10 with a median (inter-quartile) of 4 (95% CI: 3 to 5), the largest proportion (27.3%) consumed only 4 different types of food groups per day and the smallest proportion (0.5%) consumed 10 different types of food groups per day (Figure 3.7).

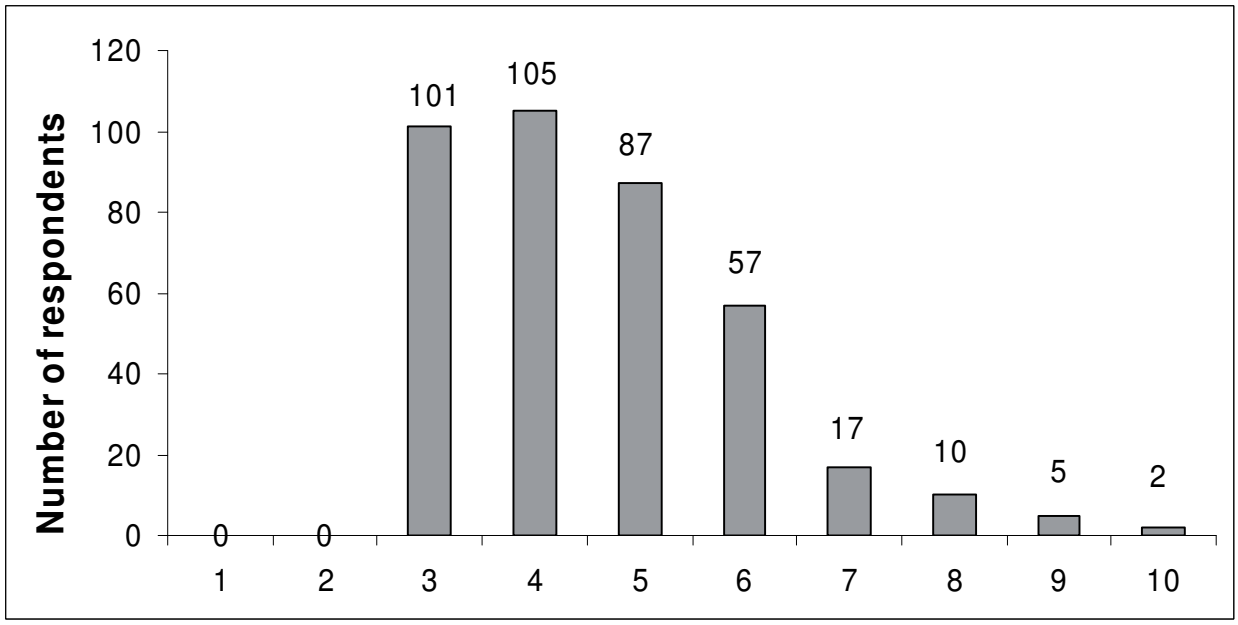

Figure 3.7: Dietary Diversity Scores, n = 384

There were three food items that were mainly consumed by most of the villagers in the study area, namely, *ugali* (mainly made out of corn flour), vegetable oil (sunflower oil) or animal fats (extracted from cow milk or pork meat), and pumpkin leaves. Of all the 384 women interviewed, 98% consumed ugali, 73% consumed pumpkin leaves and 68% used oil or fat for cooking 24 hours prior the interview. The median (inter-quartile) consumption of *ugali* and pumpkin leaves per day was similar, 2 (95% CI: 2 to 2), and that of oil/fat for cooking the vegetables was 2 (95% CI: 1 to 2). Less than 10% of the women in the study sample consumed fish, chicken, eggs or other vegetables such as amaranth leaves and other fruits including mango and papaya 24 hours prior the interview (Figure 3.8).

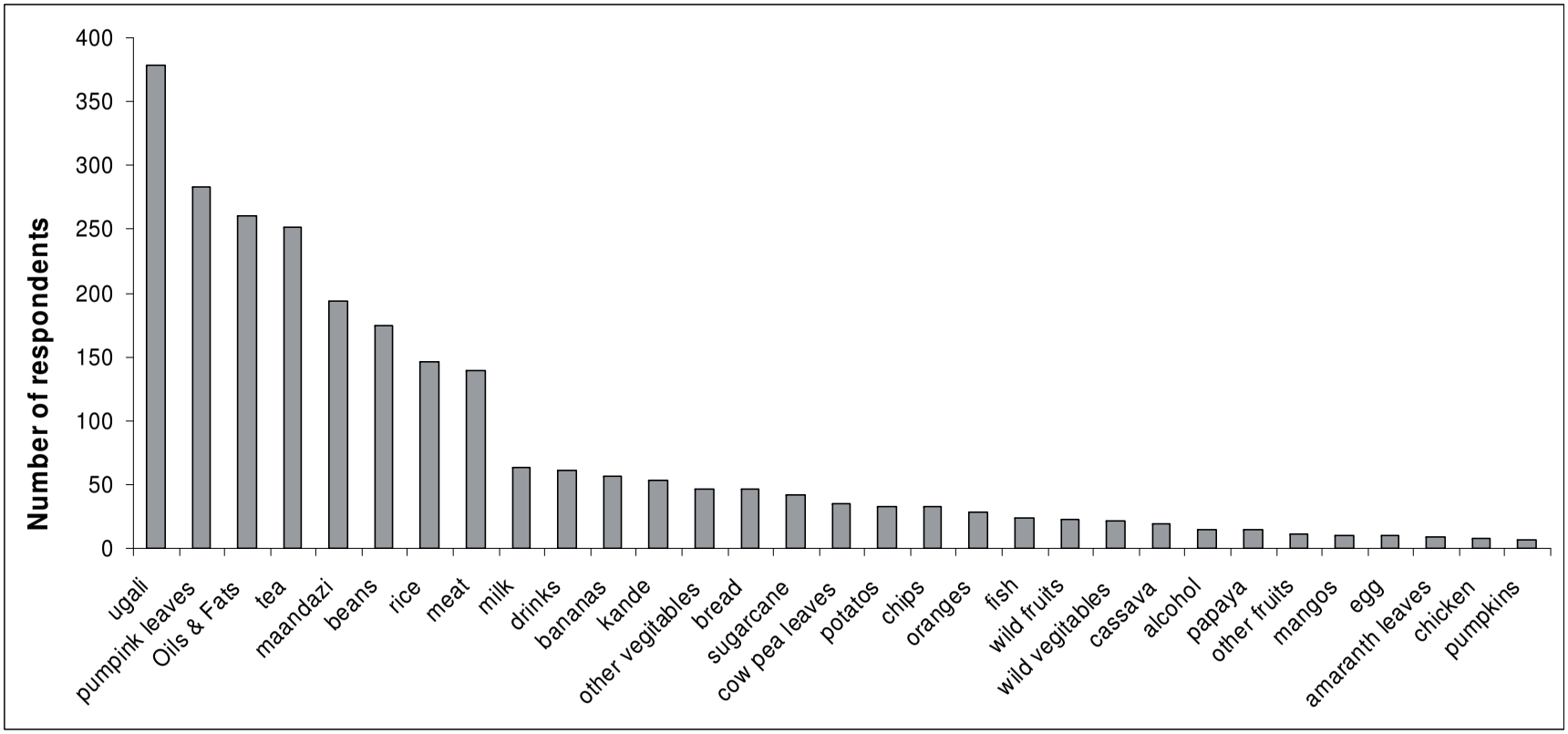

Figure 3.8: Types of food consumed by women in Malinzanga village, n = 384; multiple responses possible

Kande is made out of corn and beans. The corn can be whole and fresh or dry and half-grinded. The beans are normally whole and dry. The corn is boiled to cook. Then the beans are added to cook. Depending on available spices and preferred taste, salt, oil, onions, tomatoes, and other spices such as ginger and coconut milk can be added.

Maandazi (buns) are made out of wheat flour, yeast, water and sugar. Also depending on available spices and preferred taste, sugar, salt, eggs, milk, cardamon, and coconut milk can be added to the dough. The dough is sliced into different shapes such as a triangle, rectangle, or circle and deep fried.

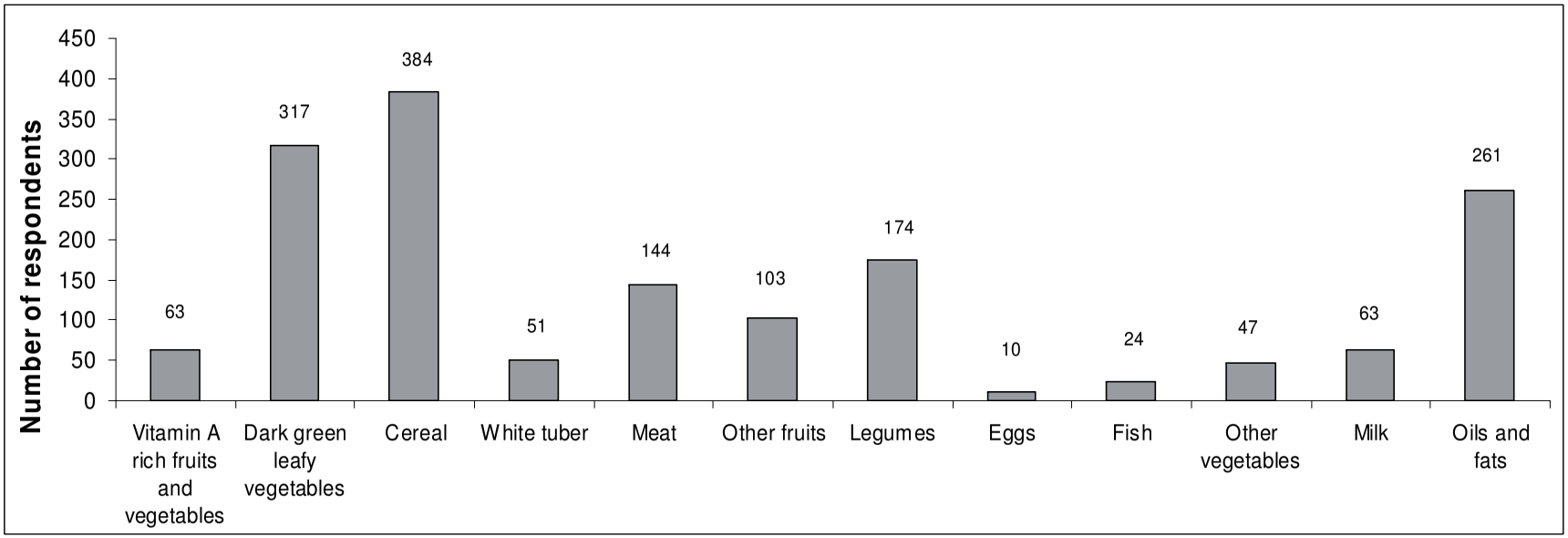

Figure 3.9: Food groups consumed by women in Malinzanga village, n = 384; multiple responses possible

As derived from food items, food groups consumed in the study area were basically cereals, oil/fat and dark green leafy vegetables. All 384 women consumed foods from the group of cereals, about 83% consumed dark green leafy, and 68% consumed oils/fats.

Consumption of groups of vitamin A-rich vegetables and milk was found relatively low. Of all the women interviewed, only 16% consumed these types of food groups. Compared to the other food groups, consumption of eggs and fish was very low. Based on the 24-hour dietary recall, consumption of eggs and fish was less than 3% and about 6%, respectively as shown in Figure 3.9.

3.6 Food choice and food frequency

Food choice in the study area was mainly influenced by its availability in the household; 85% of the women reported choosing foods to consume based on their availability. Compared to food availability, price and health benefits of the foods played a minor role in the choice of foods; 19% and 15%, respectively. To most of the women, other factors such as desire for a change and amount of food in the household played a negligible role (Figure 3.10).

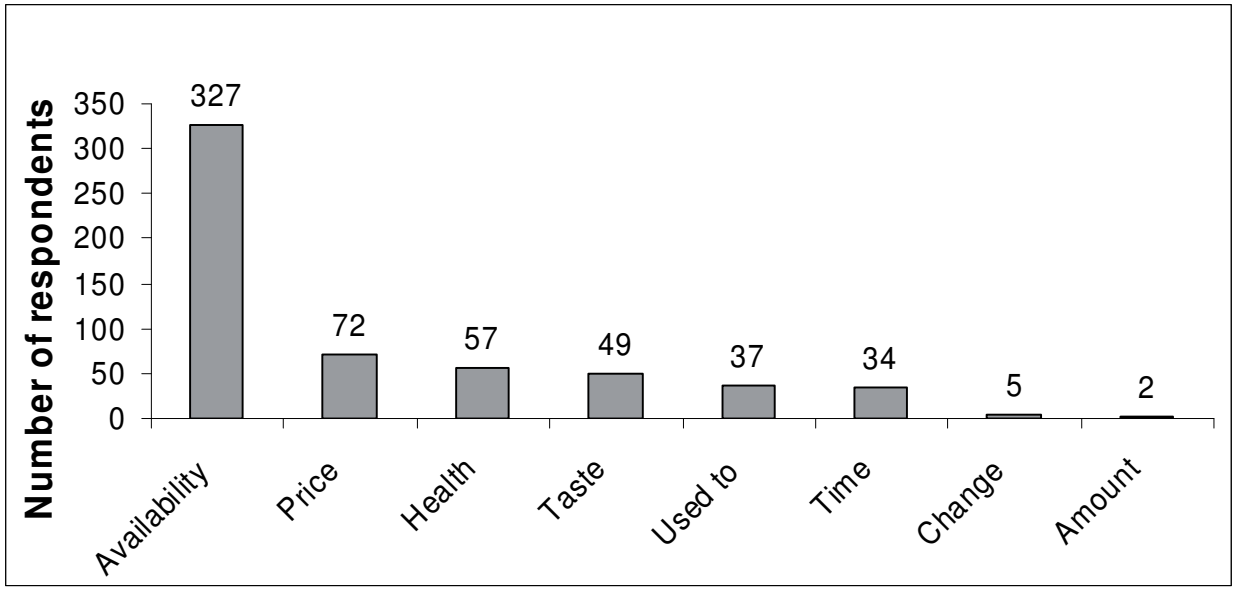

Figure 3.10: Factors influenced food choice in Malinzanga village, n = 384; multiple responses possible

To explore types of food and their consumption among the women of childbearing age in the study area, food frequency questionnaire interviews were conducted with all 384 respondents.

As observed in the 24 h dietary recall, consumption of *ugali*, green leafy vegetables and oils/fats was very high. Of all 384 women interviewed, 99.7% consumed *ugali*, 75.8% green leafy vegetables and 67.4% oil/fat everyday. Other foods that were frequently consumed were meat, rice, maandazi, and sweet potatoes. Most of the women consumed these foods at least once per week. Also of all the women interviewed, 75% consumed meat, 73.7% rice, 54.7% maandazi and 55.7% sweet potatoes at least once per week.

On the other hand, consumption of cassava, Irish potatoes and cabbage was very low. Of all the 384 women interviewed 67.4% consumed cassava, 64.4% Irish potatoes and 60.4% cabbage rarely or not at all. Only about 20% consumed these foods at least once per week, and less than 10% on a daily basis. Bread, indigenous fruits, and vegetables were among the foods that were also rarely consumed. Of all the women, about 59% consumed bread, 60% indigenous fruits and 53.1% indigenous vegetables either once per month or not at all. Daily and weekly consumption of these foods ranged between 0% and 12.5%, and 0.8% and 14.1%, respectively (Figure 3.11).

Cooked bananas are green bananas peeled and boiled to cook. Depending on availability and preferred taste, additional spices such as oil, salt, onions, tomatoes, oil, and coconut milk can be added. In addition, meat, fish and legumes can be added.

Vitumbua are made out of rice flour, yeast, water, sugar, and other spices such as cardamon and coconut milk. A thick mix similar to pancake mix is prepared and shallow fried in a special round-shape-moulded frying pan.

Chapati is made out of wheat flour, water, salt, and oil. Dough is made and divided into medium (hand-full) size balls. The balls are flattened, oil is applied, and they are rolled into a coil-like form. Then after about half an hour the coil-like rolled small dough is flattened and shallow fried similarly to pancakes.

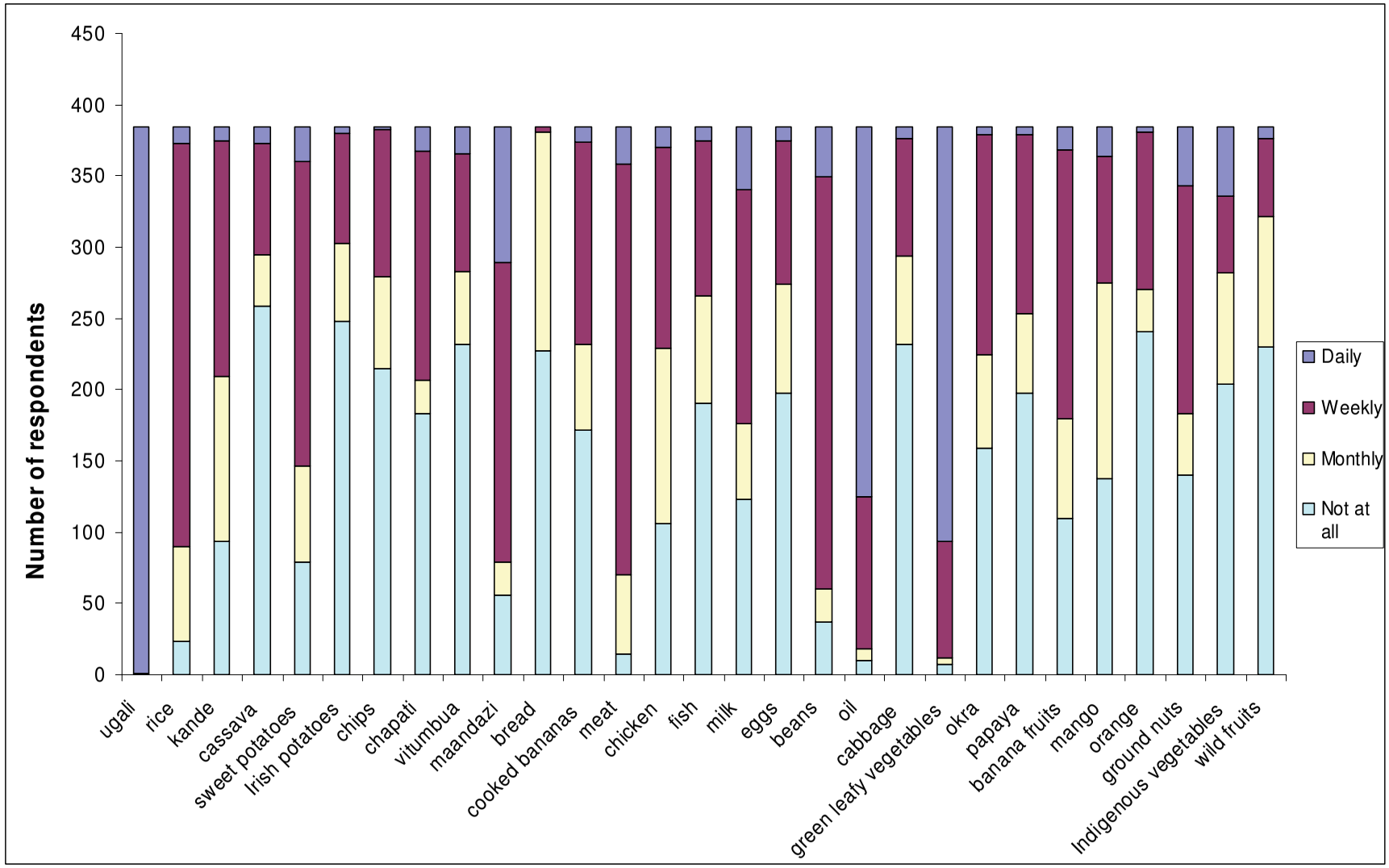

Figure 3.11: Frequency of food consumption in Malinzanga village, n = 384

3.7 Anthropometric and biochemical data

Nutritional status

The nutritional status of the women was estimated using anthropometric and biochemical measurements as well as clinical signs and symptoms. Table 3.2 shows mean, median, standard deviation (SD), minimum (min), maximum (max), and percentile of all of the parameters measured for assessing the women's nutritional status.

Table 3.2: Anthropometric and biochemical characteristics among the women in the study sample, n = 384 (all), n = 351 (non-pregnant), n = 33 (pregnant)

Characteristics	Mean	Median	SD	min	max	Percentile (25%-75%)
BMI (all)	22.76	22.08	3.49	15.75	41.53	20.49-25.5
BMI (non-pregnant)	22.65	21.93	3.53	15.75	41.53	20.35-24.34
BMI (pregnant)	23.99	24.03	2.7	18.66	31.59	21.95-25.81
MUAC (all)	27.17	26.60	3.12	20.50	42.50	25.13-29.00
MUAC (non-pregnant)	27.21	26.70	3.15	20.50	42.50	25.20-29.00
MUAC (pregnant)	26.67	26.50	2.87	20.50	34.00	24.75-29.25
Hemoglobin (all)	12.61	12.80	1.74	5.40	16.70	11.60-13.80
Hemoglobin (non-pregnant)	12.72	12.90	1.73	5.40	16.70	11.90-13.90
Hemoglobin (pregnant)	11.46	11.10	1.40	8.40	15.00	10.50-12.30
TfR (all)	5.76	4.92	3.74	1.47	43.16	3.78-6.71
TfR (non-pregnant)	5.82	4.98	3.85	1.47	43.16	3.80-6.74
TfR (pregnant)	5.13	4.46	2.22	2.79	12.59	3.74-6.30
RBP (all)	1.09	1.03	0.40	0.38	3.02	0.80-1.31
RBP (non-pregnant)	1.11	1.05	0.41	0.38	3.02	0.81-1.34
RBP (pregnant)	0.93	0.91	0.24	0.54	1.35	0.74-0.91
CRP (all)	2.98	1.09	6.50	0.00	54.62	0.39-2.65
CRP (non-pregnant)	2.92	0.96	6.60	0.00	54.62	0.35-2.54
CRP (pregnant)	3.63	1.95	5.29	0.31	27.82	0.91-3.86
AGP (all)	0.73	0.69	0.31	0.21	2.48	0.53-0.84
AGP (non-pregnant)	0.75	0.71	0.31	0.22	2.48	0.57-0.86
AGP (pregnant)	0.50	0.48	0.22	0.21	1.11	0.34-0.58

In estimating the nutritional status of the women in the study sample based on BMI, pregnant women (n = 33) were excluded. This was because BMI is not a good indicator for nutritional status of pregnant women; the weight of a pregnant woman does not reflect the actual weight of the woman. It includes the weight of the unborn baby and other excess fluids and fats due to the pregnancy. The BMI of pregnant women can be better estimated by using the weight before pregnancy as a reference and monitoring the weight gain throughout the pregnancy. Thus, among the 384 women in the study sample, only 351 were included in the analysis of BMI. According to the WHO's criteria for classification of underweight, overweight, and normal weight ranges for adults, the majority of the respondents had normal weight[4] (72%). Overweight[5] and underweight[6] were 21% and 7%, respectively (Figure 3.12).

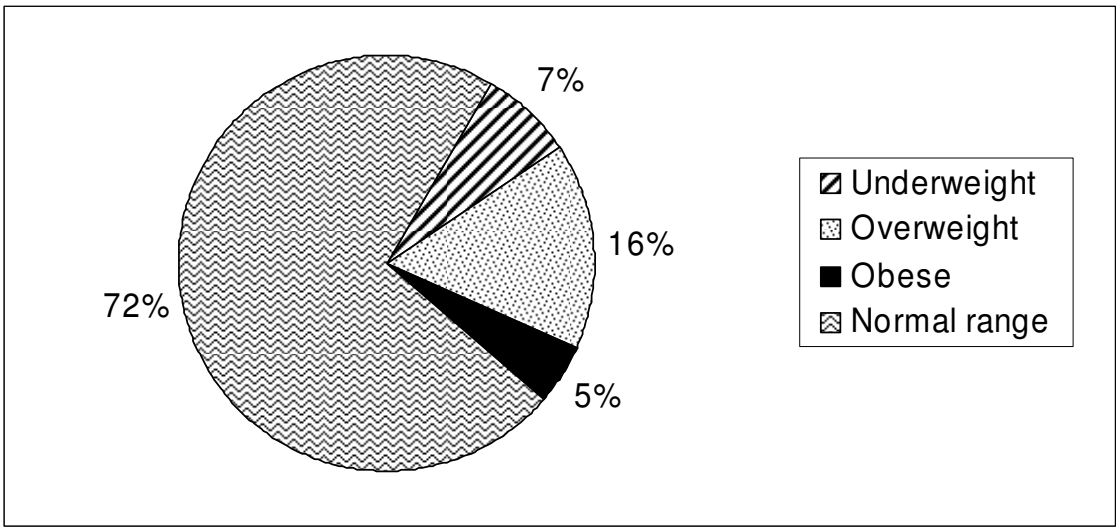

Figure 3.12: Nutritional status of women in Malinzanga village according to WHO BMI-criteria, n = 351

MUAC was used in assessing chronic energy deficiency among the women based on the recommended cut-off points for simple screening of nutritional status (James, 1994). Almost all of the respondents were not undernourished; they had MUAC > 22 cm (Figure 3.13).

[4] BMI between 18.50 and 24.99 kg/m²
[5] BMI ≥ 25.00 kg/m²
[6] BMI ≤ 18.50 kg/m²

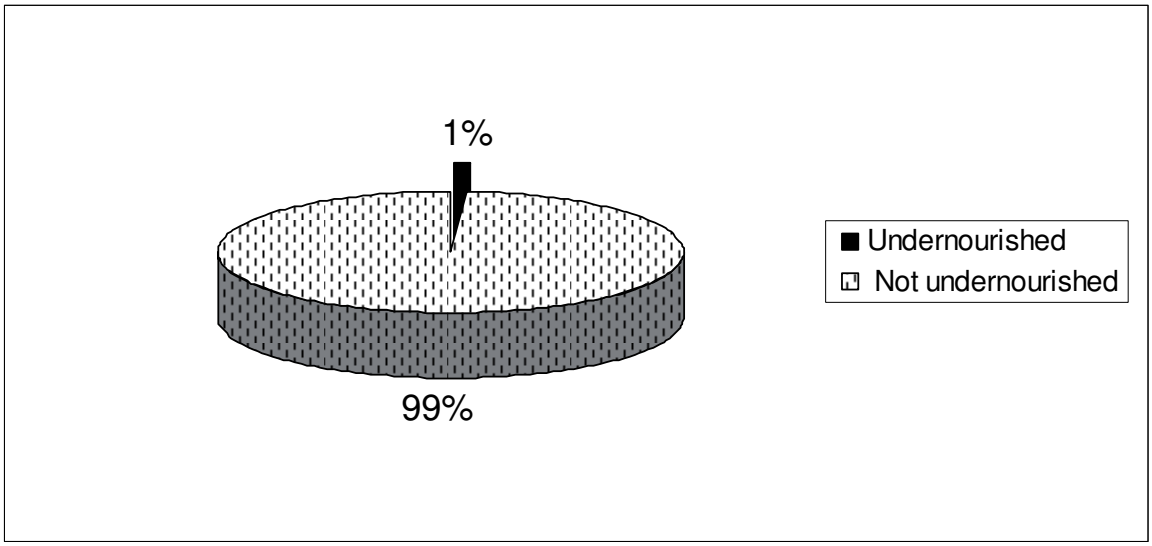

Figure 3.13: Nutritional status of women in Malinzanga village according to WHO MUAC-criteria, n = 384

Vitamin A status

Vitamin A deficiency was estimated using retinal binding protein (RBP), which was determined by dried blood spots (DBS), collected on dry filter papers and analyzed using ELISA technique as explained in the methodology. In order to avoid an overestimation of vitamin A deficiency, possible signs of acute and chronic infections were assessed using C-reactive protein (CRP) and acid glycoprotein (AGP) parameters, respectively. Following the suggested cutoff points for acute and chronic infections, respondents with CRP > 5 mg/L and/or AGP > 1 mg/L (n = 88) were excluded from the data set for the analysis of vitamin A status. Hence, of the 384 respondents, only 296 were included in the analysis of vitamin A status.

Based on WHO's indicators for assessing vitamin A deficiency, the prevalence of vitamin A deficiency in this study was relatively high; over 50%. Of the 296 women, 55% were found with vitamin A deficiency[7]; 14.3% had severe vitamin A deficiency[8] and 41% had moderate vitamin A deficiency[9] (Figure 3.14).

[7] RBP ≤ 1.05 µmol/L
[8] RBP < 0.7 µmol/L
[9] RBP between 0.7 ≥ 1.05 µmol/L

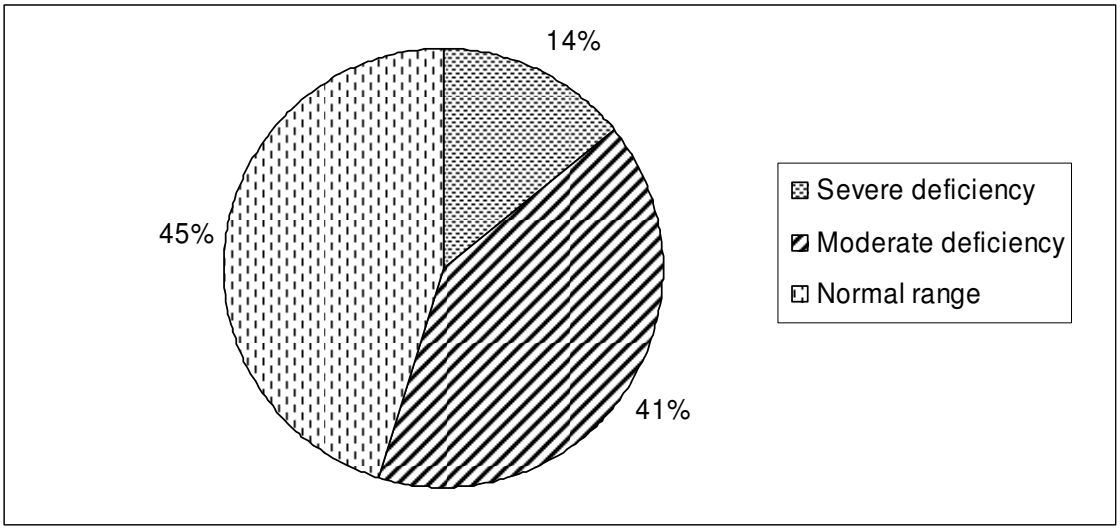

Figure 3.14: Vitamin A Status of women in Malinzanga village according to WHO RBP-criteria, n = 296

Cases of impaired dark adaptation as well as Bitot's spots were also observed among the women in the study sample. The total prevalence of impaired dark adaptation and Bitot's spots among the 296 women was 5.4% and 1% respectively. In pregnant women, prevalence of both impaired dark adaptation and Bitot's spots was much higher, 7.7% (2 of 26) and 3.8% (1 of 26), respectively, compared to their counterpart non-pregnant women, 5.2% (14 of 270) and 0.7% (2 of 270), respectively.

Table 3.3: Vitamin A status among women in Malinzanga village

Characteristic	**All (n = 384)**		**Without infections (n = 296)**	
Mean	1.09		1.07	
Median	1.03		1.01	
Std. Deviation	0.39		0.37	
Minimum	0.38		0.39	
Maximum	3.02		3.02	
	(n)	**(%)**	**(n)**	**(%)**
Vitamin A deficiency	206	53.6%	162	54.7%
Severe vitamin A deficiency	58	15.1%	42	14.2%
Moderate vitamin A deficiency	148	38.5%	120	40.5%
Normal range	178	46.4%	134	45.3%

Iron status

In order to estimate anemia, iron deficiency as well as iron deficiency anemia among the women in the study sample, levels of hemoglobin concentration (Hb), and soluble transferrin receptors (sTfR) were used. Blood samples were collected using finger pricks and dry filter papers (dried blood spots) and were measured using a HemoCue Hb 201+ Analyzer and the ELISA technique as explained in the methodology. Any form of anemia for pregnant and non pregnant women was classified by Hb < 11.0 and < 12.0 g/dL, respectively (CDC, 1989). Mild anemia was classified by Hb between 10.0 and 10.9 g/dL in pregnant and between 10.0 and 11.9 g/dL in non pregnant women. Moderate and severe form of anemia for both pregnant and non pregnant women was classified by Hb between 7.0 and 9.9 g/dL and < 7.0 g/dL, respectively. Iron deficiency was classified by plasma sTfR > 8.0 mg/L.

To avoid overestimation of anemia and of iron deficiency, respondents with possible signs of acute and chronic infections, CRP > 5 mg/L and/or AGP > 1mg/L (n = 88) were also excluded for the analysis of anemia and iron status, and that of iron deficiency anemia status. Therefore, of the 384 respondents in the study sample, only 296 were included in the analysis of anemia, iron deficiency and iron deficiency anemia.

A majority of the respondents had a normal range of Hb; of the 296, 26% were anemic (Figure 3.15).

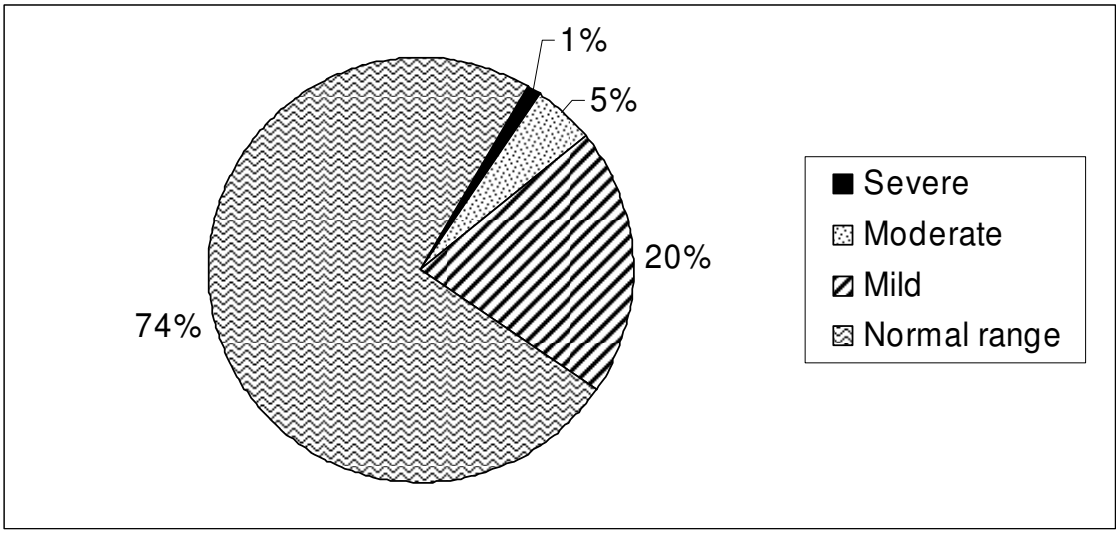

Figure 3.15: Anemia status of women in Malinzanga village according to WHO Hb-criteria. n = 296

Prevalence of iron deficiency in the study area was lower than that of anemia. Among 296 women in the study sample, 11% had iron deficiency (Figure 3.16).

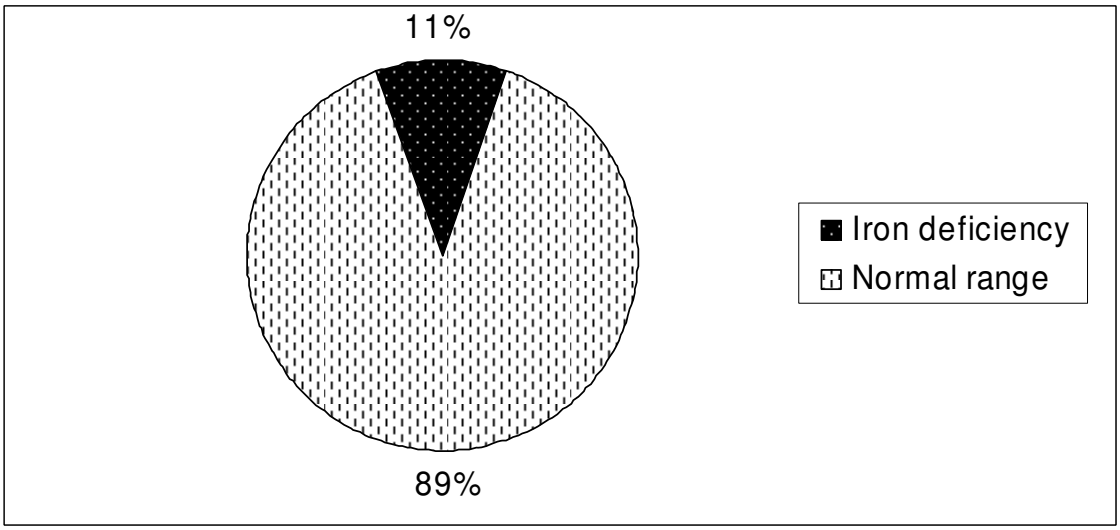

Figure 3.16: Iron deficiency among women in Malinzanga village according to Erhardt sTfR-criteria, n = 296

The levels of sTfR ranged from 1.47 to 43.16 mg/L with a median (inter-quartile) of 4.74 (3.66 to 6.13). Since both levels of hemoglobin concentration and plasma soluble transferritin receptor were not normally distributed, non-parametric tests; Sperman's rho was also applied to test for correlation between the two. A significant statistical association between anemia and iron deficiency in all 296 women was observed at p = 0.0001 with a correlation coefficient (r) of 0.240. A significant statistic

association between anemia and iron deficiency was also observed among the 26 pregnant women at p = 0.019 with a higher correlation coefficient (r), 0.457.

Chi-Square Tests: person chi-square, Fisher's exact test, and likelihood ratio were also applied to test for the strength and direction of the association. Fisher's exact test was significant at p=0.000. The probability of anemic women also having iron deficiency was about 4 times higher compared to non anemic counterparts (Figure 3.17). Of the 77 women with anemia, 23.4% had iron deficiency. Only 6.4% of the non anemic women had iron deficiency.

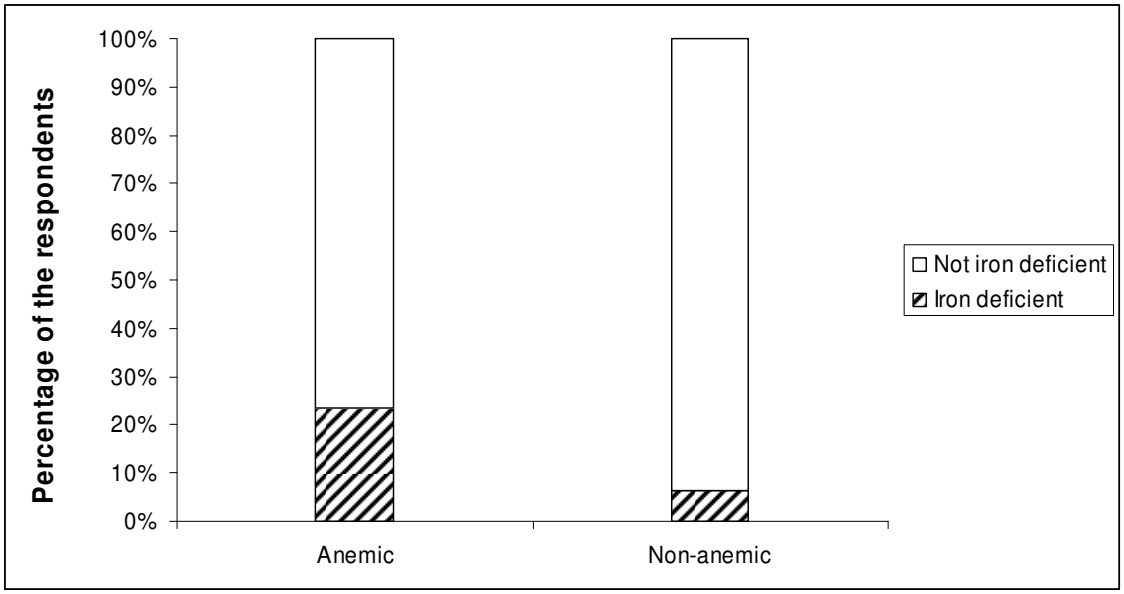

Figure 3.17: Iron deficiency anemia among women in Malinzanga village according to Hb and TfR-criteria, n = 296

To estimate the prevalence of acute and chronic infections among the women in the study sample, plasma C-reactive protein (CRP) and acid glycoprotein (AGP) were separately assessed. Based on these markers for infection and the used cutoff points of CRP > 5 mg/L and AGP > 1 mg/L to classify women with acute and chronic infections, respectively, most of the women in sample did not suffer from any kind of infection during the survey. About same proportion of acute and chronic infection was observed in the study sample. Of the 384 women, 13.8% and 14.3% suffered from acute and chronic infection, respectively. A positive significant statistical correlation between acute and chronic infection was observed (Fisher's exact test, p=0.000). About 40% of the respondents who had an acute infection also had a chronic infection (Figure 3.18). This was confirmed by Spearman's rho non

parametric correlation test at 0.01 levels with $p < 0.0005$ and correlation coefficient (r) of 0.267.

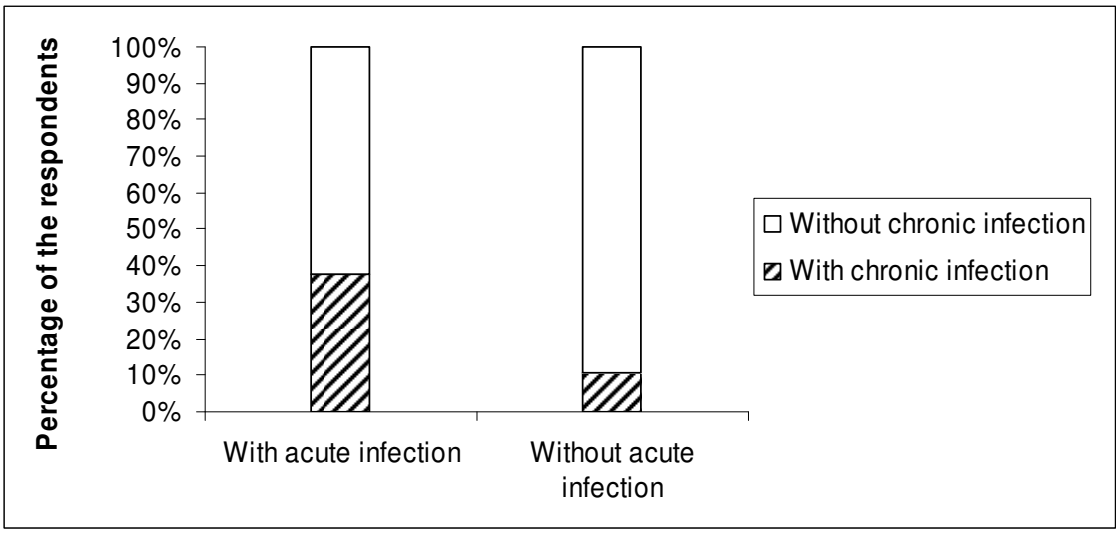

Figure 3.18: Prevalence of acute and chronic infection among women in Malinzanga village according to Erhardt CRP and AGP criteria, n = 384

3.8 Sanitation and infectious diseases

Living conditions and hygiene

Houses in the study area varied between being made out of mud walls and thatched roofs to being made out of brick and cement walls and iron sheet roofs. Nevertheless, a majority of the houses in the study area were built out of mud walls and thatched roofs. Every house had its own pit latrine; a small hut located about 10 meters away from it, and its own kitchen; another small hut located about 3 meters from the house. The pit latrines were simply a small hole with or without elevated mud blocks to step on. The kitchens were also very small and had limited ventilation. Many of the kitchens in the study area had no windows. The ones which had windows were too small to allow the smoke from firewood – often used as a source of energy for cooking (99% of the respondents used it) – to come out of the hut (Picture 3.1).

Picture 3.1: Kitchen and water condition in Malinzanga village

In the study area, tap water was the main source of water for domestic use. About 80% (305 of 384) of the respondents used tap water for domestic needs. Nevertheless, this use was limited, for the tap water was not running everyday. Thus a large percentage of people in the study area also had to depend on river water (73%) and wells (9.4%). All three sources of water provided water which was not hygienically clean and safe for drinking. Despite that, not everyone in the study area treated the drinking water. Of all 384, only 199 (51.8%) treated the water for drinking. Among these, 187 (48.7%) boiled it, 6 (1.6%) used chemicals, and another 6 (1.6%) just let the water settle and filtered it before drinking.

Twenty percent of all the respondents suffered from diarrhea regularly. Of the 77 women who had diarrhea frequently, 59 (76.6%) used river water for drinking. Among these, 53 (89.8%) boiled the water before drinking.

In the study area, washing hands before eating or after using the toilet showed no influence on frequent diarrhea. With regard to the occurrence of diarrhea, about the same percentage of those who always washed their hands with soap before eating and/or after using toilet had diarrhea equally as often as those who washed their

hands without soap, washed sometimes or did not wash their hands at all before eating and/or after using the toilet (Table 3.4).

Table 3.4 Hand washing behavior and incidence of diarrhea in Malinzanga village, n = 384

	Wash hands before eating			**Wash hands after using the toilet**		
	Diarrhea incidences			**Diarrhea incidences**		
	n	**Yes**	**no**	**n**	**yes**	**no**
Always washing hands with soap	168	23%	77%	256	19%	81%
Washing hands without soap, washing hands sometimes, or not washing hands at all	216	18%	82%	128	25%	75%

In this study, the probability (risk) of getting diarrhea was calculated as shown below:

Risk = n/N

n = Number of respondents who encountered diarrhea frequently

N = sample size

Overall risk of getting diarrhea = 77/384 = **0.2**.

Risk of getting diarrhea when washing hands with soap before eating = 39/168 = **0.2**

Risk of getting diarrhea when washing hands without soap, washing hands sometimes or not washing hands at all before eating = 38/216 = **0.2**.

Relative risk = [(n/s) / (n/ws)]

n = Number of respondents encountered diarrhea frequently

s = Number of respondents who washed hands with soap

ws = Number of respondents who did not wash their hands with soap

Relative risk = 0.2/0.2 = **1**.

Hence women who washed their hands with soap before eating had the same relative risk of getting diarrhea compared to those who washed their hands without soap before eating.

Risk of getting diarrhea when washing hands with soap after using toilet

= 48/256 = **0.2**.

Risk of getting diarrhea when washing hands without soap, washing hands sometimes or not washing hands at all after using toilet =29/128 = **0.2**.

Relative risk = 0.2/0.2 = **1**.

Also, women who washed hands always with soap after using toilet had the same risk of getting diarrhea compared to those who washed their hands without soap.

In the study area, waste is mainly disposed of in an open wide hole dug about 10m away from the house (Picture 3.2). About 70% of the women interviewed used this method. Of the remaining women, 6.3% burned, 21.4% decomposed and 3.4% threw the waste outside the house and/or in the bushes.

Picture 3.2: Common method used to dispose of waste in Malinzanga village

Malaria

Looking at the previous three months before the survey malaria was the worst common disease in the study area. Thus, it was given special attention and analyzed

separately. The frequency of malaria outranged the other most frequent illnesses reported (Figure 3.19).

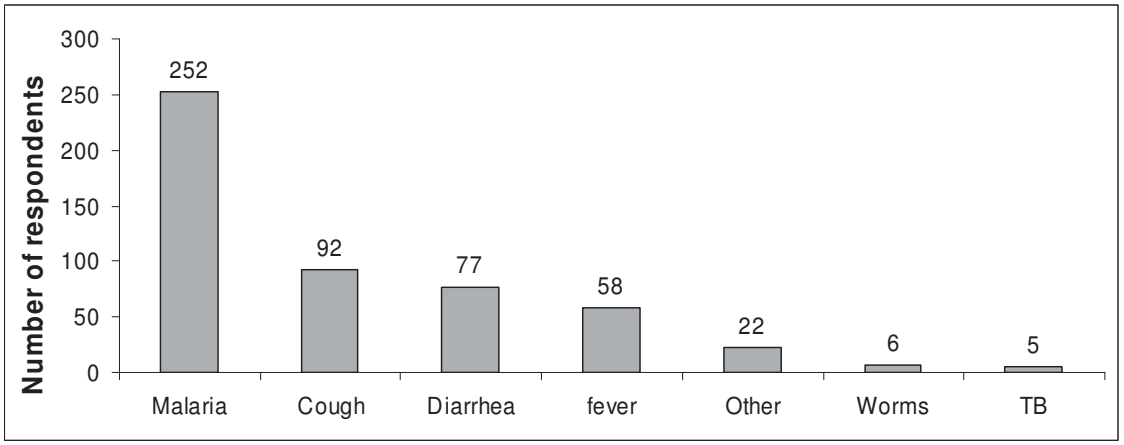

Figure 3.19: Common illnesses encountered in Malinzanga village, n =384

Multiple responses to the question about diseases and complaints were possible, for some of the respondents' encountered more than one illness. About 66% of the study sample had had malaria prior the survey. Knowledge of malaria prevention and application of available methods to prevent malaria had no influence on the frequency of malaria. Seventy percent of the respondents who knew malaria prevention methods got malaria frequently, and 67% of those who even used one of the methods got malaria frequently. In addition, in this study, neither usage of mosquito nets nor usage of treated mosquito nets prevented the villagers from getting malaria. The bivariate nonparametric correlation Spearman's rank test revealed a positive significant correlation between usage of mosquito nets and frequent malaria ($p=0.001$). Of the 363 respondents who used mosquito nets, 245 (67%) got malaria frequently.

The study also analyzed the impact of the usage of treated mosquito nets on the incidence of malaria. A positive significant Spearman's rho correlation between the usage of treated mosquito nets and the incidences of frequent malaria was observed ($p=0.002$). Of the 334 respondents who used treated mosquito nets, 229 (67%) got malaria frequently.

Furthermore, frequency of the common illnesses was assessed. In the case of malaria, more than 80% of the study population encountered malaria at least once a

month. Among the 252 respondents who encountered malaria, 16 (6%) got malaria every two weeks, 193 (77%) once per month and 43 (17%) at least once in three months.

3.9 Availability, accessibility and utilization of health care services

There was only one health care facility in the study area which provided health care services for more than 5,000 people.

The dispensary was located in Mlowa, one among the 9 hamlets in the study area. The distance to the dispensary ranged between 10 meters and 10 kilometers depending on the distance from Mlowa. There was no public transportation moving from hamlet to hamlet, thus access to the dispensary was either by foot or by bike. In case of emergencies, one had to call an ambulance from the district hospital located 60 kilometers away from the study area. The ambulance transport did cost TShs. 20,000 ($20). The time to reach the dispensary ranged from less than one hour to over 6 hours depending on location and means of transportation. A majority of the villagers took less than one hour to reach the dispensary.

Of the 384 women in the study sample, 58.1% spent less than one hour, 33.3% between one and three hours, and 8.1% between three and six hours to reach the dispensary. Matalawe had the longest distance to the dispensary; 55% of the respondents from Matalawe needed between three and six hours to reach the dispensary. Contrary to Matalawe, women from Mlowa and Majengo ”B” needed less than one hour to reach the dispensary (Figure 3.20).

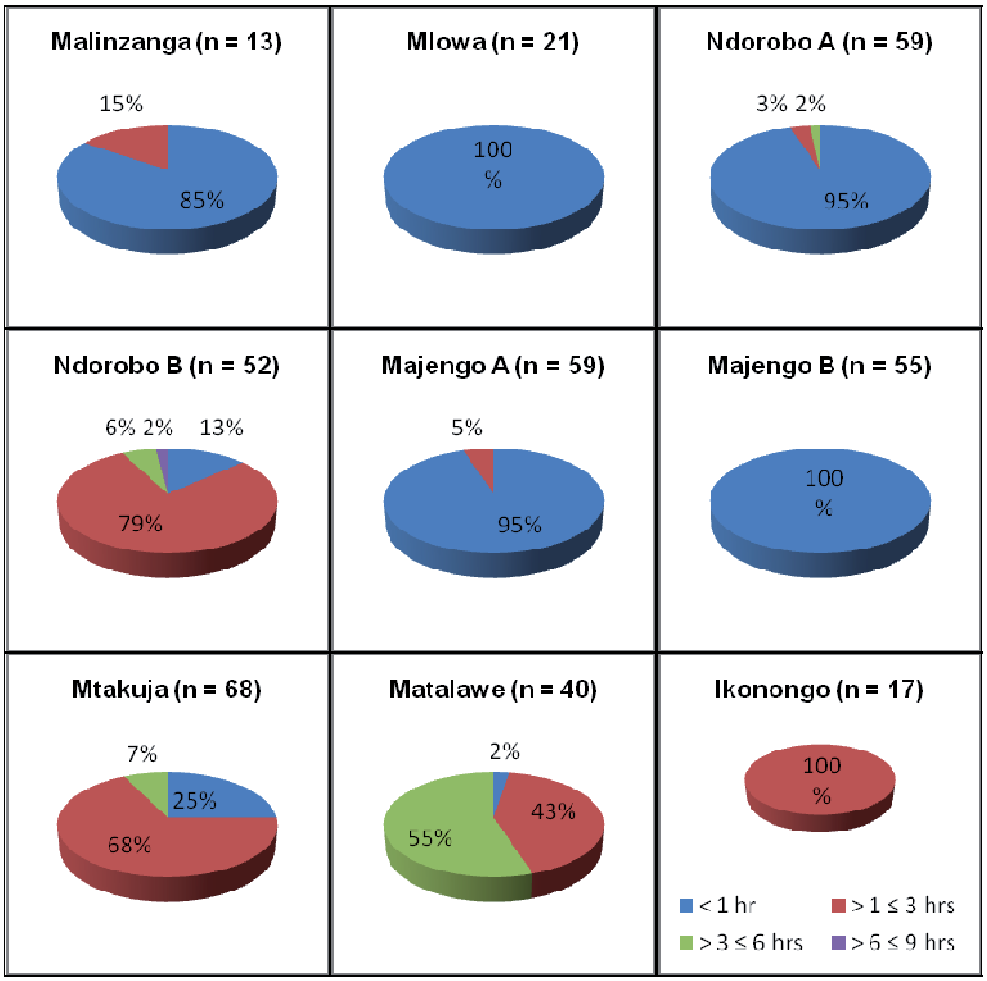

Figure 3.20: Time needed to reach the dispensary in Malinzanga village

Multinomial logistic regression showed a positive significant statistic association between distance (time taken) to the dispensary and frequency of visits (p=0.004). About 65% of the 223 women who spent less than one hour to reach the dispensary visited the dispensary more than three times per year compared to their counterparts 30% of the 128 women who spent between one and three hours and 6.5% of 31 who spent between three and six hours. A significant correlation was observed between frequency of visits and time taken to reach the dispensary (Table 3.5).

Table 3.5: Parameter estimates of nominal regression of frequency of visiting and time taken to the health facility in Malinzanga village

Frequency of visiting health facility by time it takes to reach it		Estimates	Std. Error	df	p-values	Exp(B)
More than three times per year	Intercept	0.310	0.397	1	0.435	
	Less than one hour	1.279	0.445	1	**0.004**	3.593
	Between one and three hours	0.788	0.464	1	0.089	2.200
Once per year	Intercept	-1.012	0.584	1	0.083	
	Less than one hour	1.012	0.638	1	0.113	2.750
	Between one and three hours	0.921	0.657	1	0.161	2.511
Less than once per year	Intercept	-1.299	0.651	1	0.046	
	Less than one hour	0.671	0.721	1	0.352	1.956
	Between one and three hours	0.872	0.731	1	0.233	2.391

In the study area, cost for medical treatment varied depending on the payment plan chosen. Villagers had option to pay either TShs.1,000 ($1) per person per treatment or TShs. 5000 ($5) per annum (one year family insurance). A majority of the villagers in study area used the single treatment payment plan. Of the 382 women who visited the dispensary in the study sample, 66% used the single treatment plan and 34% the annual insurance plan.

A majority of the patients that sought health care services from the dispensary were women and children. Everyday between 30 and 50 patients visited the dispensary. Among these, about 20 pregnant women seeking medical check ups and antenatal care services, between 15 and 20 women information and alternatives on family planning methods, about 4 women for delivery, and between 30 and 35 women seeking health care for under-five children.

As mentioned above, most common illnesses in the study area were malaria, cough, and diarrhea. Likewise, most of the patients who visited the dispensary had malaria, respiratory tract infection, or anemia. Due to a shortage of health staff, not all patients received the health care services needed every time they visited the dispensary. Not only a lack of staff but also a lack of instruments[10] as well as poor quality of available instruments, for instance in the delivery place and examination

[10] For malaria and HIV screening, microscopes for blood, urine, and stool examination, hemoglobin measurement kits, and instruments for antenatal care services.

room as shown in Picture 3.3 increased the risk of false diagnoses, treatment, and preventable illnesses in the study area.

Picture 3.3: Quality of delivery place (left) and examination room (right) at the dispensary in Malinzanga village

Health seeking behavior among the villagers in the study area was very good. Almost all of the women (382 of 384) in the study sample visited the dispensary when they were ill. The remaining 2 visited traditional healers instead. Most of the women (60.2%) visited the dispensary more than three times per year. As shown in Table 3.6, in the previous year prior the survey, 14.3% women visited the dispensary once per year, 8.9% less than once per year, and 8.3% not at all. About 7% (other) could not remember how many times they normally visit the dispensary.

Table 3.6: Health care seeking behavior among women in Malinzanga village, n = 384

Frequency of visit	Number of respondents	Percentage of respondents
More than three times per year	231	60.2%
Once per year	55	14.3%
Less than once per year	34	8.9%
Never	32	8.3%
Other	26	6.8%
Missed	6	1.5%
Total	384	100%

The study found a significant statistical association in multinomial logistic regression between the frequency of illnesses and visiting of the dispensary (p=0.004) among

the respondents who encountered illnesses at least once per month. This association however, was not valid among the respondents who encountered illnesses only once per year or less; p=0.404 and p=0.166, respectively (Table 3.7).

Table 3.7: Parameter estimates of nominal regression of frequency of visiting health facility and frequency of illnesses among women in Malinzanga village

Frequency of visiting health facility by frequency of illnesses		Estimates	Std. Error	df	P-values	Exp(B)
More than three times per year	Intercept	0.663	0.299	1	0.026	4.636
	Every two weeks	1.534	0.803	1	0.056	2.817
	Once a month	1.036	0.355	1	**0.004**	.
Once per year	Intercept	-1.041	0.475	1	0.028	1.594
	Every two weeks	0.348	1.314	1	0.791	.
	Once a month	0.466	0.559	1	**0.404**	4.250
Less than once per year	Intercept	-1.447	0.556	1	0.009	.
	Every two weeks	1.447	1.144	1	0.206	4.636
	Once a month	0.872	0.629	1	**0.166**	2.817

More than 75% of the respondents who visited the dispensary more than three times per year encountered illnesses once per month. In contrast, among their counterparts who encountered illnesses twice a month, a small percentage (8%) visited the dispensary more than three times per year. As shown in Table 3.8, the main reason for respondents who visited the dispensary once or less than once per year (48%) was that they were rarely ill for a long time. In addition, about every third respondent (36%) reported health care services being too expensive. The smallest proportion, 5% reported distance being an issue and 16% gave other reasons such as not having time because no one else could take care of the farm, family, or household duties on their behalf.

Table 3.8: Factors influenced health seeking behavior among women in Malinzanga village, n = 121

Reason	Number of respondents	Percentage of respondents
Too expensive	43	35.5
Too far away	6	5.0
Not been ill	58	48.0
Other	14	11.5
Total	121	100.0

3.10 Women's knowledge, awareness, and practices regarding the importance of micronutrients in pregnancy and the outcome

Knowledge on micronutrients among the women of child bearing age in the study area was very poor. The majority of the women had absolutely no knowledge of micronutrients. As mentioned above, of the 384 women, none had ever heard about folic acid, could identify one type of food with a high content of folic acid, or could name the importance of folic acid to maternal health.

After folic acid, among the nutrients inquired in this study, iron was the least known nutrient. Of the 384 women, 88.3% never heard of iron, 76.8% never heard of iodine and 59.4% never heard of vitamin A. Knowledge among the women of the good sources and the importance of the micronutrients to maternal health is summarized in Table 3.9.

Table 3.9: Summary of knowledge of women on micronutrients in Malinzanga village, n = 384

Micronutrients	**Percentage**			
Heard about iron				11.7%
Heard about iodine				23.2%
Heard about vitamin A				40.6%
Knowledge of good sources	**None**	**Low**	**Med**	**High**
High sources of iron	90.9%	3.4%	3.1%	2.6%
High sources of iodine	78.9%	12.2%	8.9%	0%
High sources of vitamin A	62.2%	9.4%	24.7%	3.6%
Knowledge of the importance	**None**	**Low**	**Med**	**High**
Importance of iron to maternal health	90.4%	8.3%	1%	0.3%
Importance of iodine to maternal health	81.3%	18.5	0%	0.3%
Importance of vitamin A to maternal health	62.8%	36.7%	0.5%	0%
Overall knowledge of the micronutrients	**None**	**Low**	**Med**	**High**
Overall knowledge of iron	88.3%	5.5%	6.3%	0%
Overall knowledge of iodine	76.8%	14.8%	8.3%	0%
Overall knowledge of vitamin A	59.4%	14.3%	26.3%	0%

The same method used to estimate knowledge of iron was used to estimate knowledge of iodine. In addition, the women were asked about the use of iodized salt, reasons for using iodized salt, and storage of iodized salt. Although the number

of women who had knowledge about iodine was almost twice as high as that of iron, overall, as shown in Table 3.9, the knowledge of iodine in the study area was still low. Nonetheless, the majority of the women used iodized salt (54%). Asked for the reason, 32.4% mentioned the iodine content and 67.6% other reasons such as availability, affordability, familiarity, and economic aspects[11] (Figure 3.21).

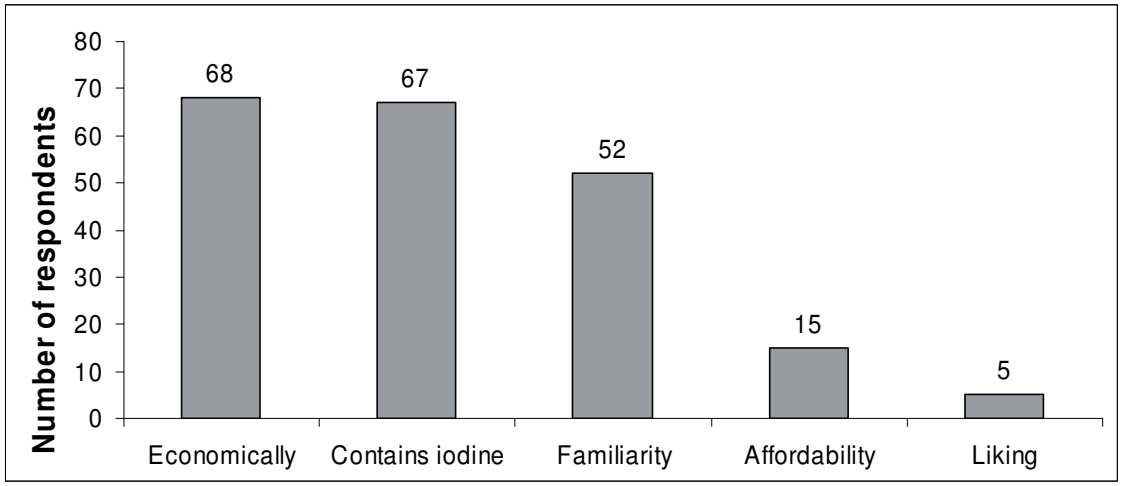

Figure 3.21: Reasons for using iodized salt among women in Malinzanga village, n = 207

More than 75% of the respondents stored their salt in a small container. Others stored in a pack (17.4%), cup (4.2%), or in a bowl (1.8%). Of all the respondents who used iodized salt, 70% stored it in a small container (Figure 3.22).

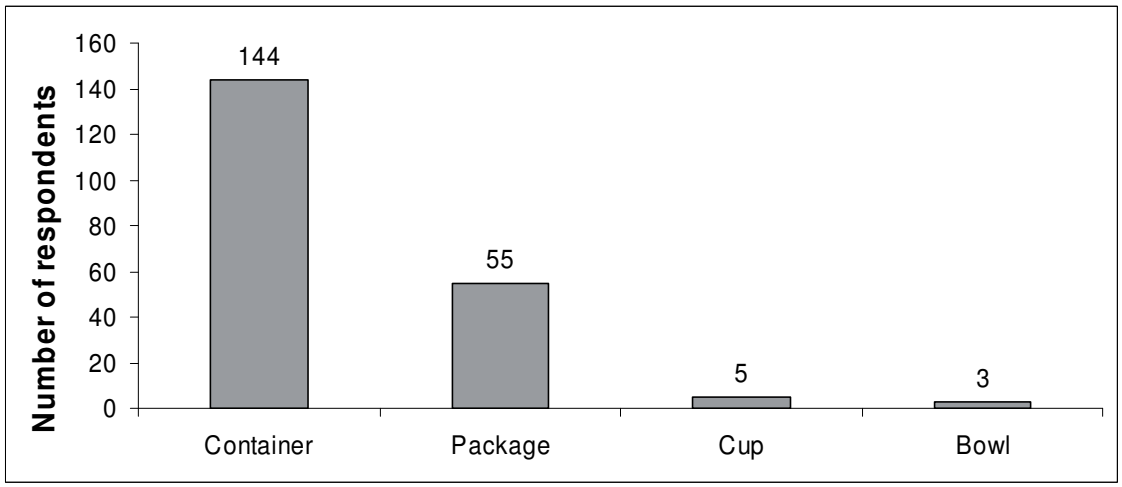

Figure 3.22: Storage of iodized salt in Malinzanga village, n = 207

[11] They need only a small amount to satisfy the requirement compared to other types of salt.

Based on the information about the knowledge of iron, iodine, and vitamin A which was collected from women of reproductive age in this study, the overall knowledge on micronutrients was very low. About 50% had absolutely none and 44% had low knowledge on micronutrients (Figure 3.23).

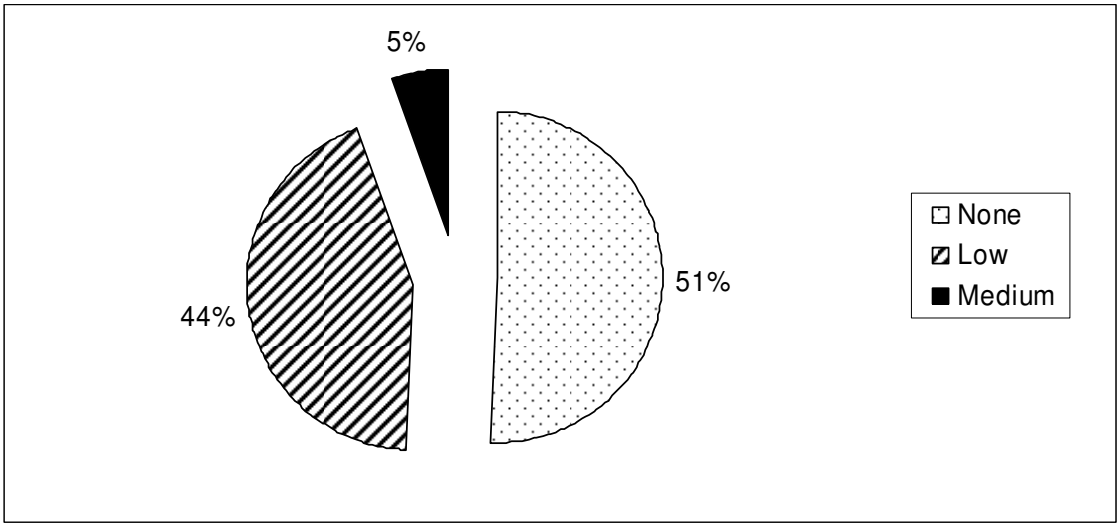

Figure 3.23: Knowledge of women on micronutrients in Malinzanga village, n = 384

Awareness and practices of antenatal care services

The majority of the women in the study sample were aware of the health and nutrition programs present in the study area. Of the 384 respondents, 60.4% reported having access to information on maternal health. Over 50% of these reported having obtained the information from community health workers, 66% from community nutrition workers, 60.8% from media, 4% from family or friends and 13.4% from school.

Linkages between health and nutrition were also known to more 50% of the women in the study sample. Despite the knowledge about links between health and nutrition among these respondents, only 88 (22.9%) had an understanding of nutrient supplements, and 85 (22.1%) were aware of the availability of supplements in the study area. Antenatal clinics, health centers, and shops were named as the major providers of these supplements. Of the 85, 38 (44.7%), 29 (34.1%) and 9 (10.6%) reported having obtained supplements from the antenatal clinic, health center, and shops, respectively. Known available supplements were iron, iodine, magnesium, and multivitamin tablets.

Use of nutrient supplements was not very common among the women of child bearing age in the study area. Among the women interviewed, only 8.8% used supplements during the time of the survey. Iron, iodine, vitamin A, and multivitamin were among the micronutrients that were used. A majority of the women who used supplements were either lactating mothers (17 of 34, 50%) taking vitamin A or pregnant women (6 of 34, 17.6%) taking iron supplements. These women also named breastfeeding and pregnancy status, respectively as being the main reason for taking the supplements. The other women who also used supplements mentioned no special reason. They simply took it because they heard of their importance from mass media, nutrition workers, family and friends, or other people.

Use of supplements among pregnant women occurred late in pregnancy. Of the 17 pregnant women who used supplements, only 3 began taking supplements within the first 3 months of pregnancy. The remaining 14 started a few months before delivery. These women planned to end the intake of supplements right after delivery, when the baby reached 3 months of age, or when the baby stopped wanting to breastfeed anymore. Likewise, the lactating-mothers who used supplements planned to stop taking the supplements when the baby reached 3 months of age or when the baby stops wanting to breastfeed anymore.

4. Discussion

4.1 Strategies to improve maternal health

Several studies on different strategies regarding the improvement of maternal health have been conducted and documented worldwide. In these studies, the importance, impact, as well as challenges facing the process of improving maternal and fetal health was shown. In Sweden for instance, the national policy favoring professional midwifery care for all births and establishment of standards for quality of care introduced in the 1880s have reduced maternal mortality by more than 50%. The reduction was from 500/100,000 (live births) in the mid-1880s to 230/100,000 by the beginning of the 20th century. This made Sweden the country with the lowest maternal mortality in Europe. Nobel price winner Robert Fogel in his study on the influence of health on national wealth conducted in the United Kingdom estimated about 30% of the United Kingdom's income growth between 1780 and 1980 was attributed to improvements in diet and health (Fogel, 1994). Arora performed a similar study in the Netherlands and other nine European countries also investigating the link between health improvement and economic development. He reported that, the changes in health increased economic growth in those countries by 30% to 40%, and that the health improvements made within this period in all the countries concerned permanently altered the slope of their economic growth paths (Arora, 2002).

In developing countries, Sri Lanka was recorded to have significant reductions in maternal deaths within a short period of time. In the past 50 years Sri Lanka has repeatedly (in a period of not more than 10 years) halved its maternal mortality rate (Liljestrand, 2004). A two-third reduction of maternal death occurred within 10 years from over 1,500/100,000 live birth in the 40s (1940—1945) to 555/100,000 in the 50s (1950—1955). Further reductions of maternal mortality continued to occur in Sri Lanka to reach the current figure of 43/100,000 (UNICEF, 2009a) The improvements that occurred in Sri Lanka were due to the combination of different strategies within the health sector[12] as well as outside the health sector[13], which aimed to improve

[12] Introduction of the countrywide system of health facilities together with an expansion of midwifery skills and the spread of family planning

[13] Free education for all, food subsidies to ensure availability of nutrient required by its people, and food supplementation programs

pregnant women and under-five children's nutritional status (WHO, 2006a; Fernando, 2003). Other countries in Asia, Central America, and Cuba have also experienced similar effectiveness of health care interventions. China has a maternal mortality rate of 48/100,000 and Cuba of 37/100,000 (UNICEF, 2009b, 2009c). This occurred after the introduction of a community-based maternal health care system, which covered all necessary care from prenatal to postpartum in these countries (WHO, 2006a).

Tanzania has applied different strategies in trying to reduce maternal and child mortality. Among them, free micronutrient (iron) supplements to all pregnant women and vitamin A to children under five years of age and mothers (eight weeks after delivery), food fortification (universal iodization of salt), food diversification, and dietary supplementation have been introduced. These strategies have shown their contribution to the reduction of micronutrient malnutrition among women and children. However in all strategies, challenges and limitations were experienced which left food insecurity as well as nutrient deficiency affecting a substantial portion of the country's rural population. In addition, access and supplies of micronutrient supplements is still poor and inadequate. Supply, use, and storage of iodized salt are also inadequate. A suitable food for iron fortification is yet to be identified, and knowledge, technology, as well as financial means for the fortification are yet to be attained. Quality and adequate knowledge and information of reproductive health still needs to be improved. Inadequate counseling, difficult access, and poor utilization of prenatal health care services as well as a poor knowledge of the importance of good nutrition to maternal health been recorded to contribute to poor maternal health in Tanzania (Galloway, 2002; Shirima, 2005; Mushi, 2007).

4.2 Consequences of maternal malnutrition

It is clear that a healthy and well-nourished woman living in an appropriate environment is capable of adapting to the periods of increased nutritional needs, such as pregnancy and lactation. The pre-gestational nutritional status and thus the nutritional status of a woman during pregnancy play an important role in the child's physical and mental development. Inadequate food intake during pregnancy results in low weight gain in the pregnant woman, leading to a low birth weight and hence placing the newborn in a high risk of mortality and impaired mental development.

Growth faltering earlier in life leaves women permanently at risk of obstetric complication and delivering low birth weight babies. This can start *in utero* leading to low birth weight and continue into childhood leading to stunting. Stunted children will most probably grow into stunted adolescents. These children are more likely to suffer from chronic diseases such as obesity, type 2 diabetes, cancer, and cardiovascular diseases during adulthood. Even at an adult age, these women are still at risk of delivering low birth weight babies, when fetal nutrition is inadequate (AED, 2007). If malnourished women remain under inadequate food and health care, they are more likely to grow into malnourished older women. These women will no longer be capable to take care of children if they have to, and therefore the children to be taken care of will have a high risk of becoming malnourished. In the same manner, malnourished women under inadequate fetal nutrition are more likely to give birth to malnourished babies. This way, the intergenerational cycle of malnutrition will never end (Figure 4.1) (Weingartner, 2005).

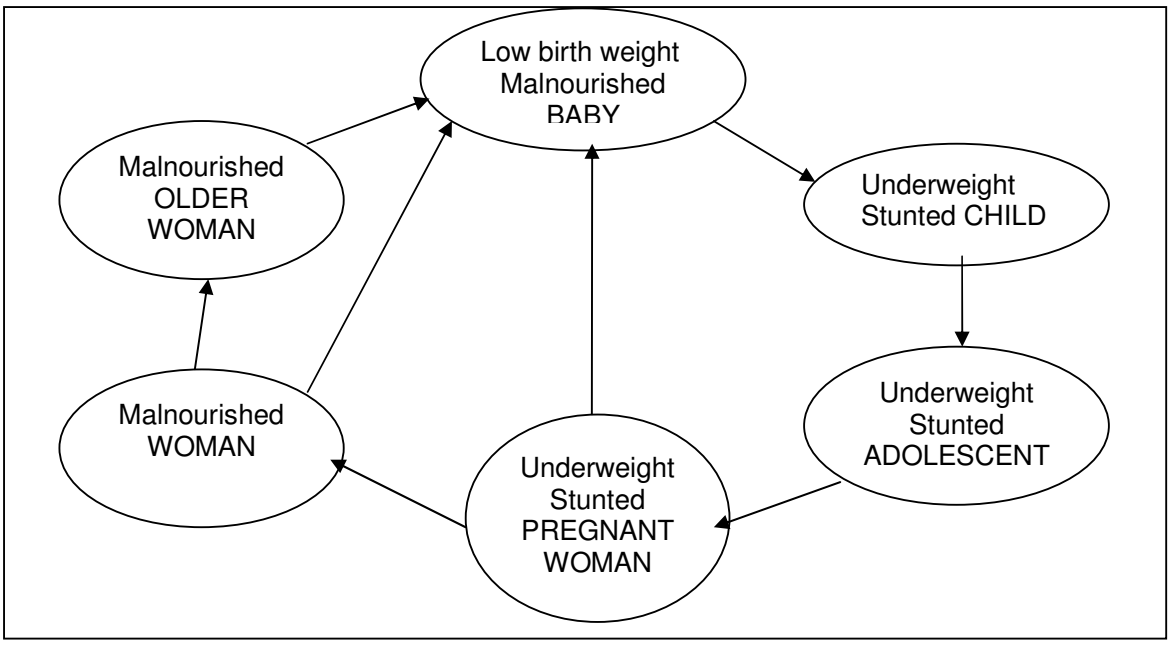

Figure 4.1: Impact of Undernutrition throughout the lifecycle
Source: Modified after Weingartner, 2005

4.3 Challenges to improve maternal nutrition

According to the United Nations 2008 Millennium Development Goals Report, important progresses towards all eight goals have been made, however fulfillment of all the commitments made in 2000 to be met by 2015 in all countries concerned is still questionable. The progresses have shown signs of hope but the remaining challenges to meet all the goals, especially in Sub-Saharan Africa are astounding (UN, 2008). Although developed countries have shown their commitment to the achievement of Goal 8, to develop a global partnership for development, by increasing aid and enhancing debt relief, the pace in doing so still lags far behind the target. Simultaneously, developing countries are fighting to achieve the other goals. In Sub-Saharan countries, significant efforts in achieving Goal 3, to promote gender equality and empower women, were observed; but the struggle is to continue achieving all the goals. Apart from Goal 1, to eradicate extreme poverty and hunger, whereby southern Asia is lagging behind all other regions, Sub-Saharan Africa is lagging behind in all other Millennium Development Goals (UN, 2006a).

Different reasons may account for this under-achievement, including political will and bad governance in these countries. Nevertheless, a decrease in foreign aid expenditure since 2005 may as well, to a large extent, contribute to these failures in many of the Sub-Saharan countries. For instance, Tanzania depends on foreign aid for about 25 to 30 percent of its government budget. In addition, 80 percent of its development budgets, from which health, nutrition, and micro-economic development projects are funded, depend on foreign aid. This indicates that foreign financial assistance determines which projects should be prioritized and to what extent they should be fulfilled (Aarnes, 2004). This also implies that foreign aid predicts and regulates the resource allocation of the country's budget, as well as concludes which goals should be achieved and which shouldn't, and also when the selected goals should be realized (UN, 2008).

MDGs targeted the reduction of maternal mortality by 75% by the year 2015. In the 2007 and 2008 UN MDGs progress assessment report, maternal mortality remained high, especially developing countries. In 2005, more than 500,000 women died during pregnancy, childbirth or in the six weeks after delivery. Ninety nine percent of

these deaths occurred developing countries. Sub-Saharan countries and Southern Asia accounted for 86% of them (UN, 2006a, 2008).

The latest statistics of maternal mortality in Tanzania recorded by UNICEF (2000-2006) reported 580 deaths per 100,000 live births. After adjustments to account for underreporting and misclassification of data, the ratio increased to 950/100,000 (UNICEF, 2000-2006). As mentioned above, in Tanzania the ratio of a woman's risk of dying from treatable or preventable complications of pregnancy and childbirth over the cause of her lifetime is estimated at 1 in 22. This is about the same as what is estimated for Africa but 332 times higher compared to developed countries (UN, 2008).

In addition to family planning, adequate reproductive health care service is reported to be vital for improving maternal health and therefore reducing maternal mortality. Although it is already known that skilled care at delivery is one of the key elements necessary for the reduction of maternal mortality, 47% of deliveries in Sub-Saharan countries- where almost 50% of the world's maternal deaths occur- are not attended by skilled health care personnel (UN, 2008). The percentage of women attended by skilled health care personnel during delivery in Tanzania is 43 (4% lower than the average of Sub-Saharan countries) (UNICEF, 2000/06). As reported by the United Nations, impoverished and rural women are less likely compared to wealthier or urban women to receive skilled health care during child birth compared to wealthier or urban women. This disparity between the rural and urban care at delivery was found to be eminently significant in Sub-Saharan countries (UNICEF, 2006a). A similar observation was made by the Tanzanian National Bureau of Statistics in 2005, whereby 63% of women in rural Tanzania reported delivering their babies at home compared to 19% in the urban areas (National Bureau of Statistics, 2005). This leads to poor health in the women and consequently to poor child health due to a lack of care. According to the United Nations, the target of improving child health also lags behind in Sub-Saharan countries. Although the trend of child mortality from 1990 to 2006 decreased; 184 to 157 per 1,000 live births in Sub-Saharan Africa and 161 to 118 per 1,000 live births in Tanzania, in order to attain the targeted 64/1,000 (two-thirds of the initial prevalence) by the year 2015, a more than 50% reduction of

child mortality still needs to occur both in Sub-Saharan Africa and in Tanzania in particular (UN, 2008; UNICEF, 2009).

4.4 Nutritional status of women in Malinzanga village and its relation to food insecurity and infections

Malnutrition among both preschool age children and pregnant women has been studied for decades. The nutritional as well as health improvements have been documented. Nevertheless, information about the nutritional status among women of reproductive age in particular is still scarce (Kusin, 2000, 1992). Thus, this study was conducted in Iringa Rural district to assess the nutritional needs among women of reproductive age in order to determine feasible, sustainable, and implementable interventions, which can be applied to improve the health and nutritional status of this group in the rural areas of Tanzania.

There are various causes of malnutrition that can be classified into immediate-, underlying- and basic causes (Figure 4.2).

Indicators, namely, body mass index, vitamin A-, hemoglobin- and iron status, as well as illnesses and infection symptoms were used to assess factors contributing to the nutritional and health status of the 384 women in the study sample. In addition, food availability and dietary patterns were also included in the assessment.

The overall nutritional status of the women in the study sample was poor. Not only did the women have energy malnutrition but they also suffered from micronutrient deficiencies, i.e. vitamin A- and iron deficiencies. In addition, the women had a high prevalence of illnesses and infections, i.e. malaria and diarrhea. These factors have been reported to affect nutritional status as well as to contribute to maternal death (UN, 2007; WHO/UNICEF, 1995).

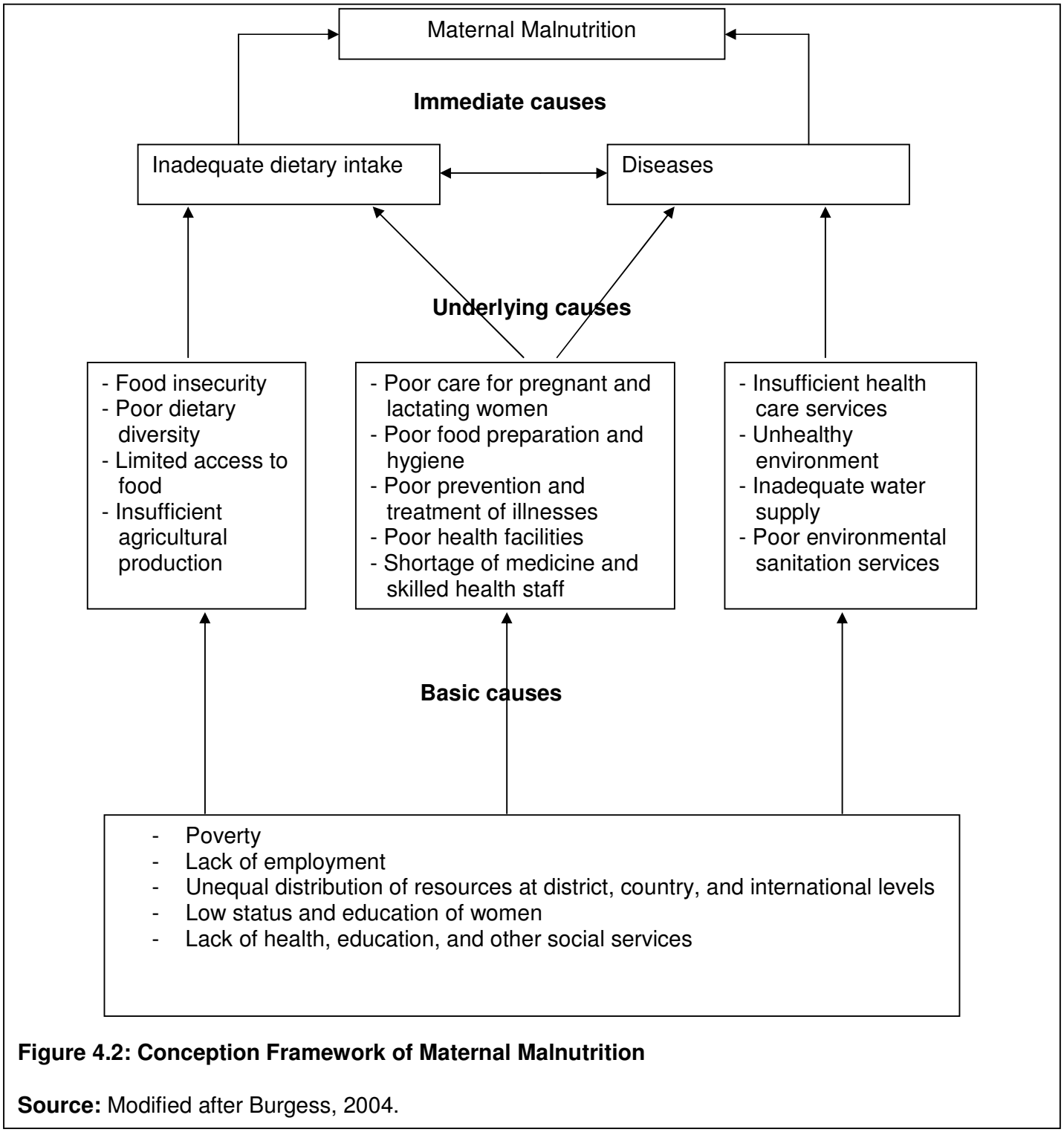

Figure 4.2: Conception Framework of Maternal Malnutrition

Source: Modified after Burgess, 2004.

Although it is believed that underweight is more prevalent than overweight in developing countries, especially in the rural areas, the current study demonstrates the opposite. As shown in Figure 4.3, the prevalence of overweight was 3-times higher compared to that of underweight. In 2006, Villamor and co-authors reported that, among women of reproductive age in urban Tanzania, trends in obesity, underweight, and wasting have rapidly increased, slightly decreased, and remained constant, respectively between 1995 and 2004. Within 10 years they observed a 2.5-fold increase in obesity (3.6% to 9.1%), 1.3-folds decrease in underweight (3.3% to 2.6%) and an unchanged prevalence of wasting.

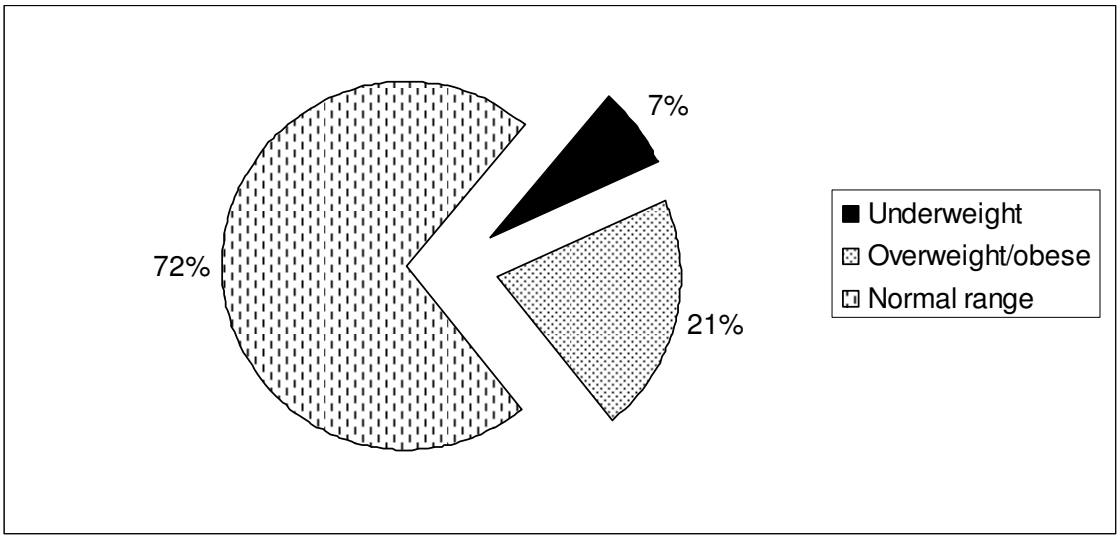

Figure 4.3: Double burden of undernutrition and over nutrition based on WHO BMI-cutoff points, n = 351

A similar observation was made by Mendez and co-authors in 2005 in different countries including Tanzania. Prevalence of overweight also exceeded that of underweight in more than half of the countries studied. The observed median ratio of overweight to underweight was almost 3-times higher in the urban compared to the rural areas (5.8 and 2.1, respectively). In Tanzania, where underweight is still known as a significant problem, a higher prevalence of overweight, both in urban and rural areas was observed in 1996; 28.5% and 11.4% overweight, and 8.6% and 9.6% underweight, respectively. When comparing these values with those in the current study, the prevalence of overweight in the rural areas has almost doubled and the prevalence of underweight has slightly decreased. The current ratio of overweight to underweight is more than twice compared to that observed by Mendez and co-

authors in 1996 (1.19). When comparing the current data with that of Villamor and co-authors, the prevalence of obesity (5%) is between the increasing range (3.6%-9.1%) and that of underweight (7%) is rather higher and off the range (3.3%-2.6%). However, the study of Villamor and co-authors did not include rural areas and was restricted to only pregnant women. Nevertheless, in the study of Eckhardt and co-authors, which included rural areas and non-pregnant women, a high prevalence of overweight with an increasing trend was observed (Eckhardt, 2008; Villamor, 2006).

Multinomial logistic regression was applied to test the association between BMI and socio-economic characteristics (age, marital status, source of income, education, and socio-economic status). The tests revealed a positive association between both underweight and overweight with age ($p=0.016$ and $p=0.020$, respectively). Ordinal regression of BMI and age also suggested a similar observation ($p=0.003$). The prevalence of overweight increased with age. A prevalence of 18.6% overweight was observed among women aged between 15 and 22 years and 26.8% among women aged between 31 and 44 years. The overall prevalence of obesity based on age was 26%, 33%, and 41% among women aged between 15 and 22, 23 and 30, and 31 and 44 years, respectively. Inversely, underweight decreased with age. A prevalence of 10.8% underweight was observed among women between 15 and 22 years old and 8.9% among women between 31 and 44 years old.

A similar observation of an increase in overweight with increasing age and a decrease in underweight with decreasing age among women in urban Tanzania was made by Villamor and co-authors. In their study the youngest group (aged less than 22 years) had a prevalence of 2.8% obesity and 3.2% underweight whereas the oldest group (aged 35 years or above) had a prevalence of 22.1% obesity and only 1.6% underweight (Villamor *et al*., 2006). As also observed in the study of urban areas in Tanzania, the current rural study revealed an association between BMI and education. The logistic regression of overweight and underweight with social economic characteristics gave a significant association between both overweight ($p=0.025$) and underweight ($p=0.030$) with education. The difference within the levels of education was not significant. Nevertheless, the non-significance could be explained by non-normal distribution of the levels of education among the women in the study sample. Less than 3% of the women had secondary education and over

80% had primary education. Other prevalences of overweight and underweight by socio-demographic characteristics are presented in Table 4.1. Also in logistic regression, BMI indicated a significant correlation with marital status (p=0.031). Unmarried women had both higher prevalence of overweight and underweight (Table 4.1).

Although the original data of other socio-economic characteristics[14] did not show any association; after adjustments, non-parametric regression revealed significant correlations of BMI with location (p=0.000), source of income (p=0.034), and assets (p=0.009) (Table 4.1). The adjustments made based on the observed geographical locations; closer to or at the village center[15], isolated and remote[16], at the dispensary[17], and remote but not isolated areas[18]. Respondents who lived closer to or at the village center had the highest rate of both overweight (27.4%) and underweight (about 9.1%) compared to the respondents who lived in rather remote areas (about 5.6% and 3.4%, respectively). This could be explained by modernization and change of lifestyle; adaptation of an urban lifestyle[19].

[14] Main source of income, assets, tribe, household population, household leadership, parity, and location
[15] Majengo "A" and Majengo "B", Ndorobo "A" and Ndorobo "B"
[16] Matalawe
[17] Mlowa
[18] Mtakuja, Malinzanga, and Ikonongo
[19] High consumption of fatty, salty and sugary foods and sedentary lifestyle with less consumption of traditional and fresh foods with high sources of roughage as well as less hard work in the farms

Table 4.1: Prevalence of over nutrition and undernutrition by socio-economic characteristics among women in Malinzanga village, n = 351 (pregnant women excluded)

Characteristics	Total number	Overweight		Underweight	
			Adjusted		Adjusted
Age	**n**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
15-22 years	102	19 (18.6)	19 (18.6)[20]	11 (10.8)	11 (10.8)
23-30 years	137	24 (17.5)	54 (21.7)[21]	4 (2.9)	14 (5.6)
31-44 years	112	30 (26.8)		10 (8.9)	
Marital status					
Married	254	49 (19.3)		15 (5.9)	
Unmarried	97	24 (24.7)		10 (10.3)	
Education					
No education	55	4 (7.3)	4 (7.3)[22]	5 (9.1)	5 (9.1)
Primary education	286	68 (23.8)	69 (23.3)[23]	17 (5.9)	20 (6.8)
Secondary education	10	1 (10.0)		3 (30.0)	
Main income					
Farming or livestock	317	61 (19.2)		24 (7.6)	
Other	34	12 (35.3)		1 (2.9)	
Assets					
Few assets	178	27 (15.2)		13 (7.3)	
More assets	173	46 (26.6)		12 (6.9)	
Tribe					
Hehe	169	51 (30.2)		9 (5.3)	
Bena	149	17 (11.4)		14 (9.4)	
Other	33	5 (15.2)		2 (6.1)	
Household population					
1 – 3 person	95	12 (12.6)		10 (10.5)	
4 – 6 person	200	52 (26.0)		10 (5.0)	
7 or more person	56	9 (16.1)		5 (8.9)	
Location					
Closer to and at the village center	197	54 (27.4)		18 (9.1)	
Isolated and remote	46	11 (23.9)		3 (6.5)	
At the dispensary	19	3 (15.8)		1 (5.3)	
Remote but not isolated	89	5 (5.6)		3 (3.4)	

[20] Younger age (aged between 15 and 22 years)
[21] older age (between 23 and 44 years)
[22] Had no formal education
[23] Had primary or higher education

At the same time, globalization and the free market (introduction of imported cheap food products that are nutritionally poor and un-predictable fall of cash crop prices) contribute to low incomes, especially in the rural areas where agriculture is the backbone of the livelihood. These factors contribute to food insecurity and poor dietary intake (Monteiro, 2004). High GNI, GNP, and socio-economic status have previously had an impact in overweight, obesity, as well as in obesity-related diseases in many urban and rural areas in developing countries including Tanzania (Maletnlema, 2000).

In Tanzania, overweight is now beginning to be seen as a health problem. Actions for health monitoring are also starting to take place. However, the rate of increase in overweight requires urgent-multidisciplinary interventions with more information on the causes, consequences, and prevention of overweight and dietary-related diseases. In addition, means of improving the economy and development from individual and household to community and national level need to be included in the intervention programs. Furthermore, interventions considered should be aware of culture and tradition, lifestyle, as well as economic barriers that influence nutrition transition as well as a poor dietary pattern of the study population. For instance in Tanzania, slimness is associated with AIDS; inversely obesity is admired and is associated with wealth and beauty (Monteiro, 2004). As observed in the current study, other main sources of income which in this case reflect sedentary lifestyles[24] contributed to overweight. Another explanation of the high prevalence of obesity observed in respondents who lived near the village center and/or performed occupations other than farming and livestock keeping would be a daily access and high consumption of fatty and sugary foods at the village center. Respondents who lived far from the village center and/or performed farming activities had limited access to high energy foods and were more likely to balance their energy intake with high physical activities through farming, weeding, and other agricultural activities. Most of these activities are still performed ordinarily[25] (Ohna, 2007).

Less than a decade ago (2000) the prevalence of obesity was very low in Sub-Saharan Africa (2.5%). Currently, as observed in this study, overweight and obesity

[24] Sitting down sawing or selling things in the shops and doing office jobs with limited physical activities
[25] Using a hand hoe and frequently moving and walking long distances searching for pasture

has dramatically increased, even in the rural areas. The causes of the increase in overweight and obesity predicted in previous studies were observed in the current study; increase in income and westernization (Mendez, 2005).

Thus, nutrition programs in Tanzania should be revised: Community nutrition education provided should be improved quantitatively and qualitatively. The focus of the education should be on both problems of underweight and overweight including the risk factors, causes and the consequences of micronutrient deficiencies, especially of vitamin A, iron, folic acid and iodine as well as methods of prevention.

Vitamin A

In addition to the correlation between BMI and socio-economic factors, multinomial (p=0.024) and ordinal regressions (p=0.031) revealed co-existence of overweight and vitamin A deficiency as well as underweight and vitamin A deficiency. The overall prevalence of vitamin A deficiency decreased with increasing BMI (Table 4.2). However, a decrease of 26% prevalence of vitamin A deficiency was observed between underweight and normal weight, and an increase of 11% between normal weight and overweight (Figure.4.4).

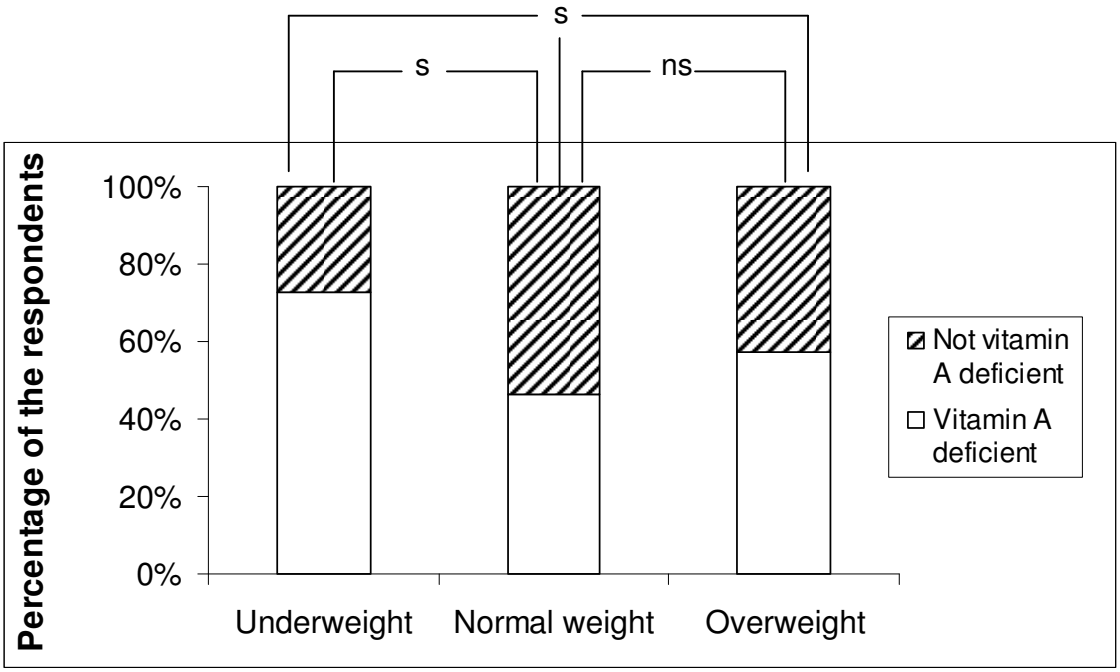

Figure 4.4: Co-existence of vitamin A deficiency with under- and over nutrition based on WHO BMI- and RBP levels cutoff points, n = 270; s = significant, ns = not significant

When a binary logistic regression was applied to test the differences in vitamin A deficiency among underweight and overweight respondents, a significant difference was observed among underweight respondents ($p = 0.024$). The chi-square test was applied to test the odds, Fisher's exact test supported the findings ($p = 0.044$) with odds ratios OR 0.357 (95% CI: 0.135, 0.943). With reference to normal weight, the risk of underweight respondents to vitamin A deficiency was two-times higher compared to their counterparts overweight. Normal weight respondents had the lowest prevalence of vitamin A deficiency compared to both underweight and overweight (Table 4.2). As observed in the current study, different dietary intake of vitamin A did not significantly alter the RBP levels of the respondents. This could be due to the overall poor dietary diversity accompanied with a low intake of foods rich in vitamin A, especially eggs, fish and milk (Figure 4.5). Multinomial regression revealed a highly significant association between vitamin A deficiency and food insecurity ($p = 0.000$). The respondents who experienced long-term food shortage, particularly between January and May, were more vulnerable to vitamin A deficiency compared to those who had short-term or no food shortage at all.

Table 4.2: Prevalence of Vitamin A deficiency and Anemia by socio-economic characteristics among women in Malinzanga village, n = 296 (women with CRP > 5 g/L and AGP > 1 g/L excluded)

Characteristics	n	Vitamin A deficient	Anemic
		n (%)	n (%)
Age			
15-22 years	84	56 (66.7)	17 (20.2)
23-30 years	122	64 (52.5)	34 (27.9)
31-44 years	90	35 (38.9)	266 (28.9)
Marital status			
Married	291	108 (49.3)	60 (27.4)
Unmarried	77	47 (61.0)	17 (22.1)
Education			
No education	49	16 (32.7)	11 (22.4)
Primary education	237	132 (55.7)	63 (26.6)
Secondary education	10	7 (70.0)	3 (30.0)
Main income			
Farming or livestock	269	140 (52.0)	72 (26.8)
Other	27	15 (55.6)	5 (18.5)
Assets			
Few assets	148	74 (50.0)	36 (24.3)
More assets	148	81 (54.7)	41 (27.7)
Tribe			
Hehe	130	76 (58.5)	29 (22.3)
Bena	137	61 (44.5)	35 (25.5)
Other	29	18 (62.1)	13 (44.8)
Household population			
1 – 3 person	78	55 (70.5)	24 (30.8)
4 – 6 person	170	82 (48.2)	43 (25.3)
7 or more person	48	18 (37.5)	10 (20.8)
Location			
Closer to and at the village center	169	97 (57.4)	45 (26.6)
Isolated and remote	36	9 (25.0)	6 (16.7)
At the dispensary	20	14 (70)	9 (45.0)
Remote but not isolated	71	35 (49.3)	17 (23.9)
BMI (n=270; pregnant women, women with CRP > 5 g/L and AGP > 1 g/L excluded)			
Underweight	22	16 (72.7)	9(40.9)
Normal weight	194	90 (46.4)	44 (22.7)
Overweight	54	31 (57.4)	14 (25.9)

The risk of food insecure respondents having a vitamin A deficiency was 1.6 higher compared to food secure or short-term food insecure respondents.

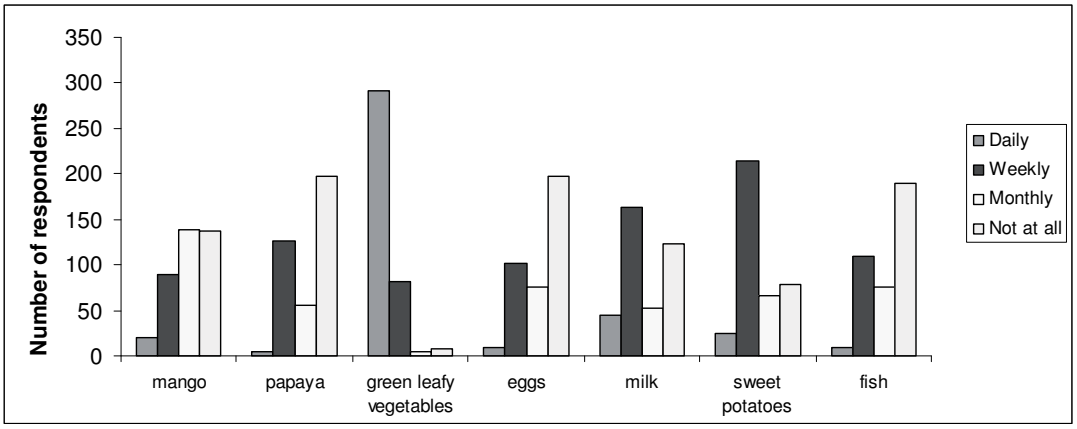

Figure 4.5: Frequency of consumption of foods rich in vitamin A among women in Malinzanga village, n = 384

Nearly 55% (211 of 384) respondents do not have sufficient food at one point during the year. As illustrated in Figure 4.6, the highest number of women who reported having a food shortage at some point during the year had a food shortage in February (95.7%).

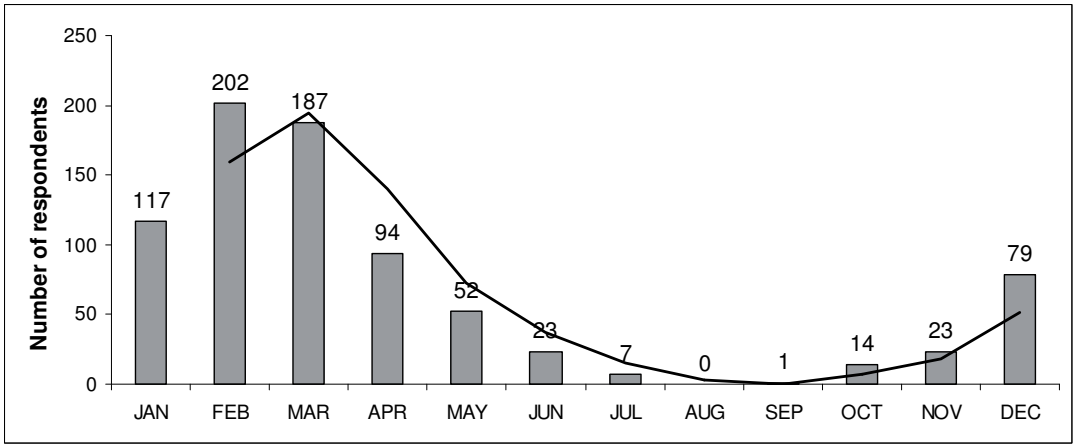

Figure 4.6: Monthly prevalence and trend of food shortage in Malinzanga village, n = 221; multiple responses possible

The food shortage slightly decreases between February and March, and then sharply decreases between March and April until August, when no woman reported having a food shortage (harvesting season). Food shortages slightly increase from October until November, and then sharply increase between November and December to the peak in February (dry season).

Although observed elsewhere, dietary diversity scores as well as frequency intake of vitamin A-rich foods did not significantly alter the vitamin A status of the respondents

in the current study (Ahmed, 1997). This could also be explained by the overall poor dietary diversity as well as an overall low intake of foods rich in vitamin A. The food frequency questionnaire showed a very frequent (on a daily basis) consumption of *ugali*, green leafy vegetables and oil/fat among the women in the study sample. Meat, rice, buns, and sweet potatoes were among the other foods that were frequently consumed. Most of the women consumed these foods at least once per week. As it is known, most of these foods (*ugali*, rice, and buns) are energy dense and not good sources of vitamin A. As shown in Figure 4.5, consumption of foods rich in vitamin A in the study area was very low. The food frequency data on vitamin A-rich foods revealed that a large percentage of the respondents in the current study did not consume eggs (55%), fish (50%), and milk (32%) at all. And about 56%, 33%, and 23% of the respondents consumed sweet potatoes, papaya, and mangoes respectively, on a weakly basis. Although the consumption of sweet potatoes was relatively high (during the season), the sweet potatoes consumed were not orange-fleshed[26] but rather white-fleshed. Therefore, introduction of orange-fleshed sweet potatoes into the study area could be one means to increase the consumption of β-carotene. Low consumption of eggs, fish, and milk could be explained by high price, low availability (fish), and food culture (milk and milk products).

Generally, Tanzanians are not accustomed to the consumption of milk and/or milk products on a daily basis beyond infancy. Low consumption of mangoes could be explained by the seasonal availability. However, as it is common in the cities such as Dar-es-salaam, mangoes can be dried and eaten as snacks throughout the year. Papayas are not seasonal fruits; therefore their consumption can be increased through emphasis on its production, consumption, and importance to health. Production, consumption, as well as the importance of other vegetables (carrots, yellow/orange/red paprika, wild amaranth, and other indigenous vegetables) to health can also be improved through campaigns, community health, and nutrition education. Tomatoes, carrots, and yellow/orange/red paprika can be produced and grow well in the study area. Wild amaranths as well as other indigenous vegetables are locally available in the community. Their consumption can also be improved through awareness and nutrition education.

[26] They are known to contain a higher amount of β-carotene compared to those with light coloured flesh

Although it was not assessed, other factors such as oxidative stress and lipid malabsorption could have contributed to vitamin A deficiency among overweight and obese respondents in the current study. Chavez (2007) made such an observation in Brazil. When age, level of education, tribe, location, household population, as well as dietary diversity scores and other socio-economic characteristics were accounted for by multinomial regression, a strong correlation was found for vitamin A deficiency with age, location, and household population. The prevalence of vitamin A deficiency decreased with increasing age. With reference to the older age group (31 to 44 years), the younger age group (15 to 22 years) had a significantly higher vitamin A deficiency: about 30% higher (p=0.036).

Although the overall prevalence of vitamin A deficiency in the study area was very high, when comparing it within the hamlets with reference to Mlowa (70%), Matalawe had low vitamin A deficiency (25%). Respondents from small household populations had a higher prevalence of vitamin A deficiency compared to those from larger household populations (Table 4.2). The difference in vitamin A deficiency was higher; 22.3% (p=0.002) between small and medium household populations compared to between medium and larger household populations; 13.7% (p=0125).

Although in multinomial regression the level of education did not show significant differences in vitamin A status (p=0.126), among respondents with no education (p=0.682) and those with primary education, an increasing trend of vitamin A deficiency with increasing level of education was observed in this study with a likelihood of p=0.030 (Table 4.2). In addition, when the chi-square test was applied, Fisher's exact test revealed a relationship between vitamin A status and education level (p=0.006). This indicates that, in addition to general formal education, nutrition education is of importance in improving the nutritional status. In some cases the nutritional status of the educated is worse than the non-educated due to the common attached factors of increase in socio-economic status; sedentary lifestyle, and high consumption of fast-refined foods (French fries, deep fried meats, *maandazi* etc.).

Current data on the vitamin A status in Tanzania for both xerophthalmia and serum/plasma retinol concentration levels are scarce. The country's recent overall

estimation of xerophthalmia, XN[27], among women aged between 15 and 49 years was estimated at 2.70% by the WHO (2004/05). However as shown in Table 4.3, the prevalence varied with age, setting, zone, and region. Contrary to the current study (Table 4.2), the highest prevalence of impaired dark adaptation observed by the WHO study was among the older group (Table 4.3). Women aged between 35 and 49 years had a higher prevalence of impaired dark adaptation compared to those between 15 and 24 years. The prevalence of impaired dark adaptation was also higher among women in rural parts compared to those in urban areas (Table 4.3). The Western zone led with the highest prevalence of impaired dark adaptation followed by the Southern and Northern zones. The Eastern zone had the lowest prevalence, and the Southern highlands and the lake zones had a slightly lower prevalence than the overall country's estimation but a much higher one compared to that of Eastern zone (Table 4.3). Among all, the Tabora region had the highest prevalence of impaired dark adaptation followed by Mara (Table 4.3).

Table 4.3: Prevalence of impaired dark adaptation among women in Tanzania in 2004/05

Area	Age (years)	Percentage
Rural and urban	35-49	4.8%
Rural and urban	15-24	2.4%
Rural	15-49	3.0%
Urban	15-49	1.6%
Western zone	15-49	5.1%
Southern zone	15-49	3.0%
Northern zone	15-49	2.8%
Eastern zone	15-49	0.4%
Southern highlands zone	15-49	2.1%
Lake zone	15-49	2.2%
Tabora region	15-49	8.5%
Mara region	15-49	5.9%
Shinyanga region	15-49	4.4%
Dodoma region	15-49	2.6%
Mwanza region	15-49	2.0%
Iringa region	15-49	3.9%

Source: WHO, 2007.

[27] Night blindness; impaired dark adaptation

In Tanzania, VAD is known to be more prevalent in drought-prone and semi-arid areas (Tabora, Shinyanga, Dodoma, and Mwanza). However, when comparing to other regions such as Iringa, Dodoma and Mwanza had a lower prevalence of impaired dark adaptation. Also, when comparing these values with those observed in the current study, the prevalence of impaired dark adaptation in Iringa has instead increased by 1.5%. Nevertheless, the current study included only women in rural areas. This may lead to an underestimation of the overall prevalence since the WHO study included women from urban and rural areas (WHO, 2007).

Data on the vitamin A status among children in Tanzania are scarcer than that of women. The latest estimates made by WHO are between 1983 and 1997. Even in children prevalences of vitamin A deficiency (Bitot's spot or Cornea xerosis and plasma retinol level) varied with age and region. The country's prevalence of severe and moderate vitamin A deficiency among children aged between 6 months and 6 years was 4.3% and 24.2%, respectively. Mpwapwa was the region with the highest prevalence of mild and moderate vitamin A deficiency; 20.6% and 57.6%, respectively, followed by Morogoro (16.7% and 40.8%), and Singida (14.6% and 60.2%). The country's prevalence of vitamin A deficiency among children under six years of age was higher in children aged between 4 and 5.99 years old compared to the rest of the children. A prevalence of 0.46% Bitot's spot was found among children between aged 4 and 5.99 years old, 0.04% among children aged between 3 and 3.99 years old, 0.07% among children aged between 2 and 2.99 years old, and 0.03% among children aged between 1 and 1.99 years old. As it was observed in women, among the regions studied, Tabora led with the highest prevalence of Bitot's spot in children less than six years of age (0.6%) compared to other regions such as Iringa (0.23%), Kagera (0.11%), and Mbeya (0%) (WHO, 2007).

The WHO uses various levels of prevalence of plasma retinol (≤ 7 µmol/L) and impaired dark adaptation to classify the severity of the public health problem of vitamin A deficiency (Table 4.4). Based on the WHO criteria, vitamin A deficiency is still a public health problem in Tanzania.

Table 4.4: Criteria for assessing the severity of the public health problem of vitamin A deficiency in a population

Criteria	Prevalence and its definition		
Indicator	**Mild**	**Moderate**	**Severe**
Impaired dark adaptation	< 1%	≥ 1 to < 5%	≥ 5%
Serum retinol (≤0.70µmol/L)	> 2 to ≤ 10%	≥ 10 to < 20%	≥ 20%
Conjunctival impression cytology	< 20%	≥ 20 to < 40%	≥ 40%

Source: WHO, 1996.

Vitamin A deficiency is classified as a public health problem in a population when at least two of the biological indicators of vitamin A status are within the values of mild, moderate, and/or severe as indicated in Table 4.4. As shown in Table 4.5, prevalence of vitamin A deficiency in the study population among women of child-bearing age was within the range of all of the three criteria; severe impaired dark adaptation, moderate serum retinol deficiency (≤ 0.70 µmol/L), and mild conjunctival impression cytology levels. This indicates that in rural Iringa vitamin A deficiency still is prevalent and a public health problem.

Table 4.5: Severity of vitamin A deficiency as a public health problem in Malinzanga village, n = 296

Indicator	Prevalence and its definition		
	Mild	**Moderate**	**Severe**
Impaired dark adaptation			**(5.4%)**
Serum retinol (≤0.70µmol/L)		**(14.2%)**	
Conjunctival impression cytology	**(1%)**		

Tanzania has applied different activities to try to improve the nutrition of its people. One of the major steps made by the government in the process of improving the nutritional status of its people was the establishment of the Tanzania Food and Nutrition Center (TFNC). TFNC was established in 1973 to fight against malnutrition by carrying out nutrition-related research as well as planning, coordinating, and implementing nutrition programs for the benefit of its people. This included nutrition programs which focused on creating awareness among the people on the importance of good nutrition and the danger of malnutrition to their health.

For prevention and control of vitamin A deficiency, the first national program was introduced in 1985. The program included supplementation as a short term measure

and promotion of the production and consumption of vitamin A-rich foods as long-term measures. In addition, the control of infectious diseases and nutrition education were included as supportive measures. Two years later, vitamin A supplementation was incorporated into the essential drug program: Supplementation was made available only to government-owned primary health facilities, dispensaries and health centers and was targeted towards children with active xerophthalmia, measles, persistent diarrhea, lower respiratory track infections and moderate and severe protein-energy malnutrition.

Based on the evaluation conducted in 1991, the disease-targeted vitamin A supplementation was not reaching all eligible children but only 61%. Even though in 1991/2 a nationwide training on diagnosis and management of vitamin A deficiency was provided to health workers and made vitamin A supplementation a part of the essential drug program, coverage among the children in need was still less than 67%. Because the coverage of the essential drug program was still low, vitamin A supplementation was integrated into the routine services of the expanded program of immunization in 1997. The focus was on children aged 9, 15, and 21 months and postpartum mothers within four weeks after delivery. The expanded program of immunization had indeed increased the coverage for children aged 9-month-old children from 55% in 1999 to 82% in 2002. However it remained low for children aged 15 and 21month. Though at a low pace, the coverage of vitamin A supplementation among postpartum women increased from 45% to 62% between 1999 and 2002.

Since 2001 vitamin A supplementation has been integrated with the Day of the African Child and the World AIDS Day. These two days were chosen based on the global recommendation of two-fold supplementation and the six-month interval (June and December). Apart from ten districts, vitamin A supplementation coverage in Tanzania has been over 90% since 2001 (Weingaertner, 2005).

Apart from a number of temporary fortification studies, fortification of vitamin A in foods accessible to all has not yet actively taken place. Even though TFNC has been piloting interventions in the fortification of maize flour with multiple micronutrients (iron, zinc, calcium, riboflavin, niacin, cobalamin, folate, vitamin C) in two rural communities in Iringa and Tanga, vitamin A was not among the nutrients added.

Nonetheless, TFNC has already identified sugar as a potential vehicle for vitamin A fortification. The reason to this choice could be that sugar is centrally (industrially) manufactured. With regard to the findings from previous studies and the current study, it is clear that vitamin A intake among women of reproductive age is very low and thus needs to be improved.

Based on the country policy, supply and full coverage of vitamin A focuses on children under-five and mothers four weeks after delivery (Gonzales-Gross, 2002; Buhling, 2003). Pregnant women, non-pregnant, and non-lactating women are not included. As observed in the current study, vitamin A status among these women was inadequate. Coverage of vitamin A supplements among the postpartum women was also low. Although an increase of vitamin A supplements coverage among the postpartum women was observed between 1999 and 2002, the coverage increased only to reach 62%.

Therefore the policy of vitamin A coverage in Tanzania needs to be revised in order to reach all women in need regardless of their physiological status (pregnancy or lactation status) and especially in remote areas. Strengthening the community nutrition education is also of importance: It is assumed that if the community is aware of the benefits of the nutritious foods to their health, it is more likely that it will change its dietary patterns and increase demand for these foods. For sustainability purposes, promotion of food-based strategies is more feasible in the study area: The community is generally poor and remote. In addition, coverage of vitamin A supplements is still low and restricted only to children under-five and postpartum mothers even in the easy accessible regions. Therefore, for the left-out women in need, supplementation is not a true option.

In the current study, women in the group discussion reported that supplements often are not available and when available they are neither supplied on time nor sufficient for all women in need. Based on the findings of the current study, fortification of vegetable oil could be one option. Vegetable oil is frequently used for frying vegetables. Nevertheless, in order to create a demand of fortified foods, the price difference has to be low enough for the villagers to afford to use the products. Otherwise, the whole process of fortification will not be effective and women will not benefit.

Iron

Similar tests (ordinal, multinomial, and binary logistic regressions) were applied to assess the relationship between BMI and iron status in the current study. No significant differences were observed (p=0.328) between the BMI and hemoglobin concentration levels. However, an interesting trend of decrease and increase in anemia with increasing BMI as illustrated in Figure 4.7 was observed. There was a decrease in anemia between underweight and normal weight (18%) and a slight increase (3%) between normal weight and overweight.

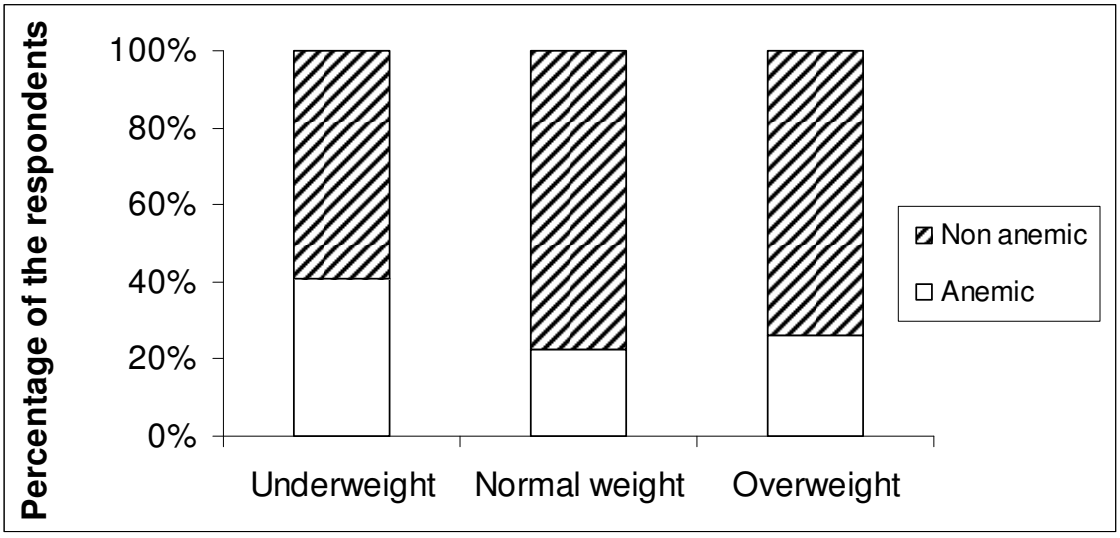

Figure 4.7: Co-existence of anemia with under- and over nutrition based on WHO BMI- and hemoglobin concentration levels cutoff points, n = 270

The differences in the anemia status among underweight and overweight respondents were separately assessed using the same dummy variables used for the vitamin A status. No significant difference was observed either in underweight (p=0.066) or in overweight (p=0.619). The chi-square test was applied to test the odds, Fisher's exact test revealed similar observation in both underweight (p=0.076) with odds ratios OR 2.268 (95% CI: 0.923, 5.574) and overweight (p=0.861) with odds ratios OR 1.076 (95% CI: 0.544, 2.133). These findings indicate that overweight and obese respondents were also iron inadequate.

Similar observation was made in Peru by Eckhardt and co-authors 2004: a linear trend of a decrease in anemia with an increase in BMI was observed, however the

differences in prevalence among the BMI groups (underweight and overweight) was not significant.

When multinomial regression was applied to test the association between anemia and socio-economic characteristics, no significant association was observed with age, education, household population, or source of income. However, anemia significantly differed with location. With reference to the hamlet at the dispensary, a significant difference in anemia was observed in remote hamlets (p=0.013), in isolated and remote hamlet (p=0.024), and in hamlets closer to and at the village center (p=0.035). Also similarly to vitamin A deficiency, the hamlet at the dispensary had the highest prevalence of anemia (45%) followed by the hamlets closer to and at the village center. The isolated and remote hamlet had the lowest prevalence of anemia (16.7%). Anemia also significantly differed with tribe. With reference to other tribes (Table 4.2), Hehe followed by Bena had a significantly lower prevalence of anemia (p=0.008, p=0.028, respectively). The prevalence of anemia in other tribes was twice as high compared to the Hehe; 44.8% and 22.3% respectively.

Overall, in the study area, the prevalence of anemia was about half of that of vitamin A deficiency. This could be due to the high consumption of iron-rich foods, especially of dark, green, leafy vegetables and meat as compared to fish, milk, eggs, and vitamin A-rich fruits and vegetables.

Multinomial regression on food availability and consumption of foods rich in iron with anemia gave a significant association in both food availability (p=0.000) and foods rich in iron (p=0.034). The anemia risk of respondents with low frequency consumption of iron rich foods was 4% higher compared to the respondents with high frequency consumption of iron rich foods. As shown in Figure 4.8, over 75% of the respondents consumed green, leafy vegetables on a daily basis and 75% consumed meat at least once per week. Nevertheless, the consumption of indigenous vegetables was very low: More than 50% of the women did not consume indigenous vegetables at all. The largest proportion of women who consumed indigenous vegetables on a monthly basis was 20%. Although the observed risk of anemia for both underweight and overweight women was relatively low, the iron needs among all women in rural Iringa were not met. Therefore the correction of

micronutrient deficiencies should not exclusively focus on pregnant women but rather on all women in need.

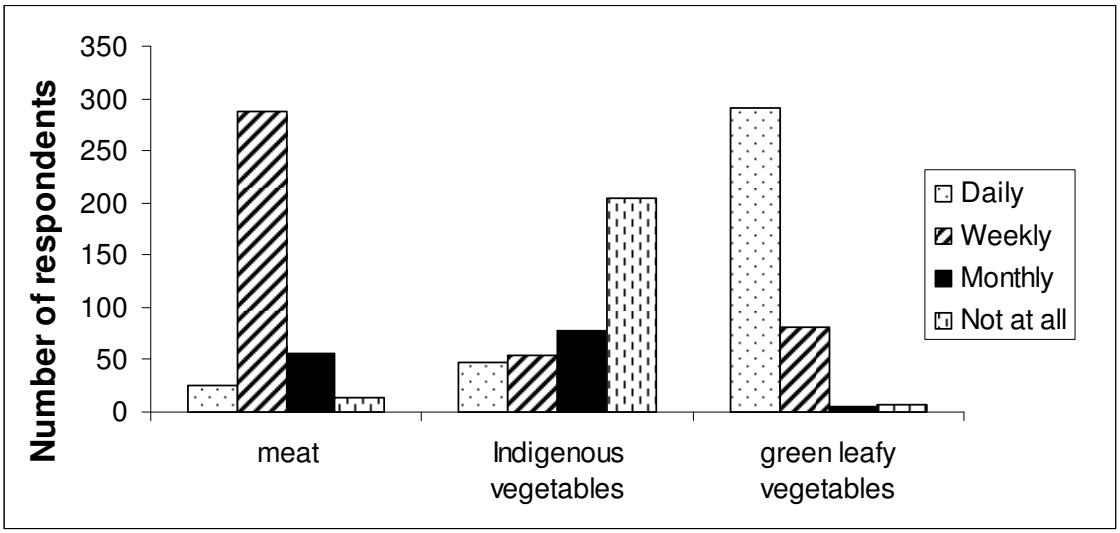

Figure 4.8: Frequency of consumption of iron-rich foods among women in Malinzanga village, n = 384

Depletion of iron includes three stages with a variation in the degree of severity ranging from mild to severe. In the current study, all levels were observed. Although the prevalence of severe anemia was only 1%, the overall prevalence of anemia was 26%.

The decrease in iron stores starts being diagnosed in serum ferritin levels. Although its depletion does not directly associate with adverse physiological consequences, it increases the risk of long-term marginal iron stores. This could eventually lead to the last stage of severe iron deficiency. The second stage of iron depletion can be explained by the increase in transferrin receptor levels. This leads to the third stage of iron deficiency; anemia (Vijayaraghavan, 2004).

Anemia is known to be one of the causes of maternal death. Anemia was estimated as one of the least causes of maternal death in Africa (4%) between 1997 and 2002 (UN, 2007). Nevertheless, hemorrhaging was marked as the major cause of maternal death, accounting for 43% of the maternal mortality rate. In our group discussions, hemorrhaging was also reported as the number one killer of women during pregnancy followed by anemia and obstructed labor.

Globally, anemia is a public health problem affecting both developed and developing countries. Though it mostly affects young children and pregnant women, it occurs at all stages of the lifecycle and is considered to be one of the major factors contributing to diseases. The WHO classifies anemia both in women and in children under five as a public health problem in Tanzania (prevalence of over 40%). The current global prevalence of severe anemia among women aged between 15 and 44 years is 1.2%. The current prevalence of severe anemia and moderate anemia among non pregnant women in Tanzania is estimated to be 1.2% and 46.9%, respectively. However, the prevalence of both severe and moderate anemia among pregnant women in Tanzania is slightly higher: 2.7% and 58.2%, respectively. Similarly to vitamin A deficiency, the country's prevalence of anemia increases with age. Women aged between 15 and 19.99 years have a lower prevalence of severe anemia (0.8%) compared to women aged between 30.00 and 34.99 years (1.7%). The prevalence of anemia also varies with zones and regions. The highest prevalence of severe anemia is in the Central region and the lowest in the Southern zone. Tanga has the highest prevalence of severe anemia (4.3%) and Mtwara the lowest (0%). Iringa has a 1.1% prevalence of severe anemia. This value does not substantially differ from that observed in the current study. In children under five years of age, the prevalence of severe and moderate anemia is much higher compared to pregnant as well as non-pregnant women; 4.2% and 71.8%, respectively. In children, the prevalence of anemia also varies with age, zone and region. Among children however, the prevalence of anemia decreases with increasing age. Children between aged 1.00 and 1.99 years have a higher prevalence of severe (7.9%) and moderate (82.6%) anemia compared to children aged between 4.00 and 4.99 years. This could be due to the transition period of breastfeeding and complementary feeding. Children may receive less from both breastfeeding and complementary food to meet their nutritional needs. Although there is no difference in the prevalence of anemia between urban and rural women, rural children have a higher prevalence of both severe (4.5%) and moderate anemia (73%) compared to urban children (3.2% severe and 66.8% moderate anemia). The highest prevalence of anemia is found in Mwanza (9.2% severe and 82.8% moderate anemia), and the lowest in Iringa (0%). Based on the findings of the current study, anemia still is a public health problem in Tanzania.

Referring to the classification of anemia as a significant public health problem as shown in Table 4.6, the current study area has a moderate public health problem of anemia (26%), prevalence of anemia ranging between 20.0 and 39.9%. Therefore, reduction of anemia is crucial for it will contribute to a large extent in achieving the 4th (reducing child mortality) and 5th (improving maternal health) Millennium Development Goals.

Table 4.6: Classification of anemia as a problem of public health

Prevalence of anemia	Category of public health significance
≤ 4.9%	No public health problem
5.0-19.9%	Mild public health problem
20.0-39.9%	Moderate public health problem
≥ 40.0%	Severe public health problem

Source: WHO, 2006a including the **(bold)** observed prevalence in the current study

Since the causes of anemia are multiple and complex, its correction should also adapt integrated approaches based on the identified major causes. With regard to the current study, free iron supplements to all women in need are of importance. In addition, community nutrition education on the importance of iron to maternal health and child development, as well as better optimization of the locally available green leafy vegetables with proper preparation and cooking methods to ensure high nutrient retention should be considered. Moreover, dietary diversification to meet the recommended daily allowance of iron is crucial. Since malaria is known to affect iron status, malaria control is of importance and should be included in the intervention programs of improving iron status of women in rural Tanzania.

Co-existence of micronutrient deficiencies

A significant co-existence of anemia and vitamin A deficiency was observed in the current study. Binary logistic regression revealed a strong correlation between anemia and vitamin A deficiency (p=0.001). The chi-square test showed a significant Spearman correlation (p=0.001) with odds, OR = 0.395 (95% CI: 0.228, 0.685) indicating an increasing risk of low hemoglobin concentration levels with decreasing retinol binding protein levels. Anemic respondents were more likely to also be vitamin A deficient. The risk of anemic women to be vitamin A deficient was 2.5 times higher compared to non-anemic women. About 70% of the anemic women were also vitamin A deficient. As illustrated in the Amos equation of model with

observed endogenous variables[28] and observed exogenous variables[29] as well as unobserved exogenous variables[30], about 30% of the vitamin A status could be explained by the hemoglobin concentration levels. Although the overall model p-value was not significant (p=304), only 9% of the causes of iron deficiency and 10% of the causes of anemia could not be explained by the model; e1 and e2 (Figure 4.9). This model with a 95% confidence interval suggested that 27% of anemia among the women in the study sample was influenced by vitamin A deficiency. In addition this model explained the increase in hemoglobin levels by the decrease in transferrin receptor levels, indicating that 28% of the observed anemia was due to iron deficiency. Moreover a significant likelihood of other factors such as food security and intake of foods rich in iron were observed to affect iron status and anemia status, respectively (Table 4.7).

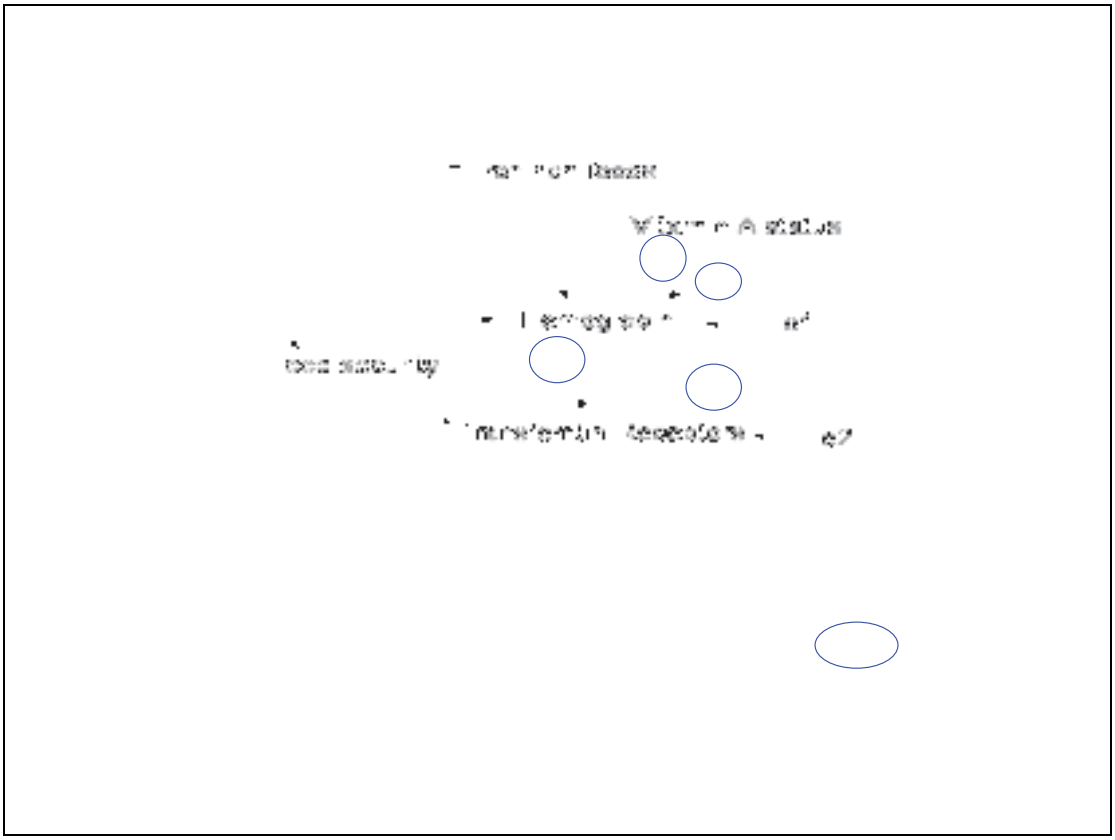

Figure 4.9: Amos equation of model of factors associated with anemia and iron status among women in Malinzanga village, n = 270

[28] Soluble transferrin receptor and hemoglobin concentration level
[29] Food security, vitamin A status, and intake of iron-rich foods
[30] Error 1; e1 and error 2; e2

A co-existence of anemia and iron deficiency was also observed in this study. Anemia significantly differed with levels of transferrin receptor in binary logistic regression (p=0.000).

Although the proportion may vary with the population group and living conditions, iron deficiency is assumed to account for up to 50% of the causes of anemia (WHO, 2001). Findings in the current study strongly support this assumption. Fifty-six percent of the anemic women were also iron deficient; they had transferrin receptor levels greater than 8 mg/L, suggesting that the observed anemia could also be due to iron deficiency.

Table 4.7: Maximum likelihood estimates of the equation of model (Figure 4.9), n = 270 (*: p<0.001, **: p<0.01, *: p<0.05, ns: not significant)**

Variables affecting each other	Regression weight Estimates	Standard Error	p-values
Food security and anemia status	-0.022	0.045	ns
Vitamin A status and anemia status	1.271	0.258	***
Iron-rich food intake and anemia status	-0.475	0.179	**
Anemia status and iron status	-0.604	0.119	***
Food security and iron status	-0.211	0.096	*

A similar observation was made in Lindi, Tanzania by Tatala and co-authors 1998. In their study a 55% prevalence of anemia was observed, and 61% of the anemia was reported to be associated with iron deficiency. Other factors that associated with iron deficiency in the current study were food insecurity (p=0.000), length of food insecurity (p = 0.000), illnesses (p=0.000) and tribe (p=0.015). The risk of food insecure women having iron deficiency was twice as high compared to food secured women. Moreover, the women who were food insecure for two to five months were more vulnerable to iron deficiency compared to those who had no food shortage or less than two months food shortage.

Although it was not tested, a high frequency consumption of cereal-based and legume diets (Figure 4.10), as well as poor preparation of dark green leafy

vegetables observed in the current study could have to a certain extent contributed to low bioavailability of the total iron intake (Tatala, 1998).

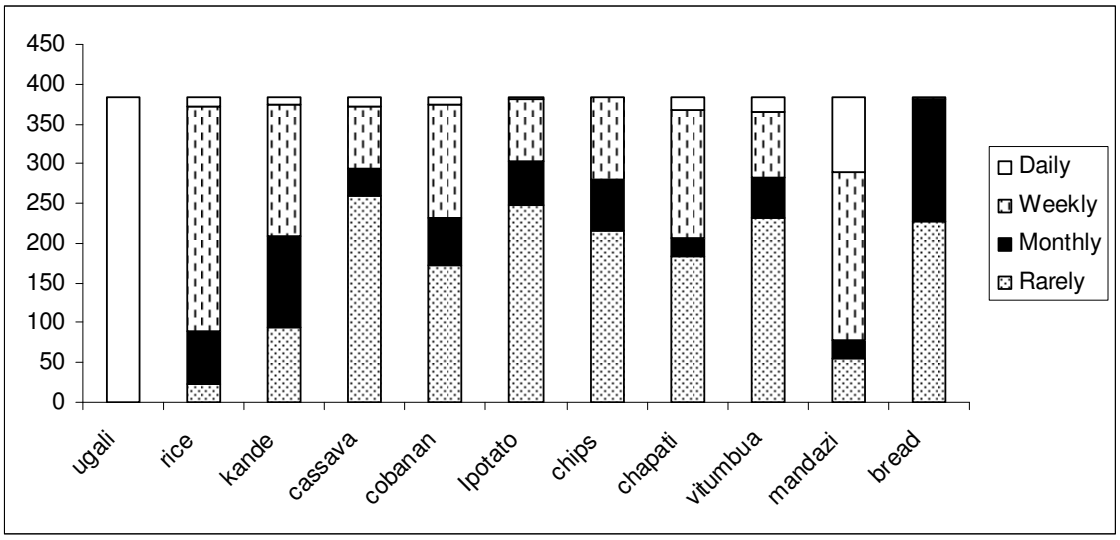

Figure 4.10: Frequency of consumption of cereal based and legume among women in Malinzanga village, n = 384

Factors associated with the nutritional status of women in the study area were complex and influenced each other as illustrated in Figure 4.11. Effect of dietary intake to the nutritional status of the women was observed. The nutritional status influenced the vitamin A and iron status, which also influenced each other. In addition, the nutritional status of the women determined their health status (illnesses). Therefore in order to ensure the improvement of maternal health and nutrition among women in the study area, all aspects of the observed major causes of maternal malnutrition (food insecurity, poor dietary intake, low vitamin A, and iron status as well as illnesses) must be addresses and resolved. Dietary diversification and intake of vitamin A-rich and iron-rich foods need to be improved to reduce deficiency of single or double co-existence of these nutrients. In addition, the efficiency and extent of malarial and hook worm prevention programs need to be improved to meet women's needs.

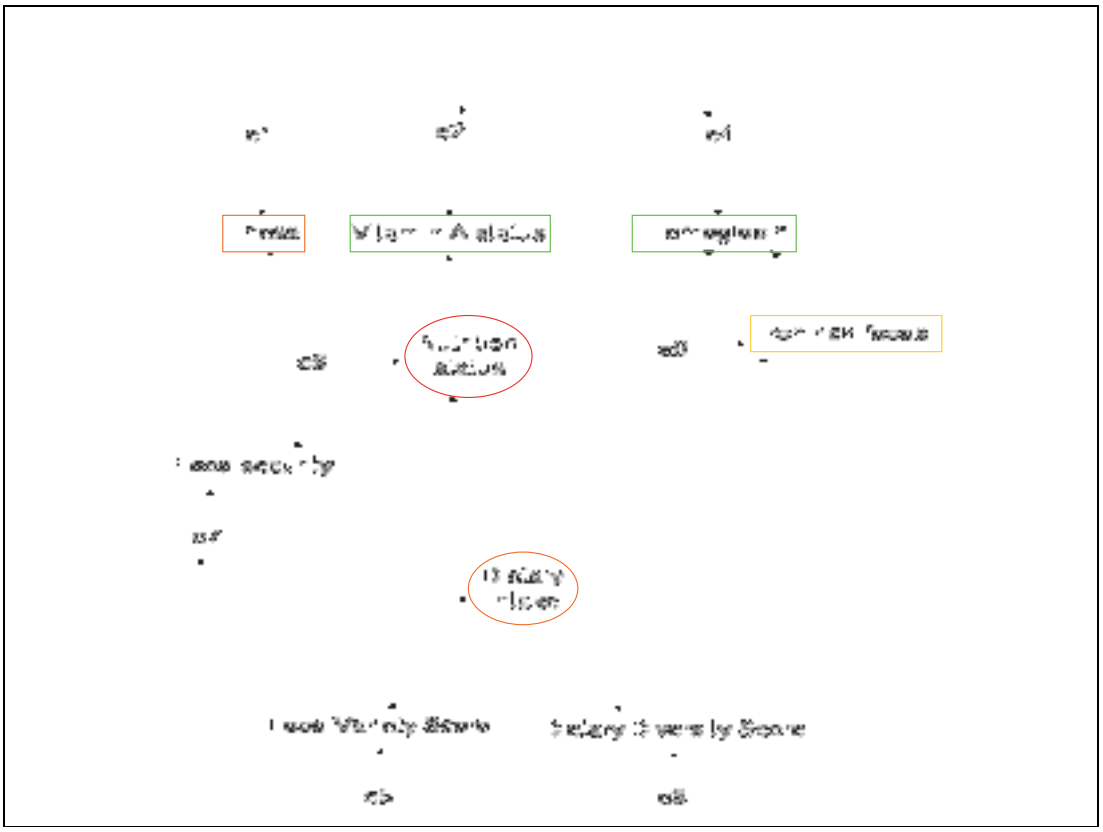

Figure 4.11: Amos overall equation of model showing the complexity of factors associated with nutritional status among women in Malinzanga village, n = 296

4.5 Interaction of micronutrient deficiencies and infections

In order to determine whether a deficiency of vitamin A and/or iron increased vulnerability to malaria and/or diarrhea among women in the study area, binary regressions were applied. Vitamin A deficiency showed a significant influence on both malaria and diarrhea infections. However the risk of diarrhea (1.695), (p=0.012) was slightly higher compared to that of malaria (1.161), (p=0.022).

Although in his study Ramakrishnan (2001) observed the role of the interaction between nutrition and infection in human health, in the current study anemia did not show significant indication of direct influence either to malaria (p=0.928) or to diarrhea (p=0.965) This could be explained by low iron intake. Non-parametric correlation and binary logistic regression of soluble transferrin receptor (sTfR) and C-reactive protein (CRP) levels also indicated no association between iron deficiency (p=0.051 and p=0.324, respectively). These findings support the findings of Wander and co-authors observed in Kenya. In their study they observed moderate iron

deficiency to suppress acute infection in children. Iron deficiency resulted in restriction of iron availability to pathogens. The children were able to optimize the inadequate iron intake to fully meet their body iron needs and so represented a nutritional adaptation to endemic infectious disease stress. A similar explanation may be applicable in the current study: Twenty-five percent of the respondents had mild and moderate anemia, respectively. The respondents with anemia and/or iron deficiency were found to be not vulnerable to acute infections, particularly malaria and diarrhea, compared to non anemic and/or iron secured respondents. Wander and co-authors (2009) called this an evolution of iron deficiency[31]. Instead of iron deficiency increasing vulnerability to infections, the body adapts the inadequate conditions to merely meet its needs and at the same time uses it as a protective measure against infections due to lack of extra available nutrients for the pathogens (Wander, 2009). In contrast, women who frequently suffered from at least one infection were more susceptible to iron deficiency compared to those who did not frequently suffer from any infection. A similar observation was also made elsewhere in Tanzania (Tatala, 1998).

With the addition of other factors that could have contributed to anemia, the current study found iron deficiency to remain the major cause. Apart from other causes, which are said to contribute up to 25% of the maternal death, hemorrhaging remains the number one cause of maternal death followed by infections (UN, 2007). Hemorrhaging, obstructed labor, and anemia were frequently reported as the major causes of maternal death by health workers, traditional birth attendants, and women during our focus group discussions. Therefore, urgent improvement of early antenatal care services[32] is required in saving thousands of lives of the women in Tanzania, especially in the rural areas.

[31] Nutritional adaptation to infectious diseases

[32] *Where women receive early detection of nutrient deficits, illnesses and/or infections, and delivery under supervision of trained health care professional as well as health and nutritional education on the importance of micronutrients to maternal health and child development as well as dietary diversification*

4.6 Knowledge, awareness and perception of women on micronutrients and their importance to maternal health

A majority of the women in the study sample had absolutely no knowledge on any of the micronutrients in question. As mentioned in the results, knowledge about iron and its importance to maternal health among the women in the current study was very low. About 90% had never heard of iron, did not know which foods are rich in iron, and also did not know the importance of iron to maternal health. No significant association between iron status (hemoglobin concentration and transferrin receptors levels) and overall knowledge about iron ($p=0.052$, $p=0.366$), knowledge about foods rich in iron ($p=0.061$, $p=0.738$) and knowledge about the importance of iron to maternal health ($p=0.367$, $p=0.489$). However, this could be explained by the overall low knowledge of iron among the women in the study sample. Since a majority of the respondents had no nutrition knowledge, the impact of the knowledge could not be found.

Thus, nutrition education should focus on the sources of foods with a high content of lacked nutrients and their importance to maternal health. Women should be aware of their nutritional and health status and also have an understanding of the benefits of improving it, especially during the reproductive age. Among others, strategies to improve women's nutrition and health status should include improvement of dietary diversity throughout the life cycle and elimination of micronutrient deficiencies, especially during pregnancy and lactation periods. In addition, parasitic infections such as malaria should be prevented and treated accordingly.

Although the current study did not exclusively focus on pregnant women, information on supply and access to supplements among pregnant women was questioned. Based on the Tanzanian nutrition policy, pregnant women in Tanzania should routinely be provided with iron supplements at antenatal care clinics. As observed by Shirima and Kinabo (2005) in other regions in Tanzania, in the study area, iron supplements are no longer supplied to all pregnant women on a regular basis. Of all 384 women in the study sample, only about 10% reported having obtained supplements from an antenatal care clinic during pregnancy, and only 1% started taking supplements within the first three months of pregnancy. Iron was named among the supplements received. However, no information about the supplement or

its importance to pregnancy or the outcome was provided. The few women receiving supplements reported taking the supplements without being informed about the purpose, which to a certain extent reduced the acceptability and adherence of the recommended supplements. A similar observation was found elsewhere where inadequate counseling and distribution of iron supplements were frequently reported as the major factors affecting supplementation programs in Tanzania (Ekstroem, 1996; Benjamin, 2003).

In the current study, almost all women who took supplements reported stopping taking them right after delivery, when the baby reached three months of age, or when the baby stopped breastfeeding. The government of Tanzania needs to enable its public health facilities to supply free micronutrient supplements regularly, especially to women in remote areas. Often they are the ones who are in a bad nutritional status and would hardly be able to afford supplements on the open markets (Benjamin, 2003). In their study they observed poor dietary intakes, low bioavailability of micronutrients and poor food preparation to attribute to the high prevalence of multiple micronutrient deficiencies.

Studies concerning improvement of micronutrient status in Tanzania and in other developing countries reported that, adherence to supplements among pregnant women is high regardless of what type of supplement is provided (Makola, 2003; Aguayo, 2005). The major obstacle to supplementation programs is the inconsistent supply and/or lack of availability of the supplements. Thus, the government of Tanzania should revise its commitment to regularly supply free iron supplements to all pregnant women in need at all times.

Although – based on the collected information about knowledge of iron, iodine, and vitamin A among the women of reproductive age in the study area – the overall knowledge of micronutrients was very low; knowledge of vitamin A among the women was much higher compared to that of iron and iodine.

Of all the women in the study sample, about 40% knew about vitamin A, had knowledge about good food sources with vitamin A, and knew at least one importance of vitamin A to maternal health (Figure 4.12). Multinomial regression of vitamin A status with knowledge about vitamin A revealed no significant association

between vitamin A status and the overall knowledge about vitamin A. This could be explained by the overall low knowledge about vitamin A, low intake of vitamin A-rich foods, and the overall high prevalence of vitamin A deficiency. However, a significant association between vitamin A status and knowledge of the importance of vitamin A to maternal health was observed (p=0.036).

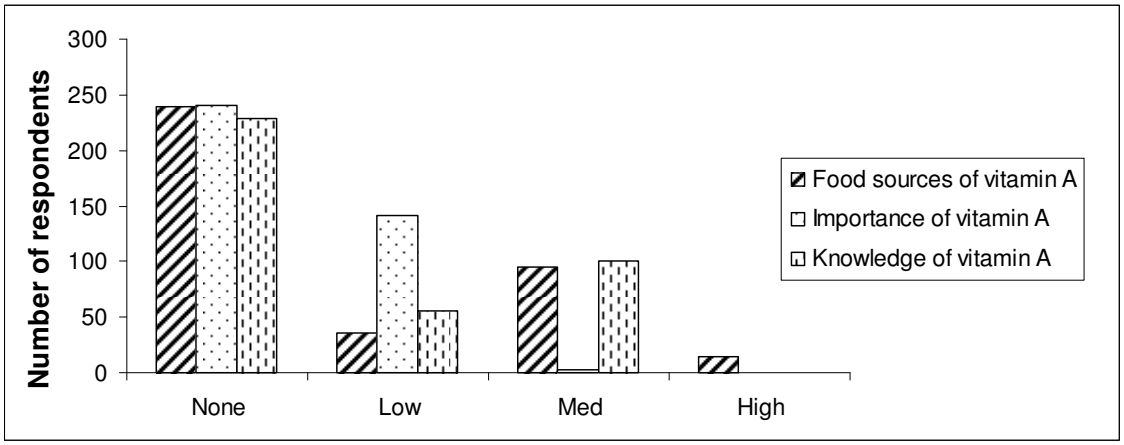

Figure 4.12: Knowledge of women about vitamin A in Malinzanga village, n = 384

Thus, improving knowledge on the importance of micronutrients to maternal health among women with micronutrient deficiencies can be one of the important means of reducing maternal morbidity and mortality. Not only because micronutrients such as vitamin A and iron play an important role in the function of the immune system by influencing the risk of susceptibility, rate, duration, and severity of infections; the consequences of malnutrition affect the ability of women to sustain work and care for their families (Mackay, 2000). Hence, solutions to the prevention and elimination of micronutrient malnutrition should include nutrition education. Furthermore, frequent reminders to women taking the supplements to meet their increasing nutritional demands due to pregnancy or lactation are of importance. Good nutrition status contributes to minimizing the risks of delivery complications, morbidity and maternal mortality.

4.7 Availability, accessibility and utilization of health care services

Availability of health care

In 1990 the government of Tanzania set a National Health Policy with the aim of improving the survival, health, and well-being of all Tanzanians, with a focus on the most vulnerable groups; children and women. In 2003, the law was revised specifically towards the following visions in order to provide and/or attain:

• Access to quality primary health care services for all;

• Access to quality reproductive health care services for all individuals of appropriate ages;

• Reduction of infant and maternal mortality rates by three quarters of the existing levels;

• Universal access to clean and safe water;

• Life expectancy comparable to the level attained by typical middle-income countries;

• Food self sufficiency and food security; and

• Gender equality and empowerment of women in all health parameters (Arvidson, 2006).

The objectives of these visions were to:

• Reduce the burden of disease, maternal and infant mortality, and increase life expectancy through the improvement of health services, sanitation, nutrition, and disease control;

• Ensure the availability of medical supplies and infrastructures;

• Ensure health services are accessible to all people;

• Train and make available a competent and adequate number of health staff;

• Sensitize the community to common preventable health problems and improve capacity at all levels to take appropriate action and encourage community involvement;

• Promote awareness among government employees and the community at large that health problems can only be adequately solved through multi-sectoral cooperation;

• Create awareness through family health promotion that the responsibility for one's health rests in the individuals as an integral part of the family, community and nation;

• Promote and sustain public-private partnership in the delivery of health services; and
• Promote traditional medicine and alternative healing system and regulate the practice (Arvidson, 2006).

As mentioned in the introduction, Tanzania has health care facilities ranging from village health care services and dispensaries to referral hospitals and treatment abroad. Although the number of people taken care of by a health care facility increases with the level of the health care facility, the number of health care facilities decreases with the increasing levels of health care facilities. Much of the health care services are provided at lower level of health care facilities, i.e. dispensaries, especially in the rural areas.

A majority of the health care facilities (60%) in Tanzania are government owned with few voluntary parastatal and privately owned health care facilities (Mamdani, 2004). The high number of government owned health care facilities supports the National Health Policy set in 1990 with the aim of improving the survival, health, and well-being of all Tanzanians (Arvidson, 2006). Although the government of Tanzania has aimed to provide one dispensary per 5,000 people, one health center per 50,000 people, and one hospital per district, the available health care facilities are inadequate and of poor quality, especially in the rural areas (MoH, 2003). A similar observation was made in the current study area. The single dispensary available was responsible for providing health care services to more than 5,000 community members.

Accessibility of health care services

As already reported in some of the previous studies, public health care facilities in Tanzania are not well equipped to provide all the health care services intended by the government (Ekstroem 1996; Galloway, 2002; Shirima, 2005). As also observed in the current study, the community of more than 5,000 inhabitants depended on only one dispensary. According to the health care officer, during our group discussions, the number of patients varied with season. During the rainy season they received more malaria patients due to increased incidences compared to the dry season. Regardless of the season and the number of patients' requiring health care services,

in the study area only three health care staff were available to provide health care services. Due to work rules and regulations, i.e. off duty and sick leave, the presence of all the health staff members at once at the dispensary was a rare case. Often two of the staff members were available and sometimes only one. The understaffing observed was also reported by the clinical officer as well as by women during our group discussions. Understaffing in health care facilities in Tanzania was also observed elsewhere (Mamdani, 2004; Manongi, 2006). In the current study, the understaffing explained the lack of time to adequately care for all patients. Thus for the government to attain its goal of providing quality primary health care services for all, training more health staff and distribution of the trained health professionals to reach all health facilities is required, particularly in the rural areas.

As already observed in previous studies, in rural areas of Tanzania, long distances to the nearest health care facilities, limited transport, and a lack of ambulances can often be a problem. Some of the villagers had to walk about 10 km over the mountains taking between three and six hours to reach the dispensary. Based on the government's target of providing health care services within the diameter of 2 km, the service was inadequate. In addition, based on the governments' target of of providing health care services to 5,000 people per one dispensary, the ratio of dispensary per inhabitant observed in the study area was also inadequate (MoH, 2003). However, the ratio of population to the health care facility does not necessarily explain accessibility. Often people living in lower population density are the ones that are lacking access to health care facilities. Hence the distance to the health care facility is more pronounced than the access to health care facilities compared to the population ratio.

The cost of treatment in the study area was TShs. 1,000 ($1) per person per treatment or TShs. 5,000 ($5) family insurance *per annum*. These costs applied to everybody including children under-five, pregnant women as well as lactating mothers. Free treatment for these groups no longer exists (Shirima, 2005). Health care fees were formally introduced in 2004 as an important component of the Tanzanian health sector reform, which aimed to improve access, quality and equity of health care services. The rationale for the implementation of the health care fees was to generate additional revenue to be used locally at the health care facility on

items directly related to quality of health care services (MoH, 2003 in Mamdani, 2004). In Tanzania, there are no countrywide statistics for charging fees for health care services and the variation is enormous. Although they were not mentioned in the current study, unofficial charges are still common in Tanzania (Mamdani, 2004). For instance, the TShs. 1,000 fee charged for a single treatment per person was not official in the rural areas in Tanzania; however it was very commonly used as reported in our focus group discussions. Whether the collected revenues at the dispensary in the study area were used appropriately according to its purpose was not inquired in this study, and therefore, further investigations on the accountability are recommended. The cost of health care services in Tanzania is known as the major obstacle prohibiting many people in the rural areas from seeking and/or receiving health care services. Emergency treatments were also found to be an issue in other studies in Tanzania (MoH, 2003 in Mamdani, 2004). In the current study however, this was not the case, except for emergencies, whereby women had to pay TShs. 20,000 for an ambulance.

Based on personal observations and information obtained from the focus group discussions of women and health workers, the dispensary in the study area was not able to provide all the health care services required. During the study survey, the dispensary lacked the following items:

- medicine for treatment of common illnesses in the community
- instruments for malaria and HIV screening
- microscopes for blood, urine, and stool examination
- hemoglobin kit
- endoscope and other instruments for pregnancy monitoring
- examination and delivery beds
- sterilizers
- sucking machine
- reliable transport for emergency cases
- sufficient well-trained health staff and
- regular supply of supplements

Women of Malinzanga village would like to receive health care services required in the village. Though it was not tested (further studies are recommended), the risk of

false diagnosis and treatment of women's health is suspected to be high in the study area. Therefore a quality management scheme for the services would be necessary. This may in turn perpetuate and/or lead to chronic diseases and sometimes death of the women, since diagnoses rely only on the information provided by the patient and the understanding of the available health staff.

Although it is well known that skilled health care services at delivery is one of the important elements necessary in reducing maternal mortality, in Tanzania, only 43% of women are attended by skilled health care personnel at delivery (UNICEF, 2009). As reported by the United Nations, impoverished and rural women are less likely compared to wealthier or urban women to receive skilled care during child birth (UN, 2006a). A similar observation was made by the Tanzanian National Bureau of Statistics in 2005, whereby 63% of women in rural areas of Tanzania reported delivering their babies at home compared to 19% in the urban areas (National Bureau of Statistics, 2005). This could be due to poor health care services provided by the health care facilities in the rural areas. As reported in our women focus group discussion, *"Hakuna upendo kwa mama mjamzito, mfano, wakati mwingine mjamzito hujifungua akiwa peke yake, nesi anaondoka…",* in translation, "Care is not sufficient for pregnant women, sometimes a pregnant woman has to deliver her baby under no supervision of skilled health care personnel because she/he is required to take care of another person at the dispensary." In the group discussion with traditional birth attendants, it was reported that about 4 to 5 women visit traditional birth attendants for delivery per month. Although the traditional birth attendants were trained about 10 years ago, during the study survey they lacked the following equipment:

- hand rubber gloves
- scissors
- towels
- washing basins
- lights
- delivery beds and
- delivery pads

As shown in Table 4.8, a large population density of Tanzanians depends on low skill-level health care workers with limited resources for health care services. This

increases the risk of communicable diseases such as HIV/AIDS and leads to poor health of the women and consequently of the child due to a lack of quality care. As shown in Table 4.9, HIV/AIDS is the number one killer in Tanzania. According to the United Nations, the target of improving child health lags behind in Tanzania. Although the trend of child mortality has decreased from 161/1,000 to 118/1,000 live births between 1990 to 2006, in order to attain the targeted 64/1,000 (two-thirds of the initial prevalence), a more than 50% reduction still needs to occur (UN, 2008; 2009).

Table 4.8: Number and densities of the health workforce in Tanzania (2002)

Type of health care worker	Total number	Density per 100,000
Physicians	822	1.695
Nurses and midwives	13,292	27.402
Dentists and technicians	267	0.550
Pharmacists and technicians	365	0.752
Environmental and public health workers	1,831	3.775
Laboratory technicians	1,520	3.134
Other health workers	29,722	61.272
Community health workers	n.a	n.a
Health management and support	689	1.420
Sum total	48,508	100.000

Source: Modified after WHO, 2006

Utilization of health care services

As mentioned in the results, health care service seeking behavior among the villagers in the study area was very good. Less than 1% of the women in the study sample never visited the dispensary when they became sick. Apart from the inadequate and poor quality of health care services, the frequency of visiting the dispensary for most of the women was relatively good. Over 60% of the women visited the dispensary more than three times per year. When a multinomial logistic regression was applied to the frequency of visiting the dispensary and the frequency of illnesses and malaria, a significant association was observed. Women who suffered from malaria ($p=0.003$) every two weeks ($p=0.038$), once a month ($p=0.020$) and other frequencies ($p=0.021$) visited the dispensary more often compared to women who suffered from malaria less frequently or suffered from any other illnesses. With reference to the frequent health care services required by the

community in the study area, the quality of health care services provided was very poor.

Table 4.9: Top ten causes of death in Tanzania, all ages (2002)

Cause of death	Deaths	In percent of all (%)	Years of life lost
HIV/AIDS	166,000	29	29
Low respiratory infections	67,000	12	13
Malaria	56,000	10	12
Diarrhea diseases	31,000	6	6
Perinatal conditions	24,000	4	5
Tuberculosis	18,000	3	3
Cerebrovascular disease	16,000	3	1
Ischaemic heart disease	14,000	3	1
Syphilis	11,000	2	2
Road traffic	10,000	2	2
All causes	583,000	100	100

Source: Modified after WHO, 2006

A significant association between time taken to the dispensary and frequency of visits at the dispensary was also observed in multinomial regression ($p=0.004$). Over 60% of the women who took less than one hour to reach the dispensary visited the dispensary more than three times per year compared to their counterparts who spent between one and three hours (30%) and those who spent between three and six hours (10%). As it is known that, long distances to the nearest health care facility is one of the major factors influencing health care seeking behavior for many in Tanzania, this was also the case in the study area.

These findings oppose other findings that indicated self-medication with traditional medicine or medicine from the local shops is common, especially in the first stage of diseases, compared to seeking health care services from a health care facility. According to Mubyazi and co-authors (2006) and Oberländer and Elverdan (2000), contact with health care facilities often depends on the degree of severity of the disease-associated symptoms (Mubyazi, 2006; Oberländer and Elverdan, 2000). Apart from traditional birth attendants other health care providers such as traditional healers who are still common in some other countries in Sub-Saharan Africa were not found in the study area.

Table 4.10: Causes of neonatal deaths (2000)

Cause of death	Deaths in percent (%)
Neonatal tetanus	3
Several infections	29
Birth asphyxia	27
Diarrhea disease	3
Congenital anomalies	7
Preterm birth	23
Others	8
Total neonatal death	100

Source: Modified after WHO, 2006

Antenatal care services

In 2002, the Ministry of Health in Tanzania developed a national adaptation plan for antenatal care services based on the recent WHO model for antenatal care services (WHO, 2002). The WHO model includes early detection and management of disease or abnormality, counseling on health promotion, birth preparedness, complication readiness, and counseling on the development of an individual birth plan. The antenatal care services include monitoring the health of the woman during pregnancy. Therefore through early detection of problems, planning for correction interventions can be done on time. This will ensure delivery of a healthy child (Abou-Zahr, 2003).

In Tanzania, pregnant women are advised to start attending antenatal care clinics before the beginning of the second trimester of the pregnancy. This is to ensure that the women receive health care assessment from the beginning of a pregnancy and are monitored throughout the pregnancy until delivery (National Bureau of Statistics, 2005). Attending antenatal care in an early stage of pregnancy and continuing until delivery can highly contribute to avoiding adverse pregnancy outcomes (WHO, 2001a). Late attendance of antenatal care will prevent the women from fully benefiting from preventive strategies such as malaria preventive treatment.

In our women group discussion it was discovered that the women in the study area were aware of the importance of attending antenatal care in early stages of pregnancy. Moreover, iron supplements and malaria preventive treatments should be provided to the women at early stages of their pregnancies, and continue following the WHO recommendation.

Currently, the WHO recommends four visits to antenatal care to ensure a low risk pregnancy. In the current study, only about 65% of the women met the WHO recommendation. These findings suggest that there is a need to improve antenatal care services to meet the WHO standards. This includes a supply of adequate supplements on a regular basis and performing tests for assessing and monitoring pregnancy. Women should also be frequently reminded of the importance of antenatal care clinic visits to maternal health and the expected child. This can be done by using a calendar for monitoring and follow-up.

As observed in the current study, no blood or urine test was conducted. Pregnancy was tested by palpating the suspected pregnant woman's stomach. Malaria was confirmed by symptoms such as fever. This is common in Tanzania, only about 45% and 30% of women give blood and urine samples, respectively for a medical examination (National Bureau of Statistics, 2005). Consequently, a high increasing risk of maternal death and disabilities, hemorrhage, sepsis, unsafe abortion, obstructed labor, and hypertensive disease of pregnancy exists. These can be prevented through the provision of appropriate reproductive health care services before, during, and after pregnancy, as well as life-saving interventions in the case of complications.

Attendance at delivery by skilled health care personnel who are well trained to detect problems at early stages of pregnancy and are able to effectively provide or refer women to emergency health care when needed is essential for improvement of maternal health in the rural areas of Tanzania.

Except for antenatal care services, health care service seeking behavior among the women in the study area was very good (99%). In comparison to the national (94%) as well as rural areas (92.6%) statistics, antenatal care service seeking behavior in the study area was relatively low (70%). Lack of time was among the common reasons given by the women for not attending the antenatal care clinics during pregnancy. In the group discussions with health workers, further information on antenatal care services seeking behavior was provided. Long distances to the dispensary, low nutrition and health education on the importance of micronutrients to maternal health, as well as poor economy were also among the factors mentioned to affect the antenatal care seeking behavior.

In the study area, reduction of the distance to the health care facility through mobile clinics was suggested. This would include increasing the number of trained health care staff and means of transportation. In addition, empowering traditional birth attendants through appropriate training, supply of equipment, as well as regular payments is of importance. Traditional birth attendants play an important role in child delivery, especially in the rural areas (Abou-Zahr, 2003). Training of the traditional birth attendants has already shown its contribution to the reduction of maternal and prenatal mortality (Bernis, 2003). Therefore, this can be taken as a challenge in the current study to also improve the health status of the women in the region.

If we are to generally improve maternal health in Tanzania and meet the Millennium Developments Goals, the improvement of quality as well as quantity of skilled health care personnel in Tanzania is crucial.

5. Conclusion and Recommendations

5.1 Conclusion

Needs and possibilities for improving maternal nutrition in rural areas of Tanzania were explored using the case of Malinzanga village in the Iringa Rural district. Some of the factors associated with the poor nutrition status among women of reproductive age in rural Iringa included food insecurity, micronutrient deficiencies, illnesses, and infections. Not only did the women of Malinzanga village have energy malnutrition, but they also suffered from micronutrient deficiencies as well as illnesses making them more vulnerable.

The nutritional status of the women differed with age, location, tribe, main source of income, and assets. BMI increased with age and number of assets possessed. Factors associated with the nutritional status of women in the study area were complex and influenced each other. Therefore in order to ensure improvement of maternal health and nutrition, all aspects of the major causes of maternal malnutrition must be addressed and resolved.

Food insecurity also negatively affected women's micronutrient status: it increased the risk of vitamin A and iron deficiency. The nutrition influenced the women's vitamin A and iron status, and these statuses influenced each other. Vitamin A deficiency increased the risk of a co-existence of vitamin A and iron deficiencies, which increased the risk of anemia as well as malaria and diarrhea among the women.

A higher level of formal education did not positively affect the nutritional status of the women. In contrast, it negatively affected the nutritional status of them: a higher level of education was associated with a high rate of overweight. This is due to the common attached factors of increased socio-economic status: sedentary lifestyle and high consumption of fast foods. However a high nutrition education positively affected the women's retinol binding protein levels.

Knowledge of micronutrients among women of reproductive age in the study area was very poor. Most of the women in the study sample had never heard of iron, vitamin A, and iodine, and they did not know good food sources for these nutrients or

their importance to maternal health. Consequently their dietary intake as well as micronutrient status, hence their health status was negatively affected. Thus, improvement of the knowledge of micronutrients, micronutrient intakes, as well as their importance to maternal health can be an important means of reducing maternal morbidity and mortality. Not only because micronutrients such as vitamin A and iron play an important role in the function of the immune system, the consequences of malnutrition affect the ability of women to sustain work and care for their families.

Hence, solutions to prevention and elimination of micronutrient malnutrition should include free regular iron and vitamin A supplementation. In addition, nutrition and health education on the benefits and possible side effects from the supplements provided should be made clear to the women. Furthermore, frequently reminding women about taking the supplements and about the importance of good nutrition to meet their increasing nutritional demands due to pregnancy or lactation is of importance. This will generally minimize the overall risks of delivery complication, morbidity, and maternal mortality.

Although the overall health care seeking behavior among women in the study sample was very good, access to the health care facility in the study area negatively affected the utilization. Antenatal care services seeking behavior in the study area was relatively low. The long distance to the dispensary was among the common reasons mentioned by the women for not attending the antenatal care clinics during pregnancy. In addition, poor economy and poor health and nutrition education were among the factors affecting the attendance of women to the antenatal care services. The antenatal care service seeking behavior in the study area can eventually be improved through mobile health care services. This will include increasing the number of trained health care service providers and means of transportation. Moreover, empowering traditional birth attendants through appropriate training, supply of equipment, as well as regular payments is of importance.

5.2 Recommendations

The findings of the current study indicate that there is an urgent need to improve maternal nutrition in the rural areas of Tanzania. Therefore, the following measures are recommended:

1. Revision of the Tanzanian Nutrition Policy: Free iron and vitamin A supplements should be distributed based on WHO recommendations, especially in remote areas.

2. Improvement of community nutrition education both quantitatively and qualitatively: The topics of causes and consequences of malnutrition, methods of prevention, and the benefits of good nutrition to maternal and child health should be covered.

3. Improvement of malaria control and diarrhea prevention, training of the health care providers, as well as increasing salaries to motivate the health care providers to remain and provide quality care in the rural areas, especially in remote areas such as Malinzanga village.

4. Fortification of vitamin A in maize flour and vegetable oil: these products are commonly used, easily available, and accessible to all people in Tanzania at all times, even in remote areas. Problem: these products are often not centrally produced but people in the rural areas often produce them locally.

5. Revision of the fee-for-service policy of health care institutions to improve access by poor citizens.

6. Assessment of the impact of improved diagnostic-methods for examination of the health status of the women.

7. Use the case of Malinzanga village and a pilot study on implementation processes. Multi-disciplinary sectors should work together in planning and implementing improved health and nutrition services and activities in the rural areas of Tanzania.

This will not only improve the overall nutrition status of the most affected women in the remote areas, but also help the country in the process of achieving the first,

fourth, fifth, and sixth Millennium Development Goals. Its effect will directly reduce child mortality, improve maternal health, and indirectly contribute to combating HIV/AIDS, malaria, and other diseases.

In achieving the goal of the current study[33], Table 5.1 is used to illustrate the logic of the interventions, indicators, and means of verification. Table 5.1 also includes different assumptions with respect to the suggested interventions. Furthermore, Table 5.2 is pointing to factors to be considered when planning the recommended interventions and during the implementation processes.

Depending on the circumstances, some weaknesses may be used as opportunities, and threats may be turned into strengths. For the best outcome, a better combination of strengths and opportunities is crucial. Since the women are open for behavior change, and the village leaders, health care providers, and nutrition workers are willing to collaborate in projects related to health and nutrition improvement, other stakeholders need to provide technical support and funds where necessary in order to realize the goals of the interventions. Where a health facility is available in the community, regular supply and distribution of adequate supplements can take place at the dispensary.

The threats and weaknesses of the health care facility can be used as an opportunity to improve the respective areas and therefore improve the overall health and nutrition situation of the women in the area. Furthermore, political will, transparency, and good governance are of importance in order to achieve a better cooperation between the local, national, and international stakeholders. This will ensure accountability of funds provided and activities planned for implementation.

[33] Providing recommendations on the feasible strategies in improving maternal nutritional status in the rural areas of Tanzania

Table 5.1: Recommended Logical Framework for Project Management

	Intervention Logic	Objectively Verifiable Indicators	Means of verification	Assumptions
Program Goal	To improve maternal nutrition in rural areas of Tanzania	- Anemia - Bitot's spots - Impaired dark adaptation - BMI - MUAC - Food availability - Dietary pattern - Food choice - Food consumption - Number of meals per day - Quality of diet - Amount of accessible tap water in the community - Number of days receiving tap water in the village - Quality of water supplied	- Hemoglobin concentration - Retinol binding protein - Soluble transferrin receptor - C-reactive protein Anthropometric measurements - 24-hour dietary recall - Food frequency - Questionnaire based interviews - Focus group discussions - Interview with key informative persons - Desk reports - Observation	- Government will fully participate in the project - Stakeholders will be well informed about their roles - Sufficient funds will be available to support the project - Stakeholders will make right decisions in implementation - Communities will be well informed about the purpose of the interventions and will fully participate in the implementation
Project Purpose	To improve dietary and nutrient intake of women among reproductive age			
	To improve quality of antenatal care services			
	To improve quality and quantity of health care providers and community nutrition educators			
	To improve household water supply and environmental sanitation			
	To supply vitamin A fortified foods in rural communities in Tanzania			
Outputs/ Expected results	Improvement of maternal health and nutrition in rural areas of Tanzania	- Behavior change on food choices and dietary patterns	- 24-hour dietary recall - Food frequency - Structural questionnaire interviews	- Women will follow the instructions given by the community nutrition workers
		- Reduction of prevalence of anemia, vitamin A, and iron deficiency	- Levels of hemoglobin concentration, retinol binding protein, soluble transferrin receptor	- Women will visit antenatal care clinics as recommended - Women will receive supplements based on the WHO recommendations - Women will adhere to recommended supplements
		- Reduction of prevalence of overweight and elimination of obesity and underweight	- Anthropometric measurements	- Women will fully participate in all activities involved in order to reach the determined BMI
		- Reduction of prevalence of malaria and diarrhea illnesses	- Questionnaire interview - Focus group discussions - Interview with key informative persons - Desk reports	- Women will improve personal hygiene and preventive measures for malaria, diarrhea, and other infectious diseases

	Intervention Logic	Objectively Verifiable Indicators	Means of verification	Assumptions
Inputs/ Planned Activities to produce Outputs	To provide basic education on the nature, causes, consequences, and prevention of malnutrition	- Number of women involved - Training of trainers - Number of trained health care providers - Number of trained community nutrition educators - Supply frequency of supplements - Number of days receiving tap water - Number of accessible fortified foods - Quality of antenatal and postnatal care services - Quantity and quality of support provided by the involved stakeholders	- Questionnaire interviews - Focus group discussions - Key informative persons - Desk reports from: - Ministry of agriculture and food security - Ministry of community development, women and children - Ministry of education and culture - Ministry of water and livestock development - Ministry of health - Non Governmental Organizations - Research Institutes - Individuals	- A large number of stakeholders will be involved in the project and work together in transparency - Government will change the policies accordingly - Stakeholders will share ideas and responsibilities - Sufficient technical support will be available for the project - Communities will actively participate in the whole process of project implementation
	To integrate health, education, agriculture, and micro-finance sectors in nutrition programs			
	To provide adequate free iron and vitamin A supplements to all pregnant and lactating women in need			
	To provide quality antenatal and postnatal care services			
	To provide proper preventions and treatments of common illnesses			
	To provide safe water and a clean environment			
	To introduce accessible common foods fortified with iron, vitamin A, and folic acid in rural communities in Tanzania			

Table 5.2: Suggested Strengths Weaknesses Opportunities Threats (SWOT) for project management

SWOT Analysis	Strengths	Weaknesses
Opportunities - Target farmers and livestock keepers - Target a wide range of age groups - Collaboration with Sokoine University of Agriculture - Collaboration with other non-governmental organizations and individuals	- Sufficient arable land for diverse agricultural production - High feasibility due to high interest of women - Region, target group, and areas of interest already identified and established - Need and importance of the project is already assessed - Community is involved in other ongoing nutrition, education, health, and wildlife conservation projects	- Including all women of reproductive age; target group too broad - Inadequate and irregular supply supplements - Lack of sufficient funds - Too short intervention periods - Lack of better preventions and treatments for malaria and parasitic infections - Lack of better health and nutrition education
	Strengths-Opportunity	**Weaknesses-Opportunity**
	- Women are open for behavior change - Village leaders, health care, and nutrition workers are willing to collaborate in projects related to health and nutrition improvement in their community - Health facility is available in the community - Possibility of integrating multi-sectored projects	- Inadequate distribution and supervisions channels - Poor education - Poverty - Lack of employment - Unequal distribution of resources - Inadequate health, education, and other social services
Threats - Lack of political will - Lack of transparency - No co-operation with education, health, and agricultural sectors	**Strengths-Threats**	**Weaknesses-Threats**
	- Trends of health care reforms (privatization and none free health care services) - Trends of political interest (low budget for health, education, nutrition, and agricultural sectors) - Attract foreign investors (high food price and local and international food market competition)	- Inadequate health staff and medical instruments at the health facility - Lack of training of health staff - Limited capacity of community nutrition staff - Poor health and nutrition education for behavior chance

Summary

Maternal mortality remains high particularly in developing countries where 99% of the deaths occur. Each year more than half a million women die from treatable or preventable complications during childbirth. Little progress has been made in saving women's lives between 1990 and 2005. Globally, maternal mortality has decreased by less than one per cent per year during this period. Although other regions such as Northern Africa, Latin America and the Caribbean as well as South-Eastern Asia managed to reduce their maternal mortality ratio by one-third, in Sub-Saharan Africa, the region with the highest level of maternal mortality, progress made was negligible. Since maternal deaths are due to multiple causes (hemorrhages, hypertensive disorders, infections, obstructed labor, anemia, abortions, and other causes), no single intervention can address maternal problems. Thus, well planned surveys that come up with location-specific findings for an improvement are crucial.

This study investigated nutrition and health problems that were faced by women of childbearing age in the Iringa rural areas in Tanzania. Furthermore, it outlined special needs and possible interventions that are feasible, sustainable, and implementable to improve maternal health and nutrition. The following specific objectives were studied:

- Factors associated with the nutritional status among women of reproductive age in the Iringa Rural District in Tanzania.
- Food availability, food consumption, and nutrient intake of the women.
- Women's knowledge, awareness, and perception towards the importance of micronutrients in pregnant women and the outcomes.
- Availability, accessibility, and utilization of health care services among women in the study area.

Sampling included women aged between 15 and 44 years living in Malinzanga village. Stratification and simple random sampling methods were used for calculating the sample size. The sample size (389) calculation was based on the country's prevalence of anemia in women of reproductive age. The study was a cross sectional community baseline survey. Data were collected in one continuous phase between February and April 2008. Both quantitative and qualitative research methods were applied in data collection. Qualitative data assessment included food

frequency questionnaire, a 24-hour dietary recall, focus group discussions, participatory observation, Bitot's spots- and goiter examinations. The quantitative data collected included height, weight, mid-upper arm circumference (MUAC), plasma levels for hemoglobin concentration (Hb), soluble transferrin receptor (sTfR), retinol-binding protein (RBP), C-reactive protein (CRP) and acid glycoprotein (AGP).

Training and pre-testing of the materials was conducted prior to the actual data collection. Interviews were conducted individually at each participant's homestead. A structured interview-questionnaire was used to obtain social demographic and economic data. Biochemical and clinical examinations were assessed by measuring hemoglobin concentration, retinol binding protein, soluble transferrin receptor, C-reactive protein, and acid glycoprotein levels. At the end of the data collection, cleaning, and entry, 384 questionnaires were admissible for further data analysis. Data were entered and analyzed using Microsoft Excel (MS Office 2007), Statistical Package for the Social Sciences (SPSS version 17.0), and Analysis of Moment Structures (Amos 16.0). Data analysis included descriptive statistics, correlation and regression analysis, as well as structural equation modeling analysis.

Factors associated with the poor nutrition status among women of reproductive age in rural Iringa included: food insecurity, poor dietary diversity, micronutrient deficiencies (vitamin A and iron deficiencies), illnesses (malaria and diarrhea), age, source of income, household population, location, education, distance to the nearest health facility, knowledge of micronutrients and its importance to maternal health, as well as a lack of and poor supply of iron and vitamin A supplements.

Not only did the women of Malinzanga village have energy malnutrition but they also suffered from micronutrient deficiencies as well as illnesses which made them more vulnerable: Prevalence of undernutrition and caloric over nutrition was 7% and 21% respectively. The nutritional status of the women differed with age, location, tribe, main source of income, and assets. Body mass index increased with age and number of assets possessed. Factors associated with the nutritional status of women in the study area were complex and influenced each other. Food insecurity negatively affected women's micronutrients status: it increased the risk of vitamin A and iron deficiency, as well as malaria and diarrhea illnesses. A prevalence of 26% anemia and 55% vitamin A deficiency was observed. Moreover, the nutrition

influenced the women's vitamin A and iron status, and these statuses influenced each other.

Most of the women in the study sample had never heard of iron, vitamin A, and iodine and did not know good food sources for these nutrients or their importance to maternal health. Consequently, their dietary intake as well as micronutrient status, and hence their health status, was negatively affected.

Antenatal care services seeking behavior in the study area was relatively low. The long distance to the dispensary was a common reason for not attending the antenatal care clinics during pregnancy. In addition, poor economy and poor health and nutrition education were among the factors affecting the attendance of women at antenatal care services.

The findings of the current study indicate that there is an urgent need to improve maternal nutrition in the rural areas of Tanzania. Therefore, the following measures are recommended:

1. Revision of the Tanzanian Nutrition Policy: Free iron and vitamin A supplements should be distributed based on WHO recommendations, especially in remote areas.

2. Improvement of community nutrition education both quantitatively and qualitatively: The topics of causes and consequences of malnutrition, methods of prevention, and the benefits of good nutrition to maternal and child health should be covered.

3. Improvement of malaria control and diarrhea prevention, training of the health care providers, as well as increasing salaries to motivate the health care providers to remain and provide quality care in the rural areas, especially in remote areas such as Malinzanga village.

4. Fortification of vitamin A in maize flour and vegetable oil: these products are commonly used, easily available, and accessible to all people in Tanzania at all times, even in remote areas. Problem: these products are often not centrally produced but people in the rural areas often produce them locally.

5. Revision of the fee-for-service policy of health care institutions to improve access by poor citizens.

6. Assessment of the impact of improved diagnostic-methods for examination of the health status of the women.

7. Use the case of Malinzanga village and a pilot study on implementation processes. Multi-disciplinary sectors should work together in planning and implementing improved health and nutrition services and activities in the rural areas of Tanzania.

This will not only improve the overall nutrition status of the most affected women in the remote areas, but also help the country in the process of achieving the first, fourth, fifth, and sixth Millennium Development Goals. Its effect will directly reduce child mortality, improve maternal health, and indirectly contribute to combating HIV/AIDS, malaria, and other diseases.

Zusammenfassung

Die Müttersterblichkeit ist immer noch hoch, besonders in Entwicklungsländern, wo 99% der Todesfälle vorkommen. Jedes Jahr sterben eine halbe Million Frauen von behandelbaren oder vermeidbaren Komplikationen bei der Entbindung. Zwischen 1990 und 2005 wurden wenige Fortschritte erzielt, um die Leben der Frauen zu retten. Weltweit ist die Müttersterblichkeit in diesem Zeitraum nur um weniger als ein Prozent pro Jahr gesunken. Obwohl andere Regionen wie Nordafrika, Lateinamerika, die Karibik und Süd-Ost-Asien ihre Müttersterblichkeit um einsdritte reduzieren konnten, ist in Subsahara-Afrika, welches mit der höchsten Rate belastet ist, kaum ein Rückgang zu verzeichnen. Da die mütterlichen Sterbefälle multiplen Ursachen zu Grunde liegen (Hämorrhagie, Bluthochdruck, Geburtshindernis, Anämie, Abtreibung, etc.), können einzelne Interventionen dieses Problem nicht lösen. Daher sind geplante Untersuchungen, die ortspezifische Befunde aufdecken, für eine Verbesserung der Situation entscheidend.

Die vorliegende Studie untersuchte die Ernährungs- und Gesundheitsprobleme von Frauen im gebärfähigen Alter in ländlichen Gebieten in Iringa, Tansania. Des Weiteren zeichnet die Studie spezielle Anforderungen und mögliche Interventionen auf die mütterliche Gesundheit und Ernährung zu verbessern, die gleichzeitig plausible, nachhaltig und implementierbar sind. Die Studie beinhaltete folgende Untersuchungsschwerpunkte:

- Faktoren, die mit dem Ernährungsstatus der Frauen im reproduktiven Alter im Iringa Rural Distrikt, Tansania zusammenhängen.
- Verfügbarkeit von Lebensmitteln sowie Nahrungs- und Nährstoffaufnahme der Frauen.
- Wissen der Frauen, ihr Bewusstsein und ihre Wahrnehmung gegenüber der Bedeutung von Mikronährstoffen für Schwangere und Kinder.
- Verfügbarkeit, Zugang und Nutzung von Gesundheitseinrichtungen von Frauen in der untersuchten Region.

Die Studienauswahl beinhaltete Frauen des Dorfes Malinzanga im Altern zwischen 15 und 44 Jahren. Stratifizierung und eine einfach randomisierte Auswahlmethode wurden für die Kalkulation der Stichprobengröße angewendet. Die Berechnung der Stichprobengröße (389) beruhte auf der Prävalenz anämischer Frauen im

reproduktiven Alter Tansanias. Die Studie war eine Baseline-Querschnittsstudie auf Gemeindeebene. Die Datenerhebung fand innerhalb einer Phase zwischen Februar und April 2008 statt. Es wurden sowohl qualitative als auch quantitative Forschungsmethoden angewendet. Die qualitative Datenerfassung beinhaltete strukturierte und halbstrukturierte Fragebogeninterviews (Verzehrhäufigkeits-fragebogen, 24-Stunden-Ernährungsprotokoll, Experteninterviews und Fokus-gruppendiskussionen), partizipative Beobachtungen, Untersuchung auf Bitot'sche Flecken und Goiter. Die quantitative Datenerfassung beinhaltete die Messung von Größe, Gewicht, mittlerer Oberarmdurchmesser (MUAC), Plasmalevel für Hämoglobin (Hb), *soluble* Transferrin-Rezeptor (sTfR), retinolbindendes Protein (RBP), C-reaktive Protein und Acid Glycoprotein (AGP).

Ein Training und Vortests der Materialien wurden vor der eigentlichen Datenerhebung durchgeführt. Interviews wurden individuell in der Heimstätte der Probanden durchgeführt. Ein strukturierter Interviewfragebogen wurde für die Erhebung von sozial-demographischen sowie wirtschaftlichen Daten herangezogen. Biochemische und klinische Untersuchungen über die Konzentration von Hämoglobin, retinolbindendes Protein, *soluble* Transferrin-Rezeptor, C-reaktive Protein und des Acid Glycoprotein wurden vollzogen. Nach Überprüfung aller Daten und deren Eingabe waren letztendlich 384 Fragebögen für die Datenanalyse geeignet.

Daten wurden analysiert mit Hilfe von Microsoft Excel (MS Office 2007), Statistical Package for the Social Sciences (SPSS Version 17.0) und Analysis of Moment Structures (Amos 16.0). Die Datenanalyse umfasste sowohl deskriptive Statistik, Korrelations- und Regressionsanalyse als auch ein Strukturgleichungsmodell.

Folgende Faktoren waren mit einem schlechten Ernährungsstatus der Frauen im reproduktivem Alter assoziiert: Lebensmittelunsicherheit, geringe Nahrungsmittel-Vielfalt, Mikronährstoffmängel (Vitamin A- und Eisenmangel), Krankheit und Infektionen, Alter, Einkommensquelle, Haushaltszusammensetzung, Wohnort, Bildung, Entfernung zur nächsten Gesundheitseinrichtung, Wissen über Mikronährstoffe und deren Bedeutung für die Gesundheit, aber auch geringe oder fehlende Versorgung mit Eisen und Vitamin A Supplementen.

Die Frauen im Dorf Malinzanga litten nicht nur unter Energie-Malnutrition, sondern auch unter Mikronährstoffmangel, Krankheiten und Infektionen, welches wiederum ihr Risiko für Krankheiten und Infektionen erhöht. Der Ernährungsstatus der Frauen unterschied sich mit dem Alter, Wohnort, Volksstamm, Haupteinkommensquelle und Eigentum. Der Body Mass Index (BMI) stieg mit dem Alter und der Anzahl der Eigentümer an. Die mit dem Ernährungsstatus der Frauen in der untersuchten Region assoziierten Faktoren waren komplex und beeinflussten sich gegenseitig. Lebensmittelunsicherheit beeinträchtigte negativ ihren Mikronährstoffstatus: es steigerte die Anfälligkeit für Vitamin A- und Eisenmangel, aber auch für Malaria und Durchfall.

In der Studie hatte die Nahrungsaufnahme einen Effekt auf den Ernährungsstatus der Frauen. Der Ernährungsstatus wirkte sich auf den Vitamin A und Eisenstatus der Frauen aus, welche sich auch wiederum gegenseitig beeinflussten: eine geringe Aufnahme von Vitamin A-reichen Lebensmitteln erhöhte das Risiko eines Vitamin A Mangels. Vitamin A Mangel erhöhte das Risiko einer Co-Existenz von Vitamin A und Eisenmangel. Dies steigerte das Risiko einer Anämie, von Malaria und Durchfallerkrankungen der Frauen.

Die Mehrzahl der Frauen in der Studienpopulation hatte vorher noch nie von Eisen, Vitamin A und Jod gehört, sowie von Lebensmitteln, die diese Nährstoffe enthielten. Des Weiteren konnten sie nicht die Bedeutung dieser Nährstoffe für die mütterliche Gesundheit benennen. Demzufolge waren ihre Nahrungsaufnahme, ihr Mikronährstoffstatus und so ihr Gesundheitsstatus negativ beeinträchtigt.

Das Aufsuchen von Schwangerschaftsfürsorgeeinrichtungen von Müttern in der untersuchten Region war relativ gering. Einer der Hauptgründe für dieses Verhalten war laut der Frauen die lange Distanz zur Gesundheitsstation (Zeitmangel aufgrund der langen Arbeitszeit). Außerdem wurde das Aufsuchen von Schwangerschaftsfürsorge durch eine schlechte Wirtschaftslage, geringe Gesundheits- und Ernährungsbildung beeinflusst.

Die Ergebnisse dieser Studie zeigen, dass eine Notwendigkeit besteht, den mütterlichen Ernährungsstatus in ländlichen Populationen in Tansania zu verbessern. Folgende Maßnahmen werden empfohlen:

1. Überarbeitung der tansanischen Ernährungspolitik: Eisen und Vitamin A Supplemente sollten kostenlos, basierend auf WHO Richtlinien, verteilt werden, *via*. in schwer erreichbaren Regionen.

2. Verbesserung der allgemeinen Ernährungsbildung; qualitativ als auch quantitativ über: Ursachen und Konsequenzen der Malnutrition, Methoden der Prävention.

3. Verbesserung der Malaria-Kontrolle und Durchfallprävention, der Bildung von Gesundheitsfürsorge-Anbieter, aber auch der Vergütung dieser für die Motivation weiterhin in ländlichen Regionen ihre Dienste anzubieten, besonders in schwer erreichbaren Gebieten wie z.B. Malinzanga.

4. Fortifizierung von Maismehl und Pflanzenöl mit Vitamin A: Diese Produkte werden weitläufig genutzt, sind reichlich vorhanden und sind für die ganze tansanische Bevölkerung zugänglich, sogar in schwer erreichbaren Gebieten. Problem: Diese Produkten sind nicht zentral verarbeitet, sondern im lokal Gemeinde.

5. Beurteilung der Verantwortlichkeit für eine Gesundheitsfürsorgeservicegebühr um die Gesundheit der armste Leute zu verbessern.

6. Beurteilung der Auswirkung von Diagnosemethoden auf den Gesundheitsstatus von Frauen.

7. Anwendung der Fallbeschreibung des Dorfes Malinzanga und einer Pilotstudie für Implementierungsprozesse. Eine Zusammenarbeit von multidisziplinären Sektoren im Bereich der Planung und Implementierung von verbesserten Gesundheits- und Ernährungsservices sowie Aktionen in ländlichen Gebieten Tansanias ist von Nöten.

Dies würde nicht nur die Ernährungssituation der am meisten betroffenen Frauen aus ländlichen Regionen und schwer erreichbaren Gebieten verbessern, sondern auch Tansania bei dem Prozess helfen, das erste, vierte, fünfte und sechste „Millennium Development Goal“ zu erreichen. Dadurch kann direkt die Kindersterblichkeit reduziert sowie die mütterliche Gesundheit verbessert werden. Außerdem werden so indirekt HIV/AIDS, Malaria aber auch andere Krankheiten bekämpft.

Muhtasari

Idadi ya vifo vya wanawake, hususan katika nchi zinazoendelea, ambako kadiri ya asilimia 99 ya vifo hivyo hutokea bado iko juu. Kila mwaka zaidi ya wanawake milioni moja hufa kutokana na matatizo yanayozuilika ambayo hujitokeza wakati wa kujifungua. Jitihada ndogo sana zimefanyika katika kujaribu kuokoa maisha ya wanawake katika kipindi cha mwaka 1990 na 2005. Katika kipindi hiki vifo vya wanawake vimepungua kwa chini ya asilimia moja. Ijapokuwa nchi kama Afrika ya kaskazini, Latino Amerika, Karibiani na Asia ya kusini-mashariki zimefanikiwa kupunguza vifo vya wanawake kwa kiasi cha theluthi moja, nchi za karibu na jangwa la Sahara Africa, eneo ambalo lina kiasi kikubwa cha vifo hivyo halijafanya maendeleo yeyote. Kwa sababu vifo vya wanawake husababishwa na vitu mbalimbali, kwa mfano, kutokwa damu, mapigo kasi ya moyo, magonjwa ya kuambukiza, uchungu wa muda mrefu, upungufu wa damu, kutoka kwa mimba na mengineyo, utatuzi wa jambo moja kati ya haya hautasaidia kutatua matatizo ya wanawake. Hivyo basi, uchunguzi wenye mpango maalum kuhusu eneo fulani kwa ajili ya kutatua matatizo hayo ni muhimu sana.

Uchunguzi huu umedadisi matatizo ya afya na lishe yanayowakabili wanawake wa wilaya ya Iringa vijijini nchini Tanzania ili kufafanua mbinu mbalimbali zinazoweza kutumika na kuendelezwa katika kuendeleza afya na lishe ya wanawake. Katika kufanya hivyo manuwio maalum yalichunguzwa kwa undani:

- Mambo yanayohusiana na hali ya afya ya wanawake wa wilaya ya Iringa vijijini nchini Tanzania.
- Uwepo wa chakula, ulaji wa chakula na viini lishe kwa wanawake.
- Elimu ya wanawake kuhusu umuhimu wa viini lishe kwa wanawake wajawazito na watoto wao.
- Uwepo, upatikanaji na utumiaji wa vituo vya afya miongoni ya wanawake katika eneo la uchunguzi.

Uchaguzi wa washiriki katika uchunguzi huu uliwashirikisha wanawake wenye umri kati ya miaka 15 na 44 waishio katika kijiji cha Malinzanga. Ufafanuzi na mahesabu ya sampluli yalifanyika kwa kutumia mfumo rahisi wa bahati nasibu. Jumla ya

wanawake 389 walichaguliwa kutokana na kiwango cha asilimia ya wanawake wenye upungufu wa damu nchini.

Mfumo wa uchunguzi ulikuwa wa kutembelea vijijini. Takwimu zilikusanywa kwa mkupuo katika kipindi kimoja kati ya mwezi wa pili na wa nne mwaka 2008. Taratibu mbalimbali za utafiti zilitumika katika ukusanyaji wa takwimu hizo. Takwimu za maelezo zilijumuisha vidodoso vyenye maswali yenye mlolongo wenye mpango maalum na usio na mpango maalum (maruduio ya milo, ulaji wa kila siku, na mazungumzo katika makundi), uangalizi wa mazingira, vitoto macho, na tezi koo. Takwimu za mahesabu zilijumuisha urefu, uzito, mzunguko wa mkono, wingi wa damu, madini chuma, vitamini A, maradhi ya mlipuko na ya kudumu.

Mafunzo na majaribio ya vyombo vilivyotumika kukusanyia takwimu yalifanyika kabla ya ukusanyaji rasmi wa takwimu hizo. Vidodoso vilifanyika majumbani mwa wanawake. Maswali yenye mlolongo maalum yalitumika kukusanya takwimu zilizohusiana na familia na uchumi. Kiwango cha damu, kiwango cha vitamini A mwilini, dalili za tezi koo, na dalili za maradhi mbalimbali vilichunguzwa kwa kutumia vipimo vya wingi wa damu, vitamini A, madini chuma, maradhi ya mlipuko na ya kudumu. Baada ya ukusanyaji, urekebishaji na uingizaji wa takwimu kukamilika, vidodoso 384 kati ya 389 vilibaki kufanyiwa uchambuzi wa undani zaidi.

Takwimu ziliingizwa na kuchambuliwa kwa kutumia programu za kompyuta zijulikanazo kama MS Office 2007, SPSS 17.0 na Amos 16.0. Uchambuzi wa takwimu ulijumuisha mchanganuo wa ujumla, uhusiano kati ya hoja husika, na michoro ya modeli mbalimbali za uchanganuzi huo.

Madhara yaliyosababisha afya duni kwa wanawake wa Iringa vijijini ni pamoja na uhaba wa vyakula, kutokula vyakula vya aina mbalimbali, upungufu wa viini lishe, maradhi, umri, njia kuu ya mapato, idadi ya watu ndani ya kaya, eneo la kuishi, elimu ya shuleni, umbali kufika kituo cha afya, elimu juu ya viini lishe na umuhimu wake kwa afya ya akinamama pamoja na mgawanyo mbaya wa viini lishe usiokidhi mahitaji ya akina mama.

Zaidi ya upungufu wa vyakula vya nguvu, wanawake wa kijiji cha Malinzanga walikuwa wameadhirika na upungufu wa viini lishe na maradhi ambayo yaliwafanya kuwa wepesi kupata maradhi zaidi.

Hali ya afya ya wanawake ilitofautiana kulingana na umri, eneo la kuishi, kabila, njia kuu ya mapato na mali walizonazo. Vitu vilivyohusiana na hali ya afya ya wanawake hao ni vingi na viliathiriana. Madhara ya lishe duni kwa afya ya wanawake yalionekana katika uchunguzi huu. Uhaba wa chakula ulichangia upungufu wa madini chuma na vitamin A mwilini na maradhi ya malaria pamoja na kuhara. Hali ya lishe ya wanawake ilisababisha kiwango cha madini chuma na vitamini A ambavyo pia viliadhiriana vyenyewe kwa vyenyewe. Kiasi kidogo cha ulaji wa vyakula vyenye kiwango kikubwa cha vitamin A kilisababisha upungufu wa vitamini A mwilini. Upungufu wa vitamini A mwilini uliongeza adhari ya kuwepo kwa upungufu wa vitamini A na madini chuma kwa wakati mmoja, ambao ulisababisha kuongezeka kwa riski ya upungufu wa damu na maradhi ya malaria na kuharisha kwa wanawake.

Karibu wanawake wote waliojumuishwa katika uchunguzi huu walikuwa hawajawahi kusikia kuhusu madini chuma, madini joto na vitamini A, ni vyakula gani vina kiasi kikubwa cha viini lishe hivyo wala kufahamu umuhimu wa viini lishe hivyo kwa afya ya akina mama. Matokeo yake, ulaji wao, hali yao ya viini lishe mwilini na hata afya zao ziliathirika.

Mwenendo wa utafutaji wa huduma za afya kwa akina mama katika eneo la uchunguzi haukuwa mzuri. Umbali kufika kituo cha afya ilikuwa ni moja ya sababu kubwa zilizokwamisha wanawake kwenda kupata huduma za afya. Vile vile, hali mbaya ya uchumi, afya na elimu duni kuhusiana na mambo ya afya zilikuwa ni miongoni mwa sababu zilizoathiri mahudhurio ya wanawake katika vituo vya afya.

Matokeo ya uchunguzi huu yameonyesha kwamba kuna umuhimu mkubwa sana wa kuboresha afya za akinamama waishio maeneo ya vijijini nchini Tanzania. Katika kufanya hivyo mapendekezo yafuatayo yametolewa:

1. Kuchanganuzi kanuni za lishe nchini: Viini lishe aina ya madini chuma na vitamin A vigawanywe kulingana na mapendekezo ya shirika la afya duniani, haswa sehemu za vijijini ambazo ni ngumu kufikiwa.

2. Uboreshaji was elimu ya afya vijijini kwa kuongeza ubora wa mafunzo na idadi ya wafunzaji. Visababishi na madhara ya utapiamlo, njia za kujiepusha na janga hilo, na faida za lishe bora kwa afya ya akinamama ziwekwe wazi kwa wanawake wote.

3. Uboreshaji wa mbinu za kuzuia ugonjwa wa malaria na kujikinga na kuhara, uboreshaji wa mafunzo ya wahudumu wa afya, na uongezaji wa mishahara kwa wahudumu wa afya ili waende, wabaki na watoe huduma bora za afya katika mazingira magumu, kwa mfano kijiji cha Malinzanga.

4. Urutubishaji wa unga wa mahindi na mafuta ya kula kwa vitamini A, maana bidhaa hizi zinapatikana kwa urahisi, wakati wote na kwa watu wote nchini Tanzania, hata kwa wale waishio katika maendeo ambayo kufikiwa ni vigumu sana.

5. Uchunguzi wa matumizi ya kodi ya huduma za afya vijijini ili kuboresha afya za walio masikini .

6. Uchunguzi wa madhara ya ukisiaji wa maradhi kwa afya za akinamama vijijini.

7. Kukitumia kijiji cha Malinzanga kama mfano katika kujaribisha mbinu za kutatua matatizo ya lishe na afya yanayowakabili wanawake waishio vijijini nchini Tanzania.

Hii haitasaidia tu kuboresha afya ya akina mama waliokithiri kwa kuathirika waishio vijijini katika mazingira ambayo ni magumu kuyafikia bali pia itaisaidia nchi katika jitihada zake za kufikia goli la kwanza, nne, tano, na sita la “*Millennium Development Goals*”. Matokeo ya jitihada hizi yatasaidia kupunguza vifo vya vya watoto, kuboresha afya za akinamama, kupunguza janga la ukimwi, malaria na maradhi mengine.

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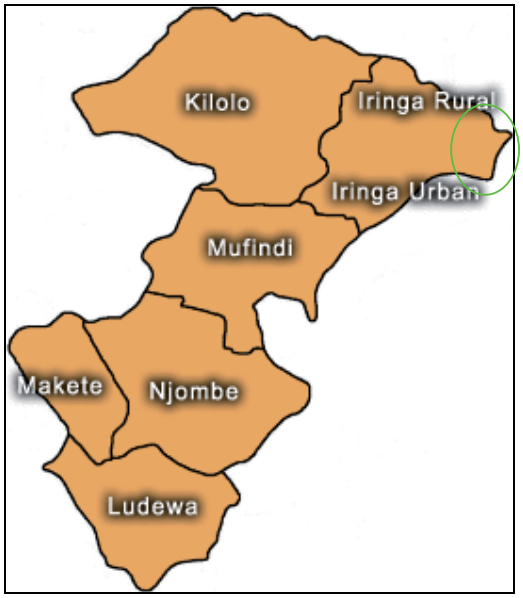
Appendicies



Appendix 1: Map of Iringa

Appendix 2: Questionnaire; NUTRITION BASELINE SURVEY: MALINZANGA VILLAGE, IRINGA RURAL DISTRICT, TANZANIA 2008

Identity No.: ☐☐☐ Date of survey: ☐☐☐☐☐☐

Name of the Interviewer: _____

Name of the Respondent: _____

Hamlet: _____

Household and social economic data				
1.	How old are you?			AGE
2.	What is your marital status?	1= single 2= married 3= widowed 4= divorced 5= living with a partner	☐	MARISTAT
3.	What is your relationship to the head of the household where you are living? I am the/a	1= head 2= wife 3= mother 4= daughter 5= sister 6= companion 7= other relative 8= non relative	☐	HEADHH
4.	How many people are living in your household?	Adults ≥15yrs _____ Children 5 - 14yrs_____ Under 5yrs_____ Infants 0-1yr_____	☐	NUHHADUL NUHHCHILD NUHHUNFIV NUHHINFAN
5.	What are your main occupations (around the year)?	1= farming 2= livestock keeping 3= farming and livestock keeping 4= business 77= other_____	☐	MAINOCCUP
6.	What are your main sources of income (around the year)?	1= farming 2= livestock keeping 3= farming and livestock keeping 4= business 77= other_____	☐	MAINCOM
7.	What is your highest education level?	1= I cannot read or write 2= <4 years of primary 3= completed primary 4=<2 years of secondary 5= completed secondary 6= high school 7= college/university 77= other _____	☐	EDUCAT

8.	Is there any reason why you did not attain a higher level of education than what you have reached?	1= none 2= I got pregnant 3= I got married 4= I failed exams 5= parents could not pay fee 6= parents died (orphan) 7= I didn't want to study further 77= other _____	☐	WHYLOWED
9.	Which religion do you belong to?	1= Christian 2= Muslim 3= Pagan 77= other _____	☐	RELIGN
10.	Which tribe do you belong to?	1= Bena 2= Hehe 3= Masai 4= Mangati 5= Gogo 6= Nyakyusa 77= other _____	☐	TRIBE
11.	What do you use for cooking and to what percentage (%)?	1= firewood 2= kerosene 3= gas 4= electricity 5= charcoal 77= other _____	☐	COKENER
12.	Which of the following items do you have?	1= car:1= yes / 2= no 2= bike:1= yes / 2= no 3= television:1= yes / 2= no 4= radio:1= yes / 2= no 5= mobile:1= yes / 2= no	(√) ☐ ☐ ☐ ☐ ☐	CAR BIKE TELEV RADIO MOBILE
Livestock keeping and farming				
13.	How many of the following animals do you keep?		**No.**	
		Cows		COW
		Goats		GOAT
		Chicken		CHICKEN
		Pigs		PIG
		Ducks		DUCKS
14.	***If you keep any***, for what reason do you keep these animals?	1= mainly own consumption 2= mainly for sale 3= both (about equal amount) 77= other_____	☐	RESANIKEP

15.	Do you have a farm?	1= yes	☐	FARM
16.	***If yes***,		hector	FARMSIZE
17.	Which of the following crops do you cultivate in your farm?		√	
		Maize		CMAIZE
		Sorghum		CSORGHUM
		Finger millet		CFIMILET
		Paddy		CPADDY
		Beans		CBEANS
		Peas/Pigeon peas/Cow peas		CPEAS
		Cassava		CCASSAVA
		Sweet potatoes		CSWETPOT
		Green leafy vegetables		CGRLEFVE
		Tomatoes		CTOMATO
		Onions		CONIONS
		Mango, papaya		COREDFR
18.	For what use do you grow these crops?	1= mainly own consumption 2= mainly for sale 3= both (about equal amount) 77= other_____	☐	RESCCROP
19.	Do you have a vegetable garden?	1= yes 2= no	☐	HOMGRD
20.	***If yes,*** what do you grow in this garden (around the year)	1= cow pea leaves 2= sweet potato leaves 3= amaranth leaves 4= mushrooms 5= cabbage 77= other _____	☐ ☐ ☐	HOMGADGR
21.	For what use do you grow these vegetables?	1= mainly own consumption 2= mainly for sale 3= both (about equal amount) 77= other_____	☐	RESHGCRO
22.	How does your household mainly obtain food (around the year)?	1= buying 2= own production 3= buying and own production 77= other _____	☐	SOSFOD
23.	Do you have enough food through the entire year?	1= yes 2= no	☐	FOODAVAI
24.	***If no, 26.*** In which months do you have food shortages?	JAN FEB MAR APR MAI JUN JUL AUG SEP OCT NOV DEC	(√)	FODSHORT

25	What do you do to overcome food shortage?	1= reduce number of meals 2= reduce meal portions 3= take consumer credits 4= sell belongings 5= look for casual labor 6= gift from neighbors/family 7= ask for food aid 8= use money savings 77= other_____	☐ ☐ ☐ ☐	OVERCFS
Eating habits and nutrition education				
26.	Which criteria do you use when choosing foods you eat?	1= availability 2= appearance 3= good for health 4= time to prepare 5= price 6= taste 7= familiar to/used to 77= other _____	☐ ☐ ☐ ☐	FODCHOS
27.	What factors influence your consumption of different foods in a meal?	1= availability 2= appearance 3= good for health 4= time to prepare 5= taste 6= cost 7= amount of food 77= other _____	☐ ☐ ☐ ☐	FODVARIE
28.	Do you understand the word fortification?	1= yes 2= no	☐	FORTIFIC
29.	***If no, 31.*** ***If yes,*** do you think there are foods that are fortified in the market?	1= yes 2= no	☐	KNOWFOR
30.	***If yes,*** name three such foods and what they are fortified with.	1= _____:_____ 2= _____:_____ 3=_____:_____		FORTFODS
31.	What type of salt are you using?	1= powdered salt 2= stone salt 77= other _____	☐	TYPSALT
32.	Why are you using this salt?	1= affordable 2= contains iodine 3= I need a small amount of it 4= I am used to it 77= other _____	☐	WHYTSALT
33.	Where do you get the salt?	1= market place 2= shop 3= own production 77= other _____	☐	SOSALT

34.	How do you store your salt?	1= pack 2= cup 3= container 77= other _____	☐	STORSALT
35.	Did you have food restriction during pregnancy or breastfeeding?	1= yes, pregnancy_____ 2= no during pregnancy 1= yes, breastfeeding _____ 2= no, during breastfeeding	☐ ☐	RESTPREG RESTBRES
36.	***If Muslim,*** do you follow Ramadan fasting rules during pregnancy or breastfeeding?	1= yes during pregnancy 2= no during pregnancy 1= yes during breastfeeding 2= no during breastfeeding	☐ ☐	FASTPREG FASTBRES
37.	Do you get information on health and nutrition?	1= yes 2= no	☐	ACINHNNU
38.	***If yes,*** where do you get information regarding health and nutrition?	1= nurse 2= nutrition worker 3= health worker 4= family 5= friends/neighbor 6= mass media 77= other _____	☐ ☐ ☐	INFHENUT
39.	Do you think there is a link between health and nutrition?	1= yes 2= no	☐	LINHENUT
40.	***If yes,*** which one(s)?	_____		HELTNUTR
Supplements				
41.	Do you understand the word supplement?	1= yes 2= no	☐	WHATSUPL
42.	***If no, 51.*** ***If yes,*** what is a supplement?			KNOSUPLE
43.	Is there a possibility for you to get supplements?	1= yes 2= no	☐	AVASUPLE
44.	***If yes,*** which supplements?	1= iron 2= iodine 3= Vitamin A 4= magnesium 5= multivitamin 77= other_____	☐ ☐ ☐	AVWSUPLE
45.	Where can you get the supplements?	1= shop 2= pharmacy 3= health center 4= hospital 77= other _____	☐	ACESUPPL

46.	Are you taking supplements now?	1= yes 2= no	☐	USESUPLE
47.	***If yes,*** which supplements are you taking now?	1= iron 2= iodine 3= Vitamin A 4= magnesium 5= multivitamin 77= other_____	☐ ☐ ☐	USWHSUPL
48.	***If yes,*** why are you taking supplements now? (I am/heard from)	1= pregnant 2= breastfeeding 3= radio 4= friend/neighbors 5= family 6= clinic 77= other_____	☐ ☐ ☐ ☐	WHYUSUPL
49.	When did you start taking supplements?	1= < 3 months ago 2= I don't remember 77= other _____	☐	BEUSUPPL
50.	Until when are you planning to take supplements?	1= conceive 2= delivery 3= child is 3 month old 4= I don't know 77= other _____	☐	ENDSUPPL
51.	Have you heard about iron?	1= yes 2= no	☐	HEARIRON
52.	***If no, 55.*** ***If yes,*** what foods do you think contain high amount of iron?	1= liver 2= red meat 3= green leafy vegetables 4= eggs 5= milk 6= cow peas family 7= I don't know	☐	SOSIRON
53.	Do you think iron is important for maternal health?	1= yes 2= no 3= I don't know	☐	IMPIRON
54.	***If yes,*** why?	1= it protects from illnesses 2= it helps build up body cells 3= it prevents anemia 4= it promotes growth 5= it strengthens bones 6= I don't know	☐	WHYIRIMP
55.	Have you heard about iodine?	1= yes 2= no	☐	HEARIODIN
56.	***If no, 59.*** ***If yes***, what foods do you think contain high amount of iodine?	1= fish 2= *ugali* 3= rice 4= vegetables 5= iodized salt 6= tubers 7= I don't know	☐	SOSIODIN

57.	Do you think iodine is important for maternal health?	1= yes 2= no 3= I don't know	☐	IMPIODIN
58.	***If yes,*** Why?	1= it protects from illnesses 2= it helps build up body cells 3= it promotes the brain development of the child 4= it promotes growth 5= it strengthens bones 6= I don't know	☐	WHYIOIMP
59.	Have you heard about vitamin A?	1= yes 2= no	☐	HEARVITA
60.	What foods do you think contain high amount of vitamin A?	1= fruits and vegetables 2=corn 3= beans 4= eggs 5= milk 6= oil, margarine, butter 7= I don't know	☐	SOSVITA
61.	Do you think vitamin A is important for maternal health?	1= yes 2= no 3= I don't know	☐	IMPVITA
62.	***If yes,*** Why?	1= it increases blood 2= it protects illnesses 3= provides energy 4= I don't know	☐	WHYVAIMP
Pregnancy and Caring during pregnancy				
63.	Have you ever been pregnant?	1= yes _____ (times) 2= no	☐	EVERPREG TIMEPREG
64.	Do you think you are pregnant at the moment?	1= yes 2= no	☐	NOWPREG
65.	***If no, 68. If yes,*** how many months?	1= 1, 2= 2, 3= 3, 4= 4, 5= 5, 6= 6, 7= 7, 8= 8, 9= 9	☐	LENGPREG
66.	***If pregnant,*** Have you been tested for pregnancy?	1= yes 2= no	☐	PREGTEST
67.	***If yes,*** How soon did you go to health facility after you realized that you were pregnant?	1= 1 month after conceiving 2= < 3 month after conceiving 3= > 3 month after conceiving 4= I don't know 5= I don't remember 77= other _____	☐	TVIHEAPRE
68.	How often do you visit/have you visited health facility during pregnancy?	1= once 2= <3 times 3= between 3 and 6 times 4= > 6 times 5= never 77= other _____	☐	VIHEFADPR

69.	***If visited,*** For what reason?	1= I wasn't feeling well 2= routine check-up 3= I was told to go 77= other _____	☐	RESVHESE
70.	Do you have a clinic card?	1= yes 2= no	☐	CLINCARD
71.	***If yes,*** When was it obtained?	1= 1 month ago 2= 3 months ago 3= between 3 and 6 mo ago 4= more than 6 months ago 5= I don't remember 77= other _____	☐	WGCLICAD
72.	***If pregnant at the moment,*** Was this pregnancy planned?	1= yes 2= no	☐	PLANPREG
73.	Do you have access to family planning information?	1= no 2= clinic 3= health center 4= hospital 77= other_____	☐	FAMPLAN
74.	Are you using any family planning method?	1= none 2= condom 3= pills 4= loop 5= syringe 6= calendar 77= other _____	☐	FAMPLAME
75.	Do you get pressure from family, relatives or friends to have a child or more children than you wish?	1= no 2= mother in-law 3= sister in-law 4= other relatives 5= friends 6= husband 77= other _____	☐	PRESHACH
76.	***If yes,*** how do you respond to that?	1= do what they tell me to do 2= say no 3= ignore them 77= other _____	☐	REPRHACH
77.	What household duties are you exempt from during pregnancy?	1= none 2= cooking 3= fetching water 4= fetching woods 5= washing cloths 77= other _____	☐ ☐ ☐	NOWOKPR

78.	Who supports you during pregnancy (P) and after delivery (AD)?	1= none 2= spouse 3= other children 4= relatives 5= friends/neighbors 6= community members 7= other wives 77= other(P) _____ 77= other(AD) _____	☐ ☐	SUPOPREG SUPAFDEL
79.	What was the role of your spouse when you were pregnant (P) and during Breastfeeding (BF)?	1= none 2= helping house work 3= taking care of the baby 77= other (P) _____ 77= other(BF) _____	☐ ☐	RSPOPREG RSPOBRES

Food frequency					
How often and how much of the following foods do you normally eat?					
Food items	**Amount** Spoon (tsp) Cup (cp) Piece (pc) Gram (g) Plate (pl) Bawl (bl) Glass (gl)	**Times**			**Preparation** 1= boiled 2= fried 3= raw 4= rinsed 5= mash 77= other _____
		day	**week**	**month**	
Ugali					
Rice					
Kande					
Cassava					
S- potatoes					
I-potatoes					
Chips					
Chapati					
Vitumbua					
Maandazi					
Bread					
Cooked banana					
Meat					
Chicken					
Fish					
Milk					
Eggs					
Beans					
Cooking oil					
Palm oil					
Cabbage					
Green, leafy vegetables					
Okra					
Papaya					
Mango					
Pineapple					
Oranges					
Nuts/seeds					
Indigenous vegetables					
Wild fruits					

24-Hour Recall (what have you eaten, source, amount and how was it prepared in the last 24-hrs)			
Type of food	**Amount** cup (cp) spoon (tsp) piece (pc) gram (g)	**Source** 1=purchased 2= produced 3= gift 77= other _____	**Preparation** 1= boiled 2= fried 3= raw 4= steamed 77= other _____
Breakfast			
Lunch			
Dinner			
Snacks			

MEASUREMENTS: MALINZANGA VILLAGE - IRINGA RURAL, TANZANIA
Number: _____ Date: _____

Name of the interviewer: _____

Name of the interviewee: _____ Hamlet: _____

Measurement	**Unit**	**Abbreviation**
Soluble Transferrin Receptor level	mg/L	FERITIN
Retinol Binding Protein level	µmol/L	RETINOL
Acid Glycoprotein level	YES/NO	AGP
C-Reactive Protein level	YES/NO	CAP
Hemoglobin concentration level	g/dL	HEMOGL
Goiter	yes/ no	GOITER
Bitot's spots	yes/ no	BITOSPOT
Night blindness	yes/no	NIGHTBLIND
Weight	kg	WEIGHT
Height	cm	HEIGHT
Mid-Upper Arm Circumference	cm	MUAC
Body Mass Index	kg/m²	BMI

Availability and use of health care system				
1.	When you get sick, where do you normally go for health care services?	1= traditional healer 2= health worker 3= health center 4= dispensary 5= hospital 77= other_____	☐	SICWHEGO
2.	Do you have to pay for treatment at that place?	1= yes: 1= 1,000, 2= 5,000 TShs. 2= no	☐ ☐	PAYSER AMPAYSER
3.	Why do you go to that specific place when you get sick?	1= It is close to my place 2= I do not know another 3= It is cheaper than others 4= I have no other option 5= I trust in that provider 77=other_____	☐ ☐	WHYTHER
4.	Which kind of health facility is nearest to your place?	1= dispensary 2= health center 3= hospital 77= other_____	☐	KIHEAFA
5.	How often do you visit this health facility (in a year)?	1= more than 3 times a year 2= once a year 3= less than once a year 4= never 77= other_____	☐	FRVIHEFA
6.	***If < once a year or never:*** Why do you hardly visit it?	1= too expensive 2= too far away 3= no diseases 77= other_____	☐ ☐☐	WHADVIS
7.	How long does it take you to get to the health facility?	1= less than one hour 2 = between 1 and 3 hrs 3 = between 3 and 6 hrs 4 = between 6 and 9 hrs 5 = > 9 hrs	☐	TIMTHEFA
8.	Do you have to pay for transport to get to the health center?	1= yes 2= no		COTRHEFA
Common illnesses				
9.	What are the common illnesses regularly occurring in this community?	1= none 2= malaria 3= diarrhea 4= worms 5= coughs 6= fever 7= vomiting 77= other_____	☐ ☐ ☐ ☐	COMILCOM

10.	What are the common illnesses you regularly encounter?	1= none 2= malaria 3= diarrhea 4= worms 5= coughs 6= fever 7= lips or throat pain 8= tuberculosis 77= other _____	☐ ☐ ☐ ☐	COMILOWN
11.	***If you encounter any of the illnesses,*** how often?	1= every 2 weeks 2= once a month 77= other _____	☐	FREOWNIL
12.	***If you encounter any of the illnesses,*** Are you normally able to get medical treatment?	1= yes 2= no 3= sometimes	☐	MEDOWILL
13.	***If yes or sometimes,*** Where do you normally get the medical treatment?	1= health center 2= pharmacy/chemist shop 3= hospital 4= health worker 5= traditional healer 6= shop in the village 77= other_____	☐	WHMEDILL
14.	Do you have to pay for the medical treatment?	1= yes 2= no	☐	PAYMED
15.	Can you afford to pay for the medical treatments?	1= yes 2=no	☐	AFFPATRE
16.	Do you get any information about the medicine you receive?	1= yes, dose 2= yes, side effects 3= yes, ingredients 4= no 77= other_____	☐ ☐ ☐	INFMED
17.	How many times in the previous year did you need medical treatments?	1= none 2= less than three times 3= more than three times 77= other_____	☐	OFNETRE
18.	Was the medical treatment available every time you needed it?	1= yes 2= no _____ (times)	☐	MEDAVAI

19.	***If no***, What was the reason?	1= lack of money to pay the cost 2= could not reach the facilities 3= shop was out of medicine 4= health facility was out of medicine 77= other _____	☐	REANOAV
HIV				
20.	Do you know anything about AIDS?	1= yes 2= no	☐	KNOAIDS
22.	Do people come to give education on HIV/AIDS in this village?	1= yes 2= no	☐	AIDSEDUC
22.	Do people from this village go and test?	1= yes 2= no	☐	PETEHIV
23.	Did you test?	1= yes 2= no	☐	TESTHIV
24.	***If yes,*** what is your status?	1= positive 2= negative	☐	HIVSTAT
25.	***If no, 37.*** ***If yes,*** Do you get medical treatment?	1= yes 2= no	☐	TREATHIV
26.	***If yes,*** what kind of HIV treatment do you receive?	1= ARVs 2= multivitamins 3= I don't know 77= other_____		KTRETHIV
27.	Where do you get HIV medical treatment?	1= health center 2= shop 3= hospital 4= pharmacy 5= traditional healer 77= other_____	☐	WHIVTRET
28.	Do you get any information about the HIV medicine you receive?	1= yes, dose 2= yes, side effects 3= yes, ingredients 4= no 77= other_____	☐ ☐ ☐	INFHIVMED
29.	Do you have to pay for the HIV medicine?	1= yes 2= no	☐	PAYHIVMED
30.	Can you afford to pay for the HIV treatment?	1= yes 2= no	☐	AFFHIVTRE
31.	Was your HIV medicine available every time you needed it?	1= yes 2= no _____ (times)	☐	HIVMEDAVA

In case of previous or actual pregnancy!				
32.	Have you been informed about the prevention of HIV transmission from mother-to-child?	1= yes 2= no 3= I don't remember	☐	INFPMTCT
33.	***If yes,*** What do you remember?	1=_____ 2=_____ 3= none	☐	REINMTCT
34.	Have you been informed about infant feeding practices for HIV positive mothers?	1= yes 2= no 3= I don't remember	☐	INFEDPRA
35.	***If yes,*** Which practices do you remember?	1=_____ 2=_____ 3= none		REFEDPRA
36.	Which practices did you use or are you using?	1=_____ 2=_____ 3=_____ 4= none		WAYFEED
Malaria				
37.	Which of the following symptoms does malaria have?	1= fever, headache, loss of appetite 2= coma 3= diarrhea 4= headache 5= poor appetite	☐	SYMALAR
38.	How is malaria treated?	1= ALU 2= SP 3= Quinine 4= Fansida 5= Metakelfine 77= other _____	☐	KNMALTRE
39.	Do you know any methods of preventing malaria transmission?	1= mosquito nets 2= mosquito repellent coil 3= mosquito repellent spray 77= other _____	☐	MEPREVMA
40.	Which of these methods do you use?	1= mosquito net 2=mosquito coil 3= mosquito spray 77= other _____	☐	MEUSPRMA
41.	What do you do when you get a fever?	1= go to hospital 2= take malaria tablets 3= take pain killer 4= nothing 77= other _____		FEVTRE

42.	Who of the family members use a mosquito net?	1= infant 2= child/children 3= spouse 4= myself 5= all 77= other_____	☐ ☐ ☐	FAMUSNET
43.	***If you're not using a mosquito net***, why not?	1= too expensive 2= not preventing malaria 3 = feel uncomfortable 77=other_____	☐ ☐	REAMOSNE
44.	Do you use "Ngao" (treated mosquito nets)	1= yes 2= no 3= I have never heard of them 4= I don't know	☐	USENGAO
45.	Have you suffered from malaria in the last 3 months and how often?	1= yes _____(times) 2= no	☐	SUFMAL3M
46.	***If yes,*** which kind of medical treatment did you use?	1= Alu 2= SP 3= Quinine 4= Fansida 5= Metakelfin 77= other _____	☐	MATREUS
47.	Why did you use that medical treatment?	1= was available at shop 2= thought they would help 3= no other medicine was available 4= I could not afford buying another one 5= was recommended by a Medicine 77= other _____	☐ ☐ ☐	WHUSMATR
48.	Where did you get the medicine?	1= health center 2= shop 3= hospital 4= pharmacy 5= traditional healer 77= other_____	☐ ☐ ☐	WHMATRE
49.	After how many days did you feel better?	1= between 1 and 2 days 2= between 3 and 5 days 3= more than 5 days 4= more than one week	☐	DAYMAREC
50.	How much did the medicine cost?	1= 1,000 TShs. 2= 5,000 TShs. 77= other _____	☐	COMATRE

In case of previous or current pregnancy!				
51.	Have you been tested for malaria during pregnancy?	1= yes, during all pregnancies 2= during some pregnancies 3= no	☐	PRETESMA
52.	Have you had malaria during pregnancy?	1= yes, during 1 pregnancy 2= yes, during >1 pregnancies 3= no	☐	PREGMAL
53.	***If yes***, how were you treated?	1= Alu 2= SP 3= Quinine 4= Fansida 5= Metakelfin 77= other _____	☐	PREMATRE
54.	Did you attend an antenatal clinic for malaria prevention during pregnancy?	1= yes, during all pregnancies 2= during some pregnancies 3= no	☐	ACMATRE
55.	***If only during some pregnancies or none***, why?	1= clinic is too far away 2= no time to go there 3= can't afford to go there 4= I have not heard about it 77= other_____	☐ ☐ ☐	WHYNOAPR
Water and Sanitation				
56.	Where do you get water for domestic use?	1= tap 2= well 3= river	☐ ☐	WATERSOS
57.	Do you treat drinking water?	1= yes 2= no	☐	WATTREAT
58.	***If yes,*** How do you treat dinking water?	1= boil 2= chemical 3= filtering/setting 77= other_____	☐ ☐	HOWTREAT
59.	Do you wash your hands before eating?	1= yes, always with soap 2= yes, always without soap 3= sometimes 4= no	☐	HWBEAT
60.	***If no or without soap or sometimes,*** why?	1= I use ashes 2= soap are too expensive 3= soap smell gives me allergy 77= other _____		NOSOEAT
61.	Where do you urinate or defecate?	1= toilet 2= ourside/bush 3= river 77= other_____	☐ ☐	TOILET
62,	Do you wash your hands after using the toilet?	1= yes, always-with soap 2= yes, always-without soap 3= sometimes 4= no	☐	HWATOIL

63.	***If no or without soap or sometimes,*** why?	1= I use ashes 2= soap are too expensive 3= soap smell gives me allergy 77= other _____		NOSOTOI
64.	How do you dispose of waste?	1= outside/bush 2= burn 3= hole 77= other_____	☐ ☐	WASTEDIS
Healthy Lifestyle				
65.	Do you smoke?	1= yes, regularly 2= yes, sometimes 3= no	☐	SMOKE
66.	Do you drink alcohol?	1= yes, regularly 2= yes, sometimes 3= no	☐	CONALC
67.	Do you consume any other drugs?	1= no 2= yes, non-filtered cigar 3= yes, ground tobacco 77= other _____	☐	CONDRUG

Appendix 3: FOCUS GROUP DISCUSSION QUESTIONNARE

i) Non-pregnant Women/Pregnant Women/Breastfeeding Mothers

1. How is the food availability in this community? 2. How is your food consumption on a daily basis? 3. Are you able to consume varieties of foods every day? 4. Which foods do you regularly eat and why? 5. Do you wish to change your food pattern?
6. Why/why not?

7. Is there a supplementation program for women during pregnancy in this community? 8. How does it work? 9. Is it easy for the women to access supplements? 10. Where can women access them? 11. Are the supplements free or charged? 12. What can you say about the positive and negative effects of the use of supplements among pregnant women in this community? 13. How do you perceive the whole issue of supplementation? 14. Do you comply with the recommended supplements? 15. Why/why not? 16. Is there any other nutrition or health related program such as iron, vitamin A, folic acid, malaria, or de-worming going on in this community? 17. Which ones and what do they provide you? 18. How do you respond to the programs? 19. Is there anything missing in these programs? 20. Do you think something should change in these programs? 21. What and why?

22. How are health services in this community? 23. Do they meet your needs?
24. Are you charged for the services? 25. How much? What would you wish to change in regard to health services in this community and why? 26. What are the common pregnancy complications in this community? 27. Have you had any complication during pregnancy? 28. What do you think could be the cause of it?
29. According to you and your experience, how should a pregnancy be handled?
30. What measures do you think need to be addressed to minimize or eradicate pregnancy complications? 31. What do you think is important for a healthy pregnancy for the mother and unborn child? 32. Where have you learned about it? 33. Is it difficult to have a healthy pregnancy? 34. Why/why not? 35. What are the barriers to achieve a healthy pregnancy? 36. What are your efforts to make it possible? 37. From what household duties are you exempted during pregnancy? 38. Who supports you during pregnancy? 39. What is the role of your spouse when you are pregnant or breastfeeding? 40. What are the roles of the other household members during this time?
41. Do you get tested for malaria once you attend an antenatal clinic? 42. After being tested and found infected, which treatments do you get? 43. Do you get tested for HIV once you attend an antenatal clinic? 44. After being tested and found infected, which treatments do you get? 45. Do you receive counseling on the prevention of mother to child transmission (PMTCT)? 46. Does the counseling help to reduce HIV-MTCT in this community? 47. What are you told to do by the HIV-counselor? 48. Do you follow the instructions? 49. Do you get information on the infant feeding options? 50. Do you follow it? 51. Is there HIV home-based care and support in this community? 52. Do you follow the instructions you receive?
53. Would you like to collaborate with us in different activities to improve maternal nutrition in this community? 54. What kind of support can you provide to contribute to this improvement? 55. Would you consider a change or an introduction to a new behavior that will contribute to the improvement of maternal nutrition in this community? 56. Why/why not?

ii) Health Personnel

1. How are the health facilities in this community? 2. Do they have all the facilities required for your patient's needs? 3. Do you make use of the available facilities?
4. How many patients do you regularly receive daily? 5. Are you able to treat all the patients you receive every day? 6. If not, what makes it difficult? 7. What patients mainly? 8. Does the number of patients differ seasonally? 9. What makes it differ? 10. What would you wish to change in regard to health facilities in this community and why?

11. What are the common pregnancy complications in this community? 12. At what period of pregnancy do these complications mostly occur? 13. Have you experienced any complication while handling a pregnant woman? 14. What do you think could be the cause of that complication? 15. What was the outcome of the complication? 16. According to you and your experience, how should a pregnancy be handled? 17. What measures do you think need to be addressed to minimize or eradicate pregnancy complications? 18. What do you think is important for a healthy pregnancy for the mother and unborn child? 19. Is it difficult to have a healthy pregnancy? 20. Why is it difficult to have a healthy pregnancy/why not? 21. What are the barriers to achieving a healthy pregnancy? 22. What are your efforts to make it possible?

23. Is there a supplementation program for women during pregnancy in this community? 24. How does the program work? 25. Is it easy for the women to access supplements? 26. Where can women access the supplements? 27. Are these supplements free or charged? 28. What can you say about the positive and negative effects of the use of supplements among the women during pregnancy? 29. How do you perceive the whole issue of supplementation? 30. Is there any other nutrition or health related programs such as iron, vitamin A, folic acid, malaria, or de-worming going on in this community? 31. Which ones and what do they provide to the women? 32. How do women respond to the programs? 33. Is there anything missing in these programs? 34. Do you think something should change in these programs? 35. What and why?

36. Do pregnant women get tested for malaria once they attend an antenatal clinic? 37. After being tested and found infected, which treatments do they get? 38. Do pregnant women get tested for HIV once they attend an antenatal clinic? 39. After being tested and found infected, which treatments do they get? 40. Do pregnant women receive counseling on the prevention of mother to child transmission (PMTCT)? 41. Do they follow the instructions? 42. Does the counseling help to reduce HIV-MTCT in this community? 43. Do pregnant women get information on the infant feeding options? 44. Do they follow it? 45. Is there HIV home-based care and support in this community? 46. Does the community follow the instructions they receive?

47. Would you like to collaborate with us in different activities to improve maternal nutrition in this community? 48. What kind of support can you provide to contribute to this improvement? 49. Would you consider a change or an introduction to a new policy that will contribute to the improvement of maternal nutrition in this community? 50. Why/why not?

iii) Birth Attendants, Nutritional Workers

1. What are the common pregnancy complications in this community? 2. At what period of pregnancy do these complications mostly occur? 3. Have you experienced any complication while handling a pregnant woman? 4. What do you think could be the cause of that complication? 5. What was the outcome of the complication?
6. According to you and your experience, how should a pregnancy be handled?
7. What measures do you think need to be addressed to minimize or eradicate pregnancy complications? 8. What do you think is important for a healthy pregnancy for the mother and unborn child? 9. Where have you learned about it? 10. Is it difficult to have a healthy pregnancy? 11. Why is it difficult to have a healthy pregnancy/why not? 12. What are the barriers to achieving a healthy pregnancy?
13. What are your efforts to make it possible?

14. Is there a supplementation program for women during pregnancy in this community? 15. How does the program work? 16. Is it easy for the women to access supplements? 17. Where can women access the supplements? 18. Are these supplements free or charged? 19. What can you say about the positive and negative effects of the use of supplements among the women during pregnancy? 20. How do you perceive the whole issue of supplementation? 21. Are you consulting women concerning supplements? 22. Why or why not? 23. Is there any other nutrition or health related programs such as iron, vitamin A, folic acid, malaria, or de-worming going on in this community? 24. Which ones and what do they provide to the women? 25. How do women respond to the programs? 26. Is there anything missing in these programs? 27. Do you think something should change in these programs? 28. What and why?

29. What capacity do you have to work in your position? 30. Are you trained?
31. Where and by whom? 32. What knowledge and skills do you have, and what do you think you are lacking to attend to your job appropriately? 33. What do you wish to change in regard to your capacity? 34. How does the community accept you working in your position? 35. What are your expectations from the community and in general? 36. What motivates you doing the job you are doing? 37. Would you wish to change? 38. What and why?

39. Would you like to collaborate with us in different activities to improve maternal nutrition in this community? 40. What kind of support can you provide to contribute to this improvement? 41. Would you consider a change or an introduction to a new behavior or policy that will contribute to the improvement of maternal nutrition in this community? 42. Why or why not?

iv) Village Leader

1. Is there a supplementation program for women during pregnancy in this community? 2. How does the program work? 3. Is it easy for the women to access supplements? 4. Where can women access the supplements? 5. Are these supplements free or charged? 6. What can you say about the positive and negative effects of the use of supplements among the women during pregnancy? 7. How do you perceive the whole issue of supplementation? 8. Is there any other nutrition or health related programs such as iron, vitamin A, folic acid, malaria, or de-worming going on in this community? 9. Which ones and what do they provide to the women? 10. How do women respond to the programs? 11. Is there anything missing in these programs? 12. Do you think something should change in these programs? 13. What and why?

14. Do pregnant women get tested for malaria once they attend an antenatal clinic? 15. After being tested and found infected, which treatments do they get? 16. Do pregnant women get tested for HIV once they attend an antenatal clinic? 17. After being tested and found infected, which treatments do they get? 18. Do pregnant women receive counseling on the prevention of mother to child transmission (PMTCT)? 19. Do they follow the instructions? 20. Does the counseling help to reduce HIV-MTCT in this community? 21. Do pregnant women get information on the infant feeding options? 22. Do they follow it? 23. Is there HIV home-based care and support in this community? 24. Does the community follow the instructions they receive?

25. Would you like to collaborate with us in different activities to improve maternal nutrition in this community? 26. What kind of support can you provide to contribute to this improvement? 27. Would you consider a change or an introduction to a new policy that will contribute to the improvement of maternal nutrition in this community? 28. Why/why not?

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